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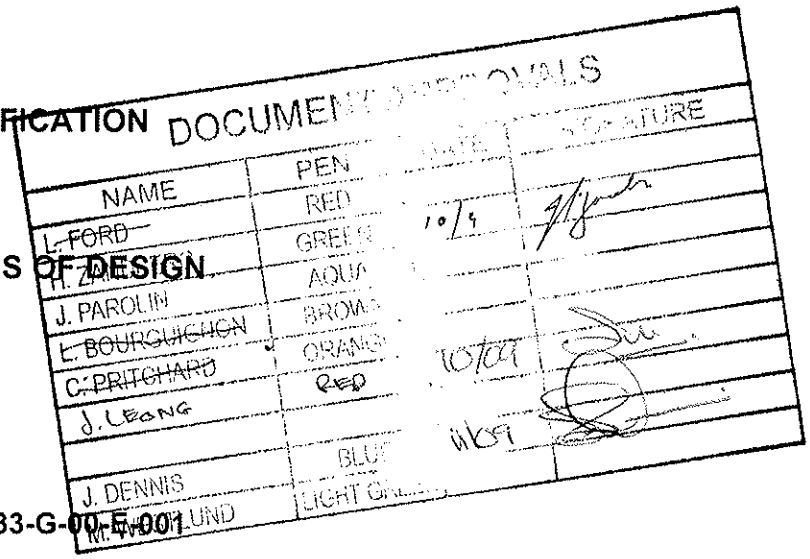
WINDIMURRA VANADIUM PTY LTD

WINDIMURRA VANADIUM PROJECT

STANDARD SPECIFICATION FOR THE ELECTRICAL BASIS OF DESIGN



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CLIENT REVEW / APPROVAL

☐ .....APPROVED EXCEPT AS NOTED
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1.0 GENERAL

The plant shall be designed for reliable operation, low maintenance and in accordance with standard mining plant philosophy for a large, long term project.

1.1 Safety

Safety considerations shall be incorporated into all aspects of plant design. The storage and handling of hazardous material shall be undertaken in accordance with AS 2430 and other relevant statutes and codes.

The following materials shall not be used:

- Asbestos and compounds thereof.
- Poly-Chlorinated Bi-phenyl (PCB's) and compounds thereof.
- Ceramic fibres.

The following materials shall not be used without specific approval:

- Chloro-fluorocarbons (CFC's) and compounds thereof.
- Radioactive materials

2.0 STANDARDS AND CODES

The design and installation shall comply with all statutory regulations and shall be subject to approval by the regulatory authorities, where appropriate.

Special attention shall be paid to the requirements of AS/NZS 3000 and AS 3007.

Australian Standards shall apply as appropriate, including but not limited to those listed in Appendix A.

3.0 VOLTAGE REGULATION AND FAULT LEVELS

Voltage levels shall not exceed the following limits:

Location	Range
Overhead distribution	95~105%
MCC Busbar (steady state)	98~105%
General Purpose Outlets	95~105%
Branch circuits for lighting, UPS, DC, etc	85~105%
Motor terminals (steady state running)	95~105%
Motor terminals (running motors during starting of other loads)	80~105%
Motor terminals DOL starting	80~105%
MCC Busbar during motor starting	90~105%

For specific voltage levels please refer to the TPJV Site and General Data.

The voltage levels shall be based on the declared nominal voltage, not the expected operating voltage.

Drives which start under loaded conditions shall be checked to ensure that sufficient starting torque is available considering the voltage drop under starting conditions, eg conveyors, crushers, etc.

The highest possible foreseen fault level at any point in the system, taking into account any probable expansion or extension, shall not exceed the design fault level at that point.

In calculating fault levels, the fault contribution of all motors rated 110 kW and above shall be taken into account.

4.0 HARMONIC DISTORTION

The specification of harmonic producing equipment such as rectifiers, inverters, variable speed motor drives, power factor correction equipment, etc. shall give due consideration to the level of harmonic voltage distortion caused by the equipment. The total harmonic voltage distortion at the point of common coupling on a network caused by this equipment shall be within values specified in AS 61000.3.6.

