B1817-RFT-002 Attachment 1

Project Specification

Woorabinda Aboriginal Shire Council

Wastewater treatment and water supply & treatment upgrades
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GENERAL PROJECT REQUIREMENTS
STANDARDS

Unless specified differently, works are to be carried out in accordance with the Capricorn Municipal Development Guidelines (CDMG). Standards, specifications and drawings, generally and the following standard specifications. Refer:


Other relevant standards included in this specification:

- Fusion Bonded Epoxy coated Ductile Iron Fittings & Pipe to AS4158. Bitumen coating is applied to the cement lined fittings. Bitumen coatings comply with the requirements of AS/ NZS3750.4.
- Stainless Steel pipe manufactured to ASTM A312M – Austenitic. Flanges to manufactured to ASTM A403M
- AS/NZS 4020 Australian Standard for potable water.
- AS3780-2008 The Storage & handling of corrosive substances.
- AS/NZS1170 Structural design actions – all parts
- AS1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation
- AS 3600 Concrete structures
- AS4100 Steel structures Wind loadings shall be in accordance with AS1170.2 for Region A terrain category4.
- AS4902-2000 General Conditions of contract for design and construct
- AS4903-2000 General Conditions of subcontract for design and construct
- AS/NZS3000:2018 Wiring Rules
- AS3008 Electrical installations - Selection of cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
- AS/NZS 3439.1:2002 Low-voltage switchgear and control gear assemblies Type-tested and partially type-tested assemblies
- AS K211-1971 Zinc chromate primers for structural steel
- AS K126-1961 Exterior finishing enamel (performance basis)
- AS 1775-1984 Low voltage switchgear and control gear - Air-break switches, isolators and fuse-combination units (up to and including 1000 Vac and 1200 Vdc)
- AS 1029-1974 A.C. Contactors (up to and including 1000 volts ac)
- AS 1675-1974 Current transformers for measurement and protection (Metric Units)
- AS/NZS 1768:2007 Lightning protection
- AS 1023.2-1989 Low voltage switchgear and control gear - Protection of electric motors Current sensing protection devices for ac motors
- NZS/AS 1023.1:1985 Low voltage switchgear and control gear - Protection of electric motors - Built-in thermal detectors and associated control units
- AS 1202 AC Motor Starters
- AS 1431 Low Voltage switchgear and control gear
- AS 1042-1973 Direct-acting indicating electrical measuring instruments and their accessories
- AS 3439 Low-voltage switchgear and control gear assemblies
- AS 3147 Approval and test specifications
• AS 1359 General Requirement for Rotating Electrical Machines.
• AS 1360.10 General Purpose Motors.
• AS 1939 Classification of degrees of protection provided by enclosures for electrical equipment.
• AS 2420 Solid insulating material used in electrical equipment.
• AS 2380 Electrical equipment for explosive atmospheres.
• AS 1044 Limits and methods of measurement of radio disturbance characteristics
• AS 2229 Electrical equipment for explosive atmospheres

No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the scheduled rates generally
MISCELLANEOUS ITEMS COMMON TO SEVERAL WORK ITEMS

SITE RULES AND REQUIREMENTS

All workers will be required to observe the limits of the areas which they may use as laid down by the Principal and they will refrain from entering any areas laid down as ‘out of bounds’ by the Principal.

Working hours will be 7am - 5pm Monday to Friday and 7am - 12pm on Saturdays. No work will be allowed on Sundays. Construction vehicles will not drive within the community on Sundays.

Any work carried out by the Contractor outside normal working hours, will be subject to the written approval by the Principal’s Representative.

The Contractor will not issue any information, publication, document or article for publication in any media which includes details of the work under the Contract without prior written approval of the Principal.

The Contractor shall abide by the Alcohol Management Plan for the region throughout the entire duration of the Contract. If the Plan is amended during the course of the Contract the Contractor shall abide by the new Plan.

The Contractor will minimise interference with the ongoing activities of the Community during the execution of the work under the Contract.

The Contractor will fully enclose the areas in which work is being carried out, using 1.8m temporary fencing. For safety, backfilling of trenches, pits and other deep excavations will be completed at the end of each day’s work unless otherwise approved by the Principal’s Representative. Furthermore, no open trench will be left unattended at any time.

The Contractor will take all reasonable steps to prevent:

- Dust, material and rubbish blowing from the site into residential areas.
- Dust, material and rubbish blowing from vehicles hauling materials.
- Stationary, noisy plant operating near residential areas.

The Principal’s Representative at any time he or she views warranted, may suspend operations of the Contractor that are causing any inconvenience to residents until such a time as the Contractor adopts methods to minimise or eliminate the problem. No claim either for an extension of time or of a financial nature from the Contractor for works necessary in conforming to this requirement will be allowed by the Principal’s Representative.

No separate payment will be made to the Contractor for compliance with this clause, but rather full compensation will be provided in the lump sum amount generally.

2.1.1. Contractor’s Site Supervisor/Foreman

The Contractor’s site supervisor / foreman will be the same person listed in the Contractor’s tender, unless approved otherwise by the Principal’s Representative. Replacement personnel for this position will be approved by the Principal’s Representative (generally on the basis of their relevant experience and referees from previous projects), prior to arrival on site.

The Principal’s Representative will not be required to issue a Progress Payment Certificate and the Principal may withhold payment if the Contractor has employed on site a site supervisor / foreman who has not been approved by the Principal’s Representative. The Principal will not
be held responsible for delays due to the need to find a replacement site supervisor / foreman who is acceptable to the Principal’s Representative.

No separate payment will be made to the Contractor for compliance with this clause, but rather full compensation will be provided in the lump sum amount generally.

2.1.2. Possession of site

The Principal’s Representative may give the Contractor possession of the site (or of part of the site) conditional upon any or all:

- The Contractor having paid the training and portable long service leave levy as required.
- The Contractor having submitted appropriate insurances for the project.
- The Contractor having established an approved Construction management plan in accordance with the requirements of Clause 33.0 of this Job Specification.
- The Contractor having established an approved quality system in accordance with the requirements of Clause 33.0 of this Job Specification.
- The Contractor having submitted to the Principal’s Representative an approved construction program in accordance with the requirements of Clause 37.0 of this Job Specification.
- The Contractor having submitted an approved safe work method statements and a safety plan in accordance with Clause 18.2 of this Job Specification.
- The Contractor having submitted an approved construction environmental management plan in accordance with the requirements of Clause 5.1 of this Job Specification.
- Copy of Quality System certification to AS/NZS ISO 9001 2008.

If the Principal’s Representative gives conditional possession of the site as specified above, the Contractor will not take possession of the site and will not commence work thereon until the Contractor has complied with each condition.

2.2. CULTURAL HERITAGE DUTY OF CARE

The Contractor acknowledges that a “Cultural Heritage Duty of Care” under the Aboriginal Cultural Heritage Act 2003 (Qld) exists in relation to works to be performed under this contract.

The Contractor is required at all times to comply with the Cultural Heritage Duty of Care during construction of the works including pre-construction activities, construction activities and post construction activities.

Where items of potential cultural heritage significance are discovered, the Contractor will immediately stop work and notify the Principal’s Representative.

No separate payment will be made to the Contractor for compliance with this clause, but rather full compensation will be included in the Schedule of Rates generally.

SHORING

During the excavation and construction of the works of the Contract, the Contractor is to comply with workplace health and safety requirements and provide all materials, plant, labour and carefully execute at their own cost, adequate shoring and in sandy or loose soil, close timbering and other work that maybe required to prevent earth or other material at sides of excavation from being shaken, slipping or falling in. The Contractor will utilise shoring
as required, in order to limit the width of disturbance. As applicable, the maximum width of disturbance for trenching will be 2.0 metres.

No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the lump sum amount generally.

CONSTRUCTION WATER

If required, the Contractor may source construction water from the existing reticulation network. The Contractor will liaise with the Principal to determine an appropriate location to source construction water. The Contractor will submit details of the location to the Principal’s Representative. The Contractor will allow to pay any Council fees and charges should they be applicable.

No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the lump sum amount generally.

RESTORATION

The Contractor will document, with photographs or video, the existing site conditions prior to commencing the works on site. The Contractor will not unreasonably destroy or damage any existing infrastructure, property, fences, gardens, walls, paved areas, concrete surfaces, paths, trees, roads, gravelled areas & grassed / landscaped areas. Items, vegetation or surfaces disturbed will be restored to the same or better condition than before commencement of the work. Where existing grassed areas are disturbed during construction, the soil will be graded, prepared, and then seeded in accordance with the CMDG Construction Specification C273. The Contractor will fertilise, water and maintain such areas in accordance with CMDG Construction Specification C273 to ensure the regrowth of grass. Backfilling will be completed by the end of each workday. As soon as practicable, remove off-site surplus spoil, construction materials and cleared waste. As soon as practicable, make good disturbed areas to the satisfaction of the Principal’s Representative.

Failure to complete cleaning up and restoration will not be considered a minor omission. The Principal’s Representative may withhold portions of intermediate payments and the issuance of the Certificate of Practical Completion until restoration is complete. No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the lump sum amount generally.

EXCAVATION IN ROCK ‘EXTRA OVER’ (PROVISIONAL)

Rock will be defined as material which cannot be broken or removed by a 20 Tonne excavator fitted with a single ripping tyne. The extent of rock and the volume excavated during each day of the contract will be agreed with the Principal’s Representative’s Project Site Representative following a joint inspection of active work areas on a daily basis.

2.6.1. Payment for Rock

An “Excavation in Rock ‘extra over’ (provisional)” cubic metre rate for the excavation of rock is included in the Schedule of Rates for all excavation in rock. Rock will be paid at a cubic metre ‘extra over’ rate based on the widths and depth of excavations as defined by the specification, standard drawings or project specific drawings as applicable. The upper surface of the rock-layer in any excavation will be agreed with the Principal’s Representative’s Site Representative. Daily logs will be required for payment. The scheduled rate for “Excavation in Rock ‘extra over’ (provisional)” will include full compensation for all labour, plant and equipment necessary for excavating in rock, over and above that required in the relevant
section for excavation and for all other costs incurred in executing and completing the works in accordance with the Contract.

**MAINTENANCE OF ROADS**

The Contractor will make all reasonable efforts not to damage any roads traversed in the course of undertaking the works. The Contractor will make every effort to minimize the number of roads traversed in the course of executing the Contract. No tracked machinery will be permitted to travel on paved roads without suitable protection for the road. The Contractor will maintain roads used in the course of carrying out the Contract. The Contractor will manage dust generation, making every effort to suppress dust. The Contractor will make good damage to roads. No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the lump sum amount generally.

**PROTECTION OF EXISTING SERVICES**

This clause describes the Contractor’s responsibilities as they relate to the relocation and/or adjustment of the various utility services necessary for construction of the works. The exact position and nature of the existing utility services will be determined by the Contractor in consultation with the relevant services authorities. The contractor shall contact “Dial before You Dig” services before any excavations are conducted. Note that the locations of some services are not known to any authority or local residents. Many of the services will be at depths at variance to the standard design depths for such services. The Contractor will have full responsibility for all co-ordination work required in regard to the relocation and/or adjustment of the various utility services within the works area. Such co-ordination will be deemed to comprise the programming of the relocation and/or adjustment work in consultation with the service authorities for such work to commence, with due advance notice having been given as agreed to by the Contractor and the service authorities concerned. Any request to service authorities for work to commence will be given in writing. A copy of any such request will be forwarded simultaneously to the Principal’s Representative for their information. The Principal reserves the right to accept the need for service relocation or to undertake alternative means of service protection.

The Contractor will exercise reasonable care in carrying out work so as to avoid damage to existing services, whether or not details of such services have been made available to the Contractor. Furthermore, the Contractor will carry out such protection works as are necessary to protect existing services from damage as a result of the works, under the supervision of the relevant service authority (e.g. additional stays or support for a power pole where the works are close).

Except as provided in the paragraph below the Contractor will be held solely responsible for any damage to existing services and in the event of damage will immediately advise the relevant authority or owner and will co-operate with the authority or owner in making safe and/or restoring the service and will bear any costs so incurred.

Before commencing work the Contractor will ascertain from the relevant authorities and owners details of all services in the area affected by the works and will comply with all relevant requirements of the relevant authorities.

Where work is to be done adjacent to or connecting to any existing service the Contractor will notify the relevant authority or owner in writing and will obtain that authority’s or owner’s written approval to carry out the work, giving any period of notice stipulated by the authority and in any case before commencing work.
The Contractor will arrange for and pay all charges incurred in any interruption of service or temporary or permanent relocation of any service and will co-operate with the relevant authority or owner.

2.8.1. Payment for Relocations

If a service that is relocated was shown on the Drawings or its presence was otherwise notified to the Contractor prior to the closing of tenders or it was visible prior to the closing of tenders then, excepting in the case of a service for which provision is made in the Schedule of Rates or of a service that is shown on the Drawings to be relocated by others, full compensation for authorities’ or owners’ charges and for any other costs incurred by the Contractor will be deemed to be included in the scheduled rates and no further reimbursement will be made.

If such service was not shown on the Drawings and its presence was not otherwise notified to the Contractor prior to the closing of tenders and it was not visible prior to the closing of tenders or if such service is shown on the Drawings to be relocated by others and the Principal’s Representative directs the Contractor to arrange for its relocation then such charges and other costs necessarily incurred by the Contractor will be valued under Clause 36.4 of AS 4902-2000.

The Contractor will coordinate, manage and carry out all relocations of services as necessary in conjunction with the relevant service authorities.

2.8.2. Service interruptions

The work of this Contract will not interfere with the operation of Principal’s sewer or water infrastructure systems.

The Contractor is required to co-ordinate and schedule with Council for any shut down and to be flexible in terms of the timing of the works (i.e. shutdowns may need to be undertaken on the weekend or at night). Scheduling of the work may be adjusted by Principal or the Principal’s Representative to provide a continuous water supply to the community. The Contractor will provide Principal and the Principal’s Representative a minimum of one week’s written notice of the preferred shut-down day.

TRAINING AND MAINTENANCE VERIFICATION

The defects liability period stated in 12 months shall commence on the date of practical completion at 4:00 pm.

The contractor shall carry out rectification at the times and in a manner causing very as little inconvenience to the occupants or users of the works as is reasonable possible.

As soon as possible after the date of practical completion, the contractor shall rectify all defects existing at the date of practical completion.

During the defect liability period, the Principal’s Representative may give the Contractor a direction to rectify a defect which:

a) Shall identify the defect and the date for completion of its rectification; and
b) May state a date for commencement of the rectification and whether there shall be a separate defect liability period therefor.

If the rectification is not commenced or completed by the stated date, the Principal may have the rectification carried out by others but without prejudice to any other rights and
remedies to the Principal may have. The cost thereby incurred shall be certified by the Principal’s Representative as money due and payable to the Principal.

MEETINGS AND REPORTING

2.10.1. Meetings

The Principal’s Representative will require the Contractor to attend meetings during the contract period. Other stakeholders including Council, the Contracted Program Manager and the Principal will be invited to attend these meetings to inspect the progress of works, assist in the dissemination of information between the Contractor and the Community, and for the opportunity to raise any new items of concern.

These meetings will include, but are not limited to, the following:

- Post-contract award meeting (off-site) if required.
- Pre-start meeting – prior to commencement of construction.
- Fortnightly meetings on-site/phone meetings
- Monthly site meetings during the Contract.
- Defect inspection – two weeks prior to practical completion.
- Practical completion, defects and commissioning meetings.

All meetings will be held on site unless directed otherwise by the Principal’s Representative.

Additional meetings may be required during the defect’s liability period/s for the works; however, these may not necessarily be held on site. Additional Site meetings outlined as per Appendix C.

2.10.2. Periodic Reporting

Throughout the Contract, the Contractor will be required to submit:

- Monthly report, in a format to be approved by Principal’s Representative.
- Weekly status report commenting on program, risks, opportunities and upcoming works, witness points, hold points and procurement, format to be approved by Principal’s Representative.

2.11.

No separate payment will be made to the Contractor for compliance with this clause, but rather full compensation will be included in the Schedule of Rates generally.

PAYMENT REQUIREMENTS

A progress claim, format to be approved by Principal’s Representative*, must be submitted by the latest 28th day of each month. If no progress claim is received the Principal’s Representative will issue a payment certificate stating the amount of the payment which, in the opinion of the Principal’s Representative, is to be made.

Within 10 business days after receipt of the Contractor’s progress claim, the Principal’s Representative will issue to the Contractor a payment certificate stating the amount of the payment which, in the opinion of the Principal’s Representative, is to be made by the Principal to the Contractor, or the Contractor to the Principal.
Within 5 business days of receiving the payment certificate, the Contractor will submit the original Tax Invoice/s to the Principal’s Representative matching the payment certificate.

Subject to receiving a correct original Tax Invoice, the Principal’s Representative will issue a signed payment certificate to the Principal for payment with a copy to the Contractor.

*Monthly application for payment (progress claim) to be detailed against tendered line items, in a way that represents the work carried out since the previous claim. Application for Payment and associated supporting documentation (quality documentation and progress photos) are to be emailed to the Principal’s Representative.
SITE ESTABLISHMENT / DISESTABLISHMENT

GENERAL

The scheduled lump sum for “Site Establishment / Disestablishment” will not be more than 20% of the total Contract amount.

3. ESTABLISHMENT

3.1. The Contractor will arrange for and provide such transport of employees and plant to the Site, establish accommodation, shelters, storage facilities and the like as are required for the Contractor’s establishment on the Site and execution of the work under the Contract.

The scheduled lump sum for “Establishment” will include full compensation for all transport, establishment of accommodation, shelters and the provision of facilities and for all costs incurred in the Contractor fully establishing on site including construction of the contractor’s camp. 25% of the scheduled lump sum for “Establishment” will be paid once the Contractor has fully established on site and has substantially commenced construction work. The balance of the lump sum will be paid progressively throughout the duration of the Contract.

3.2. CONTRACTOR’S ACCOMMODATION

Throughout the project the Contractor will be required to maintain and manage accommodation for employees, subcontractors and workers on an ongoing basis. Where a Contractor’s Camp is provided the Contractor will be responsible for payment of water and sewerage services, electrical supply as well as all other ongoing costs of providing accommodation, food and entertainment for all employees under the Contract. The Contractor is responsible for all associated costs and no additional payment shall be made for the Contractor complying with the Contract. The contractor is to note that Woorabinda Aboriginal Shire has a Zero alcohol carriage limit.

Notwithstanding whether the Principal has nominated a suitable site for the Contractor’s camp, the Contractor shall liaise with the Traditional Owners and the Prescribed Body Corporate to confirm that the land is available and whether any rental costs apply for its use. The Contractor shall establish and maintain a lockable, fenced compound for the camp and site office, for storage of all materials for the duration of the Contract, and for storage of plant when not in use for significant periods.

Suitable erosion and sedimentation controls shall be provided for the compound by the Contractor. Refuse arising from the execution of work under the Contract shall be transported to the Council’s Solid Waste Site.

