TELEMETRY AND INSTRUMENT INSTALL SPECIFICATION

REVISION 01 – 07/05/2021

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1. GENERAL

This standard specification furnishes information and sets out requirements for the installation of instrumentation and telemetry equipment.

All equipment and material shall be of a quality and type approved by the Engineer.

No equipment or material shall be installed unless it complies with the requirements of this specification.

All equipment and material shall be checked for suitability, quality and adherence to this specification. Every approval must be obtained by the Contractor prior to installation.

Any installation or installation procedure which is in contravention to this specification shall be made good or replaced, to the satisfaction of the Engineer, and all costs for making good or replacement shall be for the contractors account.

Failure to adhere to the requirements of this specification may result in the equipment or material being rejected by the Engineer.

2. STANDARD OF WORK

The complete instrumentation installation shall be carried out by skilled, competent and qualified operatives to the highest standard of safety and workmanship, using the correct tools for the operations and best quality materials.

A clean, orderly and safe environment shall be maintained in the Instrumentation Contractor's construction areas.

Cabling and wiring shall form a neat and functional appearance.

Work shall be planned such that access to equipment for the current installation or future maintenance shall not be obstructed.

The completed installation including supports, brackets, wiring, cabling and piping shall present a clean, tidy appearance and shall conform to good engineering practice.

The contractor shall install instruments and other equipment in accordance with the manufacturer's instructions, and the project drawings, taking due cognisance of the Standards and Codes listed in this Specification.

The standards and codes which shall apply to this project are those issued by the following organisations:

- ICASA – Independent Communications Authority of South Africa
- SANS 10142-1:2009. "The Wiring of Premises, Part 1 Low Voltage Installations".

- IEC 62305"Lightning Protection of Equipment".
- The Occupational Health and Safety Act, Act 85 of 1993, as amended.
- Deutsche Industrie Normen (DIN)
- American National Standards Institute (ANSI)
- The Instrumentation, Systems and Automation Society (ISA)
- DNP 3 level 4 communications protocol
- IEC/EN 61131-2
- IEC 61131-3 programming languages.
- CSA 22.2 No. 61010-1-12 and CSA 22.2 No. 61010-2-201
- UL 61010-1 and UL 61010-2-201
- FCC Part 15 Subpart B Class A (US)
- ETSI EN 300 113
- ETSI EN 302 561
- EN 301 489
- EN 60950
- EN 50383.
- EMC: EN 61000-6-2/6-4
- EMI: CISPR 22, FCC Part 15B Class A
- EMS:
- IEC 61000-4-2 ESD, Level 4: Contact: 8 kV; Air: 15 kV
- IEC 61000-4-3 RS, Level 3: 80 MHz to 1 GHz: 10 V/m
- IEC 61000-4-4 EFT, Level 3: Power: 2 kV; Signal: 1 kV
- IEC 61000-4-5 Surge, Level 3: Power: 2 kV; Signal: 1 kV
- IEC 61000-4-6 CS, Level 3: 10 V; 150 kHz to 80 MHz
- IEC 61000-4-8, Level 4: 30 A/m
- CE Marking Compliance
- American National Standards Institute (ANSI)
- The Instrumentation, Systems and Automation Society (ISA)

3. SUPPORT BRACKETING AND FIXING

The drilling of holes in structural steelwork is not permitted except with the prior written approval of the engineer.

The drilling of holes in vessels or pipework is expressly prohibited.

Mounting brackets shall be manufactured from hot dipped galvanised steel.

Instrument supports and mounting brackets shall be of a suitable strength and rigidity to ensure proper operation of the instrument. Careful attention shall be given to ensure that instruments are not mounted on or attached to equipment or structures which are subject to vibration. All proposed locations must be approved by the Engineer before installation.

Brackets shall in general, be made of hot dipped galvanised steel flat bar, angle or channel.

4. CABLE RACKS AND SUPPORTS

Cable racks shall be mounted in the vertical position. Racks shall not be mounted in the horizontal position without the prior written permission of the Engineer.