The preferred course of action is to specify equipment utilising state of the art technology which generates low levels of harmonic voltage distortion, or has integral harmonic filtering equipment. Retrofitting of harmonic filtering equipment to the equipment or supply system is the least preferred option.

The site harmonic distortion is set by the level specified by TPJV in their Site Data and General Project Requirements document C5270-00-GSS-002.

5.0 POWER DISTRIBUTION

Power consumption for each general plant area shall be metered as indicated on the plant single line diagram. Power metering will generally take place at the incoming supply or at the power station switchboard.

Overhead power lines shall not be installed in the immediate plant area.

Overhead power lines shall only be installed where no interference may be caused to mobile equipment, e.g. cranes.

HV power distribution design and installation is to be undertaken by Alinta.

6.0 SUBSTATIONS

The substations shall consist of a transportable type switchroom and transformer compounds.

The switchroom shall be installed on steel/concrete piles so that the floor levels are nominally 1450 mm above ground level.

Each switchroom shall incorporate a personnel access door and a two-leaf equipment door. The equipment door shall be fitted with a panic release device. The personnel door shall be fitted with a heavy duty night latch. Deadlocks are not permitted on any doors. All equipment room doors shall open outwards.

Detachable stairs shall be provided for access to the substation. Outdoor platforms shall be constructed from gridmesh. Handrails shall be provided on the open sides.

The switchroom shall be sized to accommodate temperature sensitive electronic equipment such as variable speed drives, PLC racks and communications devices. The substation shall be of steel frame, metal clad construction, insulated against heat and dust, sealed and lined internally with metal clad sheeting. The floor shall be fibre cement sheeting with vinyl covering. Air-conditioning units shall maintain internal air temperature to a maximum as set by the TPJV Substation Specification.

In addition to the electrical and instrumentation equipment, each switchroom shall be equipped with internal/external light and small power system, telephone, emergency lighting, safety notices, fire detection system and fire extinguishers.

Substation buildings shall be dynamically isolated from structures.

All cables shall normally enter and exit the switchroom by means of cable ladders installed under the switchroom floors. Cable entry shall be via 5 mm thick aluminium gland plates installed in the floor directly below wall mounted equipment or via cable gland boxes installed directly under the cable zones of floor mounted equipment. Split gland plates shall be provided where preformed cables with plugs are to be installed between the MCC and PCS cabinets. All building cable entry and exit points shall be sealed following the installation of the cables.

In general, bottom cable entry to the switchroom equipment will be used. This shall be used where there is a minimum of 1000 mm cabling space beneath the equipment or floor.

Transformers associated with the substations shall be located in outdoor compounds located adjacent to the substation buildings. The outdoor compounds shall comprise a concrete plinth for supporting each transformer, and a concrete bund with bund walls at least 300 mm above finished ground level, filled with crushed stone (nominal 32mm diameter) to a depth of 150 mm. The bund shall be sized according to AS 1940.

Transformer compounds shall have two hour fire rated concrete or block work walls on sides within six metres of buildings or other equipment. Other sides shall have a chain-wire fence or gates. There shall be one chain-wire access gate for installation and removal of the transformer. The walls, fences and gates shall be a minimum of 300 mm above the highest point on the transformer.

Remote substations/transformer compounds may have chain wire mesh on all sides. An equipment access gate shall be incorporated into the compound design.

The requirements of the process plant insurance company shall be incorporated into the design if additional to the above.

7.0 POWER TRANSFORMERS

The number of different transformer ratings and types shall be rationalised to facilitate spares holdings.

Transformers shall generally be oil cooled with natural ventilation (ONAN), with manual tap changers.

Pole mounted transformers shall have low creepage open outdoor bushings for both primary and secondary terminations and shall be a maximum of 315 kVA rating.

Pad mounted transformers shall generally have cable boxes for both primary and secondary terminations, fitted with non-magnetic gland plates.

Alinta will be specifying and purchasing the power transformers for the Windimurra Vanadium Project.