The scheduled lump sum for “Contractor’s Accommodation” will include full compensation for all ongoing costs of maintaining the contractor’s accommodation (including provision of a contractor’s camp where deemed necessary by the Contractor and any rental costs for the site) and will be deemed to cover all costs associated with maintaining the Contractor’s workforce on site.

The lump sum will be paid progressively throughout the duration of the Contract.

3.4. DISESTABLISHMENT

The Contractor will arrange for and provide such transport of employees and plant away from site and will reinstate any land used for the contractor’s camp, accommodation, shelters and
other facilities. All Plant and equipment will be removed from site and the site reinstated to pre-establishment condition or better.

The scheduled lump sum for “Disestablishment” will include full compensation for all transport, disestablishment of accommodation, shelters and facilities, reinstatement of land used and for all other costs incurred in the Contractor fully disestablishing from site.

The schedule lump sum for “Disestablishment” will not be paid until the Principal’s Representative is satisfied that the Contractor has returned the project site to pre-establishment condition.
CONSTRUCTION MANAGEMENT PLAN

The Contractor shall prepare and submit a Construction Management Plan, within 28 days after the Date of Acceptance of Tender to the Principal’s Representative.

The Construction Management Plan should take into account all aspects of the proposed works.

The Construction Management Plan shall outline the issues to be managed onsite including:

- Construction methodology
- Public safety, amenity and site security
- Operating hours
- Noise and vibration controls
- Air and dust management
- Stormwater and sediment control
- Waste and materials reuse and traffic management
- Emergency evacuation plan
- Site induction procedure

CONTRACTOR’S REPRESENTATIVE - CONTACT OUTSIDE WORK

4.1. HOURS

The Contractor shall ensure that at all times there is a Contractor’s representative that the Principal’s Representative can contact outside working hours.

The Contractor may name a single Contractor’s representative to be called first but shall name additional individuals that can be contacted if the named Contractor’s representative cannot be contacted.

The Contractor shall give the Principal’s Representative written notice of the names and telephone numbers of the Contractor’s representative and the additional individuals before commencing work under the Contract.

4.2 DISPOSAL OF WASTES AND REFUSE

The Contractor will be responsible for the proper disposal of all solid, liquid and gaseous wastes in accordance with all statutory requirements.

All refuse arising from the execution of work under the Contract (including packing boxes, pallets and demolition materials etc.) will be removed from the region unless approved otherwise by the Principal’s Representative. Domestic waste only (e.g. food scraps) may be disposed of at the local landfill (operated by Principal). The Contractor will be required to pay dumping fees in accordance with Council’s regulated charge.

Refuse will not be dropped free, but hoppers and shutters, chutes or refuse buckets will be used. All hoppers, chutes or buckets (Skips) for refuse will be covered or be of such a design as to fully confine the material and prevent dissemination of dust.
CONSTRUCTION PROGRAM

The Construction Program lodged by the Contractor with its Tender (including any amendment made in accordance with the Conditions of Tendering) and accepted by the Principal will be deemed to have been furnished by the Contractor on the Date of Acceptance of Tender and will be a construction program included in the Contract.

5.

FORM OF CONSTRUCTION PROGRAM

Within 14 days after the Date of Acceptance of Tender the Contractor shall furnish to the Principal’s Representative the construction program augmented and re-presented as necessary to show:

5.1.

- Any activities, including activities to be carried out by the Principal or others, that may affect the progress of the work under the Contract but are not shown in the construction program lodged by the Contractor as part of its Tender.
- The duration of each activity.
- The logical links between activities on the Gantt chart including the critical path.

The Contractor, within 14 days after the Date of Acceptance of Tender, shall furnish to the Principal’s Representative a digital copy of the construction program in MS Project 2010. The accepted construction program will become the baseline on which all status reports will be based.

5.2.

APPLICABLE REVISION OF CONSTRUCTION PROGRAM

The Principal’s Representative may give a direction at any time before the expiry of the last Defects Liability Period to revise the construction program.

The Contractor may give an updated or revised construction program to the Principal’s Representative voluntarily, but such a construction program shall not supersede an earlier construction program except as directed by the Principal’s Representative.

If the Principal’s Representative has not directed the Contractor to furnish to them a construction program but the Contractor considers that it has reasonable cause to depart from a construction program, the Contractor will:

- Give details of the cause for departure from the current construction program and obtain the Principal’s Representative’s direction whether the cause is reasonable.
- Furnish a new construction program to the Principal’s Representative and obtain the Principal’s Representative’s direction about the construction program furnished.
SAFETY MANAGEMENT

WORK HEALTH AND SAFETY MANAGEMENT PLAN

The Contract shall prepare a Site Safety Management Plan (SSMP), within 28 days after the Date of Acceptance of Tender and submit to the Principal’s Representative.

6.1. Definition

6.1.1. SSMP means a written work health and safety management plan for the workplace titled “Site Safety Management Plan”, which must be as a minimum (and without limitation) in compliance with the WHS Regulation, be signed by the Contractor and include the following components:

- The names, positions and health and safety responsibilities of all persons at the workplace whose positions or roles involve specific health and safety responsibilities in connection with the works.
- The arrangements in place, between any persons conducting a business or undertaking at the workplace for consultation, cooperation and the coordination of activities in relation to compliance with their duties under the WHS Act and the WHS Regulation.
- The arrangements in place for managing any incidents that occur.
- Any site-specific health and safety rules, and the arrangements for ensuring that all persons at the workplace are informed of these rules.
- High risk activities and associate safe work method statements (SWMS).
- Project risk assessment.
- The arrangements for the collection and any assessment, monitoring and review of safe work method statements at the workplace.

6.1.2. Preparation

The Contractor will not commence construction works until its SSMP is deemed suitable by the Principal’s Representative. The Contractor will comply with the following:

- The Contractor will prepare and submit a SSMP to the Principal’s Representative.
- If the Principal’s Representative notifies the Contractor that the SSMP is not suitable, the Contractor will at its cost amend and resubmit the SSMP.
- The Contractor is not entitled to make any claim for additional costs or expense, adjustment to the contract sum or extension to the Date for Practical Completion or to make a claim in connection with any review, approval of, or modification to the WHS Management Plan as directed the Principal’s Representative.

6.1.3. Duty to inform

The Contractor must ensure, so far as is reasonably practicable, that before commencing work each person who is to carry out construction work in connection with the works is made aware of:

- The content of the SSMP for the workplace.
- The person’s right to inspect the SSMP under the WHS Regulation

6.1.4. Revision and Reporting

The Contractor must, under the WHS Regulation, review and, as necessary, revise the SSMP to ensure that it remains up-to-date and give written monthly reports on its SSMP outlining any:
• Non-compliance.
• Work improvement notices.
• Safety incidents.
• Any other matters relevant to the management of work health and safety or reasonably required by the Principal.
• During any audit, provide the Principal’s Representative with all documents, access and assistance necessary for its completion.
• Any costs associated with rectifying the non-conformance and any associated delays must be borne by the Contractor.

6.1.5. Safety Audits

The Principal’s Representative may audit the implementation of the SSMP at any time. During any audit the Contractor must provide the Principal’s Representative with all documents, access and assistance necessary for completing the audit. Auditing may take one or a combination of the following forms:

• A check on whether the Contractor is complying with the provisions of the SSMP.
• A check on the Contractor’s individual procedures and records.

If any non-conformance in the Contractor’s SSMP is detected, the Contractor will rectify the non-conformance and resubmit the amended SSMP within seven (7) days.

The Contractor must suspend construction works (or the relevant portion) until the Contractor has addressed the safety issues identified during the audit, and in the meantime continue to comply with all duties and obligations under the WHS Act and the Contract.

If the Contractor fails to rectify a non-conformance that has been identified on three (3) separate occasions in the auditing process, the Principal may give notice to the Contractor of a substantial breach of the Contract.

6.2. CONTRACTOR’S SAFETY OFFICER

The Contractor must appoint at least one person appropriately qualified to competently discharge the functions of Safety Officer as set out in this clause and trained to at least the standard considered appropriate by the regulator as defined under the WHS Act, and consistent with legislative requirements.

The functions to be discharged include:

• Keep the Contractor informed and up to date about the overall state of health and safety at the workplace.
• Conduct regular inspections at the workplace to identify any hazards and unsafe or unsatisfactory work health and safety conditions and practices.
• Report in writing to the Contractor any hazard, unsafe or unsatisfactory work health and safety practice identified during inspections.
• Establish educational programs in work health and safety to an appropriate standard.
• Investigate, or assist in the investigation of, all incidents at the workplace.
• Assist inspectors and auditors in the performance of their duties.
• If any incident or immediate risk to health and safety at the workplace happens to immediately report the incident or risk to the Contractor and the Principal’s Representative.
• Maintain all health and safety representatives’ training and competency to the level required by the regulator under the WHS Act, and consistent with legislative requirements.
RESPONSIBILITIES AND LIABILITIES

The Contractor is responsible for and assumes liability for the duties under the WHS Act and the WHS Regulation for which the Contractor is responsible and liable as between the parties, in accordance with this clause.

Nothing contained in this clause will in any way limit or exclude any of the Contractor’s obligations or liabilities under the Contract.

NOTIFIABLE INCIDENTS

The Contractor will:

6.4.  
- Ensure that the regulator for work health and safety is notified of any notifiable incident immediately after becoming aware of a notifiable incident, arising out of or in connection with the conduct of the business or undertaking of the Contractor.
- Notify the Principal’s Representative of every notifiable incident in relation to or in connection with the workplace as soon as possible but not more than twelve (12) hours after the occurrence.
- Keep the Principal’s Representative informed of the status of any safety or health related incidents that have occurred in relation to or in connection with the site.
- Do all that is necessary to assist the Principal and Principal’s Representative with any investigations into any safety or health related incident in relation to or in connection with the workplace, including requiring, to the extent possible, the Contractor’s agents and subcontractors to assist the Principal and Principal’s Representative. As soon as practicable but no later than seven (7) days of receiving a request from the Principal’s Representative to do so, provide the Principal’s Representative with a copy of any notification to the regulator for work health and safety of a safety or health related incident. Consult, cooperate and coordinate with the Principal and Principal’s Representative in relation to any safety matters arising out of, or in connection with the workplace.
ENVIRONMENTAL MANAGEMENT

The Contractor will observe and comply with all environmental protection requirements that apply to the area in which work under the Contract is to be carried out.

The Contractor will take all practicable precautions to minimise noise arising out of or resulting from any activity associated with the works under this Contract.

7. ENVIRONMENTAL MANAGEMENT PLAN (INTEGRATED EROSION AND SEDIMENT PLAN)

The Contract shall prepare an Environmental Management Plan (EMP), within 28 days after the Date of Acceptance of Tender and submit to the Principal's Representative.

The plans will be prepared by a professional experienced in the field of environmental management and will be amended to the satisfaction of the Principal's Representative prior to commencement of work on site.

The EMP will contain/address:

- A description of the project and existing environment;
- The Contractor’s environmental policy and the objectives to be attained
- A listing of applicable licences and their conditions
- A statement of the role and responsibilities of supervisory personnel, with particular reference to responsibility for dealing with environmental incidents
- The process for dealing with incidents, including clean-up and mitigations
- Procedures for training and awareness of all site personnel
- Construction procedures to minimise the risk of environmental harm
- A management plan for each environmental element
- A monitoring program, the monitoring program will identify each issue, the action and parameter to be monitored and the frequency of monitoring, and the reporting mechanism for monitoring results
- Revegetation of the site after construction, including grass and plant types, application method (e.g., turfing, hydromulch etc.) and watering methods and schedule
- Pruning and clearing of vegetation (native and re-growth)
- Weed and pest invasion
- Storage and handling of chemicals
- Soil contamination
- Noise, dust and air quality
- Flora and fauna
- Cultural Heritage
- Bank stabilisation
- Waste management
- Storage and handling of fuels, including dealing with fuel spills
- Treatment, management and disposal of Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS).

The EMP will also incorporate an Erosion and Sedimentation Control Plan (ESCP) that will detail temporary works proposed by the Contractor to prevent erosion from the site and deposition of eroded sediments in any adjacent watercourse.

Environmental management records will be made available to the Principal's Representative for auditing on request.

Full compensation for preparation and amendment of the EMP and in complying with its requirements (except where specifically allowed for elsewhere in the Contract) will be deemed to be included in the scheduled lump sum for “Environmental Management”.

No work will be allowed on site until this plan is reviewed by the Principal's Representative.
SITE CONTROL

Except as otherwise provided in the Contract, delivery of materials to the site, space for storage of such materials and for buildings sheds, offices, workshops and other temporary structures will be allowed only in accordance with the arrangements entered into between the Contractor and the Principal and subject to such conditions as are determined by the Principal and/or Principal’s Representative.

No new tracks or roads will be formed, existing roads and tracks altered, camps erected, trees or shrubs removed, fences, water, sewerage, telephone lines or power lines cut or other things done that may affect the environment to a significant extent without the prior approval of the Principal or the Principal’s Representative.

No fires will be lit on the site without the prior approval of the Principal’s Representative.

DUST, DIRT AND WATER

The Contractor will prevent nuisance to the owners, tenants or occupiers of properties adjacent to the site and to the public generally. Nuisance includes nuisance caused by dust, dirt and water.

The Contractor will prevent dust becoming a nuisance to the community by regularly watering unsealed roads and work areas, or using other methods approved by the Principal’s Representative. The frequency of watering the roads will be a minimum of twice daily however if this is not sufficient to suppress the dust additional watering will be carried out as required.

SOIL CONSERVATION

The Contractor will take such steps as are necessary to prevent the erosion of any lands used or occupied by the Contractor in the execution of the work under the Contract. This will include all necessary measures to prevent the runoff of silt from the works into adjoining watercourses.

PRESERVATION OF FLORA

The Contractor will not destroy, remove or clear any trees or shrubs (except those marked to be removed either on the drawings or by the Principal’s Representative) from any lands used or occupied by the Contractor in the execution of the work under the Contract without prior approval of the Principal’s Representative.

Trees and shrubs allowed to be removed will be identified by the Principal’s Representative prior to construction, by marking with paint or flagging tape.

MEASUREMENT AND PAYMENT

No separate payment will be made to the Contractor for compliance with this clause, but rather full compensation will be provided in the lump sum amount generally.
QUALITY ASSURANCE & QUALITY CONTROL (QA & QC)

PROJECT QUALITY MANAGEMENT PLAN

8. The Contractor shall prepare a Quality Management Plan (QMP), within 28 days after the Date of Acceptance of Tender and submit to the Principal’s Representative.

The QMP shall cover all Quality System elements required by the appropriate Quality Systems Standard as specified in ISO 10005:2018, that are applicable to this Contract.

The QMP shall include:

• Organisational structure: A Project Organisation Chart or list of nominated Project Personnel showing their positions, lines of communication and details of the responsibilities of the positions.

• Details of the qualifications and experience of the following positions:
  ▪ Project Manager
  ▪ Project Engineer
  ▪ Contractor’s Quality Representative (QAR)
  ▪ Surveyor
  ▪ Foreman, Supervisor(s).

• Inspection and test procedures: Inspection and Test Plans (ITPs) for the various phases during construction, as applicable to the Contract, to be submitted at least 10 working days prior to commencement of relevant activity.

• Purchasing procedure.

• Monitoring and measuring procedures

• Filing System: A Register of all intended Quality Records to be used on the project, together with proformas.

Where ITPs are not developed at the same time as the QMP, the Contractor shall provide a schedule of the proposed ITPs to be used for the works. The schedule shall include target submission dates to ensure they are submitted and received 10 working days prior to the activity’s commencing.

A copy of the NATA Terms of Registration for the Contractor’s Compliance Testing Laboratory (internal or Contract) where applicable.

Project specific operating procedures or descriptions outlining as a minimum, details of activities, who is responsible for implementation/verification, identification of relevant Quality Records and distribution of such records, to be submitted at least 10 working days prior to commencement of relevant activities.

8.1.1. Documents to be provided at start of Contract

Within 14 days after the Date of Acceptance of Tender, the Contractor shall provide to the Principal’s Representative a copy of the following documents:

• Quality System certification to AS/NZS ISO 9001 2008 for construction.

The Contractor shall also provide the Principal’s Representative with access to inspect Corporate Quality Procedures applicable to this Contract.
8.1.2. Quality Assurance Representative

The Contractor shall have named its Quality Assurance Representative (QAR) in its tender. The QAR shall be a suitably qualified person that has authority to control effectively the complete quality assurance process. The QAR shall be site-based.

The Contractor shall confirm the name of the QAR to the Principal’s Representative before commencing work.

8.1.3. Inspection and Test Plans

Inspection and Test Plans shall contain at least the following information for each significant activity identified in the relevant process:

- description of activity
- specification requirements/reference
- person responsible for activity
- hold and witness point
- activity checklists
- inspection and test type
- tolerances or other acceptance criteria that are measurable
- identification of relevant procedure and quality records
- test/inspection frequency
- work item or work lot identification with the physical boundaries of each lot defined.

8.2. GENERAL

All work under this contract shall be inspected and documented by the Contractor in accordance with a non-rejected Inspection and Testing Plan (ITP) to provide evidence of compliance with the technical specifications. For this purpose, the Contractor shall subdivide all items to be treated into distinct work lots or work items. All compliance inspections and tests shall be based on work lots.

The costs for all inspections, tests and documentation shall be borne by the Contractor and shall be allowed for in any submitted tender. The Contractor shall document all equipment used in the project and all inspection and testing results in a Works Inspection Report. Such a document may be the contractor’s own standard QA documentation subject to non-rejection by the Principal’s Representative.

8.3. IDENTIFICATION AND TRACEABILITY

All work under this contract shall be subdivided into distinct work lots or work items as referenced in this document.

Work lots shall be chosen by the Contractor, consistent with any specified testing and inspection requirements. Each work lot shall be assigned a unique identification number, and the Contractor shall maintain a register of all allocated work lot numbers.

The Contractor shall ensure that traceability is maintained throughout all documented records under this contract. All test results where applicable under this contract shall be positively identified with their respective work lot number.
COMPLIANCE INSPECTIONS AND TESTING

The Contractor shall conduct sufficient inspection and testing work (and subsequent repair work where necessary) in order to satisfy work lot complies with the specification. The Contractor shall ensure that all aspects of the specification have been met prior to notifying the Principal's Representative or any other QA/QC auditors to test and verify that the work conforms to the specification.

The Contractor shall notify the Principal's Representative of any QA/QC testing scheduled for each work lot in order to verify that acceptance criteria have been met and that the relevant documentation is completed accurately.

All compliance testing and reporting shall be in accordance with the minimum requirements listed in the Inspection & Testing Plan unless the Principal's Representative has reason to demand more rigorous testing in specific work lots.