Cable rack/tray bends and tees shall be constructed as to allow all cables within trays to have a bending radius of not more than the manufacturer's specifications. No right-angle jointing of rack/tray shall be allowed.

Cable rack/trays shall be properly aligned and supported and the completed installation should have no visible deflection and be devoid of any distortion, kinks or sags.

The maximum distance between centres of adjacent supports shall be 1.5 metres. Additional supports shall be located at the joints of straight tray lengths and at every change in direction.

Supports shall be attached to permanent members of the building.

Cable racks to be fabricated mild steel and hot dipped galvanised similar or equal to the 'O' line support system.

Touching up after fabrication shall be by cold galvanising.

Hot dipped galvanised conduits shall be utilized for single cable runs to instruments from main trays.

Where required, any cable in danger of mechanical damage shall be protected by using galvanised pipe or channel. 25mm dia. galvanised conduit shall be used for cabling running inside a Water Tower.

Cable rack/trays shall be installed in accordance with the route diagram. Minor deviations in routing to avoid interference may be allowed subject to the approval of the Engineer. Where no cable routing drawing is available the cable routes shall be "site" determined in conjunction with the Engineer. Cable racks/trays shall be installed a minimum of 300mm above floor level.

Cable tray shall be linked across joints using 4mm^2 earth wire with a cable lug bolted to the tray at each side of the joint. Cable tray runs shall be earthed.

All cables run on racking or in conduit shall be fully supported to within 150mm from the gland entry on the equipment serviced or as cable size dictates.

5. CABLING AND WIRING

Cables General

Cable sizes, number of cores and cable number shall be as indicated on the cable schedules.

Cables shall be tested per drum length on delivery to site prior to installation. Results shall be documented.

Cable drums shall be rolled in the proper direction to prevent loosening of the cable. Cable shall be drawn into position using a sufficiency of rollers and cornering apparatus to avoid damaging the cable by excessive bending or dragging.

Cable shall be stored in dry areas.

The contractor shall observe the manufacturer's recommendations for minimum bending radius but shall never use less than the following radii:

- Unarmoured cables: 5 times the overall outside diameter of the cable.
- Armoured cables: 10 times the overall outside diameter of the cable.

Clips, saddles or clamps for securing of cables shall have smooth and rounded edges and shall not damage the cable sheath of serving. The type of saddle or clamps shall be approved by the Engineer before installation commences.

Instrument signal and electric power may not run bunched in the same rack/tray. If instrument cables are required to run on the same cable rack as electrical cables, then they must be installed on opposite sides of the rack/tray to ensure maximum separation.

To avoid interference arising from electrical power supply voltage dips or spikes, instrument signals and electrical power cables shall only cross at right angle to each other.

On no account shall instrument signal and electrical power wiring be transmitted in the same multi-core cable. Solenoid coils of 24V DC may be run with instrument switching signals.

Instrumentation cables may only be installed a maximum of 2 deep on racks if approved by the Engineer.

Joints in cables are permitted only where the length of the run exceeds the standard manufactured length of cable available on a drum. In these cases, the joints shall be made in a junction box mounted above ground for ease of access. No through jointing of cables shall be permitted on cable racks/trays or in any cable way.

All cables shall be labelled at each end with a strap on plastic marker tags bearing the cable number as shown on the cable schedule. (Black letters on a yellow background).
All cables shall be mechanically anchored at the position of termination using flanges of the correct size, as follows:

- Where equipment supplied is provided with cable entries having DIN, NPT, etc., threads, the contractor shall provide all necessary adapters to permit the use of standard ISO Metric thread cable glands.
- Where glands are to be used with non-threaded clearance holes, a heavy-duty lock-nut, together with suitable weatherproofing gaskets shall be provided. Holes with a tolerance greater than 1.5mm larger than the gland size shall not be accepted.

- Cables shall always be made off according to the gland manufacturers recommendations.
- When glanding off SWA cables in non-conducting enclosures the gland shall be provided with an internal earthing washer and connected to a suitable earth connection.

Cable Termination and Connection

All instruments, control panels, junction boxes, etc., shall be wired in accordance with the relevant project drawings.