8.0 HIGH VOLTAGE SWITCHGEAR

High voltage switchgear shall be type tested indoor, metal clad switchgear with vacuum or SF_6 circuit breakers on withdrawable trucks, enclosed to IP51.

Outgoing high voltage feeder circuits up to 100 A loading may be vacuum or SF_6 fuse switches in lieu of circuit breakers. Circuit breakers shall be used when rapid restoration of supply following faults is essential.

High voltage motor starters shall preferably be indoor, metal clad, withdrawable contactors of either vacuum or SF_6 technology, enclosed to IP51. A fault make, load break isolator shall be incorporated with each contactor-type motor starter.

Large, low starting frequency drives, such as grinding mills, may utilise a circuit breaker in lieu of a contactor as a motor starter.

If a circuit breaker is utilised as a motor starter, it shall have a motor charged spring charging unit suitable for remote release. The circuit breaker shall also be fitted with a no-volt release which monitors the circuit breaker trip circuit voltage. Loss of trip circuit voltage shall trip the circuit breaker. Each high voltage motor starter shall incorporate an electronic motor protection relay and shall also make provision for a 240 VAC anti-condensation heater on the associated motor. Each motor protection relay shall be capable of communicating with the control system. The type of motor protection relay will be specified by WVPL.

9.0 LOW VOLTAGE SWITCHGEAR

Each motor control centre (MCC) shall have a withdrawable circuit breaker incomer. Each incoming breaker shall have adjustable earth fault (E/F) and overcurrent tripping capable of operation without auxiliary voltage supply (i.e. under fault conditions).

Each drive shall have a circuit breaker, motor thermal overcurrent protection, ready indicator and running indicator.

Low voltage switchboards and motor control centres shall be type tested and constructed to Form 4 standard in accordance with AS/NZS 3439.1, and as per the WVPL/TPJV standard specification.

10.0 VARIABLE SPEED CONTROL PANELS

Electronic variable speed control panels shall be either floor or wall mounted panels. For larger drives a duty and stand by unit will be installed. For small VSDs a duty only system will be utilised. Other configurations for emergency operation are possible, and these shall be assessed during the electrical design.

Motors driven by variable speed control panels shall be provided with thermistor protection where specified by the client standard specification.

All variable speed control panels will normally have their speed varied from a remote location, eg plant control system. However, when the associated drive control is selected to "local" mode, it shall be possible for local speed setting to take place at the local control station via the "start" pushbutton. Once the drive is running in "local" at the preset minimum speed, pushing the "start" button once will raise the speed, pushing twice in succession will lower the speed.

11.0 ELECTRIC MOTORS

Unless otherwise approved, only four pole standard foot-mounted motors shall be used.

All electric motors shall be rated 415 V 50 Hz 3 phase, be of totally enclosed fan cooled (TEFC) cast iron construction to degree of protection IP55. The motors shall be Toshiba motors.

Motors shall be rated for continuous duty (MCR) at 40°C ambient temperature with Class B temperature rise. Windings shall be Class F insulated.

Motors above 80 kW shall be fitted with PTC thermistors terminated at a separate terminal box. Motors above 100 kW shall be fitted with an anti-condensation heater rated 240 VAC.

Motor dimensions shall be as per the international standard allocation of AS 1359.

The requirement for flameproof or other special enclosure motors shall be established during electrical design.

12.0 CABLE LADDER

Cable ladder shall be routed along pipe racks where practical, and attached to buildings and structural steelwork in other cases.

Cable ladder shall preferably be mounted horizontally, but may be mounted vertically if the application requires.

Cable ladder entering substations shall be graded to prevent water entering the substation along the cable ladder.

Consideration shall be given to the requirement for special provisions for cable ladders in corrosive or high magnetic fields areas, i.e. stainless steel, epoxy resin, fibreglass etc. Cable ladders shall be routed away from these areas where practical.

Peaked covers with stand-off spacers shall be provided on cable ladders in areas where spillage is likely to occur or where the cables are likely to be subjected to direct sunlight. The stand-off spacers shall be designed to provide a minimum 25mm clearance between cable ladder sides and cover in order to allow heat flow.

