snowy hydro Limited renewable energy	
Snowy Technical Standards	
SHL-ELE-156 (H)	***Annexure H - Instrumentation and Transducers General Low Voltage Electrical Requirements***
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This annexure forms part of the General Low Voltage Electrical Requirements Standard (SHL-ELE-156).

1. Scope

This Annexure sets out the requirements for Instrumentation and Transducers.

Instrumentation and Transducers must be designed, constructed and/or supplied conforming to the General Electrical Requirements and this Annexure.

1.1. Applicable Standards

The design, manufacture and testing of equipment and components detailed in this annexure must comply with the requirements of all relevant Australian Standards or in the absence of appropriate Australian Standards, with relevant IEC, ISO or International Standard, together with the requirements of competent authorities having jurisdiction over all or part of the manufacture, installation or operation of the equipment, except where modified by this specification.

All works must comply with the requirements of the most recent releases of the regulations and standards noted in Snowy Standard SHL-ELE-156. In the event of a conflict between different Codes, Standards or Regulations, the highest requirement must apply.

2. Safety Requirements

Instrumentation and transducers must be designed, manufactured and tested with the safety requirements detailed in the General Electrical Requirements. (SHL-ELE-156).

3. Technical Requirements

3.1. Installation

3.1.1. Instrument Pipework and Fittings

Field instrument mounting locations, tubing specification and routing must be approved by the SHL prior to installation. Separate tapping points should be provided for each instrument. Instruments, equipment and materials must be installed such that they will not impair maintenance access for personnel or equipment. Wiring, cabling and instrument pipework tubing connections for instruments must allow sufficient space to facilitate easy access and disconnection for maintenance purposes.

Pipework and tubing must be neatly run and suitably supported in a manner such that no pockets or traps can occur. If either is unavoidable then a suitable drain or vent valve that must be provided that is easily accessible from a floor, permanent platform or walkway. Instrument piping used on liquid services must be self-venting to the main, while gas and vapour instrument lines must be self-draining to the main.

Supports must be provided to prevent piping from sagging and minimise piping vibration. Piping must be installed so that excessive stresses are not imposed on the piping due to expansion and the relative movement of tapping points and adjacent steelwork. Movement of the plant, where applicable, must be taken into account to avoid damage to the piping and/or connected instrument. Supports must not be attached between steelwork and adjacent plant where relative movement due to expansion can occur. Piping and supports must not be attached to tension flanges of structural steelwork or to casings, ducts and other plant that may need to be removed for maintenance purposes.

Instrument pipework and fittings must be suitable for use with the process medium and the design pressure and temperature conditions at the tapping point. Instrument pipe work and fittings must be of a consistent design and type throughout the plant and must be 316 Stainless Steel suitable for working conditions. Compression fittings and couplings must be Swagelock or approved equivalent. All fittings must have BSP (ISO) threads, Twin Ferrule Tube Fittings and be supplied in 316 stainless steel. Instrument piping must not be less than 10 mm actual bore from the tapping point to the inlet of the instrument isolating valve.

Pipework must be designed according BS 6739, unless otherwise detailed in SHL site specific or Original Equipment Manufacturer instrumentation installation drawings.

Where the environment is corrosive or may cause blockage of a tapping point, a continuous line purge system must be provided

3.1.2. Instrument valves

Where practical, valves must be installed in a horizontal position with the spindle upward. Their position and location must also provide convenient non-hazardous operation and must allow easy access by maintenance personnel from a floor, permanent platform or walkway.

Where a tapping is used for more than one transmitter, a separate primary isolating valve must be provided for each gauge and transmitter. The pipework to each gauge or transmitter must include all valves and fittings as required for a single gauge or transmitter.

All connecting lines between tapping points and instruments, transmitters or test points must have not less than two isolating valves. This will typically comprise of a primary and secondary isolating valve.

Two primary isolating valves must be provided at all process tapping points where the process pressure is >4 MPa.

A secondary isolating valve and a regulating valve must be provided local to all gauges and transmitters. These must have valve plugs designed to give a flow opening characteristic.

High point vent valves and low point drain valves must be provided to ensure that all entrapped gas or liquid can be purged. Needle valves must not be provided for blowdown purposes. Vent valves and drain valves must be provided with a removable sealing plug.

All valves in instrument pipework must be suitable for use with the particular fluid and the design pressure and temperature conditions at the process tapping point. Valves must also be suitable for the isolating, blowdown, regulating and relief duties specified. All valves must be capable of being locked in the open or closed position.