The Contractor shall present all completed QA documents within 24 hours of completion of the work lot, for verification. A complete treatment record (Clause 8.6), including all relevant documents must be submitted to the Principal's Representative within 7 days upon practical completion of the works. The Contractor's quality system shall include sufficient quality records to provide objective evidence that the requirements of the contract have been met. This shall include sub-contractors and suppliers records relevant to this contract.

NON-CONFORMANCE REPORTS

Upon detection of a non-conformance, the Contractor shall immediately notify the Principal's Representative or their representative. Subsequently the Contractor shall submit a Non-conformance Report and a proposal for corrective action that has been approved by the manufacturer of the repair materials or corrosion protection system to the Principal's Representative within 24 hours of detecting nonconforming work.

No further work in the work lot location affected by the non-conformance shall be permitted until the Principal's Representative or their representative has non-rejected the corrective action.

The Contractor's Non-conformance Report shall clearly detail but shall not be limited to the following items:

- The nature and extent of the non-conformance.
- The work lot or work item number it relates to including the precise boundaries of the nonconforming work.
- Any relevant information, data, test results and/or measurements (as applicable).
- The corrective and preventive actions that the Contractor proposes to take.
- The time frame within which the non-conformance will be rectified.
- Potential savings or any benefits that the Principal acquires.

The method of isolating/identifying nonconforming work, applying and releasing Hold Points, etc. shall be clearly stated in the QMP.

The proposed corrective action shall be subject to approval by the Principal's Representative.
TREATMENT RECORD

Upon completion of the works, the Contractor shall submit all completed QA/QC documentation to the Principal’s Representative as a complete record of treatment of the surfaces in each structure.

This treatment record consists of:
- The completed ITP.
- All marked-up and completed drawings (RPEQ certified).
- The completed table outlining works related to work lot.
- All completed Works Inspection Reports.
- All test reports.
- All Non-conformance reports.
- All records of corrective action.
- Any correspondence related to the works conducted in each individual work lot.

INSPECTION AND QA AUDITING

The Principal’s Representative reserves the right to engage a suitably qualified and experienced Inspector in order to verify and document that all requirements of the specification are met. The Inspector shall be the sole judge of whether compliance with the specification, the materials manufacturer’s datasheets, relevant International Standards or good work practices in general are being adhered to. Issues of non-compliance shall be addressed with the Contractor upon detection.

The Contractor shall not rely on any inspection and testing that is conducted by the Principal’s Representative and the Principal’s Representative’s Inspector is under no circumstances obliged to disclose inspection and testing results. No party conducting inspections or audits shall produce non-conformance reports without notifying the Contractor that a non-conformance has been detected.

The Contractor is at all times responsible for their own QA/QC testing and documentation and is obliged to supply suitably qualified and experienced staff and suitably calibrated inspection equipment to fulfil their QA/QC obligations as outlined herein.

HOLD AND WITNESS POINTS

Hold Points

A Hold Point is defined as a position in the progress of the Contractor’s Activities, beyond which further work shall not proceed without mandatory verification by the QAR and by the Principal’s Representative (or nominated representative) where relevant.

If the Contractor proceeds beyond this point without the Hold Points being released, the Principal’s Representative may direct the Contractor to halt the work and to remove any materials from the Site.

Hold Points shall apply to this Contract to ensure compliance with the intent of the designs and with other specified requirements, and to ensure that critical and/or irreversible activities are not constructed incorrectly. Hold Points shall apply prior to commencement of designated work lots or work items. Hold Points shall be verified by the Principal’s Representative.
Except for Hold Points listed in this Clause and for additional Hold Points directed to be included pursuant to this Clause, the Contractor’s Quality System shall not require verification of Hold Points by the Principal’s Representative.

The Contractor shall be liable for the cost of any additional hold point inspections deemed necessary by the Principal’s Representative should the works not meet the requirements of this Job Specification at the initial hold point inspection.

The Contractor’s Quality System shall include at least the following Hold Points.

- Package pump station
- Submission of design documentation and calculations for the packaged pump station included in the offer.
- Concrete works
- Submission of Contractor’s batching methodology and mix design documentation prior to preparing a trial mix.
- Completion of a trial mix prior to commencing concrete installation.
- Gantry
- Submission of design documentation for the pump hoisting gantry and screenings basket lifting gantry.
- Submission of shop drawings for the pump hoisting gantry and screenings basket lifting gantry.
- Earthworks, including excavation of rock and excavation for structures and excavation of trenches
- Placing concrete
- Commencement of cleaning and surface preparation works for protective coatings
- Backfilling around completed concrete works
- Laying pipes or conduits
- Backfilling trenches.
- Pressure testing of pipes.

The Principal’s Representative may direct that any Hold Point shown in the Contractor’s Inspection and Test Plans shall not be a Hold Point.

If the Contractor’s Inspection and Test Plans show a Mandatory Hold Point that is not listed as such in this Clause and has not been directed to be added by the Principal’s Representative, that Hold Point shall not be a Mandatory Hold Point unless it is specifically accepted in writing by the Principal’s Representative.

The Contractor has sole responsible for constructing the works in accordance with the Contract. The release of a Hold Point by the Principal’s Representative’s Representative shall not in any way relieve the Contractor from their responsibility to construct the works in accordance with the Contract and does not entitle the Contractor to make any claim or in any way limit or change the Contractor’s warranties, obligations or liabilities under or in connection with this Contract. Should defective work, errors or omissions in work, be identified in the completed works following the release of a Hold Point, the Contractor is bound to rectify the defects in accordance with the Contract.

**Witness Points**

A Witness Point is defined as a position in the progress of the Contractor’s Activities, where the Contractor must notify its QAR and the Principal’s Representative prior to proceeding and the option for attendance for witnessing of inspection and test may be exercised. If any do not attend, then work may nevertheless proceed, unless otherwise instructed.
Witness Points shall apply to verify compliance of the constructed works with the Drawings. Except as may be directed by the Principal’s Representative, the Contractor’s Quality System shall not require verification of Witness Points by the Principal’s Representative.

The Principal’s Representative may direct the Contractor to insert additional Witness Points in the Contractor’s Inspection and Test Plans.

**Proceeding beyond a Hold Point or Witness Point**

The Contractor shall give the Principal’s Representative not less than ten working days’ notice of its intention to proceed beyond a Hold Point.

The Contractor shall give the Principal’s Representative not less than two days’ notice of its intention to proceed beyond a Witness Point.

The Contractor shall ensure:

- That all work lots or work items affected by the lot or item in question are conforming.
- That all Conformance Reports for all work lots or work items affected by the lot or item in question have been made available to the Principal’s Representative at least 6 working hours prior to the time the Contractor intends to proceed with the lot or item in question, thus ensuring that defective work are not built-in.

**Required Notice Periods**

Principal’s Representative/Principal’s Representative will have a maximum of 5 business days to review all hold points and requires 5 business days’ notice for onsite witness points and 3 business days to review witness point documentation.

Unless otherwise specified, the Contractor shall give the Principal’s Representative not less than five days’ notice of its intention to commence each of the operations listed below:

### 8.8.1. Site Establishment

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Design</td>
<td>Compound size and extents</td>
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<tr>
<td>Hold Point</td>
<td>Pre-Construction</td>
<td>Issue for review Project specific</td>
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<tr>
<td></td>
<td></td>
<td>- Quality Management Plan (including ITP’s and commissioning plans)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Safety Management Plan (including SWMS and proformas)</td>
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<td></td>
<td></td>
<td>- Environmental Management Plan</td>
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<tr>
<td></td>
<td></td>
<td>- Commissioning Plan</td>
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<tr>
<td></td>
<td></td>
<td>- Construction Management Plan</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
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### 8.8.2. Water Supply

ARTISIAN BORE 1
### ARTISIAN BORE 2

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
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</thead>
<tbody>
<tr>
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<td>Pre-investigation</td>
<td>Present methodology and locked in price to investigate bore viability</td>
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<tr>
<td>Hold Point</td>
<td>Pre-design</td>
<td>Bore viability to be assessed prior to progressing further</td>
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<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Pump station design and RPEQ</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Fitting specification compliance report</td>
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<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
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<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
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<td>Hold Point</td>
<td>Design</td>
<td>HAZOP report to be assessed prior to progressing further</td>
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<td>Witness Point</td>
<td>Construction</td>
<td>Commissioning and testing</td>
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</table>

### ARTISIAN BORE 3

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Design</td>
<td>HAZOP report to be assessed prior to progressing further</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Fitting specification compliance report</td>
</tr>
</tbody>
</table>
### ARETISIAN BORE 4

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Design</td>
<td>HAZOP report to be assessed prior to progressing further</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Fitting specification compliance report</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Pipe refurbishment methodology</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Commissioning and testing</td>
</tr>
</tbody>
</table>

### BORE FIELDS HEADER TANK

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Design</td>
<td>HAZOP report to be assessed prior to progressing further</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Pre-construction</td>
<td>Methodology for draining while maintaining supply to residences</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Construction</td>
<td>Present methodology and locked in price to repair damage to header tank</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Fitting specification compliance report</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Pipe refurbishment methodology</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Commissioning and testing</td>
</tr>
</tbody>
</table>

### MIMOSA CREEK SPEAR PUMP STATION

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Pre-investigation</td>
<td>Present methodology and locked in price to investigate lowering pump</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Pre-design</td>
<td>Bore viability to be assessed prior to progressing further</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Nominated flow electromagnetic flow meter / air release</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
</tr>
</tbody>
</table>
Hold Point | Design | HAZOP report to be assessed prior to progressing further
Witness Point | Construction | Commissioning and testing

8.8.3. Water Treatment Plant

ACID DOSING STORAGE

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Storage design and compliance report</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Concrete slab and structure design and RPEQ sign off</td>
</tr>
</tbody>
</table>

PAINTING OF INTERNAL TREATMENT VESSELS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Pre-construction</td>
<td>Methodology for carbon filter repair while maintaining supply to residences</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Carbon filter cost of repair and methodology to be locked in</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Pre-construction</td>
<td>Methodology for repair while maintaining supply and ensuring no contamination</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Pre-construction</td>
<td>Tank refurbishment methodology</td>
</tr>
</tbody>
</table>

SHED REPAIRS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing to note</td>
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<td></td>
</tr>
</tbody>
</table>

RESERVOIR REPAIRS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Pre-investigation</td>
<td>Present methodology (in conjunction with Council) to isolate reservoir and scour reservoir to investigate leaking issue</td>
</tr>
<tr>
<td>Hold Point</td>
<td>Pre-construction</td>
<td>Issue report of investigation to allow for assessment of lines and methodology and cost of repair.</td>
</tr>
</tbody>
</table>

SUPERNATANT PONDS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Pre-investigation</td>
<td>Present methodology (in conjunction with Council) to isolate ponds.</td>
</tr>
</tbody>
</table>
## 8.8.4. Sewage Treatment Plant

### IMHOFF TANK

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Static inlet screen design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Valve pit access stairs and steel handrail design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Fitting specification compliance report</td>
</tr>
</tbody>
</table>

### DRYING BEDS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Access ramps design</td>
</tr>
</tbody>
</table>

### SEDIMENT PONDS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Handrail design and RPEQ sign off</td>
</tr>
</tbody>
</table>

### SEWAGE IRRIGATION UPGRADE

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Isolation valve nominated location to be determined</td>
</tr>
</tbody>
</table>

### SEWAGE PUMP UNITS

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing to note</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## 8.8.5. Sewer Pump Stations

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Investigation</td>
<td>Switchboard assessment report and cost estimate if upgrades required.</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry communications unit design and RPEQ sign off</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Design</td>
<td>Telemetry control design and RPEQ sign off</td>
</tr>
</tbody>
</table>
Hold Point | Design | HAZOP report to be assessed prior to progressing further
Witness Point | Construction | Commissioning and testing

### 8.8.6. Site Disestablishment

<table>
<thead>
<tr>
<th>Point type</th>
<th>Timing</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hold Point</td>
<td>Post-construction</td>
<td>Commissioning package, including OM&amp;M, as built and test results issued to Principal’s Representative</td>
</tr>
<tr>
<td>Witness Point</td>
<td>Construction</td>
<td>Area returned in same condition</td>
</tr>
</tbody>
</table>

Where any inspection during the Works identifies an element of the structure that does not meet the minimum requirements of the Specification. All above points shall be witnessed by the Principal’s Representative or their representative. The Contractor shall advise the Principal’s Representative a minimum of 24 hours prior to reaching a hold point. The Principal’s Representative shall be notified 24 hours prior to any pull off bond strength testing. All hold points can only be released via written advice from the Principal’s Representative.

If the Contractor does not give the notice specified by this Clause, any work covered up or made inaccessible by the work for which the notice was required shall be deemed to be work covered up or made inaccessible without a required prior direction by the Principal’s Representative.

The Contractor has sole responsibility for constructing the works in accordance with the Contract. Failure to inspect the notified works by the Principal’s Representative’s Representative shall not in any way relieve the Contractor from their responsibility to construct the works in accordance with the Contract and does not entitle the Contractor to make any claim or in any way limit or change the Contractor’s warranties, obligations or liabilities under or in connection with this Contract. Should defective work, errors or omissions in work, be identified in the completed works the subject of a prior notification, the Contractor is bound to rectify the defects in accordance with the Contract.

During the execution of the Works the Contractor shall undertake formal inspections of the works at the following stages to determine the extent and the quality of works to be undertaken:
- Upon surface preparation of steel surfaces

### HANOVER DATA

Prior to Practical Completion, the Contractor shall have submitted the following to the Principal’s Representative, in accordance with the Contract:
- ‘As Constructed’ Drawings
- Maintenance and Operating Manuals
The Contractor shall submit to the Principal’s Representative, within 2 weeks of the Date of Practical Completion, the inspection and testing records for the Contract.

8.9.1. As-Constructed Drawings

The Contractor shall furnish to the Principal’s Representative ‘As Constructed’ Drawings showing full details of any departure (whether by way of variation ordered or arising in the course of construction) from the locations, levels, sizes and materials indicated on the Design Drawings. ‘As Constructed’ Drawings shall be certified by an RPEQ as being a full and accurate record of the completed works.

The ‘As Constructed’ Drawings shall be fully dimensioned at a scale identical to the Design Drawings.

The Contractor shall furnish three full sets of copies (one A1 size and two A3 size per set) of the ‘As Constructed’ Drawings of the equipment and installation. The Contractor shall also provide one electronic copy in ‘AutoCAD Release 2018’ of the drawings. The AutoCAD files shall be vector based drawings and shall be bound with all Xrefs and blocks referenced. Electronic files shall be provided on a USB drive.

Once the Contractor has prepared the As-Constructed Drawings, they will submit an A3 set of ‘draft’ ‘as constructed’ drawings to the Principal’s Representative for review prior to the provision of the signed hard and electronic copies. The Contractor will not submit final drawing/s to the Principal’s Representative until the Principal’s Representative has provided written comments to the Contractor on the draft manual/s, and the Contractor has addressed those comments.

All drawings associated with the as constructed information will be signed by a Licensed Surveyor, who will certify their accuracy.

Maintenance and Operating Manuals

The Contractor shall supply the required electronic or hard copies of an Operating and Maintenance Manual for the equipment supplied under this Contract.


The Contractor shall prepare Operations and Maintenance Manuals that are fit for the purpose of providing a “step-by-step” guide for the Principal in the operation and maintenance of the works constructed under each separable portion of the Contract. The Contractor shall ensure that a complete set of the manuals for each separable portion is available for the training to be conducted under the contract.

The Contractor shall prepare and shall supply four (4) hard copies and two (2) electronic copies of the manuals for the equipment and materials supplied and installed under this Contract. The electronic copies shall consist of one file in PDF format (latest version), comprising a single file that is index to the relevant sections, and a second file in Microsoft
All information supplied shall be in the English language and all dimensions shall be metric.

The “as-constructed” drawings described in Clause 12.4 shall be submitted as part of the manuals.

In addition to the information to be submitted in the manuals, as described in this Clause 12.5 the Contractor shall also complete the pro-forma schedule for new assets supplied to the Principal. A copy of this schedule is included for information purposes in Volume 2 – Other Information.

The completion of this schedule is not expected to be an onerous task as all the information required by this schedule forms part of the requirements for the manuals. The Principal’s Representative shall liaise with the Principal to determine which items of work are to be classed as ‘new assets’ and advise the Contractor accordingly.

The Contractor is referred to the “A Guide for the Development of Operations and Maintenance Manuals”. A copy of this guide is included for information purposes. This guide has been developed by the Principal and, as indicated, it is a draft in progress. As such it shall not form the basis for the development of the manuals by the Contractor and it shall not replace any of the requirements specified in this Clause 12.5, or those deemed necessary by the Contractor.

Once the Contractor has prepared the manuals the Contractor shall submit a draft copy of each to the Principal’s Representative for review and comment. The Contractor shall not submit final manuals to the Principal’s Representative until the Principal’s Representative has provided written comments to the Contractor on the draft manuals, and the Contractor has addressed those comments.

The manual shall include but not be confined to:

- manufacturer’s operating instructions for all items of plant and control equipment
- instructions for adjusting and setting all control, alarm protection and tripping devices
- details of all reference levels and/or datum points necessary for reinstalling equipment after dismantling
- all test certificates, type test certificates and details of tests conducted off-site
- QA information (refer to the Non-Technical specifications of this Contract).
- a schedule detailing manufacturers and suppliers (including the Contractor) of all items of plant, electrical components, and control equipment, including telephone and fax numbers and a contact person
- photos of each item of plant and control equipment, clearly labelled to point out which item in the photo is which
- diagrams and flowcharts clearly indicating the operation, maintenance and troubleshooting of equipment
- a list of workplace health and safety issues which operators/maintenance personnel need to be aware of, and what actions/procedures need to be in place to address these
- Complete RPEQ Certified Design Files for all works designed by the Contractor.
- As Constructed Drawings associated with all works completed by the Contractor including switchboard general arrangements, switchboard single line diagrams, switchboard schematics, switchboard equipment schedules, trip/closing supply schematics and general arrangements (if ordered).
• Complete details for servicing and adjusting all items of plant including instruments, relays, operating elements, mechanical interlocks and control equipment.
• Complete schedules of parts and information on the sources of supply of parts including copies of all contract sub-orders to Contractors (prices may be blanked out). Identifying codes or part numbers shall be quoted.
• List of recommended spare parts for all the major equipment supplied.

The manuals shall be clearly labelled and indexed. The manual shall be submitted in draft form three weeks prior to the delivery of the equipment or as indicated elsewhere and shall be revised as directed by the Principal’s Representative and the required copies submitted prior to the date of acceptance.

The text of the operating and maintenance instructions together with all drawings, illustrations and diagrams shall refer specifically to the plant and equipment being supplied under this Contract. General instructions referring to a range of equipment are not acceptable.

MATERIALS & FITTINGS

GENERAL

All materials and equipment used in the works will be the best of their respective kinds and in accordance with the current specifications of the Standards Association of Australia for those particular classes of material, where such specifications are applicable and do not conflict with this specification. If there is no Australian Standard Specification, then the relevant British Standard will apply.