Spare capacity shall be provided in the cable ladder installation to accommodate future cabling in accordance to WVPL/TPJV Standard Specification for E&I Equipment and Cabling Installation.

13.0 CABLES

All high voltage cables shall be steel wire armoured, XLPE insulated.

Low voltage cables shall generally be unarmoured, V75 PVC insulated if core size is equal to or less than 25 mm^2 or X90 XLPE insulated if core size is greater than 25 mm^2, and sized in accordance with AS/NZS 3008, using an ambient soil temperature and an ambient air temperature based on the site data.

All underground cables shall be armoured cable with a nylon sheath with a sacrificial PVC over-sheath.

Underground cables shall be direct buried, bedded in sand, with the exception of cables crossing under roadways which shall be installed in heavy duty underground conduit. Spare conduits shall be provided for future cabling.

Power cables shall not be smaller than 2.5 mm^2 stranded copper conductor.

Power cable conductor colours shall be red, white and blue, according to the phase. Earth conductors shall be green/yellow. Neutral conductors shall be black.

High voltage and low voltage cables shall be three or four core up to and including 185 mm^2 conductor cross sectional area. Above this size, single core cables shall be used unless the cables are buried. All buried cables shall be multicore cables.

Where heavy current carrying capacity is required; eg transformer 415 V cables,. single core copper XLPE insulated cable shall be used. Bus duct will generally not be used between transformers and MCCs, single core copper XLPE insulated cable being preferred. A significant cost benefit must be demonstrated before bus duct is specified.

Power and 240 VAC control cables may be run in common cable ladder provided the cable insulation voltage rating is identical. Separate cable ladder shall be provided for high voltage cables.

All instrument signal cables shall be routed in separate cable ladder. The instrument signal cables may be routed in the same cable ladder as control cables, separated by a metal barrier from these cables.

The WVPL/TPJV Standard Specification for E&I Equipment and Cabling Installation will be the overarching specification.

14.0 EARTHING

Earthing shall be in accordance with AS/NZS 3000. The direct earthing system shall be used throughout the installation, and the combined earthing system shall be used at substations.

A main earth bar shall be provided at each substation and earth bonds shall be installed from this earth bar to all electrical equipment to be earthed, building structures and the buried earth system. An access pit shall be installed for each system earth electrode.

A separate process control system earth shall be provided where necessary.

All plant substation main earth bars shall be inter-connected.

For all electrical installations on mine sites step and touch potentials shall be in accordance with AS 3007 and Equipotential bonding of electrical equipment and plant steelwork shall be installed in accordance with AS 3007.

A static earthing system shall be provided for LPG or other systems sensitive to static electricity.

15.0 LIGHTNING PROTECTION

A lightning risk assessment shall be carried out in accordance with AS 1768. Lightning protection shall be installed as necessary, dependent on the outcome of the lightning risk assessment.

16.0 ESSENTIAL SERVICES SUPPLY

The requirement for and operation of an essential services supply shall be established early in the design period.

Typical loads which may require essential services power are as follows:

- Plant lighting, including emergency lighting
- Thickener rake drives/agitator drives
- Tailings thickener underflow pumps
- Potable water pumps
- Fire water pumps
- Process control system
- Field instruments
- Security systems

If automatic operation is deemed appropriate, the essential loads shall transfer automatically to the essential services supply in the event of a power failure.

17.0 LIGHTING AND SMALL POWER

Plant lighting shall generally be provided by high pressure sodium (HPS) fittings (external and high ceiling internal) and fluorescent fittings (low ceiling internal).

Emergency maintained fittings shall be located in substations, control rooms, by safety showers, stairways and other critical locations.

240 VAC general purpose outlets (GPOs) shall be protected by earth leakage units set at 30mA.

Welding outlets shall be installed at strategic points on the plant. Earth leakage protection on welding outlets shall be set at 300mA.

Lighting levels shall generally be as recommended in AS 1680, and in particular as specified below.

