

APPENDIX B

OASIS STADIUM SPORTS HALL MECHANICAL SPECIFICATION AND PRICING INFORMATION.



Kalgoorlie Oasis Stadium Sports Hall Evap Cooling

Specification for MECHANICAL SERVICES

Project Number: 230352
Date: April 2024
Tender Issue
Document No.: D258135

BCA CONSULTANTS

KALGOORLIE OASIS STADIUM SPORTS HALL EVAP COOLING MECH SPEC

***Specification for
MECHANICAL SERVICES
INSTALLATION***

**BCA CONSULTANTS
CITY OF KALGOORLIE-BOULDER**

**Consulting Engineers
Client**

Project No. 230352

Date: April 2024

Tender Issue

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TENDER FORM

1 INFORMATION TO TENDERERS AND GENERAL CONDITIONS

1.1 TENDER FORM

The attached "Tender Form" and "Schedules of Technical Data", completed by the Tenderer, shall be submitted with the tender. Schedules not completed may result in a tender being considered informal and being rejected without further analysis.

1.2 SITE

Tenderers are required to make themselves fully aware of the nature of the project, site conditions and all other aspects that may influence their tender submission.

1.3 SELECTION OF A TENDER

Evaluation and selection of a tender (or tenders as the case may be) will be based on:

- ability to comply with the technical requirements of the specification.
- agreement to comply with conditions of contract.
- ability to meet target construction dates.
- submission of competitive quotations.
- previous experience.
- present commitments.

1.4 ADDENDA

Tenderers shall also state in their tender that they have received and allowed for any Addenda which have been issued during the tendering period and shall name each addendum.

1.5 ALTERNATIVE TENDERS

The Tenderers shall submit alternative tenders for separate portions of the works as requested on the "Tender Form".

1.6 BANK GUARANTEE

The Tenderers shall include in the Tender Submission, Bank Guarantees equal to 5% of the project value with no expiry date applied. The Bank Guarantees shall be released at the following stage of the Contract:

- Bank Guarantee #1: 2.5% of project value with no expiry date, released at date of Practical Completion.
- Bank Guarantee #2: 2.5% of project values with no expiry date, released upon expiry of Defects Liability Period (12 months after the date of Practical Completion).

2 GENERAL CONDITIONS

2.1 TENDER DOCUMENTS

The Tender Documents will include, amongst other documents, this specification complete with such Annexure, Appendices and Addenda as are issued up to the time of closing of tenders.

Where conflict arises between the specification and drawings, the **higher** standard/arrangement shall apply. The Contractor will be required to seek clarification during the tender period.

Drawings associated with, and forming part of, this Specification are scheduled below. The arrangements and details are approximate only. Check all dimensions and building details prior to proceeding with the work.

Drawing No. Title

230352-M00	Site Plan, Section, Equipment Schedule and Notes
230352-M01	Demo Works
230352-M02	New Works

Unless having formally qualified his tender accordingly, the successful Tenderer shall comply with the requirements of the tender drawings. Should the Contractor require changes to accommodate his equipment or method of constructions, such changes not being due to variations or amended rules and regulations occasioned after closing of tenders, then the costs and time resulting from such changes shall be borne by the Contractor.

2.2 DRAWINGS TO BE SUBMITTED

Before proceeding with the manufacture or installation of equipment submit to The Project Manager shop drawings with full details of the equipment and methods of constructions and fixing. Factory or site work shall not proceed until such drawings have been approved.

Approval of drawings refers to general principle of design only. If errors, omissions and interferences are noticed, bring it to The Project Manager's attention. Approval of drawings will not in any way relieve the Contractor of the responsibility for such errors or omissions and interference or from the necessity of furnishing such workmanship or materials as may be required for the completion of these Works in accordance with this specification.

Prepare and submit for approval construction drawings in electronic PDF format based on the drawings accompanying this specification.

Prepare drawings using AutoCAD 2004 or compatible CAD system to the following scales on sheets of the same size as the drawings accompanying the specification.

Item:	Scale:
- Floor Plans	1:50
- Sections	1:50
- Details	1:20/1:10/1:5

NOTE: DRAWINGS AT 1:100 WILL NOT BE ACCEPTED.

Provide fully dimensioned construction drawings prepared in accordance with Australian Standard 1100 - Technical Drawing detailing the following parts of the work:

- Associated works including penetrations through the structure, roof penetrations, plinth dimensions, electrical terminations and other termination points.
- Plant layouts including manufacturer's details of equipment and loads placed on the building structure.
- Plantroom layouts.
- Pipework layouts.
- Electrical schematics, power and control wiring diagrams detailing the inter-connection of all electrical components, including the identification with a name or symbol (and including a schedule of symbols) indicating each part represented on the diagram, and including a set out of

switch and relay operating times and the relevant information including priorities, zones, quotas and intervals in appropriate schedules.

Prior to submitting manufacturer's construction drawings for approval suitably stamp, date and endorse each drawing as inspected and if necessary, add comments.

Submit construction drawings in adequate time for the building construction programme to be complied with. Allow 10 working days for the return of the endorsed shop drawings.

Prepare and submit a schedule of construction drawings detailing inspected drawings, current drawings submitted for inspection, dates for re-submission for non-approved drawings and date for submission of outstanding drawings.

Approval of drawings is carried out to determine if the intent of the contract documents has generally been complied with. Such inspection does not relieve the responsibility for contractual obligations including ensuring that the work is complete, accurate and correct.

Where drawings are returned for amendment, amend and resubmit within sufficient time to prevent delays to the execution of the works. Allow a further 10 working days for the return of the endorsed shop drawings.

2.3 WORKS PROGRAMME

It is a requirement that all efforts are made to ensure the works are carried out to coordinate the works associated with all the mechanical systems. As such, all works carried out involving the full shutdown of systems shall be coordinated and liaised between the City of Kalgoorlie/Boulder.

A proposed works programme shall be submitted to the City of Kalgoorlie/Boulder for review prior to proceeding with the works. Extent of works areas for each stage and availability of works areas shall be confirmed with the City of Kalgoorlie/Boulder prior to the development of the proposed works programme.

2.4 COMPLIANCE WITH REGULATIONS

The work carried out by the Mechanical Contractor shall comply in all respects with this specification and:

- The National Construction Code of Australia 2019 Amdt 1.
- The SAA Wiring Rules and Regulations and requirements of the local electricity supply authorities.

Current issue of relevant Australian Standards including but not limited to:

- Australian Standard 1074 – Steel tubes and tubulars for ordinary service
- Australia/New Zealand Standard 1167.1:2005 – Welding and brazing – Filler metals – Filler metal for brazing and braze welding
- Australia/New Zealand Standard 1167.2:1999 – Welding and brazing – Filler metals – Filler metal for welding
- Australian Standard 1170.4-2007 – Structural design actions – Earthquake actions in Australia
- Australia/New Zealand Standard 1200 – Pressure equipment
- Australian Standard 1345 -1995 – Identification of the contents of pipes, conduits and ducts
- Australian Standard 1397-2011 – Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium
- Australian Standard 1432 – Copper tubes for plumbing, gas fitting and drainage applications.
- Australian Standard 1530 – Part 4 – 2014 – Methods for fire tests on building materials, components and structures – Fire-resistance tests for elements of construction.
- Australian Standard 1657-2013 – Fixed platforms, walkways, stairways and ladders – Design, construction and installation
- Australian Standard/New Zealand Standard 1668.1:1998 – The use of ventilation and airconditioning in buildings – Fire and smoke control in multi-compartment buildings
- Australian Standard 1668.2-2012 – The use of ventilation and airconditioning in buildings – Mechanical ventilation in buildings

- Australian Standard 1674.1-1997 – Safety in welding and allied processes – Fire precautions
- Australian Standard 1796 – Certification of welders and welding supervisors.
- Australian Standard 1851-2005 – Maintenance of Fire Protection Systems and Equipment
- Australian Standard 1905 – Part 1 – 2015 – Components for the protection of openings in fire-resistant walls – Fire-resistant doorsets (incorporating amendment 1)
- Australian Standard /New Zealand Standard 2107 – Acoustics – Recommended design sound levels and reverberation times for building interiors.
- Australian Standard 2625.1-2003 – Mechanical vibration – Evaluation of machine vibration by measurements on non-rotating parts – General guidelines
- Australian Standard /New Zealand Standard 3000 – Electrical installations.
- Australian Standard / New Zealand Standard 3008 – Electrical installations – Selections of cables.
- Australian Standard/New Zealand Standard 3500.1:2018 – Plumbing and drainage – Water services
- Australian Standard/New Zealand Standard 3666.1:2011 – Air handling and water systems of buildings – Microbial control – Design, installation and commissioning
- Australian Standard/New Zealand Standard 3666.2:2011 – Air handling and water systems of buildings – Microbial control – Operation and maintenance
- Australian Standard/New Zealand Standard 3666.3:2011 – Air handling and water systems of buildings – Microbial control – Performance-based maintenance of cooling water systems
- Australian Standard 3788 – Pressure equipment – In service inspection.
- Australian Standard 3873 – Pressure equipment – Operation and maintenance.
- Australian Standard 3892 – Pressure equipment – Installation.
- Australian Standard 4041 – Pressure piping.
- Australian Standard 4254.2-2012 – Ductwork for air handling systems in buildings – Rigid Duct
- Australian Standard 4809-2003 – Copper pipe and fittings – Installation and commissioning
- Australian Standard/New Zealand Standard 4859.1 - Materials for the thermal insulation of buildings - General criteria and technical provisions.
- Australian Standard 4942 – Pressure equipment – Glossary of terms.
- Australian Standard 60529-2004: Degrees of protection provided by enclosures (IP Code)
- Australian Standard /New Zealand Standard 61439.1:2016 - Low voltage switchgear and control gear assemblies
- The relevant Acts governing installation of the Contract Works in this class of building.
- The requirements of the Chief Inspectors of the relevant Statutory Authorities.
- All requirements of the Department of Fire and Emergency Services.
- Australian Communications Authority (ACA) Regulations.
- Electrical Supply Authority.
- Water Corporation Western Australian.
- Telecommunications Carrier Regulations.
- Any other regulations that apply directly or indirectly to such installations in the locations.

Where conflict arises between this specification and any of the applicable Acts, Codes or Standards the highest standard of materials and workmanship shall prevail.

2.5 CERTIFICATION

The Mechanical Contractor as a minimum shall provide the following certification:

- Works have been installed and are complete and in accordance with the specification and relevant codes.
- Electrical Safety Certificate upon completion of all electrical works by a licensed and qualified electrician.

Other certification may be requested throughout the contract.

2.6 PERMITS, NOTICES AND FEES

Where notice is required by any Statutory Authority having jurisdiction over the Contract Works and/or approval required there from the Contractor shall give such notice and information as may be called for and/or obtain such approval.

The Mechanical Contractor shall obtain all permits within such time as to ensure no delay to the work and shall pay all fees associated therewith.

The Mechanical Contractor shall perform any tests required by the Statutory Authority at the Contractor's expense. Any such tests shall be carried out in the presence of an Inspector of the Statutory Authority and The Project Manager. Advice of such tests shall be conveyed to The Project Manager no later than 7 days prior to such tests taking place.

2.7 CRANAGE, HOISTING AND SCAFFOLDING

Make all allowances necessary for the crantage, hoisting and scaffolding necessary for the installation of any Mechanical Services and equipment.

2.8 SITE CLEANLINESS AND RUBBISH REMOVAL

Remove from site all rubbish, debris, material cuttings and other redundant materials, which result from the works, progressively and whenever, directed.

2.9 MATERIALS, EQUIPMENT AND WORKMANSHIP

Obtain approval for and maintain uniformity of the manufacturer and type of all materials and equipment. Use only new, current manufacture, first quality materials and equipment.

Comply with the manufacturer's recommendations in respect of installation techniques and the requirements for associated materials, equipment, components and devices.

Ensure compatibility of materials and equipment with the installed environment in respect of ambient temperatures, utilities supplies and vibration.

2.10 SETTING OUT OF OPENINGS AND MATERIALS

Provide details and exact locations of all required associated works including penetrations through structure, fixings, equipment support bases, temporary and permanent access in such time as to ensure delays do not occur to the construction works.

Prepare construction drawings to detail the above requirements.

Obtain written approval for all ducts, recesses and penetrations in structural elements not shown on the architectural and structural drawings.

Check on site all penetrations, inserts and recesses prior to the pouring of concrete, confirm their acceptance accept responsibility for their accuracy.

2.11 BALANCING AND PHASE ROTATION

Balance each section of the installation evenly over all phases and ensure that phase rotation is correct throughout.

2.12 PENETRATIONS THROUGH STRUCTURE

The Mechanical Contractor shall engage a Builder to carry out all associated works required for the Mechanical Services Installation.

Ensure coordination to allow the works to be completed in accordance with the construction programme.

Provide treatment to these penetrations as follows:

- Exposed Penetrations - flash pipework and ductwork penetrations where exposed to view with sheet metal escutcheon plates.
- External Wall Penetrations - seal with silicon sealant and install weatherproof over-flashings.
- Roof Penetrations - install weatherproof over-flashings and any trimmer beams or other reinforcement necessary to support equipment, duct pipes and flues passing through the penetration.