The Principal’s Representative may require samples of any or all of the materials nominated to be submitted for their review prior to their use on the job. Whether the Principal’s Representative has called for samples or not, all materials used in the work will be subject to the Principal’s Representative’s review.

All valves and fittings will be Fusion Bonded Epoxy coated (or approved equivalent). All materials and protective coatings will comply with Category E-M of AS 2312 – 2002.

All items that may need to be replaced or serviced will be able to be removed and replaced by normal tools without the need to cut pipes or fittings.

Equipment, pipe and fittings will be suitable for operation in an environment where relative humidity of 95% and shade temperatures of 40°C can occur simultaneously (conditions inside tanks etc. may exceed these figures).

Electrical equipment and instrumentation to be mounted outdoors will have an enclosure protection rating of IP65 (unless noted otherwise) to AS1939. Protection will be provided by encapsulation and/or varnish impregnation using non-hydroscopic materials which do not age and are unaffected by sunlight.

No separate payment will be made for the Contractor complying with this clause, but rather full compensation will be provided in the lump sum amount generally.

CONCRETE WORKS

The Standard Specification G15 – Concrete 1, as amended by this Job Specification and the drawings, will apply to and form part of this Contract. Concrete used in the works will have the following 28 day compressive strengths, unless noted otherwise on the Job Drawings or in this specification:

• Reinforced concrete: N25
• Mass concrete: N20
• Lean mix concrete; flowable backfill: 1MPa (not greater than 5MPa); slump > 100mm.
The Contractor will carry out sampling during concrete construction. Sampling frequency and
testing of concrete for compliance will be in accordance with AS 1379. Slump tests and
projected assessment of each strength grade will be undertaken in accordance with AS 1379.
No separate payment will be made for the Contractor complying with this clause, but rather
full compensation will be provided in the lump sum amount generally.
DESIGN AND CONSTRUCTION
DESIGN BY CONTRACTOR

GENERAL

The Contractor shall be responsible for the design of all structural steelwork, handrails, concrete slabs and any other part of the work that is not fully detailed in the Drawings and Specification.

9. DESIGN REQUIREMENTS

The design of all items shall be undertaken in accordance with relevant Australian Standards including but not limited to the following:

9.2. • AS/NZS1170 Structural design actions – all parts
• AS1657 Fixed platforms, walkways, stairways and ladders – Design, construction and installation
• AS 3600 Concrete structures
• AS4100 Steel structures Wind loadings shall be in accordance with AS1170.2 for Region A terrain category 4.
• The Contractor shall note that all electrical works shall be designed by the Contractor. It shall be the Contractor’s responsibility to ensure that all Electrical works are completed under this contract in accordance with AS3000, AS3008 and relevant local government regulations. Any requirements of the electricity supply authority shall also be adhered to.
• Fusion Bonded Epoxy coated Ductile Iron Fittings & Pipe to AS4158. Bitumen coating is applied to the cement lined fittings. Bitumen coatings comply with the requirements of AS/ NZS3750.4.
• Stainless Steel pipe manufactured to ASTM A312M – Austenitic. Flanges to manufactured to ASTM A403M
• AS/NZS 4020 Australian Standard for potable water.
• AS3780-2008 The Storage & handling of corrosive substances.
• AS4902-2000 General Conditions of contract for design and construct
• AS4903-2000 General Conditions of subcontract for design and construct
• AS/NZS3000:2018 Wiring Rules
• AS3008 Electrical installations - Selection of cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
• AS/NZS 3439.1:2002 Low-voltage switchgear and control gear assemblies Type-tested and partially type-tested assemblies
• AS K211-1971 Zinc chromate primers for structural steel
• AS K126-1961 Exterior finishing enamel (performance basis)
• AS 1775-1984 Low voltage switchgear and control gear - Air-break switches, isolators and fuse-combination units (up to and including 1000 VAC and 1200 VDC)
• AS 1029-1974 A.C. Contactors (up to and including 1000 VAC)
• AS 1675-1974 Current transformers for measurement and protection (Metric Units)
• AS/NZS 1768:2007 Lightning protection
• AS 1023.2-1989 Low voltage switchgear and control gear - Protection of electric motors Current sensing protection devices for AC motors
• NZS/AS 1023.1:1985 Low voltage switchgear and control gear - Protection of electric motors - Built-in thermal detectors and associated control units
• AS 1202 AC Motor Starters
• AS 1431 Low Voltage switchgear and control gear
• AS 1042-1973 Direct-acting indicating electrical measuring instruments and their accessories
• AS 3439 Low-voltage switchgear and control gear assemblies
• AS 3147 Approval and test specifications
• AS 1359 General Requirement for Rotating Electrical Machines.
• AS 1360.10 General Purpose Motors.
• AS 1939 Classification of degrees of protection provided by enclosures for electrical equipment.
• AS 2420 Solid insulating material used in electrical equipment.
• AS 2380 Electrical equipment for explosive atmospheres.
• AS 1044 Limits and methods of measurement of radio disturbance characteristics
• AS 2229 Electrical equipment for explosive atmospheres

**COMPLIANCE CERTIFICATION**

Compliance of Designs by Contractor with Australian Standards shall be certified by a Registered Professional Engineer of Queensland.

**DESIGN DOCUMENTATION**

The Contractor shall supply to the Principal’s Representative for his or her comment, copies of all drawings and compliance certification for all items designed by the Contractor prior to any construction or manufacturing works taking place. In addition to the drawings and compliance certification the Contractor shall provide copies of all calculations if requested by the Principal's Representative.

**MEASUREMENT AND PAYMENT**

Full compensation for Design by Contractor including investigations, calculations, preparation of drawings, documentation and for all other costs incurred in the design in accordance with the Contract shall be included in the rates included in the Schedule.
HAZARD & OPERABILITY ANALYSIS (HAZOP)

As most of the works in this specification will be performed on equipment which is essential for the community water and sewage infrastructure, before commencing any works for this project the contractor shall submit a HAZOP for the project. The HAZOP will be presented to Principal’s Representative after the awarding of the contract. The presentation will also be attended by both operational & managerial staff from WASC.
WATER SUPPLY

ARTISIAN BORE NO.1

The contractor is to supply and install a new variable frequency drive to run the existing 11KW Bore pump. This will also include all controls to connect to the new telemetry communications unit.

The Contractor is to provide new station control & telemetry communication units for the Bore to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following:

- Running status
- Fault status
- Remote Auto/Man/Off indication and control
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Fault statistics such as faults/day

The current bore has limited flow due to environmental conditions. If ordered, the contractor is to investigate the issues of the water supply. These can include the length of casing past current usage point, height of water, effectiveness of bore.

The above surface fittings and pipes require refurbishment or replacement. Refurbishment consists of wire brush clean and coating with Bitumen Paint. Operating temperature of the fittings & Pipe to be between -10°C to 80°C. Pressure ratings of replacement fittings will be as per existing or PN16 as minimum or whichever is greater.

Fittings required to be replaced are follows:
1. DN100 Check Valve
2. DN 100 Gate Valve
3. DN100 Water Meter
4. 63mm Stainless Steel pressure gauge.
5. 1”/25mm flow switch
6. 150mm CI adaptor flange
7. 80mm 316grade Stainless Steel FL-FL pipe for air release valve
8. 80mm CI Air release valve
9. 1”/25mm Air release valve

ARTISIAN BORE NO.2 - (IF ORDERED)

The bore pump, switchboard and compound have been removed. The contractor is to investigate the viability of returning this bore back to operation. If the bore is found viable to supply water to the Header Tank, the contractor is to install a complete pump station including all pipes and fittings to connect to a new 30KL Poly water tank, concrete surround and compound fencing. A pressure pump will be installed to pressurise the outgoing pipeline along with three stage water filters and U.V. disinfection.

The pump station will be required to be connected to the new Telemetry system. The Contractor is to provide new station control & telemetry communication units for the Bore to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following:

- Running status
- Fault status
- Remote Auto/Man/Off indication and control
- Tank level indication
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Flow rate and Volume statistics (if a suitable flow meter is available)
ARTISIAN BORE NO.3

The Contractor is to provide new station control & telemetry communication units for the header tank to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following:

- Running status
- Fault status
- Remote Auto/Man/Off indication and control
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Flow rate and Volume statistics (if a suitable flow meter is available)

The above surface fittings and pipes require refurbishment or replacement. Refurbishment consists of wire brush clean and coating with Bitumen Paint.

Operating temperature of the fittings & Pipe to be between 10°C to 80°C. Pressure ratings of replacement fittings will be as per existing or PN16 as minimum.

Fittings required to be replaced are as per the following:

1. Dn100 Check Valve
2. DN 100 Gate Valve
3. DN100 Water Meter
4. 63mm Stainless Steel pressure gauge.
5. 1”/25mm flow switch
6. 150mm CI adaptor flange
7. 80mm 316grade Stainless Steel FL-FL pipe for air release valve
8. 80mm CI Air release valve
9. ½” Air release valves

ARTISIAN BORE NO.4

The Contractor is to provide new station control & telemetry communication units for the header tank to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following:

- Running status
- Fault status
- Remote Auto/Man/Off indication and control
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Flow rate and Volume statistics (if a suitable flow meter is available)

The above surface fittings and pipes require refurbishment or replacement. Refurbishment consists of wire brush clean and coating with Bitumen Paint.

Operating temperature of the fittings & Pipe to be between -10°C to 80°C. Pressure ratings of replacement fittings will be as per existing or PN16 as minimum.

Fittings required to be replaced are as per the following:

1. DN100 Gibault joint
2. DN100 Water Meter
3. 63mm Stainless Steel pressure gauge.
4. 1”/25mm flow switch
5. 80mm 316grade Stainless Steel FL-FL pipe for air release valve
6. 80mm CI Air release valve
BORE FIELDS HEADER TANK

The Contractor is to provide new station control & telemetry communication units for the header tank to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following.

- Fault status
- Remote Fault Reset
- Water Level
- Flow rate and Volume statistics (if a suitable flow meter is available)

The bore header tank has numerous weep points on the outside of the tank. The contractor is required to drain the header tank whilst ensuring that the two residences connected to the bore lines before the tank are supplied with water. Once drained, the tank is required to be pressure cleaned and inspected. Repairs are to be made to the internal and external damaged parts of the walls and floor. The repairs will be carried with XYPEX Patch’n Plug or equivalent. Any products used to repair the internal walls of the tank must comply with potable water requirements.

The external fittings and pipes require refurbishment or replacement. Refurbishment consists of wire brush clean and coating with Bitumen Paint.

Operating temperature of the fittings & Pipe to be between -10°C to 80°C. Pressure ratings of replacement fittings will be as per existing or PN16 as minimum.

Fittings required to be replaced are as per the following:
1. DN100 Water meter
2. 1”/25 Air release and isolation valves

New Galvanised support brackets are to be installed on the pipe work.

11.6. BORE FIELDS WATER METERS

The Bore supply line has approximately five-(5) take off points to fed water troughs etc. The Contractor is to provide new water meters and isolation valves in water meter pits as per Capricorn Municipal Development Guidelines (CMDG) drawing number CMDG-W-091.

MIMOSA CREEK SPEAR PUMP STATION

The current level configuration of the pumps in the well may limit the amount of water which can be delivered to the Water Treatment Plant (WTP). The contractor is to investigate if the pump can be lowered to increase the amount of water delivered to the WTP (if ordered).

The current flow meter is installed in such a position that it is affected by air in the pipeline and is not able to read without entering a confined space. The Contractor is to excavate the existing flow meter and install an air release with isolation valve and new flow electromagnetic flow meter with the display wired back to the current switchboard.

The Contractor is then to reposition the concrete shaft and install new concrete top with cast iron lid.

The Contractor is to provide new station control & telemetry communication units for the header tank to communicate to the SCADA System as per Section 15. The remote monitoring and control must allow for a minimum of the following.

- Running status
- Fault status
- Remote Auto/Man/Off indication and control per pump
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Flow rate and Volume statistics (if a suitable flow meter is available)
WATER TREATMENT PLANT

ACID DOSING STORAGE

Current storage facilities for the hydrochloric Acid dosing has caused treatment vessels and equipment to show sign of rusting. To Eliminate this, the contractor is to move the existing Acid dosing to outside the adjacent wall.

The contractor is to form and pour a concrete slab at the back of the treatment building. Then block in the new chemical bund complete with drain. The installation shall comply with accordance of AS3780-2008 The Storage & handling of corrosive substances. The contractor is to provide Colourbond shade structure over the new dosing facility to the Principal’s Representative’s approval.

The Contractor is then to move the existing Acid storage tank to the new bund area along with the dosing pumps, power and controls to the new position.

The general design is referred to below.

PAINTING OF INTERNAL TREATMENT VESSELS

The Stainless steel vessels and walkways have signs of corrosion. The two carbon filters especially have signs of electrolysis.

The contractor is to remove the filtration media from the carbon filters one at a time as to enable the treatment plant to run with one carbon filter still in operation whilst the other is being repaired. Each filter is to be removed and abrasive blasted before being inspected. Any internal points of concerns are to be welded and re-blasted with garnet before internal coating with an epoxy paint.

The contractor is to externally wet abrasive blasts the remaining treatment vessels in position (3 filters, 2 settler tanks, flocculation tank & walkway frames) and epoxy coat. Care is required to ensure that no chemicals enter the treatment process.

Painting is to consist of a low VOC, high build, semi-gloss urethane finish

Externally – Low VOK, high build, semi-gloss urethane finish.
Suggested paint – Primer: Interplus 1180, Topcoat: 2 coats Interthane 990. Colour to be approved.
Internally – Solvent free heavy-duty epoxy tank lining.
Suggested Paint – 2 coats Interline 975P White
Handrails -

SHED REPAIRS

The external tin covering the shed has suffered from chemical damage. The contractor is to replace the sheets of damaged Colourbond iron to match existing.

RESERVOIR REPAIRS

12.3. The 2ML reservoir is leaking and this is evident from the chlorinated water coming from the underdrainage.

The contractor is to work in conjunction with the Council water operation team to isolate the 2ML reservoir, then scour the reservoir to the Supernatant ponds.

The reservoir is then to be pressure cleaned before an internal inspection of the tank base and walls is to be undertaken along with a hydrostatic leak test of the scour and delivery lines. A report is to be made of the condition and supplied to the Principal’s Representative.

Depending upon the condition and leak tests, the contractor is to carry out repairs. A provisional sum is to be allowed for these repairs.

SUPERNATANT PONDS

12.5. The five (5) Supernatant ponds approximately 25m Long x 1.5m Wide x 2m Deep, are to be concrete lined. The lining is to enable Principal machinery to periodically clean out the ponds.

The contractor is to work in conjunction with operational team to isolate two ponds on one side.

The contractor is then to de-sludge the ponds before leaving them dry sufficiently so to able re-shape the ponds as per the drawing attached.

The contractor is to design the concrete lining to operate the Principal’s bobcat to clean the pond.

See Drawing of desired design below.
SEWAGE TREATMENT PLANT

SEWAGE INLET WORKS

The contractor is to design and install a 316 grade stainless steel static inlet screen. This inlet screen will replace the existing Rake screens and will be designed to remove solid waste of a particle size of greater than 3mm into the existing waste down pipes. The inlet line will be required to be able to switch direction of flow to either side of the Imhoff Tank. The contractor is to allow for all necessary handrail alterations to achieve this and shall comply with the relevant standards.

The contractor is to supply and install a new Electromagnetic flow meter to the sewage inlet line to replace the existing flow meter. The contractor is to drain the Imhoff Tank and replace the two-(2) drain valves with Resilient Seated Gate Valves. The contractor is to install aluminium covers to suit each valve pit along with galvanised steel handrails and access stairs.

DRYING BEDS

The contractor is to design and install access ramps to the Imhoff drying beds to allow for council to use a mini loader to remove the solids from the drying beds.

The contractor is to supply and install hot dipped galvanised steel safety handrails around the isolation plates on each of the five-(5) ponds.

SEWAGE IRRIGATION UPGRADE

The contractor is to supply and install 100 new 25NB galvanised steel sprinkler risers 1200mm high with sprinklers. The contractor is to locate the existing NB100 polypropylene inlet pipe which feeds the existing sprinkler lines and install new Resilient Sealed gate isolation valves to each row, five-(5) in total. The valves and covers shall be installed as per CMDG-W-060

SEWAGE PUMP UNITS

The contractor is to supply only two-(2) submersible pump units complete with plugs to suit existing pump outlets. The pump is a FLYGT SUBMERSIBLE PUMP 4.2KW 415V XP-NP3102.160SH255
SEWER PUMP STATIONS

SEWER PUMP STATION 1

The Contractor is to provide new station control & telemetry communication units as per section 15 for the sewer pump stations to communicate to the SCADA System. Contractor must investigate the usability of the current switchboard and provide estimate for a switchboard upgrade if necessary.

The remote monitoring and control must allow for a minimum of the following:
- Water Level
- Running status
- Fault status
- Remote Auto/Man/Off per pump
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Fault statistics such as faults/day

The contractor is to supply and install a flashing red LED alarm light mounted on top of the switchboard with a vandal proof metal cover.
The contractor is to supply and install site lighting. This will be to illuminate the pump well and switchboard. The lighting shall be LED with a metal vandal proof cage
The contractor is to upgrade the gantry winch, trolley and lifting chains to current Australian standards. Current lifting capacity is 500 kg.
The contractor is to supply and install a new high-pressure cleaner which is to be installed in the lockable box provided at this site. Current power for this unit is three-(3) phase.

SEWER PUMP STATION 2

The Contractor is to provide new station control & telemetry communication units as per section 15 for the sewer pump stations to communicate to the SCADA System. Contractor must investigate the usability of the current switchboard and provide estimate for a switchboard upgrade if necessary.

The remote monitoring and control must allow for a minimum of the following:
- Water Level
- Running status
- Fault status
- Remote Auto/Man/Off per pump
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Fault statistics such as faults/day

The contractor is to supply and install a flashing red LED alarm light mounted on top of the switchboard with a vandal proof metal cover.
The contractor is to supply and install site lighting. This will be to illuminate the pump well and switchboard. The lighting shall be LED with a metal vandal proof cage
The contractor is to upgrade the gantry winch, trolley and lifting chains to current Australian standards. Current lifting capacity is 500 kg.
The contractor is to supply and install a new high-pressure cleaner which is to be installed in the lockable box provided at this site. Current power for this unit is three-(3) phase.
SEWER PUMP STATION 3

The Contractor is to provide new station control & telemetry communication units as per Clause 15 for the sewer pump stations to communicate to the SCADA System. Contractor must investigate the usability of the current switchboard and provide estimate for a switchboard upgrade if necessary.

The remote monitoring and control must allow for a minimum of the following,

- Water Level
- Running status
- Fault status
- Remote Auto/Man/Off per pump
- Remote Start per pump
- Remote Fault Reset
- Runtime statistics such as minutes/day, starts/day
- Fault statistics such as faults/day

The contractor is to supply and install a flashing red LED alarm light mounted on top of the switchboard with a vandal proof metal cover.