• General indoor operating areas	200 lux
• General outdoor operating areas	50 lux
• Stairways and walkways	50 lux
• Offices and control rooms	400 lux
• Warehouse and store	100 lux
• Workshops and laboratory	500 lux

Exterior lighting shall preferably be switched by the plant PLC system, or alternatively by a photoelectric switch.

18.0 CONTROL SYSTEM PHILOSOPHY

The Process Control System (PCS) shall be configured as a three tiered pyramid network. The lowest tier shall comprise field instrumentation and control equipment. The middle tier shall comprise the process control system hardware. The top tier shall comprise the operator interface hardware.

The PCS equipment installed within each area shall function autonomously, such that a failure of the PCS in one plant area will not affect the other areas.

The PCS shall provide detailed information to the plant operators broadly classified as:

- Plant status monitoring
- Fault annunciation and logging
- Management reporting (eg shift production)

In addition the PCS shall assist the plant operators by providing start up and shut down sequencing, batch sequencing, interlocking and analogue control loops. The PCS control will be described in detail in a separate document developed as part of the detailed PID design.

The PCS shall be powered by a regulated power supply.

Any requirement for a separate Safety Instrumented Shutdown System will be established in the design phase and implemented if required.

The site standard for the control system has been specified by TPJV.

19.0 DRIVE CONTROL PHILOSOPHY

Drives will normally be controlled from the control console in the control room.

A local control station comprising a start pushbutton and lock-off stop pushbutton shall be installed adjacent to each drive. When appropriate (eg mill auxiliary drives), several start-stop stations may be combined in one panel.

Field mounted isolators shall not generally be used on drive motors. Decontactors shall be installed on all electric sump pumps and vertical spindle type pumps.

All drives, with the exception of fire pumps or similar, shall have two modes of operation, i.e. "local" and "auto".

In "auto" mode, all process control system controls and interlocks are operative, and the drive is controlled via the process control system. The local start pushbutton is inoperative in "auto" mode.

In "local" mode, all interlocks and sequence controls are inoperative, with the exception of hard-wired and critical interlocks, and the drive is started and stopped at the local control station still under the control of the process control system.

Personnel safety devices such as the drive local stop button (lock off stop) and conveyor rope switches (latching type) shall be operative in all control modes and shall be independent of the process control system.

"Local" and "auto" mode will be selected from the plant process control system operator console. Selected drives could be controlled only from the local control station depending on the requirements of the process.

For drives the operator interface will provide drive status pages, mode selection and grouped stop/start control. The operator interface system will have a serial interface to the plant PLC for all motor control. Vendor supplied equipment (with or without PLC) will interface with the plant PLC and/or the DCS. Each motor will have two control modes; Local and Auto.

Personnel safety devices such as the drive local stop button (latching type) and conveyor rope switches shall be hardwired through to the drive statutory relay. A PLC input will also be energised by each of these devices for alarming and status indication. All other protection and interlocking devices will be connected to individual PLC inputs (including drive thermal overload, thermistor etc) for totally definitive alarming.

24 VDC will be used for all digital PLC I/O and the personnel safety devices. One circuit breaker will supply 24 VDC to all I/O associated with each drive and a PLC input will monitor the availability of this control supply. This input will be used to alarm loss of control supply and to suppress consequential alarms from devices on the same supply.

The interface between the 24V DC control and the drive contactor energisation circuit (240 VAC) will occur inside the drive module. Hence the 240 VAC power will be contained within each drive module. Motor heater circuits shall be supplied via an earth leakage circuit breaker from a separate bus.

Vendor supplied packaged plant shall follow the plant control philosophy as closely as possible.

20.0 PLANT CONTROL ROOM

The Control room shall be designed to house the operator interface and provide a view into the process plant. The interior should use high quality commercial grade fittings and hard wearing floor covering and furniture. The control room shall be designed to achieve an ambient noise level of 64 dBA with the plant in full operation. The control room shall be air-conditioned and have a filtered air pressurisation system introducing air from outside the plant.