2.13 CHASING

Carry out all necessary chasing. Obtain approval for the location, route and depth of all chases prior to commencing the work. Complete the work prior to the commencement of finishing trades works.

Chasing will not be permitted in face brickwork. Install pipework or conduits to such walls on the reverse face or within cavities as applicable. Alternatively, co-ordinate coring of single leaf face brickwork and install pipes or conduits within the cores.

Keep chasing to minimum depth and width whilst ensuring a minimum of 15mm coverage by the final render.

Obtain written approval prior to chasing columns, cast and load bearing walls or other structural elements and prior to carrying out horizontal chasing.

Provide a minimum of 10mm spacing between adjacent pipes or conduits and provide expanded aluminium mesh over the full width and length of any chase wider than 80mm.

2.14 CUTTING, FIXINGS AND PLUGS

Holes shall be drilled by electric or compressed air drill wherever possible. Explosive charge fixing devices is prohibited.

Where devices are required for attaching materials or equipment to the building approved metal expansion devices shall be used except that in certain locations plastic expansion devices may be used when and where approved by the Consulting Engineer. Wooden plugs will not be permitted. Approval of a Structural Engineer engaged by the Contractor shall also be obtained prior to drilling any hole whatsoever.

The Contractor shall do all cutting and boring and shall supply and fix all hooks, bolts etc. required to secure the work. These shall be set in as the work proceeds. All cutting and boring shall be subject to approval of the a Structural Engineer engaged by the Contractor.

2.15 WELDING

Carry out welding using competent, qualified tradesmen holding a current certificate of competency to carry out structural welding. Ensure all surfaces are clean and free from scale, grease and grime.

Ensure all welds are uniform, predominantly smooth, free of spatter and conform to the minimum requirements of Australian Standard 1554 - Structural Steel Welding and Australian Standard 1674 - Fire Precautions in Cutting, Heating, Welding Operations. Provide suitable fire extinguishers whenever welding is carried out on site.

For any hot work undertaken in a hazardous area, a hot work permit shall be obtained from The Project Manager as defined in the Standard prior to hot work being performed.

2.16 FLAME CUTTING

Do not carry out flame cutting in members carrying stress at the time of cutting or members that will later be subjected to stress or without prior approval.

Do not use flame cutting equipment to enlarge holes or slots through which bolts will pass unless prior approval has been received. Provide suitable fire extinguishers whenever flame cutting is carried out on site.

Ensure all flame cutting conforms to the minimum requirements of Australian Standard 1674 - Fire Precautions in Cutting, Heating, Welding Operations.

For any hot work undertaken in a hazardous area, a hot work permit shall be obtained from a responsible officer as defined in the Standard prior to hot work being performed.

2.17 CO-ORDINATION OF INSTALLATION

The Mechanical Contractor shall co-ordinate the installation of the works with all sub-trades engaged by the Contractor to ensure a logical, sequenced approach. All costs associated with delays, re-work, making good or additional works resulting from delays, or deficiencies in co-ordination of the works or provision of information shall be borne by the Contractor.

2.18 ORDERING AND DELIVERY

The Contract shall be based upon a guarantee that all materials and equipment required for the work shall be obtained at such time as to enable the work to be completed in each element in accordance with the agreed Contract works programme. If any doubt exists regarding dates of supplies full information shall be included in the tender.

Lack of such materials due to delay in ordering shall not constitute grounds for extension of time for completion.

The Mechanical Contractor shall request instructions in writing from The Project Manager on any aspect requiring decision and shall do in such time as to enable ordering and delivery to suit the programme established with The Project Manager.

2.19 STORAGE

The Mechanical Contractor shall be responsible for storage and protection of tools and equipment whether on or off the job site and/or in transit.

Upon delivery to site all materials and equipment shall immediately be properly stacked and protected from the weather dampness and dust with particular attention to preventing ingress to working parts and pipes.

The Mechanical Contractor shall confer with The Project Manager and accept his instructions with regard to storage of materials particularly heavy loads. All equipment and materials shall be stored clear of floor slabs on timber packers.

2.20 SPECIAL SITE ALLOWANCES AND OVER AWARD PAYMENTS

Allow for all costs of any site and other union related requirements or allowances for this Contract. The type of allowance envisaged by this clause includes among other things: site allowances, safety boots, bluey jackets, T shirts, structural frame allowance, termination charge and redundancy payments, building union superannuation schemes, portability of long service leave, block allowance and any other over award payments. The Tenderer shall nominate the number of labour hours applicable to this project in the tender form.

2.21 GUARANTEES AND WARRANTIES

The Mechanical Contractor shall be sufficiently aware of the Contract requirements with respect to warranties.

Written guarantees and/or warranties shall be supplied with respect to all items of plant or equipment or the performance thereof or the performance of entire systems as required by the contract.

Guarantees and/or warranties shall be in a form acceptable to The Principal and shall be delivered to The Project Manager on completion of the Contract Works. No guarantee and/or warranty shall be drafted in a form, which shall relieve the Contractor of his responsibility in respect of the matters specified and covered, by the guarantee and/or warranty.

Final payment will not be issued until this requirement has been fulfilled.

Guarantees and/or warranties shall state that workmanship materials and installation are guaranteed for a period specified from the date of Practical Completion and that any defects that may arise during the Defects Liability Period shall be made good and any work in other trades resulting from such making good shall be done at the expense of the Contractor upon written notice to do so.

The Mechanical Contractor will have access to all available building specifications and drawings at all times during the currency of the contract and will be deemed to be fully acquainted with them including all revisions at all times throughout the job.

The Mechanical Contractor will be supplied free of cost with drawings in electronic PDF format, necessary for completion of the Contract Works for his use during the currency of the contract. The cost of preparation of any additional printed sets for the Contractor shall be chargeable to the Contractor.

2.22 INTERPRETATION

In all cases where items of equipment are referred to in the singular number it is intended that such reference shall apply to as many of these items as are necessary for the efficient operation of the installation.

Should any dispute arise as to the number of items or interpretation of plans or specifications such dispute shall be referred to BCA Consultants whose decision shall be final and binding on all parties.

2.23 PRACTICAL COMPLETION

When in the opinion of the Mechanical Contractor the Contract Works are practically completed the Contractor shall give written notice thereof to The Project Manager.

Unless otherwise stated the date of Practical Completion shall coincide with that of the Building Contract.

Pursuant to the provisions of Contract a Certificate of Practical Completion will not be issued until:

- The whole of the Contract Works are ready for handing over to The Principal.
- Services are tested and operating satisfactorily and approved by the appropriate Authorities.
- Painting and other finishes are completed.
- Work included in the contract is performed including such rectification as may be required to bring the Contract Works to approved standards.
- "As Installed" drawings and operating manuals, brochures and instruction data are supplied and approved.

Where partial occupation is effected items above shall apply.

Bank Guarantee #1 equal to 2.5% of project value with No Expiry Date shall be provided by the Contractor. Bank Guarantee #1 shall be released at the Practical Completion date.

2.24 DEFECTS LIABILITY PERIOD

The Mechanical Contractor shall warrant the whole of the Contract Works against defective workmanship and materials and against non-compliance of equipment or complete systems with specified performance and operation for the Defects Liability Period.

The Defects Liability Period shall continue for a period of 12 months after the date of Practical Completion and during this period the Mechanical Contractor shall be responsible for making good within 30 days any defects arising from defective design materials or workmanship or from any act of the Mechanical Contractor or his servants or agents that may develop in the work under the conditions provided in the Contract and under proper use.

If during the currency of the Defects Liability Period any defects are not remedied within a reasonable time, The Project Manager may proceed to do the work or have it carried out at the Contractor's risk and expense but without prejudice to any other rights which The Project Manager may have against the Contractor in respect of the failure of the Contractor to remedy such defects.

If the Mechanical Contractor replaces or renews any portion of the Contract Works the provisions of this clause shall apply to the portion of the Contract Works so replaced until the expiration of 12 months from the date of such replacement or renewal.

If during the currency of the Defects Liability Period it becomes necessary to repair or replace a defective part and the repaired or replaced part causes damage to other portions of the Contract Works the Contractor's liability shall be same as if the losses, damage or injury incurred thereby had occurred before any part of the Contract Works had been taken over.

If the replacements or renewals during the Defects Liability Period are of such a character as may affect the efficiency of the work or any portion thereof The Project Manager may within one month of such replacement or renewal give to the Mechanical Contractor notice in writing requiring that tests on completion be made in which case such tests shall be carried out as directed by The Project Manager.

During the Defects Liability Period the Mechanical Contractor shall be given the right of access at all reasonable working hours at his own risk and expense by himself or his duly authorised representatives whose names shall have been previously communicated in writing to The Project Manager to all parts of the Contract Works for the purpose of inspecting the working thereof and to records of the operation, taking notes there from. Subject to approval, which shall not be unreasonably withheld, the Contractor may at his own risk and expense make any tests, which are considered desirable.

2.25 MAINTENANCE PERIOD

The Maintenance Period shall continue for the period of 12 months after the date of Practical Completion.

Adjustments and tests, which are necessary to maintain all controls and equipment in proper adjustment during the Maintenance Period, shall be made by and at the expense of The Mechanical Contractor. These adjustments and tests shall be made after the Works have been taken over by The Principal. All costs that may be involved to perform these adjustments and tests at the convenience of The Principal shall be borne by the Mechanical Contractor. The Mechanical Contractor shall undertake regular and systematic inspections and servicing.

The cost of maintenance during the Maintenance Period shall be included in the Contract Amount.

2.26 FINAL COMPLETION

Four weeks prior to completion of the maintenance period the Mechanical Contractor shall assist with complete inspection of the Contract Works.

The Mechanical Contractor shall note all items considered unsatisfactory by the inspecting parties and shall rectify accordingly.

All rectification work shall be completed one week prior to the expiration of the maintenance period.

Final completion will not be issued until all items are approved as satisfactory.

Bank Guarantee #2 equal to 2.5% of project value with No Expiry Date shall be provided by the Mechanical Contractor. Bank Guarantee #2 shall be released upon expiry of the Defects Liability Period (12 months after Practical Completion date).

3 ASSOCIATED WORKS

3.1 GENERAL SITE FACILITIES

Hoisting:

The Mechanical Contractor shall pay all costs of hoisting and lowering of materials and equipment necessary for his work and may at his own expense provide his own hoisting equipment providing it is to the approval of the Client, including its location.

Scaffolding:

- Any scaffolding required by the Mechanical Contractor for its own use must be provided by him.

Water:

- The Mechanical Contractor shall provide at its own cost whatever piping, hoses, fittings etc. he may require to carry water from the outlet provided by the Proprietor.

Electricity:

The Proprietor shall provide to the Mechanical Contractor free of charge:-

- 1 off 240V, 15A single phase power supply within 60m of places of use.
- The Mechanical Contractor shall provide at its own cost whatever conduits, wiring, leads, lamps and similar items may be required for his work. The Proprietor shall supply the Mechanical Contractor with all power required to install and commission the plant.
- Power in excess of the above, required by the Mechanical Contractor, shall be his responsibility.

Protection/Access:

- The Mechanical Contractor shall provide guards or barriers around openings.

Telephone, E-mail and Printer:

- The Mechanical Contractor shall organise its own remote mobile phone, e-mail and printer facilities. Alternatively, the Mechanical Contractor is to negotiate with the Proprietor the use of the facilities and shall pay the Proprietor for use of these facilities.

Other Services and Facilities:

- Any other services or facilities required by the Mechanical Contractor shall, where applicable, be subject to arrangement with the Superintendent.
- Any services or facilities required by the Mechanical Contractor in excess of those provided for in their tenders, shall be the sole responsibility of the Mechanical Contractor and no claim for variations to Contract Sums shall be entertained by the Proprietor.

3.2 SETTING OUT AND OPENINGS

The precise location of all openings and other work required by the Mechanical Contractor shall be shown on the Mechanical Contractor's Builder's Works drawings. If openings or work are wrongly located due to incorrect or late information supplied by the Sub-Contractor, he shall be responsible for the cost of remedying the error.

Where openings are shown on the drawings supplied by the Consulting Engineer these are not intended to be a full record of all openings required by the Mechanical Contractor.

The drawings supplied by the Consulting Engineer are diagrammatic and unless otherwise specified shall not be used for determining the precise positions of equipment, openings, outlets etc. The exact location of these will be determined from the drawings supplied in proper time by the Mechanical Contractor.

3.3 MAKING GOOD

The Mechanical Contractor shall make good, or pay all costs in respect of making good, all work in respect of patching, filling, painting etc. of holes and chases or damage caused by the Mechanical Contractor and/or his Sub-Contractors in the execution of the contract works. Such making good shall be of a standard to restore the surface to its original condition.

3.4 TEMPORARY WEATHERPROOFING

Any equipment for use in this contract shall be protected by the Mechanical Contractor against any damage, including damage by exposure to weather. Crates and equipment, immediately after delivery to site, shall be placed under cover.

The Mechanical Contractor shall provide all polythene and tarpaulin protection to equipment stored on site.