Each conductor shall be fitted with an insulated double crimp lug of the correct size. Pin lugs shall be used for pressure type terminals. Ring or spade lugs shall be used for post type terminals.

A proprietary type of wire stripper must always be used. The stripping tool must be checked regularly and is subject to inspection by the Engineer. The termination of stranded conductors where one or more strands have been damaged or broken is expressly prohibited.

The crimping tool used for attaching termination lugs shall be of the ratchet type which requires a specific amount of pressure prior to release, recommended by the manufacture of the crimp lugs.

All wires are to be terminated. Spare terminals shall be provided for unused pairs or cores. All spare terminals of field multi-cores shall be connected together and bonded to instrument earth.

Terminated wires shall be arranged neatly and loomed where necessary using cable ties. Spiral lacing shall be used for flexible or semi flexible looms.

Each wire shall be numbered with the respective terminal number by means of interlocking slip-on plastic ferrules of the correct size. Split or clip on ferrules are not acceptable. The ferrules shall be a tight or interference fit on the wire.

Cable colours:

- Normal signal cables - Purple outer sheath
- Earth cables - green

Conductors to be 0.5mm flexible stranded twisted copper wire for normal instrument signals and 1,5mm for solenoid valves.

Nylon washers shall be put on all cable glands and cable gland adapters on weatherproof boxes.

Cables must not be trapped in lagging.

Cables to field instruments must have at least 30cm slack which should be neatly looped before the instrument.

Cables incorporating shields or screens shall have the shield or screen isolated for electrical earth throughout its length and it shall be earthed only at the point indicated on the drawing

Only cable in the following standard sizes shall be used:

1 pair	8 pair
2 pairs	12 pair
4 pairs	24 pair

For field instrumentation power supply only 3 core S.W.A. or Dekaron cable shall be used.

The approved cable is Dekaron type 1853 for single pair and1875 for multi pairs. The conductor size shall be 0.5mm² for all instrumentation signals unless specified otherwise in the instrument cable schedule.

Cables are to be labelled according to the cable schedule.

6. JUNCTION BOXES

Junction boxes must be numbered on the door or lid with an engraved plastic type label having numbers at least 5mm in height. (Refer section 12 Instrument Labels).

Terminal rails and individual terminals shall be numbered.

An earth plate or rings for the cable glands shall be put in the bottom of each junction box, where required.

Cables must enter from the bottom of the junction box.

Spare holes for cable glands must be plugged with the approved type of plugs.

Shield wires must be strapped together.

The box must be classified IP65 or better.

The box must be mounted securely.

Junction boxes shall be polycarbonate. Painting or other colouring is not required.