A PLC/OIS/DCS technicians and training room shall be located adjacent or below the control room. This room shall include adequate space for archiving disk and tape backups, plant statistical process information, drawings, PLC/OIS/DCS system manuals etc.

21.0 INSTRUMENTATION AND ACTUATED VALVES

Field instruments shall be enclosed to IP65, and shall provide control signals at 4-20 mADC, fully isolated where required.

Valves controlled by the PCS shall be pneumatically actuated using electric solenoid pilot valves for on/off operation and 4-20 mA controlled positioners for modulating operation. On/off actuated valves shall include end of travel limit switches monitored by the PCS. Valve selection will be based on the valve and piping design criteria.

In special circumstances where instrument air is not available electric motor operated on/off and modulating valves may be used.

21.1 Field Instruments

All field instrumentation shall conform to the following general requirements:

In general the plant instrumentation shall be electronic, utilising signal transmission of 4-20 mA analogue and 24 VDC digital between field and control room. Any necessary conditioning of signals shall be carried out by the centralised control system unless otherwise specified.

Where pneumatic signals are used for control valves the signal shall be 20 to 100 kPa.

All two wire transmitters will be supplied from the 24 VDC supply of the central control system unless otherwise specified. All two wire transmitters shall be capable of supplying full signal into a 600 ohm circuit when supplied with 24 VDC.

All instruments requiring an external 240 VAC supply shall give an isolated 4-20 mA DC analogue signal and shall be capable of supplying a 600 ohm load.

All switched outputs from field instruments shall be galvanically isolated.

All instruments mounted in an outdoor or exposed location shall have enclosures with a weatherproof classification of IP65. All transmitters exposed to direct sunlight shall be provided with a sunshade.

Additional protective enclosures shall be provided for all instruments where considered necessary. This includes such areas subject to slurry spills, corrosive fluid spills and mechanical damage.

All transmitters shall be immune to electromagnetic interference from UHF and VHF radio transceivers to Australian Standards and European Standard IEC 801.1.

Vibration effect on all transmitters shall be equal to or less than +/- 0.05 percent of maximum range.

Where instruments are to be installed in classified electrical hazardous areas, the instruments shall be certified as suitable for the areas concerned. The classification of hazardous areas shall be in accordance with AS 2430.

All process wetted materials shall be suitable for the duty as specified, ie., no corrosion or any other deterioration due to chemical reaction or attack of the material within a minimum of two (2) years. All process wetted materials for all instruments, especially in-line type instruments, shall be suitable for the duty as specified with respect to erosion. A minimum service life of two years continuous duty before maintenance repair (relining or replacement) shall be guaranteed by the instrument vendor.

All transmitters shall be mounted remote to the element when process fluid temperature, vibration conditions or access prohibit direct mounting.

Where applicable, all transmitters to sensor cables shall be Vendor supplied. These cables shall be a minimum of five metres long.

Recording, indicating and control instruments shall be part of the supervisory system within the control room unless otherwise specified (i.e. local indicator / controller to be kept to a minimum).

Package plant shall include all local indicating instrumentation eg. pressure gauges, thermometers etc. unless otherwise specified.

Package plants and systems shall include adequate interlocks and safety devices to ensure safe operation of the plant appropriate to Australian Standards. All safety interlocks and trips shall be hardwired by the package plant Vendor unless otherwise specified. Sufficient voltage free contacts shall be made available from all switches to allow for remote alarming and indication.

All package plant instruments shall be fully documented by the package plant Vendor. Package plant instrumentation shall bear tag numbers provided by the purchaser.

Access to instruments that require regular operation or maintenance attention (eg. transmitters, control valves etc) is to be from grade or permanent platform. Access from a ladder is not acceptable.

Equipment shall be arranged to fail safe in the event of loss of instrument air, electrical power, or plant malfunction. Alarm and trips shall be initiated from normally open contacts (closed for plant healthy, open for alarm and trip).