Any components showing signs of rust or other forms of corrosion shall be made good by the Mechanical Contractor at no cost to the Proprietor.

3.5 HOLES

The Mechanical Contractor will arrange all holes. The Mechanical Contractor shall allow for packing around all ducts and pipes passing through floors and walls as shown on the accompanying drawings.

The Mechanical Contractor shall confirm the exact sizes and indicate locations on shop drawings of all holes required by the Contract.

The Mechanical Contractor shall engage a registered Structural Engineer to review and approve all penetration requirements as indicated on shop drawings prepared by the Mechanical Contractor.

3.6 ACCESS OPENINGS

The Mechanical Contractor will provide all access openings in ceilings, roofs and generally where indicated on the accompanying drawings.

3.7 ASSOCIATED WORK AND SERVICES BY MECHANICAL CONTRACTOR

General:

Note. The Mechanical Contractor is the lead contractor and any subtrades including any builder's work are to be included in the Mechanical Contractors Tender. all of the following items are to be provided by the Mechanical Contractor

The following items are not intended to be a full specification of items to be provided. They are provisional only and indicate the general extent of work. Full details should be coordinated with the various sub-trades before installation.

The Mechanical Contractor shall ascertain the exact associated work requirements for the installation and should any discrepancy occur over and above the list of items included, shall allow for the cost for the same in his tender.

The Mechanical Contractor shall ensure that a sufficient level of cleanliness is maintained to the areas where works are being performed.

Associated work to be provided for:

The following associated work are required for the air-conditioning installation works as defined in this specification and shall be provided for by the Builder:-

General site facilities as previously detailed.

- New penetrations and/or modify existing penetrations in walls to facilitate ductwork.
- Water supplies to new indirect evaporative cooling units.
- Provide concrete plinths to suit new equipment layout.
- Extension of plant enclosure to suit new equipment layout.
- Steel support frames for mechanical plant.
- Access for balancing and commissioning.
- Drain points adjacent mechanical plant.

A dilapidation survey report shall be undertaken and allowed for within the Tender by the Mechanical Contractor prior to starting works on site to identify pre-existing condition of the building elements. The dilapidation survey report shall form the basis of the requirement to make good Builder's works items, amended as a result of the Services installation. Failure to identify pre-existing conditions in the vicinity of

the Services installation works, within the dilapidation survey report, renders the Mechanical Contractor responsible for the making good of such items.

4 DESCRIPTION OF INSTALLATION

4.1 GENERAL

The Mechanical Services described in this specification and on the accompanying drawings are for the evaporative cooling units replacement works Kalgoorlie Oasis Stadium Sports Hall located in Kalgoorlie-Boulder.

4.2 DESCRIPTION OF INSTALLATION

The following systems and services form part of the Mechanical Services installation.

The Mechanical Contractor shall be responsible for the provision of associated works as described in the previous section of this Specification.

Mechanical Contractor is to familiarise himself with the site prior to submitting the Tender.

Note: Mechanical contractor must submit workshop drawings prior to any new installation work being undertaken on site

Also Mechanical contractor to provide indicative program as soon as the project is awarded

- Demolition, removal and disposal of existing evaporative cooling units, ductwork and fittings as indicated on drawings.
- Supply and install nine (9-off) new indirect evaporative cooling units
- Supply and install three (3-off) new axial flow inline duct booster fans
- Supply and install new external rigid ductwork including supply air manifolds, internal fabric ductwork and associated fittings.
- Supply and install new electrics & controls for above systems.
- Modification to existing MSSB to suit new equipment
- Testing and commissioning of the above new systems.
- Painting, identification and labelling of the plant and equipment piping systems associated with the above systems.
- Provision of installation manuals, as installed drawings for the above systems.
- Maintenance and servicing, warranty and defects liability for a period of 52 weeks from the date of practical completion.

4.3 DESIGN CRITERIA

The following design criteria have been used as the basis for ventilation calculations and equipment capacities. All equipment shall be selected to operate at full load capacity when subjected to the conditions indicated below:

Item	CRITERIA
External ambient conditions for plant full load performance	Summer 45°C dry bulb maximum 24°C wet bulb maximum Full Solar Load
Courts space temperature setpoint - occupied	Approx. 27°C
Sports Hall Ventilation:	
Supply Air Ventilation	Approx. 4800 L/s per Court
Outside Air:	

Item	CRITERIA
All Areas	In compliance with AS 1668.1 and 2
Maximum noise levels at adjoining property boundaries	To requirements of the Noise Abatement Act. (Acoustic consultants review is required).
Maximum noise levels in occupied areas.	To the requirements of AS2107. (Acoustic consultants review is required).
Electric Supply	240 volts, +4%, -6%, 1-phase, 50Hz or 415 volts, +4%, -6%, 3-phase, 50Hz and otherwise in accordance with Western Power Supply Authority Service Rules and Conditions of Supply. Voltage drop from connection point to equipment items not to exceed 3%.

5 PLANT AND EQUIPMENT

5.1 GENERAL

Supply and install plant and equipment in accordance with the requirements of this specification.

Include all incidental and ancillary equipment necessary for the completion of the installation, the safe and efficient operation of the plant and the maintenance of the plant including the following items:-

- Valves, fittings, flexible connections, isolation mounts
- Relief valves, safety railings, warning lights and alarms, electrical interlocks, earthing
- Lubricating facilities, access panels, gauge connections, manufacturer's nameplates.

Obtain approval for the manufacturer of all plant and equipment prior to ordering.

Guarantee the plant and equipment to provide the specified capacities and performance in the installed environment without objectionable noise and vibration.

The term "approved equal" requires the contractor to seek written approval for alternative manufacturers during the tender period. Where this is not obtained the specified manufacturers will be deemed to have been allowed for.

Accept responsibility for assessment of the actual system resistances and pressures, submit for approval copies of all associated calculations, and order equipment to suit it.

Provide fully certified and guaranteed performance curves for design and part load conditions and sound power level data at full load conditions for all plant and equipment.

Incorporate restraining devices to all plant and equipment, and internal baffles to tanks, complying with the requirements of Australian Standard 1170.4-2007 – Structural design actions – Earthquake actions in Australia.

Refer to the schedule of equipment on drawings for quantities of equipment and capacities of plant.

5.2 TECHNICAL INFORMATION TO BE SUBMITTED

Prior to the ordering of any equipment the Contractor shall submit technical details of the same for review by the Contract Administrator. The Contractor shall submit with each technical submission a conformance certificate signed by the Contractor, stating that the proposed equipment complies with the specification in its entirety. Should the proposed equipment not comply in its entirety, the Contractor shall detail all deviations upon the certificate for consideration by the Contract Administrator. Any review or subsequent acceptance of any proposed equipment by the Contract Administrator does not relieve the Contractors responsibility to comply with this specification.

5.3 INDIRECT EVAPORATIVE COOLING UNITS

Supply and install indirect evaporative cooling units complying with the following general performance and construction criteria.

Cabinet:-

- construction from marine grade aluminium incorporating the motor/fan assembly, non-corrodible heat exchange core and ancillary equipment mounted on a heavy gauge base frame

Fan and motor:-

- multi-blade, centrifugal type with backward curved blades
- cast aluminium rotor and plastic impeller
- high efficiency electric motor, inverter driven and responsive to 0-10V control signals

Heat Exchange Core:-

- meticulously designed to facilitate efficient heat transfer between the wet air passages and the dry air passages
- exchange to occur without the addition of any extra moisture

- long-term high efficiency in cooling processes

Water management system:-

- continuously monitoring and control of the maximum salinity level and chlorination of the water reservoir
- water reservoir equipped electric drain valve
- Automatic water dumping

Air filter:-

- filter is framed with aluminum and is washable
- safety screen to protect the fan and a cover to minimize rain intrusion

Electrical cabinet and controls:-

- houses critical components for system operation
- Modbus-compatible PLC screen and interface for local control and functionality
- PLC and controller with temperature and humidity sensors

Approved Makes:-

Climate Wizard or approved equal.

5.4 FANS - AXIAL FLOW

Supply and install axial flow type fans complying with the following general performance and construction criteria.

Casings:-

- full length hot dipped galvanised steel complete with mounting feet.
- incorporate access panels complete with neoprene gaskets, threaded studs and wing nuts on all fans over 300mm diameter.
- externally located terminal boxes on fan casings.
- extend lubricators to outside of fan casings adjacent terminal boxes for motors which are not sealed for life bearings
- incorporating flanges or spigots for duct connections, mounting feet and non-return dampers

Motors and drives:-

- direct drive type.
- maximum operating speed 1440 rpm.
- motor power sufficient to supply 110% of design air quantity against the corresponding system pressure increase.
- design bearing life 40,000 hours.

Impellers and hubs:-

- die cast aluminium alloy construction.
- adjustable pitch aerofoil type blades.

Approved Makes:-

- Fantech or equal.

6 AIR DISTRIBUTION SYSTEMS

6.1 GENERAL

Construct and install all components of air distribution systems including ductwork, dampers, access panels, conditioners, plenums and air diffusion equipment in accordance with the requirements of this specification and also in accordance with AS1668 Parts 1 & 2, and AS3666.

Construct and install the air distribution systems including ductwork, subducts, thermal and acoustic insulation and fire and smoke dampers in accordance with the Australian Standard 1668 Parts 1 and 2 Mechanical Ventilation and Air Conditioning Code and all applicable statutory requirements.

The drawings are a schematic representation of the various systems to be installed and as such do not purport to detail offsets and transitions required for the detailed coordination between trades and the as built structure.

Duct dimensions nominated on the drawings are in millimetres and are the clear air passage dimensions with the first dimensions indicating the side of ductwork in view on the particular plan or elevation.

Construct ductwork ensuring smooth airflow without obstruction, stiffen ducts and dampers to eliminate all startup, shutdown or operating noise due to panel movement or vibration.

All supply and return air ductwork serving the air conditioning systems to be fully insulated for thermal and acoustic requirements.

6.2 SCHEDULE OF CONSTRUCTION AND INSTALLATION STANDARDS

Construct and install ductwork in accordance with AS4254 - Ductwork for Air Handling Systems in Buildings.

Fabricate ductwork from galvanised sheet steel to Australian Standard 1397-2011 – Continuous hot-dip metallic coated steel sheet and strip – Coatings of zinc and zinc alloyed with aluminium and magnesium.

Seal watertight all joints in ducting exposed to the weather including evaporative cooling ductwork with silicon sealant compound "Expandite" or approved equal applied to the metal prior to constructing the joint.

Provide tapered top hat sections over the top transverse joint reinforcement and cross break all ductwork exposed to the weather.

Construct ductwork utilising material thickness and reinforcement schedules in accordance with the AS4254 2" w.g. (500Pa) standard and the following minimum material thickness, transverse joint reinforcement and intermediate reinforcement schedule.

Longest Side (mm) up to	Material Thickness (mm)	Frame	Reinforcing
450	0.6	Drive cleat	Nil
750	0.8	25mm TDF	Rib Roll @ 600 CTR
1200	1.0	38mm TDF	25 x 25 x 3 @ 600 CTR
3000	1.2	50mm TDF	38 x 38 x 3 @ 600 CTR

Proprietary duct flanges of TDF, TDC, Metu etc may be used up to 38mm frame depth.

Seal ductwork operating at pressures in excess of 500Pa at all longitudinal and transverse joints (including proprietary flanges) with high pressure duct sealant and leak test.

Construct circular ductwork in accordance with the AS4254 2" w.g. (500Pa) pressure classification.

6.3 EXPOSED CIRCULAR DUCTWORK

Construct exposed ductwork to provide a neat aesthetic appearance. Construct and install ductwork as follows:

- support ductwork from the top with concealed hangers.

- heavy gauge drive cleat transverse joints with corners filled and ground smooth with body filling compound.
- Pittsburg lock type longitudinal joints with joints located at the top on a concealed side.
- tapered top hat sections over angle flanges.
- transverse joints to circular ductwork to be of the spigotted type, filled and ground smooth with body filling compound.
- Replace damaged ductwork with new ductwork free of dents and buckles.

6.4 EXPOSED CIRCULAR FABRIC DUCTWORK

Fabric ductwork selection has been based on Prihoda make. Construct exposed ductwork to provide a neat aesthetic appearance. Construct and install ductwork as follows:

- support ductwork from the top with mounting system consisting of plastic-coated galvanized wire hanging system.
- Wire hanging system supported via cable support to roof structure complete with cable clamps. Wire hangers or clamps shall be plastic-coated. Ensure adequate support distances in accordance with the manufacturer's recommendations
- Fabric duct sections shall be attached via proprietary zippers and sufficiently sealed to maintain static pressure in the ductwork system.
- Fabric duct material shall have perforations arranged for directional air diffusion into the occupied space directed sideways and downwards into the occupied space. Air diffusion shall be designed not to exceed 0.2m/s upto 6m/s from finished floor level in and around court area.
- Fabric duct colour selection to be confirmed in conjunction with the Client.

6.5 SUPPORTS, REINFORCEMENT AND BRACING

Construct and install supports, reinforcement and bracing in accordance with AS4254 Ductwork for air handling systems in buildings.