Figure 1: field wiring through Junction Box

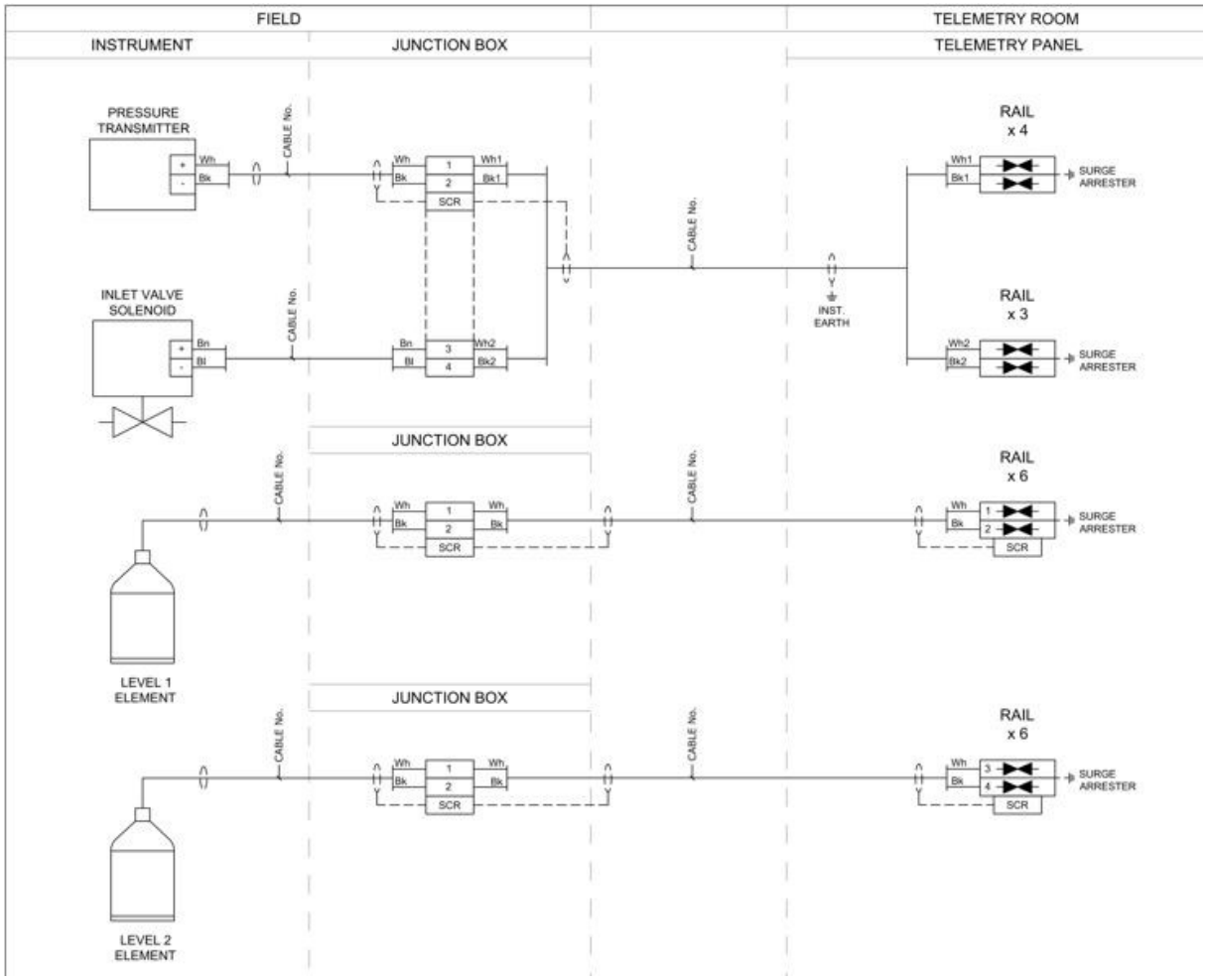
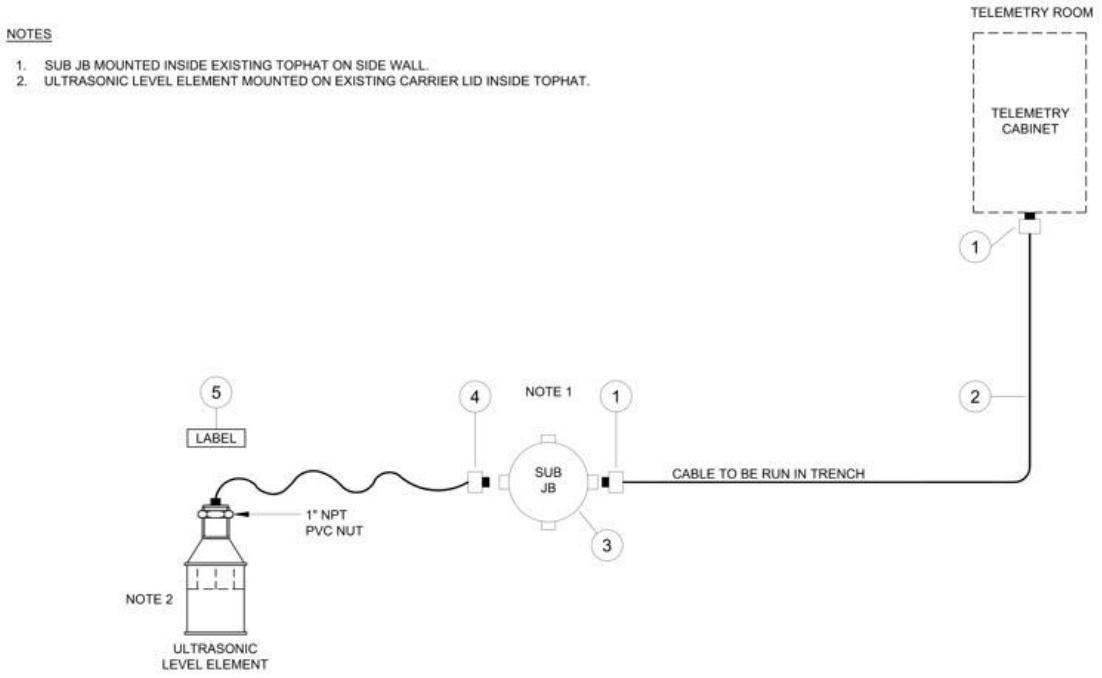