All valves must provide clockwise rotation of the handle to close the valve, tight shutting, and packings must be suitable for the design conditions and must not cause corrosion of any materials with which they are in contact.

A stainless steel instrument manifold must be provided between primary isolating valves and instruments to

enable blocking, venting and calibration and equalising valves.

3.1.3. Instrument stands and mounting brackets

Instruments must be mounted at 1000 mm above walkway level adjacent to the element at a walkway or other accessible position (e.g. base of tank for level instrumentation). Instruments must not be supported by its instrument tubing and must be provided with an appropriate instrument stand or mounting bracket

Instrument stand and mounting brackets must be of a carbon steel construction with a hot-dip galvanised finish.

It is permissible to co-locate instruments on the same instrument stand.

3.1.4. Labelling

Instruments and valves must be provided an individual label with a stainless steel matt finish construction.

The labels must be permanently fixed to or immediately adjacent to the equipment so that they are clearly visible from the normal access position. Where the visibility and functionality of the labels is not reduced by fixing to a permanent structure adjacent to the equipment (i.e. a wall), this location must be used. Provision of stainless steel label.

Fixing must be by mechanical means. Gluing or double sided tape must not be used.

The labels must have the following layout and include the following information:

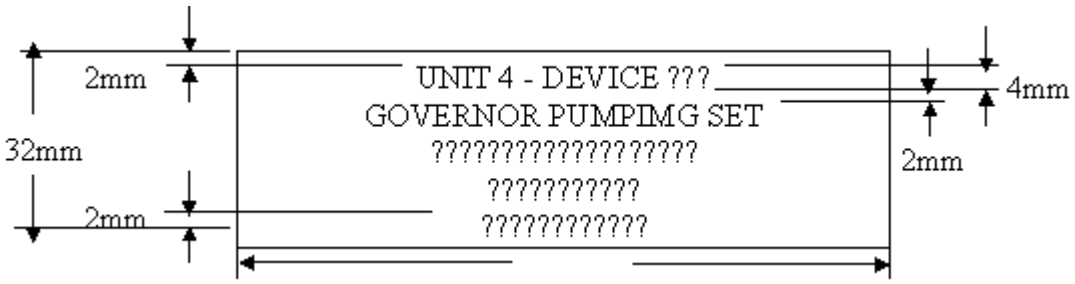

Figure H.1: Label layout

- Unit number: eg, UNIT 4
- Sub-system (if appropriate): eg, GOVERNOR PUMPING SET
- Description which identifies the item and its purpose: eg, UNLOADER 'A'

Valve labels must also include valve number and the notation NO or NC indicating the valve is normally open or normally closed where appropriate. Valve labels must be fastened to a galvanised sheet steel bracket held in place by the valve flange bolts, or by two galvanised steel straps around the pipe adjacent to the valve.

3.1.5. Thermowells

Suitable thermowells or protective sheaths of approved design must be provided for all types of temperature measuring elements to enable instruments to be replaced without requiring the plant to be shut down.

Thermowells must be located in positions where there is sufficient space for removal of the instrument without interfering with adjacent equipment, and easily accessible for maintenance of the instruments fitted in them.

Thermowells must be installed in threadolets unless otherwise specified or approved.

Thermowells must generally be downstream of pressure instrument connections. Where required, a check thermowell must be provided next to the thermowell for each remote reading temperature instrument. Each check thermowell must be fitted with a removable plug which must be threaded Rp 3/4 or Rp 1/2 BS 21 as specified.

Thermowells must be of the quick response type and must be of an approved material for the service.

Thermowell insertion lengths must be appropriate to the measurement process location.

Special care must be taken in the design and installation of thermowells mounted in locations subject to movement, vibration and high velocities.

3.2. Analogue/programmable transducers

3.2.1. General

All transmitters must be of a "smart" type, 24V DC 4-20mA loop powered, using the same protocol (eg; HART). Each transmitter must include an integral local display and include internal diagnostics. Transmitters must be provided with a M20 electrical connection with a blind plug

Transducers that monitor the same type of process variable (pressure, level, etc.) must be from the one generic family of a single manufacturer.

Transducers must be suitable for use in the vicinity of large electrical power generation equipment.

Transducers must be resistant to the effects of shock and vibration.

R/LVDT devices must be used for position feedback of all critical control actuators.

3.2.2. Environmental and protection requirements

Transmitters must operate over an ambient temperature range of -10°C to 60°C and a relative humidity of 0-95% non-condensing and must be enclosed in weatherproof and corrosion resistant cases of at least IP 65, unless otherwise detailed.