Construct hanger straps, proprietary flanging systems and all supports exposed to the weather, moisture or to view from galvanised sheet steel.

Fabricate hanger rods and all bolts from zinc coated or hot dipped galvanised steel.

Construct all other flanges, brackets and bracings from mild steel treated with 1 coat of zinc chromate primer.

Utilise "Prestick" to the full width of all other flange joints including proprietary flanges.

6.6 DUCT MOVEMENT AND VIBRATION

Install ductwork to allow movement due to expansion and/or contraction without placing stress on either the ducts or building structure.

Provide flexible connections and vibration isolators as required to ensure vibration and/or noise is not transmitted to the building elements.

6.7 FLEXIBLE CONNECTIONS

Provide flexible connections at evaporative cooling units discharge connection.

Construct flexible connections from neoprene glass coated fabric having a density of not less than 1kg/m² for normal applications at less than 90°C.

Provide weatherproof covers constructed from galvanised sheet steel to all exposed flexible connections.

Ensure flexible connections are completely air tight and a minimum of 100mm wide at duct connections to all fans and items of air handling equipment.

Align associated ductwork, fans and equipment prior to installing the flexible connections.

6.8 LEAK TESTING

- Carry out leak testing comprising hand feel and audio checking of all joints.
- Seal open end ductwork, pressurise and ensure leakage rates in accordance with AS4254.
- Seal all leaks with "3M EC.800" or approved equivalent.

6.9 PITOT TUBE OPENINGS

Provide pitot tube openings in ducts as required for commissioning purposes. Seal openings with rubber grommets.

Incorporate 2 openings on perpendicular centre lines in circular ducts and incorporate openings on 2 perpendicular faces of rectangular ducts at a maximum spacing of 200mm.

7 THERMAL INSULATION

7.1 GENERAL

Supply and install thermal insulation to pipework, ductwork and equipment in accordance with the requirements of the specification.

Install the insulation using only skilled tradesmen, experienced and competent in this type of work.

Clean all surfaces thoroughly of scale, rust, grease, oil and dirt prior to the application of the insulation. Complete all pressure and leak testing prior to the application of the insulation. Maintain close contact between insulation and applied surfaces. Ensure insulation is continuous, with all joints firmly butted together.

Test all insulation systems, including coatings, facings, vapour barriers and adhesives in accordance with AS1530 Method for Fire Tests on Building Materials Components and Structures.

Manufacture insulation systems from materials having test results of Ignitability Index 0, Spread of Flame Index 0, Heat Evolved Index 0 and Smoke Developed Index not greater than 3.

7.2 SCHEDULE OF INSULATION

Supply and install thermal insulation to all ductwork, pipework, domestic hot water unit flues, conditioner casings and plenums and equipment in accordance with the following schedule.

Insulate within the factory of manufacture all equipment in accordance with the Plant and Equipment Section of the Specification and the following schedule.

Equipment, System	Thermal Insulation Requirements
Air conditioning ductwork	All rigid ductwork not acoustically insulated, to be thermally insulated to achieve R-values as further defined.

7.3 AIR DISTRIBUTION SYSTEMS INSULATION

Provide thermal insulation to all ductwork, comprising flexible fibre insulation factory faced with aluminium reinforced foil facing in accordance with Specification J5.2 of the Building Code of Australia and AS/NZS 4859.1.

Refer to Building Code of Australia Schedule 3, "Definitions", Figure 2 and Table 2 for climate zones referred to below. The following tables are obtained from the Building Code of Australia.

Table J5.5 Ductwork and Fittings – Minimum Material R-Value

Location of ductwork and fittings	Minimum material R-Value for ductwork and fittings in each climate zone	
	1, 2, 3, 4, 5, 6 or 7	8
Within a conditioned space	1.2	2.0
Where exposed to direct sunlight	3.0	3.0
All other locations	2.0	3.0

Minimum insulation thickness shall apply to achieve the required R-Values.

Apply the insulation to form an effective thermal barrier over the whole surface of the ductwork including flanges, stiffeners and support angles with all insulation joints butted together and with the aluminium foil overlapping at least 50mm and fully adhered with a non flammable adhesive.

Fix the insulation to the ducts with speed clips and pins at a maximum of 450mm centres. On ducts having a maximum duct dimension greater than 450mm provide fixing bands at each joint and at 600mm centres maximum.

8 ELECTRICAL

8.1 GENERAL

Supply and install all electrical wiring systems and ancillary equipment associated with the Mechanical Services systems.

The power supply to the mechanical services switchboards will be 3-phase, 4 wire, 415V \pm 5%, 50Hz. All equipment provided shall be suitable for connection to this supply.

Install the Electrical Services system using only skilled qualified Electricians, experienced and competent in the type of work, with the necessary Class to suit.

Comply with the requirements of the Supply Authority and with the current Australian Standards. In particular comply with the requirements of AS3000 Wiring Rules, AS2430 - Classification of Hazardous Areas, AS3439.1 - Low Voltage Switchgear and Control Gear Assemblies, AS3008 - Electrical Installations, Selections of Cables, AS1668.1 - Fire Precautions in Buildings with Air Handling Systems.

Earth the entire installation. Provide a separate earthing conductor to each outgoing sub-circuit originating at the earth bar in the associated SCA.

Comply with the requirements of Office of Energy - WA Electrical Requirements July 2000, in particular - Motor Starting.

Supply and install packaged equipment complete with control cubicles containing motor starters, fuses, associated switchgear and safety controls as necessary to suit the installation.

Confirm the electrical loads of all equipment prior to the purchase of sub-mains cables by the Electrical Services Contractor. Pay all costs associated with delays, rework, making good, additional work and any other associated costs involved due to alterations, resulting delays, or deficiencies in the coordination of these works or provision of information.

Read this section in conjunction with the Controls Section of this specification and include all control and switching functions as necessary and as required for the safe and satisfactory operation of all plant and equipment.

8.2 SCHEDULE OF ELECTRICAL WORKS

Supply and install the complete electrical installation as required for the satisfactory operation, control, maintenance and safety of the Mechanical Services systems.

Include the following items and equipment:

- Sub-Mechanical Services switchboard (SCA) as scheduled on drawing complete with switchgear and controls for all mechanical plant served.
- Modification of existing Mechanical Services Switchboard 1 chassis as necessary for power supply to new sub-Mechanical Services Switchboard.
- Motor starters, switchgear and controls, complete with all necessary accessories for all electrically operated equipment.
- All final power sub-circuits between the switchgear and control gear assemblies (SCA) and the various plant components, including connections to SCA and equipment.
- All control wiring and connections between the SCA, thermostats, control and solenoid valves, pressure switches, packaged units and the like.
- Testing and commissioning of the entire installation, as detailed in the Testing and Commissioning Section of this specification.
- Maintenance of the electrical systems during the maintenance period.
- Supply of "as installed" drawings as detailed later in this section of the specification.
- Supply of Electrical Safety Certificate upon completion of all electrical works by a licensed and qualified electrician.

8.3 ELECTRICAL INTERFERENCE

Design and use electrical equipment, including any electronic control equipment associated with any air conditioning plant and other similar installations, which will not cause interference with radio, television or other electrical equipment in the vicinity. In the event that the inherent characteristics of equipment make interference possible, fit effective suppressors to eliminate the interference.

Maintain radio and television interference level within the limits set out in Australian / New Zealand Standard CISPR 14.1:2010 – Electromagnetic Compatibility – Requirements for household appliances, electrical tools and similar apparatus - Emission.

Maintain electrical disturbances within the limits set out in TR IEC 61000.3.6:2012 – Electromagnetic compatibility (EMC)-Limits – Assessment of emission limits for the connection of distorting installations to MV, HV and EHV power systems.

In the event of the inherent characteristics of the electrical installation being such that interference is possible, provide efficient devices capable of eliminating such interference.

Define the areas susceptible to interference prior to the purchase of equipment and appliances and advise the methods to be adopted to reduce the interference.

8.4 EARTHING

The earthing system shall comply with Wiring Rules Office of Energy and Supply Authority requirements. Earthing shall be a MEN system.

Earth equipment, motors, socket outlets and fixed wiring to appliances by means of the earth conductor, which forms part of the respective circuit cabling.

A separate earthing conductor shall be used for each circuit.

Provide earth studs in all equipment and appliances.

Run earthing conductors back to the earth bar within the switchboard from where the supply originated.

Earth all exposed metal fittings associated with the Electrical Services.

8.5 WIRING SYSTEMS

Adequately rate cables for their duty with due allowance made for voltage drop, method of fixing, derating factors for numbers of cables enclosed and types of enclosures.

Rate cables on a voltage drop from the point of supply to each item of equipment not exceeding 3% of the supply voltage for power cabling and not exceeding 7½% of the nominal voltage for control cables operating at extra low voltage.

Colour code the whole wiring installation. Number all terminals and each control wire. Cross reference numbers to the wiring diagrams.

Fit proprietary brand lugs to cables terminating on a screw bolt or stud. Ensure the current rating of cables and associated lugs is as near to identical as possible. Do not fit lugs of lower current rating than that of the cable. Fix lugs in accordance with the manufacturers recommendations.

Install cables such that circulating eddy currents and inductive currents are minimised. Slot cable entry holes to equipment where cables are rated at 300 amps or above. Group cables in 3-phase formation.

Maintain adequate spacing between cables to allow heat dissipation. Maintain at least 25mm spacing between PVC/PVC cables and MIMS cables to prevent heat affecting the PVC/PVC cables. Apply derating to cables installed in groups as required by AS3008 Cables for Alternating Voltages up to and including 0.6/1kV.

Install cables using the loopin/loopout system of wiring. Use only continuous conductors between terminal points. Where cable route length exceeds maximum manufactured cable length, join cables using the manufacturers recommended procedure.

Insulate extra low voltage control cables to the same standard as the mains voltage cables and screen all cables. Segregate extra low voltage control cables from power and power control cables.

Loop cables twice prior to terminating to equipment mounted on vibration isolation mounts. Rigidly fix the cable to the solid structure and to motor terminal box such that straining or movement of the cable gland under

all conditions is entirely eliminated. Provide a single loop to all other cable terminations except SCA where looping is not required.

Provide cables of the following types:

Power Cables, MIMS:

- Manufacture MIMS cables from 1kV class magnesium oxide insulated copper conductors with bare copper sheath complying with AS3187 Approval and Test Specification Mineral Insulated Metal Sheathed Cables. Provide PVC sheathing to cables subject to corrosive environments, exposed to the weather, installed underground or in contact with dissimilar metals (excluding galvanised trays in dry locations).
- Where MIMS cables serve fire duty equipment capable of operating at elevated temperatures (smoke exhaust fans, stairwell pressurisation fans, kitchen exhaust etc.), terminate cables using brass pot and gland bodies filled with Pyrotenax 135 sealing compound, with stub caps of polypropylene. Insulate tails using silicone rubber sleeving.
- Terminate MIMS cables in accordance with the manufacturer's recommendations using brass pot and gland bodies, fitted with MO4 silicon resin sealing compound, with stub caps of glass/silicon material and tails insulated using P.T.F.E. sleeving.
- Install MIMS cables in accordance with the manufacturer's recommendations in straight runs, with bends not less than 6 times the cable outside the diameter and with at least 250mm of straight cable prior to any termination.
- Fix MIMS to cable supports with a stainless steel straps to provide adequate support, prevent sagging and provide a neat workmanlike appearance.
- Test all MIMS cables immediately before and after each pot is made off, and again after 14 days using a 500 volt insulating tester. Obtain an infinity resistance reading. Should this not be achieved, dry out cables and retest. Replace cables if the correct reading is not obtained.

Power Cables, PVC Insulated:

- PVC and PVC/PVC cables of minimum V75, 0.6/1kV insulated stranded copper conductor in accordance with AS3147 PVC Insulated Electrical Cables and Flexible Cables for Working Voltages up to and including 0.6/1kV.

Control Cables, Field Signalling, up to 110V AC, 150V DC:

- Stranded copper conductor, minimum 0.8mm², V105, 110V AC, 150V DC, PVC insulated pairs or triples, V90 PVC sheathed with aluminium polyester tape screen, tinned copper drain wire and rip cord. Earth screens at the send end only.
- Maximum capacitance core to core 200pF, core to screen 300pF. Utilise lower capacitance cable where dictated by operating parameters for proper system performance.
- Earth screens at the send end only.
- Terminate by exposure of not more than 50mm of insulated conductor. Maintain twist to connection point and insulate screen and drain wire from inadvertent earth or conductor contact by heat shrink sleeving.
- "Olex Dekoron" or equal approved.

Power Cables Polymeric Fire Rated:

- 0.6/1kV halogen free cross linked polyolefin copolymer insulated and sheathed with contra rotating double lapped glass mica flame barrier.
- Type tested and approved without further enclosure in accordance with Australian Standard 3013:2005 – Electrical installations – Classification of the fire and mechanical performance of wiring system elements as follows:
 - Multi-core cables, up to and including 1mm², WS51W.
 - Multi-core cables, 1.5mm² to 50mm² inclusive, WS52W.
 - Single core, double insulated cables, up to and including 50mm², WS51W.