The contractor is to supply and install site lighting. This will be to illuminate the pump well and switchboard. The lighting shall be LED with a metal vandal proof cage.

The contractor is to upgrade the gantry winch, trolley and lifting chains to current Australian standards. Current lifting capacity is 500 kg.

The contractor is to supply and install a new high-pressure cleaner which is to be installed in the lockable box provided at this site. Current power for this unit is three-(3) phase.

14.4. SEWER PUMP STATION 4

The Contractor is to provide new station control & telemetry communication units as per section 15 for the sewer pump stations to communicate to the SCADA System.

The remote monitoring and control must allow for a minimum of the following,

- Water Level
- Running status
- Fault status
- Remote Auto/Man/Off per pump
- Remote Fault Reset
**SCADA**

This section of the specification covers all works necessary for the completion of the Supervisory Control and Data Acquisition System. These requirements are considered to be the minimum requirements only with regard to the Supervisory Control and Data Acquisition System. The Contractor shall make his own assessment of whole-of-life costings and may offer an increased level of performance for consideration of the Principal’s Representative in maximising value for money for the project.

**SCADA TELEMETRY SYSTEM**

The contractor shall provide a new SCADA/telemetry system to control and monitor the entire Water and Sewer Treatment Plants and the Pump Station network. The current Citect SCADA system monitors the Water Treatment plant only and it is interfaced with the Outpost 2 SCADA system which monitors the remote pump stations over an analog radio network. The new SCADA system shall be an advanced ClearSCADA database system or equivalent providing monitoring and control access of the plant via a graphical operator interface. The system shall include a local area network (LAN), desk top computer, laptop computer, communication equipment, alarm notification modems and printer. The Scada server must be installed at the Water Treatment Plant.

Secure internet access will be provided by the Principal for remote monitoring and operation of the plant. Internet access will permit viewing of all information and reporting in a format identical to that available to the operators on site. The current analog radio network used onsite utilizing a licensed radio spectrum is to be upgraded with a digital radio network which supports TCP/IP protocol over the radio network. Preference will be given to radio solutions which operates over unlicensed radio spectrum. The SCADA and Telemetry network should be capable of providing site to site communication where required to ensure smooth automated running of the system. The telemetry network design for monitoring the remote stations should incorporate DNP3 protocol and allow for a minimum of 8 hours of data buffering with timestamp if the communication is lost. The telemetry controllers should support remote configuration management via file transfer over the wired/wireless communication infrastructure. The controller also must have ability to incorporate an additional backup communication channel in the future.

The SCADA/telemetry System shall provide as a minimum the functionality set out below and any additional functionality necessary for provision of comprehensive monitoring and control of the Facility. Additional specifications are provided as Appendix B

- Continuous monitoring of performance of the Water and Sewer treatment process.
- Continuous monitoring of the operational status of all significant plant and equipment.
- Ability to reset alarms, isolation and activation of plant and equipment, adjustment of dose rates, flows and key operational parameters via remote control.
- Graphical display of trending for any parameters selected to facilitate optimisation and identification of emerging issues.
- Preparation of standardised automatic reporting on alarms, flows, effluent quality, chemical dose and usage and relevant performance indicators. The reports are not to require third party software to generate or access the report other than MS Word or MS Excel.
- Generate alarms in response to process and plant and equipment failures or excursions and initiate communications (auto dialler) to call out staff.
- Monitor and Control the Sewer Treatment plant equipment.
- Monitor and Control the entire water and sewer pump stations and reservoirs.

The SCADA software and data shall be able to be accessed both from a computer system located at the WTP as well remotely by Council at STP, Council’s offices or Depot. Remote access shall have the same functionality as the Main Station. The option of automatic
notification of alarms to pre-set telephone numbers (text and/or email) shall also be provided, with the facility to defer further notification (1 hour, adjustable) following operator acknowledgement of the fault.

The final SCADA functionality will be agreed with Principal operators prior to completion of programming.

Contractor must provide full backups of the entire configuration with all required licenses and login information. As a minimum the following documentation must be included:

- Operator Manual
- Maintenance Manual

The Contractor shall provide training in the system for up to 6 of the Principal’s staff.
APPENDIX A - PHOTOS

WATER SOURCE UPGRADE

Photo 1: Bore No. 1, 3 & 4 requires replacement fittings and rust proofing/painting of existing pipework.

Photo 2: The header tank pipe work requires a new flow meter and the pipe/fittings require rust treatment/painting.
Photo 3: Bore No. 2 requires a complete pump station.
16.2. WATER TREATMENT PLANT UPGRADES

Photo 4: The Mimosa Creek Spear Flow meter requires replacement and Air valve fitted prior. The concrete shaft requires straightening and new lid installed.

Photo 5: Water treatment aerial photograph
Photo 6: The existing Acid dosing is to be moved to the outside wall to eliminate the effects of acid fumes on the internal equipment and structure.

Photo 7: External wall where the Acid dosing is to be relocated.
Sewer Treatment Plant Works

Photo 8: Woorabinda Sewage Ponds have seven-(7) isolation/sampling points and the filtration backwash out pipeline.

Photo 10: The Imhoff Tank has two (2) drain valves require replacement along with installation of Aluminium pit covers, access stairs and handrails.

Photo 11: New parabolic screens are required to replace the existing rake bar screens. The screens will dump the solids into the existing down pipes.
Photo 12: The Inlet flow meter requires replacement.

Photo 13: The six (6) sewage drying beds require driveable ramps for future use of machine to clear dried solids. Separation block walls are also required for the concrete slabs for storing the solids and refill sand piles.
Photo 14: Sewage Irrigation Fields
APPENDIX B - SCADA SPECIFICATIONS

This section of the specification covers SCADA system works.

SYSTEM RELIABILITY

17. The equipment to be supplied shall achieve the following reliability:
   • Complete system outage - no control or indications to or from all field stations for a period exceeding 30 mins with mean time between failure not less than 40,000 hours.
   17.1.
   • Complete system outage - no control or indications to or from all field stations for period exceeding 3 mins but not exceeding 30 mins with mean time between failure not less than 20,000 hours.
   • Complete system outage - no indications or control to or from all field stations for a period exceeding 3 mins with mean time between failure not less than 10,000 hours.
   • Failure of a field station to transmit indications or respond to commands with mean time between failure not less than 5000 hours.
   • Automatic backup and archiving such that the maximum data lost in any failure of the system shall be 24 hours.
   • Uninterrupted power supply facilities shall be provided for all key elements.

17.2. RESPONSE TIME

The time between the change of an indication state (non-latched contact open or closed) in the field and the field display/indication of that changed state shall not exceed three seconds.

The time between the transmission of a command from the master station and the reception and initiation of that command at the field and the display of the changed indication state at the master station shall not exceed the command operate time plus three seconds.

Data transmission equipment shall be selected by the Tenderer to optimise the Bit Error Rate performance.

DATA ACQUISITION

Data shall be collected from all points shown on the P&ID and also include.
   • Pumps/Motors and other mechanical equipment status.
   • Valve Status.
   • Chemical dosing equipment status and dose rates.
   • Flowmeters.
   • Tank levels.
   • Any water quality monitoring devices.
GRAPHICAL DISPLAYS

The system shall be capable of displaying all alarms, indications and historical report data as specified, in details on a series of pages on a computer screen, selectable from the keyboard. The software used shall be user friendly and provide graphical menu driven system for access to various displays on the computer. The graphical display shall include the following:

- Mimic diagrams
- Overall view of plant - Detailed process mimic with real time status displays.
- Control Display

FUNCTIONAL BRIEF

17.5. Enable start/stop control from the keyboard/mouse for specified equipment and process.
17.6. Historical data and real-time display of key parameters (including specified Performance Guarantee parameters and flows) in graphical format.

TRENDING

Trending shall be provided for all values. The time scale shall be defined by the user. Multiple channel trending shall be provided. Trending shall either be constructed from real time data or from historical data (minimum 5 years). For data not automatically captured by the SCADA system the facility to manually input the data shall be provided (e.g. Lab test results of parameters not automatically monitored). Any chosen trend display shall be able to print out or transferred to storage for later viewing or inclusion in other reports.

ALARM

All alarms to have positive feedback. Alarm logging shall be provided for both active alarms and non-active alarms. A dedicated printer shall be used for alarm printing.

Alarm information when the Master Station is unattended shall be announced by dialling a selected, telephone number and transmitting the alarm information via a text message or an email.

MANAGEMENT REPORT

A free form management report shall be provided. The format of the management report shall be decided by the user. The management report typically takes the form of daily/weekly reports. These reports can include raw and processed data such as daily/weekly production, accumulated values, periodic consumption, events or alarms, etc. The data shall be able to be output to Excel file formats for latter processing.
APPENDIX C - ELECTRICAL SPECIFICATIONS

This section of the specification covers the electrical works.

These requirements are considered to be the minimum requirements only with regard to electrical works. The Contractor shall make his own assessment of whole-of-life costings and may offer an increased level of performance for consideration of the Principal’s Representative in maximising value for money for the project. In addition, if a higher level of performance is required to suit the Contractor’s design, then that higher level of performance shall prevail.

GENERAL

Irrespective of any requirements specified in these documents, the installation as a whole shall comply with:

      AS 3008.1 Electrical Installations - Selection of Cables, Part 1.
      The rules and regulations of the relevant local Electricity Supply Authority.
      Any other Authority having jurisdiction over the installation.

INTENTION

The Contractor will be responsible for the following:

18.2. Make application for alteration of electricity supply as required and metering and pay all fees and charges on behalf of and in the name of the Principal.
      Provide all power and control for the complete operation of the various sites under the tender.

FIELD INSTRUMENTATION REQUIREMENTS

The field instrumentation includes primary measuring elements and associated instrument transmitters for sensing of physical and analytical plant variables for monitoring and/or control purposes.

The most suitable type of instrument shall be selected for each application. Suitability shall be assessed based upon reliability, response time, accuracy and the amount of maintenance required. Where a significant cost saving may be achieved without a major compromise of any of the above criteria, the lower cost alternative may be offered by the Contractor as an option.

TESTING AND COMMISSIONING

In addition to testing requirements specified elsewhere in this specification, the requirements of this clause shall also apply.

Performance tests shall be undertaken and recorded at the site to validate undertakings given in written warranties and performances levels specified in this Specification.

Sample test and commissioning records of the type to be used for testing and commissioning the works described in this Contract shall be submitted to the Principal’s Representative within two weeks of award of contract.
PERFORMANCE SPECIFICATION

After review of the records by the Principal’s Representative, additional records and/or requirements may be forwarded to the Contractor for use in testing and commissioning these works.

18.5. At the minimum, the following records shall be provided:

- For insulation and continuity testing for all cabling.
- For distribution board and switchboard insulation test.
- For TOL and other equipment settings.
- For instrument configuration.
- Other records and procedures to be followed during testing and commissioning as appropriate for the equipment and/or system.

Testing and commissioning records shall be kept by the Contractor. Copies of these records shall be forwarded by the Contractor to the Principal’s Representative immediately on request. Copies of the records shall be incorporated in the Operations and Maintenance Manual.

Commissioning shall comprise a minimum of two stages:

- Testing and pre-commissioning by the Contractor on site of individual equipment and of integral system operation; and
- Final commissioning by the Contractor as directed by the Principal’s Representative of equipment and integral system operation to the satisfaction of the Principal’s Representative.

18.6. SWITCHBOARD

Switchboards shall be metal clad, front connected cubicle type. The switchboard shall be to AS3439.1 and shall comply with AS 3000, AS 3439.1, and other applicable standards and Supply Authority requirements.

All equipment shall have front connection and removable cover plates shall be provided to permit ready access for this purpose.

Switchboards shall be constructed to withstand a prospective unfused fault current of not less than 16 kA. The switchboard shall be type tested in accordance with AS 3439.1. Internal separation shall be to Form 2 of AS 3439.

Each unit shall be constructed suitable for plinth mounting.

All equipment, other than auto transformers, shall be mounted at a minimum height of 300 mm above the floor level.

Switchboards shall be arranged so that all live parts of equipment immediately accessible when the switchboard doors are opened are insulated. All connections to busbars or equipment shall be either sheathed with PVC to approval or shall be made behind a removable cover plate.

The switchboard door mounted equipment shall have suitable insulated barriers fitted to prevent contact of personnel against live equipment with the doors in the open position. The barriers shall also prevent mechanical damage to door mounted equipment.

Prior to dispatch to site switchboards shall be subject to the tests in the applicable standards and a functional test.
Degree of Protection
The minimum degree of protection provided by the switchboard against contact with live parts and ingress of foreign bodies and liquid as required by AS 3439.1 and as defined in AS 1939 shall be IP S2 unless specified elsewhere.

Construction
Aluminium and Stainless Steel

All sheet metal used in the manufacture of switchboards shall be cold rolled mechanical sheet mild steel, marine grade aluminium or 304 grade stainless steel which shall be supplied flat, free from dents, rust, scale and other blemishes.

The minimum thickness of stainless-steel sheet shall be:

a) Cabinets of maximum width 600 mm without frame - 1.5 mm.
b) Cabinets of maximum width 900 mm without frame - 2.0 mm.
c) Cabinets of maximum width greater than 900 mm without frame - 2.5 mm.

Notwithstanding the above, where cabinets are of less than 150 mm in depth, the minimum thickness of sheet shall be:

- For (a) and (b) above - 1.5 mm.
- For (c) above - 2.0 mm.

The minimum thickness of aluminium sheet shall be 3 mm regardless of cubicle dimensions.

Blind rivets or self-tapping screws shall not be used in any part of the switchboard unless specifically noted.

Welding
All welds shall be full penetration fillet welds ground and machined smooth and all weld spatter shall be removed.

Welds shall be treated and dressed to conform in appearance and finish to the component material. The dimensions of the weld shall be as such as to provide adequate penetration and strength to the component concerned to enable it to fulfil its normal service function.

All joints, particularly lap joints and joints to the framework, shall be completely and continuously welded throughout the entire periphery of the section to avoid differential oxygen concentration between the outside and inside of the joint.

Finish
Application of all coating systems shall be carried out using suitable spray equipment, brushes and applicators and coatings shall not be applied to surfaces affected by moisture, dust, dirt or grease or contaminated in any way.

The coatings shall be applied to clean dry surfaces when the relative humidity and ambient temperature are within the ranges recommended by the manufacturer.

Minimum and maximum drying and curing times recommended by the manufacturer shall be strictly observed before recoating.

Each coat shall be of a different shade or colour from the preceding coat to facilitate identification. Where necessary, this shall be achieved by the addition of an approved tinter to the first coat.

Care shall be taken in the application of the finishing coats to ensure that no air is entrapped between the zinc primer coat and the finishing coats.
All coating work including the application of finishing coats shall be carried out prior to delivery of steelwork or equipment to site. Adequate protection to the coating system shall be provided to ensure minimum damage during transport.

**Indoor Applications**
- Primer Coat Zinc Chromate Primer (AS K211 - Type 2) to a minimum dry film thickness of 40 micrometres.
- Finishing Coats Two coats of premium quality Alkyd (AS K126) in the required colour to a minimum dry film thickness of 35 micrometres for each coat.

**Outdoor Applications**
- Primer Coat As above except dry film thickness of 75 micrometres.
- Finishing Coats As above except dry film thickness of 45 micrometres for each coat.

**Escutcheon Plates**
Escutcheon plates shall be neatly cut to fit around equipment so as to conceal wiring ducts, cables, busbars and the like.

Escutcheon plates shall be not less than 1.5 mm zincanneal. Escutcheon plate fixing screws shall be of the mushroom head type.

Escutcheon plates shall be provided with handles to facilitate ease and safety in removal from the switchboard. The handles shall consist of at least two 100 mm long "D" type metal handles locknutted to the escutcheon plate.

**Cable Entry**
 Provision shall be made at the top and bottom for conduit and cable gland entries. 6 mm thick brass gland plates are to be provided as required. Fix gland plates by means of bolts and captive nuts. All glands passing through a gland plate shall be fitted with approved nylon gland seals to prevent ingress of corrosive fumes.

**Busbar System**
Busbars shall be rounded-edge hard drawn high conductivity (HDHC) copper and shall comply with AS 3439.1 where applicable.

The main busbars shall have a minimum continuous rating equal to the incoming circuit breaker or isolator.

All droppers or tee-off busbars to circuit breakers or controlling devices shall have the same rating and that rating shall be equal to the maximum possible load on any one set of droppers.

The earth busbar shall be rated to suit the prospective fault level and shall be a minimum cross section area of 100 sq mm.

All joints take off points and other connections on the busbars shall be adequately prepared to avoid high contact resistance for the life of the board. This preparation shall include as a minimum requirement, abrading with fine grade emery paper or draw filing then coating with a non-corrosive rust inhibiting compound or preferably silver plated.

Busbar clamps, for clamping two sections of busbar or droppers from busbars, shall have a minimum of two bolts complete with locking devices. These bolts shall not be used to support the busbar.

Busbar supports shall be non-hygroscopic, have adequate mechanical strength and be spaced for the full fault capacity of the board.
The main busbars shall be coated with extruded PVC or heat shrink insulation in the following colours:

- A Phase Red.
- B Phase White.
- C Phase Blue.
- Neutral Black.

The earth busbar shall be identified with a 50 mm long coating, of green or green/yellow extruded PVC or heat shrink insulation at each section of the switchboard.

The main busbars in the Main Switchboard shall be completely enclosed and except for power take-offs, shall be segregated from all other equipment and wiring. Provide inspection covers in each busbar enclosure.

Neutral and earth busbars shall be completely isolated from each other, apart from the interconnecting link which shall be made within the main switchboard. The link shall be readily accessible from the front of the board. The termination points for connection to the main earthing system shall also be located in this position.

The earth bar shall be tapped at regular spacings to provide at least four tapped holes per motor starter. Aluminium to copper interfaces shall be treated to prevent corrosion without increasing electrical resistance at such joints.

### CIRCUIT BREAKERS

18.7.

The contractor shall ensure that all circuit breakers are correctly sized to protect the downstream equipment against overload and fault conditions.

In the case of sub-circuit circuit breakers, the main circuit breaker may be used as a current limiting device. The cascaded circuit breakers shall fulfil the following conditions:

- The peak value of current interrupted by the back-up breaker shall not be more than the level which the breaker on the load side can withstand mechanically.
- The I2t during the short circuit current interruption shall not be more than that which the breaker on the load side can withstand thermally.
- The rated breaking current of the breaker on the load side shall be higher than the current value at the crossing of its break-time characteristic with the opening time characteristics of the back-up breaker.
- Circuit breakers shall be selected in accordance with the manufacturers recommended cascade co-ordination chart, Category II only.

The circuit breaker trip ratings shall be labelled or inscribed on the circuit breaker body in an approved way. This inscription shall be clearly visible with covers in place.

Horizontally mounted circuit breakers shall have been fully tested as being capable of successfully operating under full load and short circuit conditions in the horizontal position.