Adjustments must not require breaching the IP seal of the device.

Transmitters must be selected and installed in such a manner that they are not damaged or lose accuracy due to over range (150%), vibration, static pressure and pulsations.

Transmitters must not be measurably affected by the use of portable radios, which transmit 4W of power, next to the transmitter.

Transducers must have the following protection features:

- Over-voltage protection;
- Protection against reversal of polarity;
- Short-circuit protection.

3.2.3. Accuracy requirements

Transmitters provided must have at least the following measurement accuracy, unless otherwise specified:

Measurement	Accuracy
Pressure	+ 0.5% of span
Level or differential pressure	+ 0.5% of span
Position (rotary or linear)	+ 0.5% of span
Absolute Pressure	+ 0.5% of span
Flow	+ 0.75% of span (including square root extraction)
Temperature	+ 0.25% of span

Note - "Accuracy" must be deemed to be the combined error of linearity, hysteresis and repeatability.

Transmitters of all types must have a repeatability of better than 0.1% of span and the resolution must be better than 0.05% of span. The influence on the output by a 10°C ambient temperature change must not exceed 0.1% of the span, in the ambient temperature range 10 - 50°C. The influence on the output by a change in supply voltage must not exceed 0.05% of span per ten volt change, over the full specified operating supply range.

The long term stability of all transmitters must be such that, after one year's operation without adjustment to any of the equipment, their accuracy does not exceed the limits specified, by more than 0.5% of span.

Transmitters must have a five year calibration interval.

3.2.4. Sun protection

Where instruments are exposed to direct sunlight for significant periods of time, a suitable shading mechanism must be provided.

3.3. Digital instruments

3.3.1. General

Digital instruments, such as switches, must have a minimum of two single pole, single throw contacts available. The contacts must be rated for 1A at 24V DC.

It is permissible for switches used in the control system to output a 4-20mA analogue output. In this scenario the requirements of section H3 apply.

Where the digital instrument is to be used for protection of the plant, the instrument must have a minimum of two single pole, single throw contacts available. The contacts must be rated for 1A at 250V DC. Gold plated contacts are preferred for protection purposes due to the low minimum switching load of the protection relays.

3.3.2. Environmental requirements

Digital instruments must operate over an ambient temperature range of -10°C to 60°C and a relative humidity of 0-95% non-condensing and must be enclosed in weatherproof and corrosion resistant cases of at least IP 65, unless otherwise detailed.

Digital instruments must be selected and installed in such a manner that they are not damaged or lose accuracy due to over range (150%), vibration, static pressure and pulsations.

3.4. Temperature measurement

3.4.1. General

Thermowells and temperature measuring equipment must be fitted in positions to suit the operation and testing of the plant.

Temperature measuring primary elements for distant reading must be resistance thermometers or thermocouples. The preferred types are as follows:

- IEC 60751: platinum resistance thermometer elements
- IEC 60584: type selected to suit application.

Temperature measurement below 120°C must use RTD's.

Each thermocouple or resistance thermometer assembly must consist of the primary element and connection head (IP67). The base of the connection head must be at least 75 mm clear in all directions of pipe lagging and must be arranged to avoid excessive temperatures at the head assembly.

Redundant head thermocouple / RTD’s must be used for control loops and protection logic.

Temperature sensing element heads must contain a gasket of waterproof material between the head and the body that is suitable for the temperature conditions at the respective location.

Terminals must be of the screwed clamped type and must be rigidly fixed to the sensing element body.

Where filled system thermometers are to be installed, the thermeter must be of the direct mounted rigid stem type, but where a capillary is required it must be armoured and its length must not exceed:

- 4 metres when used for alarm or control purposes
- 10 metres for other purposes

Thermocouple or resistance thermometers must be sized to suit the thermowell length. Thermocouple or resistance thermometers must utilise spring-loaded fittings when installed in thermowells to ensure that the sensor tip is in constant contact with the thermowell bottom. This helps minimise the time constant in the temperature measurement.

3.4.2. Thermocouples

Thermocouples must be enclosed in a 316 stainless steel sheath filled with magnesium oxide to insulate the thermocouples from the sheath.

Mineral-insulated metal sheathed thermocouples must be thoroughly dried out before installation, and the insulation resistance value must be not less than 2 megohms before the cold seal is made.

Thermocouples must have polarity identification provided at the terminals.