- Single core, double insulated cables, 70mm² and above, WS52W.
- Install strictly in accordance with manufacturers recommendations and Supply Authority regulations.
- Use only stainless steel cable ties approved for the specific cable system.
- Provide additional protection where required for compliance with Australian Standard 3013:2005 – Electrical installations – Classification of the fire and mechanical performance of wiring system elements.
- Terminate and joint utilising approved fire rated seals and tubing equal to Sucofit.

Control Cables, Field Signalling, 240V AC:

- Stranded copper conductor, minimum 1.5mm², minimum V75, 0.6/1kV PVC insulated building wire or PVC/PVC.
- Up to and including 4 core, standard PVC/PVC circular power cable construction, orange sheath.
- 5-core and above, circular Multi-core control cable, orange sheath, white cores with black lettering and numbering, green/yellow earth. "Olex BFCP" or equal approved.
- Heating element controls V105.

Control Cables, Field Actuators:

- Stranded copper conductor, minimum V75, 0.6/1kV PVC insulated and sheathed with insulated earth conductor.
- Standard PVC/PVC circular power cable construction, orange sheath.

Supply and install cables and cable enclosures or supports as follows:

Within Plantrooms and Service Shafts:

- Single insulated PVC cables enclosed in heavy duty rigid non-metallic conduit or cable troughs where multiple cable runs are required.
- Enclose all cable installed at a height less than 1500mm above floor level in heavy duty rigid non-metallic conduit. Do not use cable troughs in plantrooms at a height less than 1500mm AFFL.
- Utilise flexible PVC conduits and terminators of approved manufacture at connections to motors and controls.
- Cabling to large motors, as an alternative, can be run in PVC/PVC cables on cable tray.
- Install MIMS cables in accordance with the manufacturer's recommendations in straight runs, with bends not less than 6 times the cable outside diameter and with at least 250mm of straight cable prior to any termination and/or vibration coils at equipment.
- Run single MIMS cables fixed directly to masonry building elements with copper double sided saddles at maximum of 600mm centres and within 150mm of any connection.
- Run single MIMS cables where distant from masonry building elements and multiple MIMS cables on cable tray fixed with stainless steel straps at maximum of 600mm centres and within 150mm of any connection.

External to Plantrooms:

- PVC/PVC cables supported on cable trays or as open wiring supported in accordance with Australian Standard 3000SAA Wiring Rules, and classified as cables likely to be disturbed may be installed.
- Provide catenary wires to support cables clear of ceiling tiles. Cables shall run parallel to structural beams to the equipment.
- Utilise PVC cables enclosed in galvanised steel conduit for all cabling in lift machine rooms.

Fire and Essential Services:

- Utilise MIMS cables for all cabling associated with Fire and Essential Services equipment including smoke exhaust fans and all associated control items, including damper motor wiring, fan status indicators and equipment control circuits essential for fire and smoke control.
- Segregate cabling from other cabling installations.

Exposed to the weather:

- Single insulated cables enclosed in heavy duty, rigid, ultra violet resistant HFT PVC conduit sealed weathertight.
- Locate conduits to ensure protection from mechanical damage.

Manufacture conduits in accordance with AS2053 – Non-metallic Conduits and Fittings.

Manufacture cable troughs from not less than 1.2mm thick galvanised sheet steel, adequately sized to suit the cross sectional area of the installed cables. Lay cables in straight runs avoiding crossovers. Lay cables in a flat formation with constant phase grouping maintained throughout. For cables rated in excess of 250 amp, lay cables in trefoil formation with phase grouping consistent throughout. Group parallel conductors in 3-phase formation. Tape together cables for individual 3-phase circuits and control cables at intervals not exceeding 5000mm.

Manufacture cable trays from galvanised sheet steel of 1.0mm thick for trays up to 300mm wide, and 1.6mm for trays over 300mm wide. Provide a folded edge not less than 19mm deep and radiused. Perforate the sheet steel in "Admiralty" pattern. Utilise approved fittings for bends, tees, crosses and the like.

Install and support trays to ensure a neat workmanlike finish and ensure sufficient space is maintained around cable trays for air circulation.

Install cables parallel with and neatly saddled to the trays and allow 30% spare space for future cable installation.

Provide cable tray covers as necessary to prevent mechanical damage to the cables.

8.6 SWITCHGEAR AND CONTROL GEAR ASSEMBLIES (SCA)

Comply in all respects with Australian Standard 61439.1:2016 - Low-voltage switchgear and controlgear assemblies – General rules and Australian Standard 60529-2004: Degrees of protection provided by enclosures (IP Code).

Incorporate all necessary starting arrangements, facilities and accessories.

Construct the supply section main busbars within the SCA up to and including the outgoing functional units to be capable of withstanding a minimum fault level of 16kA for 1.0 second or, as scheduled, whichever is the greater with a peak factor of 2.0, in accordance with AS61439.1. Submit for approval, a type test certificate for the proposed busbar design to substantiate the fault rating and incorporate a compliance plate on the SCA.

Construct SCA from 1.6mm thick using commercial quality drawn zinc seal mild sheet steel with mounting frames not less than 2.0mm thick fully welded, machine bent and folded providing surfaces smooth and free from warps, twists and other distortions. Provide an internal angle iron framework to adequately stiffen the SCA such that all equipment is adequately supported and stresses imposed during transportation and installation are withstood.

Construct mounting panels of the following minimum thickness material:

Diagonal Dimension Thickness

< 900mm 2.0mm

> 900mm 2.5mm

Fit chrome plated, lockable handles to all doors or lift off panels complete with chromed handles and locating pins or wedges. Key alike to standard keys.

Fill and grind smooth all visible welds, remove all scale, rust and grease before painting.

Provide hinged fascia panels above the doors for the mounting of switches, meters and pilot lights.

Adequately ventilate the SCA by mechanical or natural means such that the maximum temperature inside the cubicles does not exceed the limits set out in Ta AS61439.1. Provide brass fly mesh behind to air intake louvres.

Provide, within the SCA, a minimum of 25% spare space for possible future circuits over and above any specified provisions. Include spare space provisions for all SCA sections including fuse ways, contact and relay panel space and fascia panel.

Provide cable entry provisions via removable gland plates or pre-punched conduit knockouts.

Panel mount, front connect and front wire all switchgear fixed to drilled and tapped steel mounting panels with zinc plated steel bolts and shake-proof washers.

Run wiring within wiring channels with all wiring neatly run and clipped. Number the terminal blocks and each end of all control cabling.

Provide numbered terminal strips to which all control cabling entering and leaving the SCA are to be connected.

Run field power wiring for equipment such as motors and heaters direct into the control equipment via cabling ducts.

Connect all control actives to the red phase.

Manufacture and install SCA equipment to comply with the following:

Main Busbars:

- High conductivity electrolytic hard drawn copper, machine bent and folded to avoid stressing and phase colour coded in 50mm bends in each busbar compartment using 2 coats of enamel on an etched and primed surface. File or sand joints smooth and join using high tensile steel bolts with washers. Support rigidly independent of functional units. Torque bolts up in accordance with the manufacturers recommendations.
- Adequately sized busbar for the maximum current rating of each and all items of switchgear, rigidly supported on approved material and able to withstand the fault levels nominated.
- Configure to match incoming conductors, with uniform phase rotation.
- Submit complete busbar calculations with shop drawings for approval prior to construction.
- Pre-drill busbars and supports for incoming and outgoing supplies, future switchgear and CT's.
- Provide readily removable busbar sections for CT mounting.
- Construct main interconnections and tee-offs in excess of 60A rating using busbar.
- Machine bend and form all busbars at radii appropriate to busbar dimensions. Do not mark or stress. Draw file or belt sand matching faces smooth before jointing. Use high tensile steel bolts with washers, torque tensioned to the manufacturer's recommendations for all busbar joints. Other approved proprietary busbar connection systems may be offered for switchboards up to fault rating 15kA for 1.0 sec.
- Use only pencils, crayons or dye when marking out. Scribing is not permitted.
- Identify phases with 25mm wide bands of flat enamel paint at regular intervals to that when any section of the busbar is exposed, the phase colour may be easily seen and identified.
- Colour busbars in Form 2 and Form 3 assemblies on each busbar section in each compartment by means of phase colour coded insulated heat shrink sleeving.

Neutral and Earth Busbars:

- Provide adjacent neutral and earth bars for the full length of SCA in excess of 900mm in length, extended into cable zones.
- Fit miniature circuit breaker distribution sections with screw terminal type neutral and earth bars mounted adjacent. Provide connection devices with tunnel connectors of 4.8mm diameter with provision for lug or stud connectors for all cables 10mm² or greater.

Switchgear and Control Gear:-

- Provide equipment with rated capacities defined as the nett values after application of de-ratings relative to the enclosure, situation and service conditions of the SCA and equipment.

Miniature Circuit Breakers:-

- Circuit breakers shall be mounted on a purpose made chassis. Removal of any breakers shall not disturb connections to other circuit breakers.
- Miniature over current circuit breakers shall have instantaneous short circuit and inverse-time over-current tripping characteristics and shall also have positive identification status "ON", "OFF" and "CENTRE TRIP", positions.

Moulded Case Circuit Breakers:-

- Moulded case circuit breakers shall be a solid state trip unit insensitive to changes in ambient temperature. The breaker shall be fitted with adjustable rating plugs that permit changing of breaker trip rating without removing the breaker cover and provide maximum overload protection and coordination. Rating plugs shall be keyed to prevent interchangeability between breaker frame sizes.
- The breaker shall be supplied with a short time delay to provide system selectivity. The short time delay shall be adjustable from instantaneous to 10 cycles using one control that simultaneously adjusts magnetic pick-up current and time delay in all phases.
- Circuit breakers shall have positive identification of breaker status "ON", "OFF" and "CENTRE TRIP" positions. All solid-state breakers shall be capable of field testing with a hand-held test unit while still in service and without exposure to live parts. The tester is to operate from a 240V 50Hz outlet and be capable of testing the overload calibration and short circuit performance of each breaker. A push-to-trip button shall be provided on the breaker face for mechanical verification.
- Removable line and load covers shall be provided to allow inspection and retightening of the breaker terminals.

Power Isolating Switches:-

- To AS 3133 – Approval, Test Specification for Air Break Switches and AS 3947 Low Voltage Switchgear and Control Gear Air Break Switches, Isolators and Fuse Combination Units (up to and including 1000V AC and 1200V DC) of AC rating to match the duty.

Contactors and Motor Starters:-

- To AS 1029 - Low Voltage Contactors and AS 1202 - AC Motor Starters (up to and including 1000V AC), class 0.3 duty, utilisation category AC3. Use moulded encapsulated coils and arrange for replacement of coils and contacts without the need for special tools. Minimum life 1,000,000 no load operating cycles.

Auxiliary and Overload Contacts:-

- Fit all contacts and starters with the number of auxiliary contacts as required by the control circuit. Fit no voltage release and delayed, temperature compensated thermal overload relays with inherent single phase detection and manual reset to Australian Standard 60947.8-2005 – Low-voltage switchgear and controlgear – Control units for built-in thermal protection (PTC) for rotating electrical machines. Provide embedded thermistor protection to all motors rated 11kW and above.
- Fit no voltage release and delayed, thermally compensated over current relays with manual reset to Australian Standard 60947.8-2005 – Low-voltage switchgear and controlgear – Control units for built-in thermal protection (PTC) for rotating electrical machines.
- Utilise electric type thermal overload relays of "Sprecher and Schuh CT3" manufacture or equal approved for motors up to 50kW.
- Utilise electronic type thermal overload relays of "Sprecher and Schuh CEF1" manufacture or equal approved for motors 50kW and greater.
- Provide embedded thermistor protection to all motors rated 11kW and above.

- Where required to operate in smoke control mode provide bypass contactors to shunt overload protection initiated by fire alarm signal.
- Over-current relays and under voltage releases are not required where the equipment is controlled by a variable frequency speed controller complying with this specification.

Rotary Switches:-

- Cam operated, to AS 1431 - Low Voltage Switchgear and Control Gear Circuit Devices and Switching Elements.

Indicator Lights:-

- Coloured to AS 1431 - Low Voltage Switchgear and Control Gear Control Circuit Services and Switching Elements. Fit lights of the backlit designation type, capable of dissipating continuous rated power and visible through a 180o viewing angle. Fit double filament lamps. Provide a lamp test button.

Alarm Circuit:-

- Connect each alarm/fault function to an individual fault indicator. In addition, provide one only common fault/alarm signal changeover 16A contact to each SCA.

Current Transformers:-

- General use transformers: Separate current transformers shall have 5-amp secondary windings and Class 0.5 accuracy unless otherwise detailed.
- Protection transformers: Protection current transformers shall have 5-amp secondary windings and be Class P with a Composite Error of 2.5 and Rated Accuracy Limit Factor of 20 unless otherwise detailed.
- To AS 1675 Current Transformers, Measurement and Protection.
- Protection, 5 Amp secondary, Class P, composite error 2.5, rated accuracy limit factor 20.
- Instrument, 5 Amp secondary, accuracy Class 1.0.
- Suitably rated for connected burden.
- Use separate protection and instrument current transformers.