All instruments shall bear an engraved tag number identification. The tag number shall be in accordance with the documentation provided. Where applicable the tag number shall be securely attached to the instrument without prejudicing the enclosure IP rating or the surface protection epoxy coating. Adhesive tapes alone are not an acceptable means of fixing tags. The minimum height of lettering on tags shall be 10 mm.

21.2 Weighing Systems

Weighing of solid materials shall normally be accomplished with electronic weigh scales on conveyor belts or mass weight meter. Bin weighing with electronic load cell weighing systems may be used where applicable, for example in batching operations and finished product load out. Strain gauges will be considered where application warrants. Bin weighing systems accuracy shall be selected on application.

21.3 Control Valves

21.3.1 Standard Control Valves

Butterfly, knifegate, globe, diaphragm and ball valves may be used. Consideration will be given to other body designs.

Equal percentage characteristics shall be specified unless on/off function is required.

Valve bodies should be the maximum size required for any anticipated operating condition. If the actual flow rate is substantially less than expected future maximum then a reduced valve trim shall be considered.

Valves other than Butterfly should be limited to 15% lift at design turndown conditions and a maximum of 90% lift at worst surge conditions.

Valve body material shall be in accordance with pipe line specification as a minimum. All control valves that have flanged connections shall be to the applicable plant piping specification.

The process media shall determine the choice of seat material. When possible, material rating shall be at least 50°C above the maximum design temperature.

If tight shut off service is required for butterfly, eccentric disc or ball valves with soft seat materials shall be used.

Packing shall be compatible to the process fluid and the operating temperature.

Actuator stems shall have adequate strength to withstand the maximum developed thrust of the actuator.

All control valves shall be furnished with stem position indicators where valve construction permits.

Limits switches shall be fitted where necessary. Limit switches shall be of a non contact type. Limit switches integral with the positioner are preferred.

Noise control shall be considered an essential design feature of any control valve. All valves shall be specified for a maximum noise of 85 dBA at one metre. Noise reduction shall be achieved by valve and/or trim selection or increase of exit pipe.

All modifications to standard equipment in order to meet this noise specification shall be clearly stated by the Vendor.

21.3.2 Valve Positioners

Digital valve positioners shall be fitted to all modulating valves. Positioners shall be fitted with gauges to indicate supply air pressure, signal pressure and output pressure to actuator.

Positioners shall be provided with a bypass feature if specified. Positioners shall be fitted with a filter regulator complete with a two micron (or less) filter, a self draining system, an output air pressure gauge and be of sufficient capacity to supply air to the positioner and valve actuator under all operating conditions. The positioner and actuator will be supplied with instrument air.

Positioners shall preferably have sufficient capacity to supply the actuator without the use of booster valves, be field reversible and be tubed to the actuator. Positioners shall accept a 4-20 mA input signal.

21.3.3 Actuators

Control valve actuation shall be pneumatic, gas, electric, hydraulic or water. Pneumatic operation is preferred. Actuators shall supply sufficient thrust/torque to operate the valve against pressure drops as specified.

The fail action shall be designed to ensure the operation of the valve (to open, close or remain in last position) when required by process design or HAZOP requirements.

Actuators shall be capable of operating the valve over its full range of travel.

21.3.4 Solenoid Valves

Solenoid valves shall:

- be 24 VDC direct operated.
- be fitted to the actuator of all on/off valves.
- have the enclosures to IP65.
- have an electrical connection suitable for glanding and terminating 1.5 mm^2 2C+E Cu PVC/PVC cable.

- have a sufficient number of ports of sufficient size for matching actuator.
- have correct porting arrangements to allow for the main valve to fail in the correct position in the event of power failure.
- be tubed to the actuator

22.0 INDICATING LIGHTS

Colours for indicating lights shall be as follows:

Red	Equipment running
Amber	Caution or failure
Green	Power on/ready
White	Position indication

Led cluster type lights shall be used for indicators.