3.4.3. RTDs

Resistance elements must be platinum PT100. Cable connections between the resistance element terminals and the processing unit input terminals must be made without any intermediate joints.

The resistance thermometers must have three leads to provide for lead resistance compensation

The resistance thermometer must be accuracy class A, as defined by IEC 60751

3.4.4. Infrared Pyrometers

Infrared pyrometers can be utilised where non-contact measurement of a process is required (i.e. bus bar monitoring).

3.5. Position measurement

3.5.1. Limit switches

Where limit or travel switches are intended to form part of an actuator installation the requirements outlined in section H10 apply.

Mechanical limit switches must be roller lever-type and suitably durable to provide at a minimum:

- 10 million mechanical operations / 500,000 electrical operations
- 120 mechanical operations per minute / 30 electrical operations per minute

Mechanical limit switches must be selected to provide adequate vibration and shock resistance for the application. Limit switches must be installed such that they will not be damaged by over-travel of the drive, and must have a snap-action contacts.

3.5.2. Proximity probes

Proximity probes must be inductive type probes.

Proximity probes must be supplied with the following protection features:

- Short circuit
- Overload
- Reverse polarity
- Transient noise protection

3.6. Pressure measurement

3.6.1. General

All pressure tapping points must preferably be on the horizontal centre line of main pipes, which are not running vertical.

A second isolating valve manifold incorporating a test gauge connection must be supplied and fitted adjacent to each pressure gauge or transmitter. Isolating valves of gauges must be readily accessible.

Each pressure instrument must be capable of withstanding the piping design pressure at its tapping point. When a pressure instrument range must be low relative to this design pressure an approved automatic pressure-limiting device must be provided just before the pressure instrument isolating valve.

Differential pressure instruments must be capable of taking full static line pressure on one side only without damage or loss of calibration. Each must be provided with a 5-valve manifold as a minimum, the centre valve being used for equalising pressure for zero checks.

Where the environment is corrosive or may cause blockage of a tapping point, a continuous line purge

system must be provided.

3.6.2. Pressure transmitters

Pressure transmitters must be diaphragm-type. The transmitters must be provided with overpressure protection.

Care must be taken, when using hydrostatic head or differential pressure meters to measure levels, that suitable compensation is allowed for the density difference between the HP and LP legs, or when the external pipe is partly filled with condensed liquid and vapour.

3.6.3. Pressure switches

Differential pressure switches must be electromechanical piston-spring loaded type. Where provided for the purpose of monitoring differential pressure across filters, the differential pressure switch must incorporate local status indication.

Pressure switches used for plant protection must be electromechanical piston-spring loaded type.

Pressure switches with mechanical action must be fitted with snap-action contacts. Pressure switches must be adjustable for both set pressure and hysteresis

Pressure switches used for control and monitoring purposes may be either electromechanical piston-spring loaded type or solid state. Solid state pressure switches must be provided with an inbuilt display.

3.7. Level measurement

3.7.1. General

Liquid level must be measured by the following means, as appropriate:

- locally mounted gauges such as tubular gauge glass, transparent gauge glasses, reflex gauge glasses, hydrostatic pressure gauge, float-and-cable tank gauge and magnetic coupling float operated glandless indicator.
- locally mounted level switches such as magnetic coupling glandless switches, tuning fork switches and ball float switches.
- locally-mounted transmitters such as displacers, magnetic floats, differential pressure and ultrasonic beam.

Where turbulence or other undesirable conditions are present and are likely to introduce error, a still well is to be provided enable representative and stable level measurements to be made.

Glandless level instruments using magnetic coupling between the float and output device must be protected against the accumulation of magnetic deposits where present in steam or water by a flexible waterproof hood or other approved means.

Depending on the detection means, level transmitters and switches will be mounted external to the tank or vessel, and fitted with isolation, drain, vent or fill valves to permit on-load testing.

Level switches with mechanical action must be fitted with snap-action contacts.

3.7.2. Float level switches

Mobrey-style float style float switches are preferred.

3.8. Flow measurement

Where flow is measured by differential pressure devices, (e.g. Venturi tube, averaging pitot tube (“Annubar”) flow nozzle or orifice plate), materials of construction must be suitable for the particular service in which the device is located. Orifice plates and flow nozzles must be of stainless steel. Every orifice plate must have an integral tab or handle, which must extend at least 75 mm beyond the pipe lagging, or flange lagging and must have the following items permanently marked on the inlet face of the handle: orifice instrument number; orifice throat diameter; flange size, flange rating and "INLET". The identifying information must be located on the outer 25 mm end of the tab or handle for easy identification.