ELV Control Circuit Transformers:-

- To AS 3108 - Particular requirements for Isolating Transformers and Safety Isolating Transformers 240/24 volt AC double wound and sized for the connected load. Provide separate fused control supply.

Control Relays:-

- To AS/NZS 3947.4.1 – Low-voltage switchgear and controlgear – Contactors and motor-starters – Electromechanical contactors and motor-starters, AS/NZS 3947.4.3 – Low – voltage switchgear and controlgear – Contactors and motor-starters – A.C. semiconductor controllers and contactors as AS 1431 – Control Circuit Devices and Switching Elements. Plug in interchangeable, rail mounting, translucent cover, front connected with retaining clips. Provide a spare relay of each type plugged into a dummy socket on each SCA.
- Fitted with not less than 4 field selectable self-wiping contacts.
- Fitted with field adjustable pneumatic or electronic timing mechanism where required.

Under Voltage and Phase Failure Relays:-

- Combination adjustable function relay with 1 only 16A changeover contact as follows:
 - Under-frequency 4550Hz
 - Over-frequency 5055Hz
 - Under-voltage pickup 350450V AC, dropout 7090% of pickup
 - Over-voltage pickup 300600V AC

Terminals:-

- "Sprecher and Schuh" or equivalent screwed tunnel type, rail mounted.

Earth and Neutral Links:-

- Provide adjacent neutral and earthing busbars for the full length of SCA in excess of 900mm in length and extend into cable zones. Fit each supply section with readily accessible and removable neutral and earth links permanently and legibly labelled. Provide connecting devices with tunnel connectors of 4.8mm diameter with provision for lug or stud connections for all cables greater than 10mm².

8.7 SCA REQUIREMENTS

Incorporate the following equipment and comply with the design criteria as scheduled below and also in the Schedule of Equipment Section of the specification for each SCA:

Prospective short circuit current	Refer to Schedule of Equipment.
Form of segregation	Form 2B.
Arcing fault containment	Not required.
Thermal design conditions	Maximum SCA internal temperature not to exceed 75°C.
Service conditions	To AS 61439.1 - Low Voltage Switchgear and Control Gear assemblies
Special service condition	Insect and vermin proof.
Diversity factor for load circuits	To AS 61439.1 - Low Voltage Switchgear and Control Gear Assemblies
Degree of protection	IP54.
Equipment served	Refer to Schedule of Equipment.
Sub-mains connected	Refer to Schedule of Equipment.
Sub-mains protection	Refer to Schedule of Equipment.
Fire and essential services (MIMS wiring)	Refer to Schedule of Equipment.
SCA equipment	Rotary Test switches Auto/Off/Manual for each item of equipment, pilot lights (run/fault) for each item of equipment, lamp test facility, kilowatt hourmeter, ammeter and under voltage and phase failure relay.

8.8 MOTOR ISOLATING SWITCHES

Provide isolating switches, located adjacent the equipment for all items of equipment of "Clipsal 56 series" modular isolator generally or "Clipsal WMB series" where the equipment operates in the fire mode, incorporating provision for padlocking and capable of interrupting 800% of motor full load current.

Fit engraved label with 6mm red letters on white background detailing "Warning": This isolating switch must be locked in the "OFF" position as the fan is required to run during a fire." to all isolating switches serving motors associated with fire and smoke control, in accordance with AS1668.1.

8.9 VARIABLE FREQUENCY SPEED DRIVES

General:

- Variable Speed Drives (VSD) shall be solid state 16 bit microprocessor type suitable for control of three phase induction motors (squirrel cage) and shall be of the variable frequency type.
- The input circuit shall consist of an uncontrolled, three phase, minimum six pulse rectifier. The output stage shall consist of three phase, minimum six pulse converter bridge operating in Sine

Code Pulse Width Modulated mode (Sine Coded PWM) with a variable voltage/operating ratio to provide the highest efficiency possible for a centrifugal load.

- Switching devices should be IGBT, IPM type to 17A and IGBT type above 17A.
- The VSD shall be capable of operating at a minimum ambient temperature of 10oC to a maximum of 50oC without impairment to its operation.

Interference:

- The radio interference of VSD's shall conform to AS 1044/AS 2064 and harmonics generated into the supply system shall be no greater than permitted by AS 2279, Part 2. Also any individual harmonic should not exceed 1.5%.
- All chokes, filters and the like necessary to meet this requirement shall be included. The performance of the VSD in this respect shall be demonstrated during commissioning.
- To comply to above standards filters provided must include 3-phase balanced input reactors of capacity in excess of 30 milli Henry divided by the KVA capacity of the VSD.
- Also output reactors must be provided not only to comply to above RFI requirements but also to ensure excessive peak voltages are not applied to the motor.
- Total losses of input/output filters selected should not exceed 5% of rated KVA capacity.

Rating:

- The VSD shall be selected on the basis of maximum motor full load "nameplate" amps and torque requirements and not motor KW rating.

Speed Control Signal:

- The VSD shall accept an electrical input signal, either 4 20mA, d.c. or 0 10 volts, d.c. (to suit remote device output) and shall produce an output frequency proportional to the input signal within + 1%.
- VSD should shut down when commanded speed signal is below a freely programmable speed of 0 20 Hz to avoid motor running at low speed when no flow is requested by the DDC. In this instance, it should be possible to run the drive directly through the analog signal to reduce control wiring.
- The VSD shall have manual adjustments allowing presetting of maximum and minimum speed arranged such that these limits will be maintained regardless of the input signal.
- The VSD shall include a local keypad with manual speed adjustment to allow testing and commissioning of the unit.
- It shall be possible to run the VSD in Fire mode operation. In Fire mode the VSD shall bypass analogue signal and operate at freely programmable fire mode speed. All non-critical faults such as
- Heat-sink over-temperature shall be bypassed.

Protection:

- The VSD shall be equipped for both self protection and protection of the connected motor.
- The overload current setting of the protected motor shall be adjustable through parameters.
- Provide an isolator located adjacent to the motor to prevent the application of a voltage to the motor terminals when in the "off" position. Isolators shall be three phase power isolator for motors up to 7.5 Kw and control isolators for bigger size switching off input supply to the VSD.
- The following safety protection features shall be provided as a minimum requirement.
- Isolation:
 - Provide 2000V RMS minimum isolation between control input circuits and the VSD logic circuits.
 - Use transformer or optic isolators.

Current limit

- To limit output current to 110% of that of the VSD rating. The current limit shall be designed to function automatically to prevent over-current trip due to momentary overload conditions, allowing the VSD to continue operation.
- Over-current limit
- Should the output exceed 110% but be less than 150% of the rated current, then the VSD shall automatically limit the output to 110% by ceasing to accelerate or decelerate until the current drops below 110%, when acceleration or deceleration shall resume.
- VSD shall not be damaged by currents up to 300% of nameplate rating, should the output current exceed 150%, then the VSD shall be protected by the operation of an instantaneous over-current trip.
- Instantaneous Over-current Trip.
- To safely limit the output current due to short circuits or severe overload conditions.

Under-voltage Trip

- To protect the VSD due to non-momentary power or phase loss. The under-voltage trip shall activate automatically when line voltage drops below rated input voltage. Momentary drops in voltage should not result in under-voltage trip.

Over-Voltage Trip

- To protect the VSD due to voltage levels in excess of its rating. The over-voltage trip shall activate automatically when the d.c. bus voltage exceeds 150% on nominal.

Over-temperature Trip

- To protect the VSD from elevated temperatures in excess of its rating. It should be possible to read heat-sink temperature in °C on the display.
- Automatic Reset/Restart
- On operation of protection, drive should attempt to restart after a programmable delay.
- Restart attempts should be freely programmable to a maximum of 10.
- Sustained Power Loss
- In the event of sustained power loss, the VSD shall be designed to shut down safely without component failure. Upon return of power, the systems shall be designed to automatically return to normal operation if the start is in the "on" condition.

Restart of Rotating Motor

- The VSD shall be capable of restarting a rotating motor, (either forward or reverse rotation) with controlled deceleration and acceleration as required. Time delays are not acceptable as a means of achieving this feature.

Momentary Power Loss

- In the event of a momentary power loss, the VSD shall be designed to shut down safely without component failure. Upon return of power, the system shall be designed to automatically return to normal operation (if the start is in the "on" condition), i.e. being able to restart a rotating motor regaining positive speed control without shut down or component failure.
- Short Circuit Protection
- In the event of a phase to phase short circuit on the output, the VSD shall be designed to shut down safely without component failure.

Earth Fault Protection

- In the event of a phase to earth short circuit on the output, the VSD shall be designed to shut down safely without component failure.

Power Interruption

- In the event that an input or output power contactor is opened or closed while the VSD is activated, no damage to the control shall result.

Stand Alone Operation

- To facilitate start up and troubleshooting, the VSD shall be designed to operate without a motor or any other equipment connected to the inverter output.
- Any of the alarms or trips shall raise a fault alarm on the associated Mechanical Switchboard.

Controller Performance:

- VSD's shall be capable of maintaining adequate motor torque throughout the complete speed range for the particular application Speed control shall be stepless.
- Efficiency, when operating with centrifugal load characteristics shall not be less than the following:
 - 100% Speed 97% efficiency (including all losses in filters)
 - 50% Speed 90% efficiency
- The increase in motor losses caused by the use of the VSD shall be demonstrated to the Architect to be not greater than the following when compared to operation on a sinusoidal waveform.
- 100% Speed 0.5% of the input power
- Motor audible noise with VSD should not be appreciably higher as compared to when it ran on commercial supply.
- Input Specification
 - Supply Voltage 415V+15%
 - Supply Frequency 50Hz+5%
 - Minimum input power factor 0.96
- Output Specification
 - Frequency Range 1 to 50Hz
 - Voltage Range 10 to 415V
 - Frequency Ramp Uptime 3 to 300 sec. (Adjustable)
 - Frequency Ramp Downtime 3 to 300 sec. (Adjustable)
 - Overload Capacity 150% for 60 seconds minimum
- Drive should have inbuilt automatic adjustment of acceleration and deceleration ramp over and above the programmed values to avoid nuisance over current and over voltage trips under varying supply and load conditions.
- Provide programmable facilities to skip selected frequencies when any selected range to eliminate mechanical or electrical resonance effects.

Status Indications:

- Display

VSD front panel display should provide the following status indications and diagnostics:

- Input power on;
- VSD on local or remote mode;
- Fault;
- Output frequency;
- Setting frequency;

- DC bus voltage;
- Motor current;
- Motor output voltage;
- Heat-sink temperature;
- Thermal overload time to trip;
- Fault history inclusive of frequency and current at moment of trip (4 previous faults)

Analogue Outputs

- Two freely programmable analogue outputs should be available for scaled 0 to 10V output and programmable for following data.
- Output current
- Output voltage
- Output power/torque current
- DC bus voltage
- Heat-sink temperature
- Relay Outputs
- Following relay outputs should be available.
- Fault relay change over contact
- Run relay freely programmable to any of the following:
 - when drive output is on
 - when motor is running, i.e. run relay to switch off when output isolator is off.

Enclosure:

- The VSD shall be totally enclosed and protected to classification IP54, AS 1939. Forced (fan assisted) ventilation, if used, shall only be provided to the heat sinks located outside of the enclosure housing the electric and electronic components.
- Construct the enclosure from mild sheet steel. Provide protective finish to the same standard as mechanical switchboards.
- Incorporate an anti-condensation heater where required to avoid moisture build-up within the enclosure caused by ambient temperature and humidity conditions.
- Wall mount the enclosure adjacent to the associated mechanical switchboard.

External Connections:

- Use shielded control cable to connect the input circuit to the control source.
- Provide a separate fused supply to each VSD.

Approved Makes:

- Danfoss, ABB or approved equal.

8.10 CONSTRUCTION DRAWINGS

Before proceeding with the installation submit fully detailed drawings prepared on AutoCAD 2004 or compatible system, showing the proposed electrical installation for review.

Include the following:

- Control diagram and power wiring diagram on common sheets.

8.11 AS INSTALLED DRAWINGS

Include as installed wiring diagrams and switchboard layouts in the Maintenance Manuals as specified in the Testing and Commissioning Section of this specification. In addition to these drawings, one set of "as installed" wiring diagrams to be supplied in each switchboard, prior to the issue of a Certificate of Practical Completion. Keep drawings up to date with any changes which occur during the Maintenance and Defects Liability Period and at the end of this period and before final payment is made issue one (1) complete set of drawings and place in each switchboard.

Supply one complete set of all wiring diagrams, in the form of reproducible transparencies, at the end of the Maintenance Period.

All drawings to include modification of the existing 'as installed' drawings and all alterations made up to and including the end of the Maintenance Period.

9 CONTROLS

9.1 GENERAL

Provide control systems as necessary for the safe, correct and efficient operation of the plant. Include all necessary equipment such as motors, valves, relays, temperature sensors and interlocks to provide the complete operating systems.

Read this section in conjunction with the Electrical Section of this specification and include all functional requirements as required.