23.0 CONTROL PANEL WIRING

Control panel internal wiring shall be flexible copper and shall have the following minimum sizes:

Control wiring	1.0 mm²
Power wiring	1.5 mm²
PLC/instrument signal wiring	0.5 mm²

The colour coding for control panel internal wiring shall be as per the following table:

Service	Colour	Description
DC+, Switched Signals	Grey	Includes 24 VDC digital signals
DC-	Black	
Earth	Green/yellow stripe	All earth conductors
240 VAC or 110 VAC Line	Red	
240 VAC or 110 VAC Neutral	Black	
4-20 mA +ve	White	Twisted pair
4-20 mA –ve	Black	

24.0 COMMUNICATIONS

A PABX telephone system shall be installed with telephones in all offices, control rooms, substations, laboratory and workshops. Voice, fax and data links shall be provided to the Telstra network.

A mobile radio network shall be provided for all mining vehicles and maintenance vehicles, with base stations in the mine administration office and main administration office.

The mobile radio network shall have a minimum of two channels: mining and others. In the event of emergency operational procedures will set out radio channel allocation and operation.

A fibre optic based communications network shall be used for data and process control system links external to buildings.

25.0 FIRE PROTECTION

Fire protection for substations and control rooms will generally be limited to hand held portable fire extinguishers.

Very early smoke detection and alarm (VESDA) systems shall be installed in substations and control rooms. Operation of the VSEDA system will sound a siren in the plant, an additional siren being located in the vicinity of each fire panel. Overhead sprinkler systems will not be installed. Manual call points shall be installed outside the substation adjacent to each door.

APPENDIX A: STANDARDS & CODES

AS 1000	The International System of Units (SI) and its application.
AS 1076 (Parts 7 & 8)	Code of practice for selection, installation and maintenance of electrical apparatus and associated equipment for use in explosive atmospheres (other than mining applications)
AS 1102.101	Graphical symbols for electrotechnical documentation - General information and general index.
AS 1188	Radio Transmitters and Similar Equipment - Safe Practices.
AS 1349	Bourdon Tube Pressure and Vacuum Gauges.
AS 1359 (All Parts)	Rotating Electrical Machines - General Requirements.
AS 1680	Interior Lighting Set
AS 1768	Lightning Protection
AS 1940	The storage and handling of flammable and combustible liquids
AS 2067	Switchgear assemblies and ancillary equipment for Alternating Voltages above 1 kV.
AS 2129	Flanges for pipes, valves and fittings
AS 2293	Emergency Escape Lighting and Exit Signs Set
AS 2360 (All Parts)	Measurement of fluid flow in closed conduits
AS 2374 (All Parts)	Power Transformers
AS 2381 (All Parts)	Electrical equipment for explosive atmospheres - Selection Installation and Maintenance.
AS 2430.3	Classification of hazardous areas - Examples of area classification
AS/NZS 3000	Electrical installations (known as the Australian/ New Zealand Wiring Rules)
AS 3007 (All Parts)	Electrical Installations - Surface mines and associated processing plants.
AS/NZS 3008.1	Electrical Installations - Selection of Cables
AS 3439 (All Parts)	Low-voltage Switchgear and Controlgear assemblies
AS 3947 (All Parts)	Low-voltage Switchgear and Controlgear
AS 60068.1	Environmental testing - General and guidance
AS 60079.10	Electrical apparatus for explosive gas atmospheres - Classification of hazardous areas
AS 60265.1	High-voltage switches - Switches for rated voltages above 1 kV and less than 52 kV

AS 60529	Degrees of protection provided by enclosures (IP code)
AS 60947.8	Low-voltage switchgear and controlgear - Control units for built-in thermal protection (PTC) for rotating electrical machines
AS 61000.3.6	Electromagnetic compatibility (EMC) - Limits - Assessment of emission limits for distorting loads in MV and HV power systems.
AS 61000.3.7	Electromagnetic compatibility (EMC) - Limits - Assessment of emission limits for fluctuating loads in MV and HV power systems.
AS 62271 (All Parts)	High-voltage switchgear and controlgear - A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV
BS 6739	Code of practice for instrumentation in process control systems: installation design and practice
IEC 801.3	International Electrotechnical Commission Electromagnetic compatibility for industrial-process measurement and control equipment.