Circuit breakers shall incorporate the following features:

- Arc interrupting device.
- Toggle action quick break.
- Inverse time limit characteristics.
- Trip-free handle.
- Contacts to be non-welding.
- Mechanism to be non-tamperable.
- Common tripping device for multiphase units.
- Uniformity of style and construction.
- Padlockable in the "off" position.
Handles shall have an intermediate trip position.
Double pole circuit breakers shall be used on 24 V dc circuits.

FUSES

Fuses shall be HRC type and shall comply with CSA C22.2.106 : 2005 and shall be suitable for the fault level of the installation. All fuse cartridges (excluding those mounted in fuse combination units and fault current limiters) shall be held in a fully enclosed moulded fuse holder with shrouded contacts.

Fault current limiter cartridges shall be held in approved holders and shall be readily accessible.

Fuse cartridges or fuse base/carriers shall clearly state the name of the Australian manufacture or purchasing agent.

Where fuse extraction handles are required, they shall be clipped inside the cubicle adjacent to the fuses. Where the fuses are located behind more than one cover, one handle shall be provided behind each cover.

At least one 3 phase set of fuses for every size included in the switchboard shall be mounted in fuse clips with individual fuse size labels in a spare fuse rack on the inside of one of the doors or inside a dedicated cabinet for spare fuses.

Fuse Combination Units

Fuse combination units shall be of the totally enclosed type and shall comply with AS 1775. The FCU's shall have the following details unless noted otherwise:

- Type of Switching "Independent Manual Operation"
- Duty Rating "Uninterrupted Type"
- Utilisation Category AC-21 Minimum, AC-23 for Motor Circuits

Indicated fault capacity refers to the "Rated Fuses Short Circuit Current".

Additionally, the following features shall be incorporated in an approved manner:

- Padlocking facility in the "Off" position. This facility must be able to accommodate a minimum of 2 standard "Lockwood" padlocks.
- A primary indication of FCU "on-Off" status by the operating handle.
- A secondary indication of FCU "On-Off" status shown on the FCU body internal to the switchboard (i.e. behind escutcheon or door). Alternatively, this indication can be obtained through a transparent window.
- Where fuses are mounted on a withdrawable carriage which ensures isolation from the supply before access to the fuses is possible, this secondary indication can be omitted.
- All "On-Off" Status indications must be clearly marked on the FCU so that they can be seen under poor lighting conditions.

MAIN SWITCHES

The main switches shall be suitable for fault making/load breaking duties to AS 1775. Suitable main switches are auto circuit breakers, fused FCU’s of fault make/load break switches.

Non-auto circuit breakers or FCU's with solid links are not acceptable unless they have been tested for fault make/load break duties to AS 1775.
Unless noted otherwise, the following duties shall apply:

- Type of switching “Independent Manual Operation”
- Rated Duty “Uninterrupted Type” for non-vented enclosure.
- Fault Capacity “Rated Short Time Withstand Current”
- Utilisation Category AC-21 Minimum, AC-23 for Motor Loads

**CONTACTORS**

AC Contactors shall comply with AS 1029.

Unless otherwise indicated, the following details shall apply:

- Block style, electromagnetic, air break type.
- Rated duty shall be “uninterrupted type” for non-ventilated enclosure.
- AC utilisation category shall be “AC-2” minimum (“AC-3” or “AC-4” for motor loads).
- DC utilisation category shall be “DC-2” minimum (“DC-3” to “DC-5” for motor loads).
- Quiet in operation.
- Series or parallel contacts shall not be used to achieve the required ratings.

**CURRENT TRANSFORMERS**

18.10. Current transformers shall be resin encapsulated window type and shall comply with AS 1675.

Unless otherwise indicated, the following details shall apply:

- Rated primary current shall have a current rating equal to the maximum current rating of the frame size of the controlling device.
- Secondary windings of measurement current transformers shall be rated at 5 A. The burden shall be 0.4 ohms (10 VA) minimum and the accuracy shall be class 2 minimum.
- Secondary windings of protection current transformers shall be rated at 5 A and shall be suitable for the burden.

**MOTOR ISOLATORS**

All motor isolators shall be rated to AC-3 Duty in accordance with AS 1775-1984 and shall be lockable in the OFF position only. Each motor shall have an isolator provided at the switchboard.

**SURGE DIVERTERS**

Metal oxide shunt diverters specifically designed for multi-pulse lightning events on powerlines shall be installed immediately on the load side of the main incoming switchgear between each phase and the Neutral bar by the shortest most direct route using straight copper bar or braid of minimum cross-sectional area 35 mm².

The diverters shall be rated at 275 V RMS, 80 kA on a single shot 8/20 uses impulse with an energy absorption capability exceeding 2800 Joules. Each device shall comprise five MOV segments whose status is continuously monitored and displayed on a five segment LED bar panel. The device shall be encapsulated in shock absorbent material and be fitted with
integral 250 VAC 2A changeover isolated alarm contacts. Reduction in surge handling capacity to below 80% shall activate the contacts. Peak let through voltage as defined in AS 1768-2007 Cat C 20 kA pulse conditions shall not exceed 900V. The device shall have a design capability of withstanding and diverting at least 1000 20 kA Cat C pulses.

The diverters shall be mounted in the switchboard so that the LED indicators are clearly visible at all times without the need to open doors.

OVERCURRENT RELAYS

Motors rated up to 15 kW shall be protected against overcurrent by thermal protection relays which comply with AS 1023.2 and incorporate the following features:

- Be ambient temperature compensated.
- A manual reset button, and selection of auto or manual reset.
- Single phasing detection which will operate at 60% of motor full load rating under single phasing conditions.
- One N/O and one N/C electrically separate auxiliary contact.
- Be directly connected to the contactor by proprietary links.

Motors rated at 15 kW and up to 55 kW shall be protected against overcurrent by electronic protection relays incorporating integral current transformers featuring simulated motor thermal image based on phase currents, integral thermistor protection, phase failure and asymmetry protection.

Motors rated at 55 kW and above shall be protected by electronic protection relays featuring individual heating and cooling time constants for the motor thermal image, single phasing protection, ground fault protection, stall protection, incorrect phase sequence protection and adjustable underload protection. The Relay shall be front panel flush mounted. Settings shall not be adjustable without the use of tools.

18.15.

PHASE FAILURE RELAY

The relay shall be suitable for 415 V 50 Hz.

The relay shall be normally energised and drops out on voltage or phase unbalance, loss of single phase, undervoltage or reverse of phase sequence.

The phase difference sensitivity shall be adjustable between 5 and 15% of rated.

The undervoltage shall operate at 80% of rated.

A minimum time delay of 100 ms shall occur before the relay drops out.

The minimum electrical and mechanical life shall be one million operations.

THERMISTOR

Thermistor overtemperature units shall comply with AS 1023.1.

- The following features shall be incorporated:
- An integral Manual reset push-button.
• Automatic reset after power failure.
• One N/O and one N/C auxiliary contact.
• A green LED to indicate normal condition.
• Provision for remote reset.

MOTOR STARTERS

AC motor starters shall:

• Comply with AS 1202.

18.17. Be electromagnetically operated.
• Be rated for intermittent duty 0.1 minimum (and also uninterrupted duty).
• Have minimum utilisation category AC-3.
• Be rated for enclosed operation.
• Include a triple pole thermal overcurrent relay.
• Include a thermistor overtemperature unit where:
– Motor rating is 15 kW or above; or
– Thermistors are installed in the motor.

• Include control switching devices where indicated or require.
• Be rated for ten million no-load operating cycles.
• Be rated for one million on-load operating cycles.
• Have a rated operational current (i.e.) of auxiliary circuit AC-11, 6A 240V ac.
• Be rated for the greatest of:
– Actual motor rating.
– Indicated starter rating.
– 15 A.

Auto transformer type starters shall be parallel, closed transition in accordance with Diagram B1, Appendix G, of AS 1202.3, however, three poles of the “star” contactor shall be utilised.

The contactors K1 and K3 shown in Diagram B1, AS 1202.3, shall include mechanical and electrical interlocks to prevent both contactors closing simultaneously.

Each starter shall include:

• One auto transformer tapped at 50%, 65% and 80%, suitable for enclosed rating. The transformer shall be provided with a set of PTC thermistors complying with AS 1023.1 to protect the windings.
• A remote indication light shall be provided labelled “AUTO-TRANSF. OVERTEMP.”
• Reset push-button for above.
• One-time delay relay used for the automatic change-over.
• A thermistor overtemperature unit for auto transformer.

The auto transformer enclosures shall be suitably fire rated from the remainder of the switchboard. All wiring to and from the auto transformer compartment shall have fire preventative covering.
RELAYS

All relays shall be plug-in type equal to either RPL or Sprecher and Schuh.

Fit relays with clear plastic dustproof covers which enclose the complete relay.

Coils, contacts and insulation shall comply with the manufacturer’s recommendations particularly with regard to AC or DC voltage and current to be applied.

Use contactors for switching current in excess of 6 A. Contactors used as relays shall have clear plastic dustproof covers which enclose the complete assembly.

Provide twin contact spring sets for relays used for light duty switching (under 1 A).

Use the constant resistance contact type, egg, gold contact or reed relays for switching electronic circuits.

Where relay contacts are to be used for mixed voltages, each contactor shall be separately isolated from each other by means of a clear plastic cover or similar to approval, to prevent accidental short circuiting.

Clearly mark voltage type on each contactor, e.g. 24 V D.C., 240 V A.C.

Minimum mechanical life shall be 10 million operations.

A minimum of 2 spare contacts shall be provided, one N/O and one N/C within each relay.

18.19. TIME DELAY RELAYS

Each time delay shall be of the plug-in type.

For electronic time delays, power failures of less than 20 milliseconds duration shall not affect timer operation.

Provide visual indication of "power on" and "time up" condition on each timer.

Each time delay relay shall be adjustable over a time range to suit the particular application.

Minimum mechanical life shall be 10 million operations.

TIMERS

The timers shall be suitable for industrial use.

The timers shall be panel mounted with a minimum front of 72 mm square.

The timers shall be suitable for operation of 240 V 50 Hz. The timers shall have a maximum setting error of +2% and a maximum repeat error of +0.5%.

Minimum mechanical life shall be one million operations.

Each timer shall be adjustable over a time range to suit the particular application. 24 Hour Timers

The timers shall be suitable for industrial use.
The timers shall be panel mounted.

The timers shall have a minimum of 4 "on-off" adjustable switch points with a minimum "on" period of not more than 15 minutes.

The timers shall be suitable for operation of 240 V 50 Hz.

**SWITCHES**

Rotary switches shall be cam-operated. Unless otherwise indicated, switch positions shall be arranged with a displacement of 60°. If "OFF" position required, it shall be in a vertical plane.

The escutcheon plate shall be a minimum of 60 square and shall be reverse engraved to clearly indicate switch functions.

**INDICATING LIGHTS**

Indicating lights shall be of the oil-tight transformer type with glass lens and chrome bezel. Size classification shall be uniformly D25.

The secondary supply of the transformer shall be suitable for operation of a maximum 18 V lamp. Indicating lights shall be complete with an extra-low voltage lamp and shall be suitable for the indicating lights used, minimum rating 1.2 W, maximum rating of 5 W.

Three (3) spare lamps per 10 indicating lights shall be provided as spare parts.

Colours of indicating lights shall comply with "Colours of indicating lights and their meaning" AS 1431, Part 2 (1977) Section 5, Table 5.3.1(A).

**METERING**

Meters shall comply with AS 1042.

Unless otherwise indicated, the following details shall apply:

- Flush mounting.
- Square bezel 90 degrees quadrant scale. All meters on the one switchboard shall be of the same style and size.
- Accuracy class 1.5 (minimum).
- Meter movements shall be suitable for a high degree of vibration. They shall be jewel and pivot or taut band with oil damping.
- Impact resistant anti-glare glass.

The scale shall be suitable for the motor full load current with five times overscale and shall be marked in red at the motor nameplate current.

Hours run meters shall be flush mounting cyclometer dial type to 9999.9 hours suitable for 240 V 50 Hz.
TERMINALS

Terminals shall be designed for the connected cables and also be suitable for cables at least two sizes larger. All terminals suitable for up to 70 mm² cable shall be of the same manufacture and type and shall be suitable for mounting on standard 32 rail DIN 46277 and manufactured from polyamide.

18.24. For cables up to and include 6 mm², two-screw tunnel terminals, with M4 (minimum) brass or plated steel screws, shall be provided. Screw diameter shall not be less than 70% of tunnel diameter.

Spring washers shall not be used for bolted electrical connections.

For cables greater than 6 mm², any one of the following links is acceptable.

- M8 (minimum) brass or plated steel screws sweated into a 6 mm thick (minimum) brass or copper bar. A full nut and flat washer shall be fitted to each screw.
- M8 (minimum) hexagon head, plated steel or brass set screw tapped into a 6 mm thick (minimum) brass bar. A flat washer shall be provided for each set screw.
- Tunnel terminals with one allen head grub screw per terminal. Screw diameter shall not be less than 90% of tunnel diameter.
- Approved nut-tightened, line-tap clamp that prevents the cable strands spreading and securely clamps the conductors.

For aluminium cables, only types (a) and (b) are accepted.

Terminals for cables above 70 mm² shall be stud connecting and screw mounted to the switchboard. (They shall not be rail mounted).

Terminal blocks shall be mounted horizontally, not more than 200 mm from the top of the switchboard. Rail lengths shall be such as to provide capacity for future terminals. Such capacity for each rail shall be minimum 20% or 3 terminals, whichever is the greater.

Terminals of thermistor circuits shall have an engraved label so that access to the terminals is prevented without removing the label. The label shall read “Thermistor terminals - do not test above 2.5 V”.

18.25.

LABELLING

All fuses and circuit-breakers shall be numbered and described using engraved laminated plastic labels. Where double or triple pole circuit-breakers are used, numbering shall allow for all poles and neutral terminals to be provided on the neutral bar so as to allow for future replacement with single pole breakers. All zones shall be clearly marked and labelled.

All switches, circuit-breakers, contactors, relays and the like shall be labelled with the circuit function as detailed in the Contractor’s design.

All labels shall be black lettering on white background. Engraving on labels shall be of minimum height 6 mm unless otherwise approved.

All labels shall be mechanically fixed with round head metal thread screws, nutted or tapped.

A card index identifying labels and numbers with connected circuit functions printed or typed shall be inserted in the card holder on the inside of the door. The card index shall also indicate cable size(s) for associated mains and/or sub-mains to and from the panel.
NAMEPLATE

For switchboards specified to comply with AS 3439.1, provide and install on the switchboard one or more nameplates with essential marking as required by Clause 5.1 of AS 3439.1.

TERMINATIONS

Blank removable gland plates shall be provided at all cable entry points. The gland plates shall have a thickness of 6 mm and shall be of sufficient size to have at least 20% extra capacity over and above the allowance for future equipment.

All external cabling shall enter through stainless steel glands and non-ferrous gland plates and terminate on terminal strips inside the switchboard or panel. Exceptions to this are the motor power cables 10mm² and larger and mains cabling which may terminate directly onto their respective devices.

Cabling shall be adequately tied, run neatly and enclosed in a cable duct. Duct shall have perforated sides for cable access to individual terminals and shall be fitted with a lid. Ducts shall have a minimum spare capacity of 25% over and above the allowance for future equipment.

Cable sleeving or inner sheath shall be left on the cable wherever possible i.e. from the gland to approximately the first termination.

The terminal blocks shall be mounted on a horizontal steel rail and shall be placed so that connections can be easily, safely and reliably made and viewed.

Terminals should be logically grouped, and terminals of different voltages shall be separated by means of an approved barrier.

There shall be sufficient room and clearance in the termination areas to permit the future disconnection and reconnection of cabling without creating a hazard or requiring a shutdown of other circuits.

All power circuitry and terminations shall be segregated from control and other circuits and shall be shrouded and provided with a cautionary label in the vicinity to prevent unintentional contact with potentially lethal voltages.

Where access can be gained to uncovered energised conductors, a cautionary label shall be located to provide effective warning. The label shall bear the words "Alive - Isolate Elsewhere".

Circuit groups having operating voltages in excess of 100 volts shall be protected by means of an approved insulating cover bearing the legend "Warning 415/240 Volts".

All terminals shall be numbered sequentially and labelled accordingly.

Terminals shall be sized and arranged so that one wire only is terminated in either side of each terminal block. Extra terminals with bridging connector links shall be provided where multi-terminations occur. Minimum size of terminals shall be of Sprecher and Schuh type VR2-2-5.

Spring loaded terminals shall be used for all control and auxiliary supply terminations.
Each wire shall be terminated with the correctly sized and approved insulated crimp lug fitted in accordance with the manufacturer's recommendations. The lug shall be of the type and size most suited to the device terminal e.g. ring tongue for stud terminals and lip blade for tunnel type terminals.

Only one wire shall be crimped in each terminal lug, except in looping earth connections where it is necessary to maintain earth continuity under all conditions.

Each cable core shall be marked at each termination with neat fitting sleeve type ferrules and the marking shall comprise of the cross-reference number from the relevant schematics and prefixed by the drive reference number. Neutrals shall be identified with the motor reference number.

Incoming cable cores shall be terminated sequentially (by core number) along the terminal strip with no cross over of cores.

WIRING

All wiring shall be carried out in a neat and workmanlike manner and shall be enclosed within approved wiring ducts. Wiring ducts shall have perforated sides and positive continuous clipping (or clamping) edges on both the wiring channel and cover.

Internal wiring shall be insulated (0.6/1 kV grade) with V75 PVC insulation.

The control and instrumentation wiring shall be of adequate size, a minimum of 1.0 mm² (32/.0.20) rating, multi-stranded flexible copper conductors, PVC V75 Grade. The minimum size for power cables shall be 2.5 mm². Each control wire shall be tinned and terminated with a pin crimp. Wires shall be colour coded as follows:

Phase wiring (A, B & C) - red, white and blue
Voltmeter and current transformer connections
- red, white, blue and black
240V control active - white
Thermistors and no volt contact - orange
240V neutral - black
ELV positive - brown
ELV negative - grey
Telemetry - violet
Earth - green-yellow

Wiring on (or to) all equipment, doors or hinged panels shall be arranged in a manner that prevents any strain or chaffing of the wiring over the full travel of the door or panel.

Flexible wiring shall be used across such hinged or removable sections.

Wiring shall not rest on busbars or metal edges.

All cable cores shall be of sufficient length at each termination to allow a fresh connection to be made.
FIELD EQUIPMENT

General
Unless specified elsewhere, all electrical field equipment shall be housed in stainless steel enclosures with a minimum protection rating of IP 65 for all areas. All fixings shall be corrosion resistant. All fasteners shall be captive to the enclosure body or lid.

Local Control Stations
The term local control station (LCS) shall be taken to include all associated works including mounts/foundations, base, stands, sunhoods, equipment and enclosures.