Where the environment is corrosive or may cause blockage of a tapping point, a continuous line purge system must be provided.

3.9. Actuators

3.9.1. General

Actuators must be totally integrated "smart" actuators with 4-20mA input.

All actuators must be of the same manufacturer and be of the one basic design.

Actuator selection and installation must be appropriate for the process conditions and operational duty.

When installing actuators the manufacturer's specification must be followed for ambient temperature, vibration and mounting angle, ease of maintenance and to ensure that the handwheel, local control switches and plug connectors are readily accessible. Scaffolding must not be necessary for operation and maintenance access.

Actuators must be constructed to IP66 and must operate over a minimum ambient temperature range of -10°C to 70°C and a relative humidity range of 0 to 95% non-condensing.

Actuator gearboxes must be oil or flow grease lubricated. Conventional grease lubrication is not acceptable.

Changeover limit switches, at each end of travel of the actuated device, must be provided and interfaced to the control system.

The manufacturer's nameplate listing all rated values must appear on each actuator.

3.9.2. Position indication

Each actuator must be fitted with a mechanical-type position indicator that must be clearly visible from the local control station.

All modulating actuators, all regulating duty non-modulating actuators, and seal in duty actuators with stop facility must be provided with a DC analogue position transmitter interfaced to the control system.

Regulating duty non-modulating actuators are those that have remote inching control or those that have a remote stop control.

The position signal must be 4 to 20 mA DC from a non-contact transmitter. All position transmitters must be suitable for resolving to less than 0.2% of actuator travel.

Actuators must have a solid method of fixing the position feedback to prevent unwanted drift. Friction clutch arrangements are not acceptable.

Actuators must have physical limit switches for end of travel position feedback.

3.9.3. Failure of control or power signals

The actuator must freeze in the last position, unless it is required to shut/open for process safety purpose, on:

- Failure of motive power;
- Loss of control signal to the actuator.

The actuator must only be released on return of motive power/control. Whilst frozen, the actuator position must not change by more than 1% of full travel.

3.9.4. Electric Actuators

Actuators must contain an electric motor, a hand wheel or equivalent, a torque and limit switch system and accessories fully wired to plug connectors.

Both power and control cables must be connected to the actuator via appropriate plugs and sockets.

Modulating electric actuators must be rated for the number of starts required to provide continuous control of the process under all conditions.

All actuators must be self-locking in all modes of operation including transition between manual and electrical operation.

Modes of operation

Actuators must be capable of three modes of operation:

Electrical - Remote

Each actuator must be normally operated from the control system.

Electrical - Local

Each actuator must contain open, close and stop push buttons and a local/remote control selector switch.

The stop push button must be a latch-in type and must be in-circuit in both local and remote modes of operation.

Manual - Local

Each actuator must be capable of manual operation by one person using the hand wheel. The hand wheel must clearly indicate the open and close direction of rotation and must de-couple when the actuator is operating under power. The hand wheel must be turned in a clockwise direction to close the device.

Manual operation must be completely independent of the power gear train. The maximum manual force for operation must not exceed 350 Newtons at the rim of the hand wheel.

Motors and protection

Each actuator motor can be either 230V AC single phase or 415V AC three phase and must have class F insulation or better.

Motors must comply with Annexure F – Low Voltage Motors.

Torque and travel limit switches

Each actuator must be fitted with a minimum of two physical limit switches at the open end of travel and two physical limit switches at the closed end of travel for use as integral controls and for I&C system inputs. Each limit switch must consist of one N/O contact and one N/C contact.

All limit switches not used for integral controls must be wired out to terminals.

Each actuator must be fitted with two sets of torque limit switches to operate in both directions of travel for integral controls and control system inputs. Where these are not required to limit travel such as on a parallel slide valve, they must be connected to prevent damage should the travel limit switch fall or the device become jammed. Torque limit switches must not be of the self-resetting type and once operated must remain set until the valve is driven in the opposite direction. For actuators operating on valves that seat on torque limit, means must be provided to prevent the torque switch from tripping during initial unseating of the valve.

Control circuitry and equipment

Electrical control equipment must be integral with the actuator, must be housed in a common compartment and must be readily accessible. The control supply must be derived from the three-phase power circuit and must be 24V DC.

A monitor relay must be provided. The monitor relay must have one normally closed contact wired to the plug connector. The monitor relay must provide a fault signal to the control system for control supply fail, incorrect phase rotation, motor overload, battery fail, remote control unavailable, and stop button latched-in. Monitoring of local operation must be provided in the HMI.