Modify existing systems as necessary for the required control functions of all plant and equipment as further described herein this specification.

Controls set point, differential and time delay criteria shall be determined during plant commissioning to ensure optimum plant performance.

Provide all specified functional requirements utilising the supplier's "standard system". Where the standard system is at variance with the specification in respect to system architecture, software programmes and general configuration, then clearly describe all such deviations in the tender and seek approval prior to installation of any equipment and control strategies.

9.2 MANDATORY ITEMS AND CONTROL FUNCTIONS

9.2.1 Indirect Evaporative Coolers

General:

- Auto/off/test switch and run and fault lights for the fan on the SCA.
- Provide user friendly interface for manual adjustments
- Control to display temperature, humidity and system status
- Interlock operation of system with associated booster fan

9.2.2 Booster Fans

General:

- Auto/off/test switch and run and fault lights for the fan on the SCA.
- Interlock fan with operation of associated indirect evaporative coolers

9.2.3 Fire Mode Control Sequence

General:

- All systems to shutdown.

9.3 CABLING INSTALLATION

- Install cables and cable enclosures as specified in the "Electrical" section of this specification.
- Use stranded cable minimum 0.8mm² cross sectional area, multi core twisted and shielded as recommended and required by its connected devices to eliminate interference.
- Earth shield at controller end only.
- Install and connect all interface cabling from controllers to terminals in mechanical switchboards field devices and to Electrical Services equipment as required.
- Use fixings that are mechanically fixed to slabs and structural beams.

9.4 OPERATOR TRAINING

- Allow for training of the facility manager, by skilled personnel experienced in all aspects of the installed system operation.
- Training to commence at Practical Completion.
- Ongoing assistance to operators during the Maintenance and Defects Liability Period.

10 GENERATED NOISE AND VIBRATION CONTROL

10.1 GENERAL

Select and install all plant, equipment, piping and ducting systems to ensure quiet and vibration free operation in compliance with the specified noise and vibration level criteria.

Replace and modify all systems causing undue noise or vibration exceeding the specified criteria.

10.2 SUB CONTRACTORS RESPONSIBILITY

The contractor shall be fully responsible for the acoustic assessment of mechanical services plant noise levels and determination of acoustic treatments for duct borne noise control requirements for all systems.

It is required that the contractor engage a qualified acoustic consultant to undertake this work, and the acoustic report be submitted to the consulting engineer for review. The contractor is expected to make any adjustments to accommodate acoustic treatments as required.

In the event noise problems exist after commissioning it will be the responsibility of the contractor to return to site and rectify it.

10.3 SCHEDULE OF GENERATED NOISE AND VIBRATION CONTROL SYSTEMS

Accurately balance, both statically and dynamically, all rotary machinery. Comply with the requirements of Australian Standard 1359.114-1997 – Rotating electrical machines – General requirements – Vibration measurements and limits, Australian Standard 60034.9-2009 – Rotating electrical machines – Noise limits and Australian Standard 2625 – Evaluation of machine vibration by measurements on non-rotating parts.

Provide flexible connections to all rotary machinery and equipment containing rotary machinery including flexible connections between ductwork and fans, flexible pipe connections to pumps and flexible conduits and coiled cables (MIMS) to motors and other operating devices subject to vibration.

Provide acoustic attenuators as required to achieve either specified noise levels or Australian standard noise levels, as required.

Provide acoustic lining to ductwork as required and acoustic seals to pipe, duct and conduit penetrations through plantrooms and acoustic barriers.

Select plant and equipment with operating noise ratings and rotational speeds less than the specified requirements.

Install vibration isolation mounts and hangers, plinths, inertia bases and floating slabs as scheduled:

Equipment & Systems	Vibration Isolation Mounts & Hangers	Minimum Isolation Efficiency %	Static Deflection mm	Mounting Base
Indirect evaporative Cooler	Neoprene double deflection mounts	90	10	Plinth
Axial flow fans suspended	Spring hangers with neoprene inserts Type B	98	25	N/A

10.4 VIBRATION ISOLATION MOUNTS

Provide vibration isolation mounts selected to comply with the scheduled isolation efficiency and static deflection requirements. Calculate total static deflection from the scheduled static deflectors plus the floor deflection.

Incorporate restraining devices to prevent excessive movement of plant, equipment and piping systems.

Additionally, incorporate restraining devices, to all plant, equipment and piping systems, complying with the requirements of Australian Standard 1170.4-2007 – Structural design actions – Earthquake actions in Australia.

Construct all brackets, housings, base plates, restraining devices and supports from galvanised steel and rubber/neoprene components from oil resistant materials.

Neoprene Pads:

- Ribbed type, "Mason Type W, Waffle Pads" or equal approved.
- Limit loading to 400KPa.

Spring Mounts Type B:

- Free standing type, "Mason SLF" or equal approved.
- Selected and positioned to provide uniform deflection for all springs.
- Mean coil diameter to compressed length ratio equal to not less than 0.8.
- Incorporate levelling screws and locknuts and holding down bolts.
- Incorporate ribbed neoprene pads.

Hangers:

- Incorporate spring and double deflecting neoprene cups in series, "Mason Type PC 30N" or equal approved.
- Selected and positioned to provide uniform deflection for all springs.

10.5 PLINTHS

Provide plinths as follows:

- 150 x 1.6mm galvanised sheet steel edging frame firmly fixed by masonry anchors to the floor and sealed water tight where edge of frame edging meets with plinth.
- Adequate steel reinforcement welded to the frame.
- Structural grade concrete steel trowelled to a smooth finish.

11 PAINTING, IDENTIFICATION AND LABELLING

11.1 GENERAL

Utilise capable and skilled tradesmen for all painting. Ensure the areas in which the painting is to be carried out are cleaned and free from dust. Protect all work from the weather.

Use only best quality paints, fillers, temporary surface dressings and all other painting materials delivered to site in the original manufacturer's sealed and labelled containers.

Select sealers, primers, undercoats and finishing paints as specified by the manufacturer as appropriate for the particular application.

Apply the painting on correctly prepared surfaces strictly in accordance with the manufacturer's recommendations and provide a high standard of finish having an even colour and smooth surface without imperfections or blemishes.

Make good all damage to surfaces with motor body filler prior to painting.

Take all measures to ensure that all surrounding and adjacent areas on the site are suitably protected whilst painting is in progress and pay all costs incurred in making good where damage or marking occurs.

On completion of the painting thoroughly clean the installation and surrounding building surfaces of all paint marks, grease, oil and dirt. Polish all equipment identification plates and normally bright metal parts.

Protect all finished painted surfaces.

Paint, with an anticorrosive primer before dispatch to site, factory assembled steel components to provide adequate protection against dampness and weather during transport and storage.

Provide black and yellow diagonal stripe danger notation to all motor drives and edges of ductwork, pipework and equipment installed at low level or likely to be hazardous.

Painting of equipment that is exposed to sun light shall use UV rated paint with paint details included in the operation and maintenance manuals.

11.2 SCHEDULE OF PAINTING AND FINISHES

Paint, identify and label the plant, equipment, air distribution and piping systems including associated fittings, machine bases, supports and insulation.

Paint the following:

- Pipework, thermal insulation, valves, fittings, hangers and supports exposed to view.
- Ductwork, thermal insulation, hangers and supports within the plantrooms and exposed to view.
- Roof cowls.
- Conduits, cable trays and electrical ducts exposed to view.

11.3 PLANT AND EQUIPMENT

Supply plant and equipment factory finished to a high standard. Touch up minor damage to paintwork on site.

Totally repaint factory equipment where damage to finishes is extensive.

Paint concrete mounting bases with 1 coat of a sealer and 2 coats of synthetic emulsion paint.

11.4 PIPING SYSTEMS

Paint pipework with 1 coat of zinc chromate or etching primer (as appropriate) and 2 finish coats of full gloss enamel. Special quality and protection required for external pipework exposed to the weather.

Attach identification bands on the pipework, in colours in accordance with Australian Standard 1345-1995 – Identification of the contents of pipes, conduits and ducts, and identification lettering to approval.

Provide bands and lettering at all pipe connections to equipment, pipe junctions and at approximately 7500mm intervals. Provide arrows indicating direction of flow adjacent the identification bands. Bands shall be of durable quality with sufficient strength to remain attached to external surfaces.

Use the following identification:

Service	Code
- Heating water	HTW (F) (R)

11.5 IDENTIFICATION AND LABELLING

Provide engraved plastic labels to all instruments, gauges, indicators, control equipment, valves and switchboard equipment with black lettering on a white background. Attach labels using screw fixings.

Fix to pressure relief valves, tags indicating the set pressure. Stamp all pressure valves with the manufacturer's design and test pressure rating. Label valves with water balance position.

Label, using experienced sign-writers, all items of equipment with lettering not less than 50mm.

Provide colour coded IPA studs and traffolyte label identifying the source switchboard from which power supply is derived to all isolating switches and power outlets.

Utilise red markers to signify the location of equipment requiring maintenance.

11.6 SCHEDULE OF COLOURS

Paint systems and equipment to colours as scheduled. Colour codes relate to Australian Standard 2700-2011 – Colour standards for general purposes.

System, Equipment	Colour Scheme
All equipment	N35 Light Grey, N55 Lead Grey lettering
Heating water	BSS275 Traffic Green, White lettering
Machine bases	B64 Charcoal Grey

12 TESTING AND COMMISSIONING

12.1 GENERAL

Test, balance and commission the Mechanical Services systems.

Carry out the works using competent personnel trained and holding appropriate qualifications for this type of work. Provide all necessary equipment and instrumentation.

Pre-plan, schedule and coordinate the works with the other trades to ensure they are carried out in a safe and efficient manner with the minimum of inconvenience to all concerned.

Provide a minimum of 3 days notification of tests. Failure to provide adequate notice of tests and in the event tests are unsuccessful then the consultant and The Project Manager's costs for same will be back charged direct to the mechanical contractor for payment. For each abortive test a minimum charge of \$500 will apply.

Carry out all tests required by Statutory Authorities including the local Fire Authority, Health Authorities and Electricity, Water and Gas Supply Authorities to prove the systems operate to their satisfaction and in accordance with the appropriate Codes and Regulations.

Pay the costs associated with all power, fuel and water consumed during testing and commissioning of the installation.

12.2 COMMISSIONING REPORTING REQUIREMENTS:

During the commissioning period the contractor is required to advise both The Project Manager and BCA Consultants in an appropriate notice time frame of commissioning tests to allow all parties to attend to same and sign off prior to practical completion.

This Section details the commissioning requirements, however we draw the contractors attention to the certification and witnessing requirements by The Project Manager and BCA Consultants. Practical completion will not be granted if all systems have not been fully tested, witnessed and certified.

12.3 SCHEDULE OF PRE-COMMISSIONING PROCEDURES

Carry out the following works prior to the commencement of the commissioning of the systems:

- Slug dose with chemicals, pressure and leak test piping systems.
- Clean and flush out all water systems including piping systems and connected equipment. Use non foaming detergent compatible with final selected water treatment to flush out the system, followed by a second flushing using clean water. Remove and clean out all strainers.
- Pressure and leak test air distribution systems.
- Submit for approval manufacturer's test certificates, performance curves and tables for all plant, equipment and electrical components.
- Submit for approval, instrumentation calibration certificates, commissioning and test log sheets.

12.4 SCHEDULE OF COMMISSIONING PROCEDURES

Carry out all commissioning and testing necessary to ensure the systems operate in a stable, safe, automatic and integrated manner providing optimum efficiency under all load conditions and that all plant and equipment meets design requirements as specified in this specification and as specified by the equipment manufacturer. Include the following commissioning and testing:

Plant and Equipment:

- Check the operation of the plant and equipment including direction of rotation of motors, noise and vibration levels, operating temperatures, pressures and flows.
- Check and prove all operating and safety controls.
- Check and prove performance characteristics at full and part load.

Water Systems:

- Check and prove all pressure and flow activated controls.
- Adjust system water flow rate as necessary to the specified flows by varying pump speed.
- Permanently mark final settings of balancing valves.

Air Distribution Systems General:

- Check and prove all pressure and flow activated controls.
- Balance the systems such that air flows at all points in the system are within - 0% and + 10% of the specified flow rates. Adjust air flows such that pressure drops through dampers, at or near air diffusion equipment, is the minimum possible and the minimum possible fan speed is used by the minimum use of dampers in the highest resistance run of ducting.
- Adjust supply air outlets to ensure direction and throw of air is adequate for the application, free from draughts and uniform over the face.
- Measure air diffusion terminal velocities.
- Measure air supply through ductwork via pitot tube openings to confirm design airflowrate figures.

Electrical Systems:

- Progressively and finally test the complete installation to ensure it is mechanically and electrically safe and operates correctly under normal, emergency and fault conditions.
- Check all terminations, clamps and fixings.
- Check phase identifications match throughout the installation.
- Check for excessive heating at all joints.
- Ensure phases are balanced and include full load figures in the operation and maintenance manuals for mechanical services switchboard.