LCS shall be constructed of 3 mm marine grade aluminium or 2 mm grade 316 stainless steel with sunhood and supported on a marine grade aluminium channel post and base with cover plates. The LCS equipment enclosure shall be sufficiently deep for at least two contact blocks to be used or have available a replaceable lid which will enable the use of two contact blocks per operator. Provide Terminal strip for all cabling other than motor sub-circuits. Provide safety strap, to support open front cover if not supported by hinges. LCS shall not be used for the looping or marshalling of cables.

Junction Boxes
Junction boxes shall be used for the marshalling and looping of all field cabling and shall be constructed of 3 mm marine grade aluminium or 2 mm grade 316 stainless steel.

Separate junction boxes shall be provided for each different drive or equipment system and for sections of different systems which are not isolatable at one location.

Provide terminal strip. Junction boxes shall have provision for 25% spare cabling in addition to that provided for initial requirements.

Field Cables, Wiring and Accessories
All cabling and wiring shall be supplied and installed in accordance with the applicable standards noted elsewhere in this Specification, in particular AS 3000 and AS 3008.

Wiring shall be of the size required by the wiring rules for the actual circuit loading, or as specified. Minimum size shall be:

- Lighting 1.5mm²
- Control 1.0mm²
- Power 2.5mm²

Where motors are subject to vibration, care shall be taken to prevent vibration damage to supply cables.

All cables are to be terminated in pre-insulated crimped lugs or pin terminations similar to "Utilux".
Final connections to instruments and similar equipment which is withdrawable from its mounting shall be made with flex entries in PVC double insulated flex not less than 32/0.2 mm. Sufficient flex, neatly strapped, shall be provided to permit easy withdrawal of equipment.

All conductors shall be copper.

Firmly fix all flex connections at each end by an approved type plastic locking grommet.

All cables and wiring shall be identified at each end where they are connected to apparatus or terminal strips using ferrules similar to hellerman, hellagrip or hellaclip. The identification used shall correspond to that shown on the drawings.

Cable distinguishing colours shall comply with the following:

Single Phase: Red - Active
Black - Neutral

Three Phase: Red - "A" Phase
White - "B" Phase
Blue - "C" Phase
Black - "N" Neutral
Earth: Green / Yellow
Control Wiring Grey

Wiring which may be energised when cubicle is isolated: Orange

Wire to and connect all outlets, equipment and the like.

Wiring shall not be run through fittings.

Wiring shall enter and leave at the one point.

Wiring shall be as follows:

- TPS cables in false ceiling areas and partition walls.
- TPS or TPI cables protected by conduit where:
  - Exposed to damage.
  - In poured concrete slabs, columns and the like.
  - Within brick and blockwork cavities.
  - Where embedded in plaster or the like.

Wiring shall not be installed between roof sheeting and insulating material when insulation is directly beneath roof sheeting.

Surface conduits are not acceptable.

Conduits shall be generally light duty rigid or corrugated uPVC except where exposed to mechanical damage, where heavy duty rigid or corrugated uPVC conduit is to be used.

Corrugated conduit only to be used in difficult areas to a maximum length per run of 3 m between draw in points.
All uPVC conduit in poured concrete to be heavy duty with a minimum outside diameter of 25 mm.

Screwed galvanised steel conduit shall be used where required by AS 3000, e.g. lift and fire protection circuits, and in locations of likely severe mechanical damage.

Provide cable trays/ladders or formed ducting where required.

**TPI and TPS Cable**

TPI and TPS cables shall be 0.6/1 kV grade as applicable in accordance with AS 3147.

Insulation shall be V75 grade.

All cables shall have multi-stranded copper conductors.

**Instrument Cables**

Instrument cables shall be as supplied by or as recommended by the instrument manufacturers.

**Aluminium Cables**

Where aluminium conductors are specified joints and/or terminations shall comply with ruling "enquiry C259/76 on rule 3.21.4 of AS 3000, Part 1.

Joints and/or terminations shall be carried out by crimping.

Lugs for aluminium cable shall be of the bi-metal type with copper palm.

**PVC Armoured Cables**

PVC armoured cables shall be 0.6/1 kV grade comprising stranded copper conductors PVC insulated and bedded, galvanised steel wire armoured, and PVC sheathed overall.

PVC armoured cables shall comply with AS 3147.

PVC armoured cables shall be terminated in heavy compression type glands having wedge type armour clamps for steel wire armouring.

**MV Terminations**

Where screened signal wires are specified, screening shall be continuous from the signal source to the receiver. Earthing of the screen shall be at the substation end only and shall be achieved by connection to the instrument earth busbar.

**Cable Glands**

Cable glands shall be of an approved weatherproof type similar in style and quality to ALCO WG series. PVC cable glands of an approved type may be used for cables entering the top of indoor switchboards.

PVC weatherproof shrouds shall be provided and fitted for glands mounted outdoors or in readable visible areas. The shrouds shall be Alco 'SG' type or approved equivalent.

All gland plates shall be drilled to the sizes required by the cable gland. The gland sizes shall conform, for each cable size, to the manufacturer's recommendations.
Brass glands shall not be used in aluminium alloy boxes as fittings.

Where it is required that PVC cables be connected to equipment that is too small to accommodate the gland, or if permanent wiring is provided with equipment (e.g. solenoid valves), then cables shall be terminated in a conveniently located two-way junction box. The connection to the equipment from the junction box shall be made using flexible PVC coated metal conduit and approved fittings. Ensure enclosure rating of the junction box and fittings is appropriate for the area of installation.

**Cable Terminals**

All cable terminations shall be made using pre-insulated crimp lugs.

Crimp lugs shall be crimped with an approved crimp tool. Where hand operated crimping tools are used, the tools shall be of the type which will not release until full compression is applied.

Hexagonal crimping dies shall be used on all cables of 70 sq mm or mm2 cross section and above.

Suitable sized bolts shall be used for the connection of lugs onto equipment terminals. Where lug holes are not big enough for the size of bolt being used, copper flags shall be provided and fitted.

Wire stripping shall be performed using an approved wire stripper. The wire shall be stripped to an extent that prevents the covering entering the terminal connection or crimping lug but does not allow the protrusion of bare wire from the terminal block or lug.

No more than one wire shall be connected to one side of any terminal.

The correct size and type of screwdriver shall be used for making terminal block connections.

Terminal strips shall be provided within enclosures and equipment for control cable terminations.

Terminal strips shall be provided with the number of terminals required on the drawings plus 10% spare rail capacity.

The terminal blocks shall be coloured as follows:

- 240 volt white.
- 24 volt grey.
- Analogue yellow.
- Intrinsically safe blue.
- Earth green/yellow.

Where control cables and power cables (above 50 V D.C.) are connected to terminal strips in the same enclosure approved protective covers and warning labels shall be installed overpower connections.

Terminals shall be Sprecher and Schuh type VR2-2.5 or approved equivalent. Each terminal shall be identified with a number in accordance with the drawings using permanent clip-on non-flammable terminal markers with black characters on a white background.

**Cable Ferrules**
The cores of all cables shall be continuity checked and numbered with white engraved ferrules with black numbers to correspond to the relevant termination diagrams and equipment drawings. Wrap around adhesive markers will not be acceptable. The Contractor shall ensure that the component numbers of the identifier are aligned, and that the identifier is clearly visible.

Ferrules shall be of a sleeve type which will not slip off the ends of the cables.

The overall cable shall also be labelled with approved tags and identifying references.

**ELECTRIC MOTORS**

**General**

This aspect of the Principals Project Requirements established the minimum standard for document covers all squirrel cage induction motors of general design.

Electric Motors shall comply with the requirements of the latest editions of the following specifications and standards (where required):

- AS 3000 SAA Wiring Rules.
- AS 1359 General Requirement for Rotating Electrical Machines.
- AS 1360.10 General Purpose Motors.
- AS 1939 Classification of degrees of protection provided by enclosures for electrical equipment.
- AS 2420 Solid insulating material used in electrical equipment.
- AS 2380 Electrical equipment for explosive atmospheres.

**Voltage and Frequency**

All motors shall be designed for a 50 Hz grounded neutral power supply system. Unless otherwise specified, motors shall be squirrel cage induction motors designed for 415V, 3 phase power supply.

**Duty and Starting**

All motors shall be maximum continuous rated (MCR) and shall be sized with a nameplate rating of 110% of the demand power of the driven equipment.

Motors shall be suitable for DOL starting and shall be capable of continuous full load operation at voltages within +or-5% of normal supply voltage. Standard motors shall conform to Design N as defined AS 1359.

Motors to be subjected to high friction torques, high inertia loads, or other special loads shall be entirely suitable for the duty, and the motor vendor shall guarantee the motors suitability for these conditions.

Unless otherwise specified motors shall be capable of two starts in quick succession (i.e. <30 seconds) with the motor at normal operating temperature followed by further restarts at 5-minute intervals.

Unless otherwise specified all motors shall be suitable for automatic restart at 80% of rated voltage.

The safe stall time from hot and cold must be specified by the supplier.
Motors for use on variable voltage or variable frequency drives shall be sized and guaranteed fit for the purpose.

**Enclosures**
All motors shall be cast iron or fabricated steel frame and end plates, totally enclosed, fan cooled (TEFC) and weatherproof, with protection of a minimum of IP56. Independent IP type certificates shall be made available upon request.

All electrical motors to be used outdoors in open areas, shall be specially weatherproofed and suitable for use in a high humidity, with fungicidal treatment to the stator winding. All gaskets shall be one piece. Motor output ratings shall be the Australian/British preferred values as per AS 1359.30 Table 30.4.

Dimensions shall be in accordance with AS 1360 for motors having outputs within the range of that Standard.

Motors that will be installed vertically with the fan at the upper end shall have a conical rain shield fitted over the fan end of the motor.

TEFC Motors located outside in a wet or dusty environment should be fitted with Dust shields.

Porous drain plugs shall be provided on all motors.

**Insulation**
Terminal boxes shall be centre-mounted and shall be capable of rotation through four times 90 degrees to allow cable entry from different directions.

An earthing terminal shall be provided in the terminal box of 415 Volt motors. The earthing terminal on HV motors shall be located either on the outside of the terminal box or adjacent to it.

The earth terminal shall be sized to continuously carry motor full load current.

All terminal boxes shall be protected to IP56.

Main terminal boxes shall be designed for air termination of copper conductors. Phase separation insulators shall also be provided in terminal boxes of HV motors. All motors 5.5 kW and above shall have six ends out to the terminal box.

The terminal board shall be of material to AS 2420 Grade A, with creepage and clearance distance to AS 2380.1 Table 2.1.

Motors shall have separate IP56 terminal boxes for space heaters, thermistors, RTDs and other accessories.

Main terminals shall be marked in accordance with AS 1359.3.

Captive screws shall be fitted on all terminal box lids.

All HV motors have a pressure relief device incorporated into the terminal box to prevent explosions occurring as a result of termination faults. The terminal box shall be constructed of fabricated steel.

The cable duct between the motor frame and the terminal box must be sealed in motors 355 frame and above to prevent internal faults causing damage to the terminal box.
It shall be possible without affecting the performance of the motor, to change the position of the terminal box from left hand side to right hand side and vice versa.

**Anti-Condensation Heaters**

Motors above 250 frame size shall have 240 Volt single phase space heaters, sized to raise winding temperature to $3\,^\circ C$ above ambient. On low voltage motors these heaters should be attached to the motor end winding prior to impregnation to ensure good thermal contact with the winding.

High voltage motors should be fitted with metal-sheathed heaters which should be fixed to the motor frame/end shield.

Leads for space heaters shall be brought out to a separate terminal box. Heater terminal boxes shall be labelled “DANGER - 240V HEATERS”.

The anti-condensation heater voltage and wattage shall be included on the motor rating plate or a separate stainless-steel plate.

**Winding Protection**

All 415-volt motors larger than 225 frame and up to and including 315 frame shall be fitted with three PTC (positive temperature coefficient) thermistors, one per phase, embedded prior to impregnation in each phase, connected in series. The terminals shall be wired to a separate terminal box labelled “THERMISTORS”. The location of winding thermistors shall be at the hottest point in the stator winding for that machine.

Motors 355 frame and above, shall be furnished with six RTDs (PT100) embedded prior to impregnation in the stator winding at equal intervals around the periphery.

The winding RTDs shall be wired to a separate terminal box labelled “Winding Temperature”. The RTD leads shall be terminated to RTD to 4 to 20 ma converters. The converters shall be of the two-wire self-powered type.

The bearing temperature RTD shall be terminated in suitable housings that will accommodate the RTD to 4 to 20 ma converters. The RTDs shall be terminated to the converters.

The instrument circuits of high voltage motors shall be protected by the fitting of surge diverters to all RTD’s.

The manufacturer should provide recommended alarm and trip temperatures for RTDs.

**Efficiencies**

**Bearings**

Bearings shall be in accordance with the manufacturer’s standard for various sizes of motors. Rolling element bearings are preferred. Sleeve bearings may be provided if no suitable alternative exists.

Ball or roller bearings in all motors frame size 132 and larger shall be provided with grease nipples and relief valves to automatically eject old grease from the bearing housings. All systems (grease valve) should have ability to be purged whilst running. Greasing systems should also force new grease into the back of the bearing whilst exhausting old grease to atmosphere to ensure that the maximum amount of old grease is expelled.
Grease purging shall incorporate V-ring seal to prevent ingress of moisture into the bearing. The removal of an exhaust plate/plug when regreasing is NOT acceptable.

All bearings fitted with a grease relief system shall be fitted with studs for condition monitoring. All rolling element bearings shall have metallic cages. Plastic cage bearings are not acceptable.

Ball or roller bearings shall have an L10 rated life of at least 50,000 hours for radial loaded applications and 100,000 hours for direct coupled applications.

Bearing shall be of standard types, enabling replacements to be readily available from recognised bearing manufacturers. Bearings of SKF, NSK or FAG must be provided.

Shaft voltages shall be measured and included on the routine test on all motors 355 Frame and above. Insulated bearings shall be fitted to both ends of motors with shaft voltages exceeding 250 mV.

Shaft end float shall be stated for all motors 75 kW or larger to enable a check to be made on the end float of the coupling to be supplied with the driven equipment.

Where sleeve bearings are used, the Magnetic centre should be marked on the motor as well as the limits of end float.

Dummy bearings should be fitted for the transport of sleeve bearing motors.

**Shaft**

The motor shafts shall be fitted with neatly fitting shaft keys. An anti-seize type grease coating shall be applied to the shaft before the coupling, pulley or any other power transmitting device is fitted to the shaft.

**Fans**

All fans on motors 132 frame and larger shall be fabricated steel or cast/ductile iron. For TEFC motors, the direction of air flow shall be from the outboard end to the coupling end.

Motors shall only have Uni-directional fans where required to meet specified noise criteria.

**Direction of Rotation**

415 Volt motors shall be bi-directional unless otherwise approved. Efficiencies and performance data supplied shall be for bi-directional rotation where applicable.

Uni-directional motors shall have the direction of rotation clearly marked.

The noise level of motors shall not exceed 80 dB(A) (No Positive Tolerance) Mean Sound Pressure level at 1.0 metre at no load without prior agreement.

**Vibration**

Balance should be undertaken with a half-key and rotors should be balanced to G2.5 or better.

**Painting**
All motors shall be primed and painted with 2 pack epoxy paint suitable for the environment. The manufacturer’s standard epoxy painting system shall provide protection against a marine environment.

**Rotor Construction**
The rotor construction shall be a minimum of pressure cast rotor bars that are integrally cast to the end rings and cooling fans.

### INSPECTION AND TESTING

**Works Testing**
For both Low and High Voltage motors test certificates from routine commercial test are required for every motor. Type performance test certificates and noise test certificates shall be provided. ITP, certificate of conformity and certified drawing shall be supplied. All suppliers shall be fully accredited to ISO 9001.

Full Surge Test and Tan Delta test records shall be provided for all high voltage motors.

**Identification and Packaging**

**Name Plates**

Each motor shall be fitted with stainless steel nameplate containing the following information.

- Information as required by AS 1359 and other applicable standards.
- The mass of the motor in kg.

**Shaft Clamps**

Shaft clamps shall be fitted to prevent damage to bearings during shipment on motors of 160 frame and larger.

**ID Plate**

Each motor shall be fitted with a bank brass ID plate to allow the motor to be identified by its unique plant number.
INSTRUMENTATION

General Technical Requirements

Accuracy
The accuracy of each instrument shall be within +1 percent of span unless otherwise specified.

Accuracy in the case of primary elements and their associated signal converters/transmitters shall relate the analogue signal output to the actual measured variable value. For secondary instruments, accuracy shall relate the output signal or indication or pen record (as appropriate) to the analogue input signal.

Instruments
All instruments shall be suitable for continuous unattended operation and shall maintain their rated accuracy with a minimum of maintenance or need for calibration and adjustment.

Transmitters
Where possible “Smart” transmitters shall be offered as an option in addition to the standard models. Communications shall utilise the “HART” protocol with transmission via high frequency signal superimposed on top of the 4-20 mA output signal.

“Smart” communications to the transmitter shall allow remote interrogation, diagnostics and reconfiguration without interruption of the transmitters signal to the control system.

Circuits and Components
Circuits and components shall be standardised for all similar applications to facilitate design, construction, testing, operation and maintenance. They shall be readily available within Australia and be arranged and designed to form a simple, safe and reliable system allowing rapid removal and renewal of components as required.

All electronic components shall be high grade solid-state discrete or integrated circuit devices having been substantially underrated for the duty required. All components shall be assembled on high-quality fire-resistant epoxy fibreglass laminate or similar non-hygroscopic plug-in printed circuit boards preferably with gold plated plug and plug-top contacts. Each printed circuit board shall be clearly identified and shall be varnished or similarly protected.

Circuit board components shall be liberally spaced whilst light emitting diodes (LED’s), test points and links shall be provided; all to assist in on-board fault detection. Test facilities, presetting adjustments and LED indicators shall be arranged on each printed circuit board, so they are accessible and visible when the board is in its normal position.

Integrated circuit devices shall be used wherever possible to reduce the component count and the number of circuit boards and consequently increase reliability.

All equipment shall be suitable for operation in the vicinity of other electrical plant and shall be immune to electromagnetic interference when subjected to field strengths up to 10 volts per metre over a frequency range of 10 kHz to 1000 MHz. Electromagnetic interference and high frequency distortion of the terminal voltage generated by the operation of equipment shall not exceed the limits defined in AS1044. The generation of harmonics of the mains frequency shall not exceed the limits defined in AS2279.
Signals
The analogue output of all electronic signal converters, transmitters, controllers, etc., shall be a live zero 4 to 20 mA direct current signal. Each output shall be capable of operating into a load in excess of 600 ohms.

Discrete outputs (on/off) of all electromechanical equipment such as flow switches, pressure switches, level switches, valve position switches, relay circuits, etc., and of all electronic switching devices such as electronic level and limit switches, etc., shall be voltage-free contacts rated for at least 1 amp at 110 Volts AC.