Remotely operated open and close control facilities must be provided.

Position control

A protection circuit must be provided to ensure that the actuator does not operate in the event of motor control failure.

Each modulating electric actuator motor must be controlled by a solid state position controller integral with the actuator.

All electric modulating actuator positioning controllers must be interchangeable and settings that must be readjusted in such cases must have sufficiently fine scales to enable 0.1% reproducibility of adjustments.

Non-modulating electric actuators

Reversing contactors must be supplied with each actuator. Two normally open auxiliary contacts, one from each contactor, must be wired in parallel and brought out to the plug connector to provide "device operating" feedback.

Modulating electric actuators

Each modulating actuator must be rated for thirty starts per minute with a load that would require it to take full stalled current for one second after each start at 60°C ambient temperature. The stall torque rating must be twice the operating torque value.

Actuator gearboxes and drive linkages

The actuator to drive element linkage geometry must provide:

- Adequate adjustable mechanical travel stops at each end of travel, fixed to the actuator housing and independent of actuator position limit switches,
- Correct link/lever geometry angle of 90 degrees at mid-stroke.

3.9.5. Pneumatic and Hydraulic Actuators

Valves position feedback must be 4-20mA.

Proximity switches must be used where limits are employed for binary feedback.

SMART digital valve positioners are preferred. Where SMART valve positioners are provided they must be provided which include internal diagnostics and provide digital communication for configuration and calibration over a 4-20 mA signal loop.

Local and remote valve position indication must be provided on all modulating actuators. Position detection must be provided with redundant position proximity switches (digital outputs) at each end of travel and position transmitters with standard loop powered 4-20 mA DC output signals (contact less LVDT transmitter, NOT potentiometer).

Solenoid valves must be supplied which provide high reliability and which have been proven by use in safety systems.

Pneumatic actuators used for shutoff valves and dampers as part of plant protection schemes, must have associated solenoid valves permanently energised to maintain the controlled device in the operational (i.e. non trip) state. Loss of power to the trip solenoids must result in the controlled device going to the trip state. Loss of actuating medium must also result in the controlled device going to the trip state.

In cases where solenoids are not used for plant protection, dual coil solenoids must be energised for a preset period only to cause a change of state of the controlled device. Provision must also be included to prevent drift when the solenoid is de-energised.

Solenoid valves must have a local mechanical button to enable an operator to operate the valve without any power supplies.

Solenoid valve controllers and their respective field power circuit breaker (if applicable) must be housed in dedicated cubicles.

Filters / regulators must be provided in the supply to the pneumatic and hydraulic positioners. Where the actuated device is required to “fail in place”, a pressure switch on the supply must detect low pressure and activate the lock up solenoids to maintain pressure on the diaphragm. Similarly failure of the analogue output channel or loss of I/O module power must also result in lockup in place of the drive.

3.10. Hazardous areas

3.10.1. General

Where hazardous areas have been classified in accordance with AS/NZS 60079, it is preferable to locate instrumentation outside the classified hazardous area.

Where the instrumentation is required to be located inside a hazardous area, the selection, installation, operation and maintenance must comply with AS/NZS 60079 series.

3.10.2. Equipment selection

The preferred method of protection technique for instrumentation in hazardous areas is Intrinsic Safety. Instruments installed in hazardous areas must meet the minimum requirements for Intrinsic Safety for the Zone classification.

Where Intrinsic Safety barriers are to be installed outside of a control cubicle, Intrinsic Safety barriers must be provided a separate enclosure for the sole purpose of housing the Intrinsic Safety barriers and related components.

All instrumentation and related equipment (i.e. barriers) must have a ‘Certificate of Conformity’ issued according to the ANZ Ex or IEX Ex schemes by an Australian Test and Certification body and carry the minimum marking as set out in AS/NZS 60079.11.

3.10.3. Equipment installation

Instruments in hazardous must be installed in accordance with AS/NZS 60079.14.

Where the instrument are connect to a process and the instrument comprises of single seal, an additional seal must be provided (i.e. a compound seal) to prevent the migration of the process down the cables and conduits.

3.10.4. Documents and records

The following documents and records must be provided as part of the design and installation of any instruments in hazardous areas:

- Certificates of Conformity
- All calculations undertaken to verify the instrumentation installation complies with the Intrinsic Safety requirements for the hazardous area classification
- Locations of each equipment, cables and enclosures
- Records of installation and commissioning