Automatic Controls, Gauges and Instruments:

- Adjust and activate the controls system. Prove the operation of all operating safety and emergency controls, for each item of equipment, each system and the installation as a whole.
- Provide hand instrumentation as necessary to supplement the permanent gauges and instruments to check and log all operating conditions including ammeter readings for all motors, megga tests of all electrical equipment, voltage tests, air pressure drops through filter banks, coils, variable air volume terminal units, speeds of fans, motors and pumps, ambient and internal dry and wet bulb temperatures and water flow rates in all system components.

Noise and Vibration:

- Take noise level measurements via a recognised acoustic consultant/engineer with details of sound pressure levels in each octave band mid frequency from 63Hz to 8000Hz inclusive in all strategic locations only if complaint arises or request by client to determine if acoustic levels have been achieved.
- Where excessive vibration is evident measure the vibration levels.
- Where excessive noise and vibration is evident provide associated solutions and action to be undertaken to rectify same.

12.5 INSTRUMENTATION

Provide all instruments and apparatus necessary to carry out the commissioning and performance testing.

Calibrate all test instruments at an approved laboratory prior to carrying out the tests and provide certification of same.

Calibrate and test all gauges and instruments forming part of the permanent installation. Recalibrate this equipment 6 months after practical completion. Replace any gauges or instruments not maintaining calibration.

12.6 PERFORMANCE TESTS

Carry out performance tests on the new ventilation systems on design heating days over a period of 8 hours each day or longer as required to prove system performance and the system operating sequences.

During the tests log internal and ambient temperatures and current draw and overload settings of each electrical drive.

12.7 COMMISSIONING AND PERFORMANCE DATA

Submit for approval copies of all data recorded during commissioning and testing of the installation together with all necessary inspection certificates from approving authorities within 7 days of completing the works.

Submit for approval all data relative to the performance tests within 7 days of completing the tests.

Submit for approval all test sheets and certificates.

Provide pump and fan curves for relevant equipment indicating design points and actual points as commissioned. Include a neat legible copy of each item of equipment in the operation and maintenance manual.

12.8 POST CONTRACT DRAWINGS

Submit for approval, prior to Practical Completion, copies of the construction drawings modified to reflect all field changes. Notate the drawings to highlight the position of all items requiring maintenance and pertinent to the functioning of the system such as valves, dampers, timing devices and fuses.

Submit for approval 2 copies of the drawings, both in hard copy full scale and USB thumbdrive, inserted in plastic envelopes and bound in the installation manual.

12.9 INSTALLATION MANUAL

Submit for approval draft copy Installation Manuals in PDF format prior to Practical Completion. All contractors submitting on this project shall be familiar with the high standards expected by The Project Manager in relation to as constructed information and manual data. The onus of getting the information in the manuals correct is the mechanical contractor, not the consulting engineer or The Project Manager. The consulting engineer will backcharge direct to the mechanical contractor any review and commentary on manuals beyond the initial review. This will be charged at \$500 per review.

Submit Installation Manuals in PDF format to Consultant and Client.

Format the front page of the Manual as follows:

INSTALLATION MANUAL
FOR
MECHANICAL SERVICES
AT
KALGOORLIE OASIS STADIUM SPORTS HALL

Client City of Kalgoorlie-Boulder

Consulting Engineers BCA Consultants

Mechanical Contractor Insert/Delete as applicable

Include the following contents and format the manual with PDF bookmarks as follows:

Fly Sheet:

- Include names and addresses of all members of the Project Consulting Team and Services Contractors.

Section 1 - Index:

- Include sections and subsections.
- Include list of drawings.

Section 2 - System Description:

- Include general description of the system and its components.

- Include manufacturer's literature for all equipment.
- Include schedule of capacities for all equipment.
- Include a detailed functional description of plant/system operation.

Section 3 - Installation Maintenance and Operating Instructions:

- Include detailed maintenance log sheets for each item of equipment.
- Include manufacturer's installation, maintenance and operating instructions for each item of equipment.

Section 4 - Plant Operating Instructions:

- Include a complete description and correct sequence of all actions necessary for the starting up, operation and shutting down of the plant.

Section 5 - Performance Test Results:

- Include commissioning data, performance test results and Authorities test certificates.

Section 6 - Installation Drawings:

- Include the post contract drawings in hard copy and disk copy form.
- NB: Where DDC or other controls contractor has submitted independent manuals, they must be incorporated into the main operation and maintenance manuals. Independent manuals will not be accepted.

Submit one complete electronic copy of manual in Acrobat reader format.

12.10 INSTRUCTIONS IN PLANTROOMS

Submit for approval a maintenance log book of loose leaf A4 format for logging date of servicing and insertion of the detailed maintenance log sheets.

Place within the main switchboard a copy of the electrical control diagrams.

12.11 HANDING OVER AND PRINCIPAL INSTRUCTION

Complete the testing balancing and commissioning of all systems, provide all commissioning and performance data and provide the installation manuals including post contract drawings prior to handing over the installation.

Practical completion will not be granted until the above requirements have been met.

Provide the services of the Commissioning Engineer for a period of 1 day or as necessary to instruct the Project Manager in all details of the plant operation.

13 MAINTENANCE AND SERVICING

13.1 GENERAL

Maintain and service the installation for a period of 12 months from the date of Practical Completion.

Carry out all maintenance, servicing and test procedures in accordance with the current requirements of the Building Regulations, Australian Standards and the Local Authority regulations.

Maintain the installation on a quarterly basis and provide emergency service on a 24 hour call out basis.

13.2 SCHEDULE OF MAINTENANCE AND SERVICING REQUIREMENTS

Carry out maintenance and servicing to ensure the safe, reliable and efficient operation and long life of the plant, equipment and systems.

Maintain the plant and equipment in accordance with the manufacturer's recommendations and the following:

Plant and Equipment Quarterly:

- Check and lubricate all bearings.
- Check and adjust all belt drives, pulleys, couplings and guards, pump glands and shaft seals.

Piping Systems Quarterly:

- Check and rectify water leakage and air locking.
- Inspect for and rectify corrosion.
- Check and rectify damage to insulation.
- Check valve settings and control valve actuation.
- Check operation of relief devices and refrigerant expansion devices.
- Check that drains and overflows are clear and traps are live.

Air Distribution Systems Quarterly:

- Check for air leakage in flexible duct connections, access panels, inspection holes and adjust and repair as necessary.
- Check damper settings and damper operation.

Electrical Systems Quarterly:

- Check operation of circuit breakers, interlocks and indicator lights.
- Check thermal overload settings.
- Check electric motors for excessive noise and excessive temperature.
- Check timer settings.

Controls Systems Quarterly:

- Check and test the operation of all safety and fire and life safety controls and systems.
- Check operation and settings of all controls and adjust settings as necessary.

Noise and Vibration Control Quarterly:

- Check anti-vibration mountings and adjust as necessary.
- Check and tighten all holding down bolts, clamps and brackets.
- Check equipment for excessive noise.

Water Treatment Systems Quarterly:

- Carry out chemical analysis and add treatment as necessary to maintain safe residual limits.
- Check chemical storage levels and replenish as necessary.

Piping Systems Annually:

- Repeat monthly service
- Clean out all strainers.

Electrical System Annually:

- Repeat monthly service.
- Check, clean and adjust all contacts, circuit breakers, starters and timer delays.
- Check all terminations, clamps and fixings.

Painting and Finishes Annually:

- Clean off corrosion, dirt and dust build-up.
- Touch up any damaged paintwork.
- Provide all consumables necessary for the proper maintenance and servicing, including grease and oil.
- Replace all components worn during the maintenance period including belt drives, fuses and globes.

13.3 DOCUMENTATION OF MAINTENANCE AND SERVICING

Bank Guarantees will not be released until quarterly completed reports have been received at the appropriate times and approved. Should the maintenance and services visits not be completed within the Maintenance and Defects Liability period, then that period, including all equipment warranties, will be extended until the maintenance and servicing requirements have been met. Administration services by the consultant for extended maintenance periods will be charged directly to the mechanical contractor at \$2,000 per quarter.

13.4 RECTIFICATION OF DEFECTS

Separately to the 24 hours call out service to be provided under this contract, all defects shall be rectified on a continuous basis as they arise during the defects liability period. The contractor shall rectify defects within 2 days unless the defect is considered critical requiring more urgent attention.

Should the contractor fail to attend to defects in a prompt manner, The Property and Project Managers may at their discretion employ an external contractor to rectify the defects, wherein the contractor will be required to continue warranting the work and shall be responsible for the costs incurred by The Principal.

Bank Guarantees will not be released until all defects have been rectified.

14 SCHEDULE OF EQUIPMENT

14.1 GENERAL

The schedules shown on drawings have been prepared as a guide for tendering price purposes. They form a summary of the preceding Clauses in the specification and should be read in conjunction with these Clauses and the Project Drawings.

Air and water quantities and temperatures may be changed slightly to suit the particular manufacturers equipment providing full details are submitted, any changes shall not affect the "Guarantee of Performance" or conflict with any By-Laws, Statutory or Health Requirements or the overall design in general.

Pressure drops and fan static pressures have been calculated from assessed average equipment and have been given as a guide for initial tendering purposes only. Allow for all pressure drops through the equipment offered and to suit the ductwork and pipework layouts prepared as part of the Construction and Workshop Drawings. The schedule is not be used direct for technical purposes when ordering equipment.

BCA CONSULTANTS**CONSULTING ENGINEERS****KALGOORLIE OASIS STADIUM SPORTS HALL EVAP COOLING MECH SPEC****MECHANICAL SERVICES****TENDER FORM****Job No. 230352**

We, the undersigned, hereby tender to carry out the complete works for the Mechanical Services Installation, in accordance with the specification and drawings for the sum set out hereunder:

1. Tender Sum

Tender price for the ventilation upgrade works including Associated Works and Site Allowances, excluding GST

\$ _____

Goods and Services Tax

\$ _____

Grand Total including GST

\$ _____

The above price to be Fixed Lump Sum, **NOT** subject to Rise and Fall and valid for 90 days from the Tender Closing Date.

2. Tender Sum Breakdown For Ventilation Upgrade Works

The following breakdowns will be used as the basis for assessing contractor progress claims, contractor variations and may be used to remove portions of the contract from the contractors works.

Item	Amount
Demo works	\$ _____
Indirect evaporative cooling units supply and installation	\$ _____
Booster fans supply and installation	\$ _____
Supply Air Insulated External Ductwork supply and installation	\$ _____
Supply Air Fabric Ductwork supply and installation	\$ _____
Controls and Electrics	\$ _____
Commissioning	\$ _____
Project Management	\$ _____
Engineering and Drafting	\$ _____
Builders Works – Miscellaneous	\$ _____
Total	\$ _____

3. Proposed Works Programme

Proposed Contract Works Programme for Supply and Delivery of Materials _____ weeks
 Proposed Contract Works Programme for Site Installations _____ weeks

4. Payment Schedule

The following proposed payment schedule is to be completed in full:

Progress Payment 1 – Upon delivery of equipment to site	_____ %
Progress Payment 2 – Upon completion of installation	_____ %
Progress Payment 3 – Completion of all defects (Practical Completion)	_____ %
Total	100 %

5. Variations

Nominate below details of any variations or alternative proposal items (priced separately) from that specific and/or shown on the drawings. (Provide separate details if insufficient room):-

6. Addenda

We acknowledge the receipt and inclusion of the following addenda in our tender submission:-

Dated this _____ day of _____ 2022

Signature of Tenderer _____

Company _____

Address _____

Telephone _____

BCA CONSULTANTS
CONSULTING ENGINEERS
KALGOORLIE OASIS STADIUM SPORTS HALL EVAP COOLING MECH SPEC
MECHANICAL SERVICES

SCHEDULE OF TECHNICAL DATA

Job No. 230352

This Schedule of Technical Data will be used for assessing tender submissions and will not relieve the Tenderer from complying with the requirements of the specification. Code numbers, trade names, model numbers, classification etc. shall be thoroughly checked for compliance with the specification by the Mechanical Contractor prior to ordering any equipment.

1. Responsible Personnel:

List of all personnel responsible for this project.

Construction manager -

Project Engineer -

Site Construction Manager -

Site Construction Personnel -

Site Commissioning Supervisor -

Maintenance Supervisor -

2. Proposed Sub-Contractors:

Ductwork -

Electrical -

Controls -

Painting -

Commissioning -

Others -

3. Equipment (Initial Information):

The following information is to be submitted with the initial submission for all items of plant and equipment:-

Unit No.	Manufacturer	Model No.	Any Deviations (Y or N)
<u>Indirect Evaporative Coolers</u>			
General
<u>Booster Fans</u>			
General
<u>VSDs</u>			
General

4. Schedule of Deviations:

If there has been any significant deviations from the specifications for items of plant and equipment, listed in 3 above, itemise them in the following space or by separate attachment if insufficient space:-

.....

.....

.....

5. Equipment (Supplementary Information):

In addition to the above information, supplementary information must be provided within 48 hours of request for full technical details, manufacturing details, capacities, materials, performance curves and similar information for each item of equipment proposed. Set out in a similar way to that of the Schedule of Equipment, Section 14 of this specification.

Dated this _____ day of _____ 2022

Signature of Tenderer _____

Company _____

Address _____

Telephone _____