Power Supply Units
Instruments shall where possible be of the “two wire” type deriving electrical power from the loop 24 V DC supply. Where a separate power supply is required for instrument, integral power supplies shall be provided to allow reliable operation directly from the existing power supply.

The AC mains supply available within the plant is as follows:

- 415 VAC + 10%, -15% 50 Hz +/- 1 Hz
- 240 VAC + 10%, -15% 50 Hz +/- 1 Hz

Surge reduction filters shall be provided as necessary to protect all instrument power supplies against input over-voltage and mains borne sags, surges and impulses originating from lightning, switching operations or other causes. Common and normal mode noise rejection, and isolation characteristics of the supplies shall be adequate to allow for reliable operation. Voltage and frequency regulation shall be provided as necessary.

The surge reduction filter shall be rated at 250 Vrms, 40 kA on a single shot 8/20 microsecond impulse with an energy absorption in excess of 3500 Joules and shall be capable of continuous supply of 10A. The maximum let-through voltage of the device shall be 500V. A surge diversion failure indicator shall be provided which shall be clearly visible on the switchboard front panel without the need to open doors.

A non-sacrificial “L” section filter shall be incorporated in the surge reduction filter and shall consist of a series inductor and shunt capacitor arranged such that the capacitor is connected on the load side of the inductor. The inductor shall be a non-saturable air-cored type and the capacitor shall be a metallised polypropylene film type.

Environmental Considerations
All instrumentation and control equipment supplied as part of this contract shall be suitable for continuous operation in the environment nominated as follows:

- Temperature 0C to 50C
- Relative Humidity 10% to 90% (Non-condensing)

Enclosures
All electrical components, terminals, linkages, etc. of field instruments shall be contained in hose proof dustproof enclosures to Class IP65 (AS1939) unless otherwise specified. Tapped cable entries shall be provided to accept cable glands. Enclosures shall be treated with an epoxy paint or similar durable corrosion resistant finish unless materials of construction afford this protection inherently.
**Differential Pressure Transmitters**

Each electronic differential pressure transmitter shall be of the capacitance or strain gauge types and shall transmit a current signal proportional to differential pressure. "High" and "low" process pressures shall be applied to sensing diaphragm(s) in the measuring section. These pressures shall be transmitted to a measuring element connected to an electronic transmitter. Adjustable internal damping shall be provided.

Positive over-range protection shall be provided. Zero and span shall be independently adjustable. The transmitter shall include an integral output indicator accurate to ± 2% and scaled from 0 to 100%.

The transmitter shall be supplied with a 3-way manifold to provide for isolation and pressure equalising.

All wetted materials of the differential pressure transmitter, and 3-way manifold shall be as specified or as otherwise suitable for this application.

When part of a flow measurement system the range and maximum working pressure of the differential pressure transmitter shall suit the associated flow element.

**Pressure Transmitters for Pressure and Level Measurement**

Each electronic pressure transmitter shall be of the capacitance, strain gauge or similar manufacture and shall transmit a current signal proportional to pressure.

The pressure shall be applied to a sensing diaphragm in the measuring section and transmitted to a measuring element connected to an electronic transmitter. Remote sensing diaphragms shall be provided where specified or where appropriate for the application.

Adjustable internal damping shall be provided along with adjustable elevation and suppression where appropriate. Positive over-range protection shall be provided. Zero and span shall be independently adjustable. The transmitter shall include an integral indicator accurate to ± 2% and scaled from 0 to 100%.

All wetted materials shall be suitable for this application. The range and maximum working pressure shall be as specified or as otherwise suitable for the application.

In the event that a differential pressure transmitter is utilised, the low pressure vent to atmosphere shall be via protective piping arranged to prevent the ingress of dust moisture and insects.

**Pressure Switches**

Wetted materials shall be suitable for each application. Each pressure switch shall satisfy enclosure Class IP65 or better and shall be provided with a voltage free, changeover contact output. A calibrated adjustment for the setpoint shall be provided. Each pressure switch shall be suitable for the application.

Process connections shall be as specified including the provision of remote sensing diaphragms.

The adjustable set point range shall be such that the noted setpoint falls between 30 and 70 percent of the adjustable range. The switch shall be of the automatic reset type with an adjustable switching differential.
Pressure Gauges (Bourdon)
All pressure gauges unless otherwise specified shall be of the Bourdon type, of Budenberg or equivalent manufacture and shall be fitted with a gauge isolating cock.

The gauge and isolating cock shall be constructed from materials which are corrosion resistant to the fluid being measured or as otherwise specified.

Pressure gauges shall have a concentric dial of 80 mm diameter unless otherwise specified and shall be calibrated in kPa with a range as specified. Where specified, or as required, pressure gauges shall be oil-filled and fitted with isolating diaphragm to ensure the process material does not foul the gauge.

Snubbers shall be fitted to pressure gauges subject to pulsations.

Where pipework is subject to mechanical vibration, pressure gauges shall be mounted adjacent to the pipework and connected to the pipework tapping via pipework.

Where specified or as otherwise required where gauges are subject to a process medium of high temperature that would affect operation, a syphon shall be provided to isolate the medium from direct contact with the gauge.

Pressure gauges shall be accurate to ± 1% of full scale.

Pressure Gauges (Magnehelic)
Pressure gauges where specified shall be of the diaphragm actuated “Magnehelic” type of Dwyer or equivalent manufacture and shall be fitted with a gauge isolating cock and vent valve.

The gauge and accessories shall be constructed from materials which are corrosion resistant to the fluid being measured or as otherwise specified.

Pressure gauges shall have a quadrant dial of 120 mm diameter unless otherwise specified and shall be calibrated in kPa with a range as specified.

Where gauges are to be utilised for differential pressure measurement across a filter, the gauges shall be provided with all accessories required including static pressure tips, vent valves, tubing and mounting brackets.

Pressure gauges shall be accurate to ± 2% of full scale.

pH Measurement
pH measurement equipment shall include either single combination electrodes or discrete measurement and reference electrodes. The reference electrode shall be sealed, gel filled and non-flowing with a ceramic or similar junction that resists fouling. Each pH electrode housing shall comply with the requirements of enclosure class IP68 (AS1939) and shall contain a sealed high impedance amplifier to all pH signals to be transmitted over low impedance circuits. A differential high impedance amplifier shall be preferred, to reduce ground loop noise and the effects of reference electrode coating and plugging. Automatic temperature compensation shall be provided for each pH measurement.

The pH electrodes shall be equipped with an automatic electrode cleaning device to reduce routine manual cleaning. The cleaning method utilised shall be entirely suitable for the process fluid monitored. The pH electrode housing shall be manufactured from glass fibre reinforced polypropylene or similar.
The pH monitor/converter shall be of the "two-wire" type deriving its electrical power from the loop 24 V DC supply and shall provide an isolated 4-20 mA DC signal for remote transmission.

An indicator should be provided as part of the unit to display the output on a scale directly calibrated in pH units, to an accuracy better than ± 2% of span.

The monitor/converter shall include facilities for manual range changing, zero and span adjustment and for any other adjustment necessary for accurate calibration of the instrument.

All input circuits shall be isolated from the mains supply and output circuits.

**Temperature Transmitters (Resistance Type)**

Unless otherwise specified resistance thermometers shall be utilised for temperature measurement.

Each resistance thermometer shall include a 3-wire platinum resistance temperature detector complying with BS1904 (Ro=100 ohms). The sensing element shall be sealed in a ceramic former and enclosed in a stainless steel sheath. Sensing currents of up to 10 mA shall not have a significant effect on accuracy.

Each thermometer shall include a suitable connector head, with enclosure class equivalent to IP65 (AS1939) allowing cable entry via a compression type cable gland.

Pockets (thermowells) shall be provided for installation of the resistance thermometers. Pocket material shall be 316 stainless steel. Inside diameter of the thermowells shall be sized to match the thermometer so as to permit easy removal whilst providing close contact for maximum heat transfer and fast accurate temperature measurement.

Installation of the resistance thermometers, including wiring to the associated resistance to current converter, shall comply with BS1041 Part 3. A “3 wire” circuit shall be used between each thermometer and the associated converter. The converter shall be located in the thermometer connector head.

Resistance to current converters shall be of the “two wire” type deriving electrical power from the loop 24 V DC supply. Converters shall include continuously variable span and zero. The output shall be a 4-20 mA DC signal linear with respect to temperature.

Accuracy shall be ± 0.5% of span or better.

**Temperature Transmitters (Thermocouple Type)**

Where specified or as otherwise required for the temperature range, thermocouple type sensors shall be utilised for temperature measurement.

Each thermocouple shall include a type J, single element, ungrounded temperature detector. The sensing element shall be sealed in a ceramic former and enclosed in a stainless-steel sheath.

Each thermometer shall include a suitable connector head, with enclosure class equivalent to IP65 (AS1939) allowing cable entry via a compression type cable gland.

Pockets (thermowells) shall be provided for installation of the thermocouples. Pocket material shall be 316 stainless steel. Inside diameter of the thermowell shall be sized to match the thermocouple so as to permit ready removal whilst providing close contact for maximum heat transfer and fast accurate temperature measurement.
Thermocouples and signal converters shall be interconnected with wire that will maintain the specified accuracy of the temperature measurement. The converter shall be located in the thermocouple connector head.

Signal converters shall be of the “two wire” type deriving electrical power from the loop 24 V DC power supply. The output shall be a 4-20 mA DC signal linear with respect to temperature. Converters shall include continuously variable span and zero.

The converter shall include automation reference junction compensation and thermocouple burnout protection.

Accuracy shall be ± 0.5% of span or better.

**Temperature Switches (Thermostats)**

Temperature switches (thermostats) shall be of the mercury bulb type of Danfoss manufacture or equivalent.

Where specified or as otherwise required a copper, tube protected capillary shall be provided for connecting the switch mechanism to the remote bulb installation.

A calibrated adjustment for the setpoint shall be provided. The adjustable set point range shall be such that the noted setpoint falls between 30 and 70 percent of the adjustable range. The switch shall be of the automatic reset type with an adjustable switching differential (except where noted).

Wetted materials shall be suitable for the application. Each temperature switch shall satisfy enclosure class IP65 or better and shall be provided with voltage free, changeover contact.

**Temperature Indicators (Thermometers)**

All temperature indicators (thermometers) shall be of the mercury bulb type, of Budenburg or equivalent manufacture.

Thermometer gauges shall have a concentric dial of 80 mm diameter unless otherwise specified and shall be calibrated in Deg.C.

Each thermometer system shall be of all welded steel construction filled with mercury at high pressure.

Copper tube protected capillaries shall be provided where specified or as otherwise required for connection of the gauge to remote bulb installation.

**Level Switches (Float Type I)**

Each level switch shall be of the encapsulated immersible mercury switch type. Each shall be supplied complete with a sufficient length of heavy-duty flexible cable to provide a generous allowance for adjustment of the operating level.

All wetted materials shall be inherently noncorrosive material and entirely suitable for the application.

**Level Switches (Float Type II)**

Each level switch shall be of the float-activated bulkhead mounting type.
Float, stem and other wetted materials shall be constructed from inherently noncorrosive material and entirely suitable for the application.

Each level switch shall be provided with a voltage free, changeover contact.

**Level Switch (Paddle Type)**

Level switches for sensing level of non-liquid bulk materials shall be of the motor driven rotating paddle type. The detection of material is achieved by a rotating paddle with the control signal changing when material impedes rotation of the paddle.

Shafts and paddles shall be constructed from materials which are corrosion resistant to the material being sensed.

The number and size of paddle vanes shall be selected as appropriate for the density of materials sensed.

The paddle switch sensing unit shall include controls to ensure that when material impedes the rotation of the paddle that all moving parts are stationary, and no wear takes place.

Each paddle switch shall satisfy enclosure class IP65 or better and shall be provided with a voltage free, changeover contact output.

**Capacitive Level Switches**

Each capacitive level switch shall consist of an electrode (or probe), and an electronic signal converter unit. An earthing electrode (or probe) shall be provided as necessary for correct operation.

The electronic signal converter shall have a sensitivity suitable for the application.

Each electrode (or probe) and all other wetted materials shall be suitable for the application.

Where the electronic signal converter is mounted in the head of the probe it shall be encapsulated in an inherently non-corrosive, durable material to at least electrical enclosure class IP65 (AS1939).

Each electronic signal converter shall satisfy enclosure class IP65 (AS1939) or better and shall be provided with a voltage free, changeover contact output.

**Level Transmitters (Capacitance Type)**

Each capacitance level measurement system shall consist of an electrode (or probe), an electronic unit in the head of the probe and a signal converter unit. An earthing reference shall also be supplied if necessary.

The electronic unit shall operate at a frequency suitable for the application, shall be mounted in the head of the probe and shall be encapsulated in an inherently non-corrosive, durable material to at least electrical enclosure class IP65 (AS1939).

Each electronic signal converter unit shall generate an isolated 4-20 mA DC current analogue output corresponding to the level and shall incorporate provision for continuous adjustment for both measurement span and zero. The signal converter shall incorporate an analogue or LED indicator with an accuracy of better than ± 5% of full scale. The power, frequency and pulse rate shall be suitable for this application.
Level Transmitters (Ultrasonic Type)
Each ultrasonic level measurement system shall consist of a transducer, an electronic unit in the head of the transducer and a signal converter unit.

The transducer shall transmit ultrasonic pulses and receive the echo from the surface of the tank contents. The ultrasonic frequency shall be suitable for the application. The electronics in the head shall operate at low voltage and shall be encapsulated. The head enclosure shall provide enclosure class of IP65.

The electronic signal converter unit shall generate a 4-20 mA DC current analogue output based on time of flight with temperature compensation. Provision shall be made for span and zero adjustment. The converter shall incorporate an analogue or digital indicator. Overall accuracy shall be better than ± 5% of full scale.

Rotameter (Variable Area Flowmeter)
Each rotameter shall be of the tapered tube and float type, of straight through construction, with flanged or threaded end connections as required.

The flowmeters shall have tempered glass tubes, stainless steel end fittings and stainless-steel floats. The flow meters shall incorporate a metering tube that can be removed and cleaned without removing the meter body from the line.

The flow meters shall be selected to suit the range for each individual application and shall be accurate to ± 2% of full scale over a minimum turndown ratio of 10:1. The flow meters shall be fitted with a direct reading scale, nominally 250 mm long and scaled in litres/second as appropriate for the flow ranges of each application.

Rotameter (Purgemeter)
The Flow meters required for monitoring purge air flow shall include an integral inlet needle valve to allow adjustment of the flow of air. Flow meters shall be of Fischer & Porter 10A3620 type or equivalent.

Each rotameter shall be of the tapered tube and float type, of straight through construction with screwed end connections.

All materials shall be suitable for the application.

The flow meters shall be selected to suit the range for each individual application and shall be accurate to ± 2% of full scale over a minimum turndown rates of 10:1. The flow meter shall be fitted with a direct reading scale, nominally 70 mm long and scaled in litre/second or as appropriate for the flow ranges of each application.

Indicators
Indicators shall be of the digital display type of flush mounting pattern utilising a gas discharge or light emitting diode display. They shall be fitted with an inconspicuous front panel zero adjustment.

Indication shall be sufficient to allow for accurate reading at a distance of 3 metres from the unit. Indicators shall be scaled from 0 to 100% or as otherwise specified.

Indicators shall include continuously variable span and zero adjustments. Adjustment shall be provided via inconspicuous front panel controls.
Each indicator shall accept a 4-20 mA DC signal input with a maximum input resistance of 100 ohms.

Each indicator shall be mounted in a clear enclosure to at least enclosure class IP65 (AS1939).

**I/P Transducers**

Current to pressure transducers shall be of the closed loop pressure feedback control type.

Each transducer shall be of the "two wire" type deriving electrical power from the loop 240 A DC supply and shall accept an isolated 4-20 mA DC input current signal with a maximum input resistance of 250 ohms.

A continuous adjustment for both measurement span and zero shall be provided. Accuracy shall be better than ± 0.1% of full scale.

Integral damping adjustment to prevent overshoot and "hunting" shall be provided.

Each transducer enclosure shall satisfy enclosure class IP65 (AS1939).

The maximum air consumption for each transducer shall be less than 0.04 litres/sec.

Output pressure shall be in the range of 20 to 100 kPa.

**Magnetic Flow Meters**

The flow meter shall comprise an electromagnetic detector, power supply and converter providing an overall system accuracy of ± 1%.

The detector shall have a stainless-steel metering tube suitably lined to resist wear and corrosion. The whole of the detector unit shall be suitable for continuous submerged operation.

The converter shall incorporate all range settings, zero settings and necessary controls and shall produce a linear 4-20 mA analogue signal. The converter shall be capable of accurately rejecting quadrative signal components and line voltage variations of 6% to -10%.

Signal cables between the detector head and the converter shall be screened to suppress interference and the entry at the detector head shall maintain waterproof protection of the coil enclosure. Electricity supply shall be derived from a single pole circuit breaker within the switchboard and the Contractor shall provide transformers required for operation of equipment at voltages other than 240 V AC.

The Contractor shall use a calibrated flow simulator to test the converter and meter. The Contractors proposed testing procedure shall be fully detailed in the Schedule of Guaranteed Technical Information.

**On-line Analysis Meters**

The analyser system shall comprise dual membrane sample filters for each sample stream, automatic stream switching facilities, the evaluation instrument, reagent solutions, calibration solutions, precision peristaltic pump, all interconnecting pipe work and valves, and connections to mains power, control system, sample stream and drain.
The membrane filters shall be provided in duplicate for each sample stream on the basis of one in service and one on standby. Changeover to the standby filter shall be by manual valving.

The filters shall be entirely suitable for the nominated sample stream and produce a filtrate entirely suitable for the associated analysers. Provide all cleaning equipment and chemicals required for routine maintenance of the filter membrane.

Stream splitting shall be fully automatic and programmable. Provide facilities to sequence streams in any order. The evaluation output of the analyser for any stream shall hold its value while other streams are analysed.

Reagent solutions shall be supplied in robust containers neatly housed in a cubicle manufactured from materials entirely resistant to the reagent chemicals. Interconnecting tubing shall be concealed yet easily replaceable. If reagents are to be prepared on site, provide one spare reagent container for each reagent. Reagent volume in one container should last for 4 weeks of normal operation.

Calibration solutions shall be supplied for two-point calibration of the evaluation instrument and shall be housed similarly to the reagent solutions. Calibration shall be fully automatic at programmable time intervals.

The peristaltic pump shall be suitable for long term continuous operation without maintenance of any type including lubrication or replacement of metering tubing. Replacement of the tubing shall be a simple procedure undertaken by the operator without special tools.

The evaluation instrument and any associated reactors shall be preferably temperature controlled, or at least temperature compensated.

Front of panel indication shall include digital (3 Digit) readout of the species concentration, and LED indication of alarms and calibration sequence.

The whole system shall be housed in a corrosion proof cabinet protected to IP31 for liquid handling systems and IP55 for electrical/electronic systems.