Figure 2: Cables through Junction Box



7. TELEMETRY CABINET

7.1 CONSTRUCTION

Telemetry assemblies shall be wall mounted, with front access, suitable for bottom cable entries from cable trenches below the assembly. The schematic drawings or project specification show the specific requirements applicable to each assembly.

The assembly shall be constructed of electrolytically deposited zinc coated metal steel sheet similar to Zintex manufacture, having a minimum thickness of 2mm except for gland plates which shall be a minimum of 3mm. If thinner material is offered, the construction technique must be approved by the Employer's representative prior to fabrication. The assembly shall be powder coated.

The degree of protection shall not be less than IP 55, in accordance with SANS 1222 and capable of withstanding the temperature, humidity and conditions normally associated with heavy industrial applications. The assembly shall be fully vermin proofed. The cabinet shall be fitted with a removable gland plate positioned at the bottom of the panel. All cabling shall enter through this gland plate only.

The manufacturer's detailed working drawings of the assembly must be approved by the Employer's Representative before any fabrication commences. Any other construction or type of assembly proposed as an alternative to that specified, must have the approval of the Employer's Representative in writing.

In general, the panel shall be Siemens Grey, but the final colours are to be confirmed with the Employee's Representative.

7.2 PANEL WIRING

220 V AC	-	Brown
Neutral	-	Blue
+24 V dc	-	Red
-24 Vdc	-	Black

Each end of the conductor shall be terminated in a pre-insulated, pin type lug, applied by means of the recommended colour coded crimping tool. All control wiring shall be clearly marked by interlocking plastic ferrules, the numbers corresponding to wire numbers on the schematic diagrams.

If control and/or supervisory wiring is required for equipment which is installed on the doors of the panel the wiring shall be bunched together and suitably strapped with spiral binding in the form of a vertical "U" loop between the door and the panel, to ensure that there is no tension on the wiring when the door is rotated along is vertical axis. Approved wiring supports shall be fixed onto the hinged panels, to relieve the weight of the cables off the equipment terminals. Each door shall be suitably earthed.

Ensure correct sizing of lugs to wire dimensions where two wires need to be grouped together then double entry bootlace lugs shall be used

There shall be no joins for lengthening of incoming cables/wires

Telemetry panel wires shall be neatly grouped utilizing correct slots of trunking only 1mm panel wire shall be used for 24 vdc positive wiring

Only 1.5mm panel wire shall be used for 24vdc negative wiring. Earth for DB Boards shall be green 2,5mm

Only one common shall be taken to MCC. One common only shall link different modules/boards.

10mm earth wire shall interconnect Telemetry Panel and Earth Bar.

Mains supply shall be via 2,5mm 2 CORE ECG cable, armoured – No Surfix shall be used.

All cable shields shall be neatly twisted together and terminated to an earth terminal in the Telemetry panel.

Return cables should be fed via appropriately sized PVC conduit to the nearest cable tray which feeds the Telemetry panel.

Incoming cables/wires shall be cut to size with no excessive slack or bundling of cable/wires.

7.3 SURGE PROTECTION

Where specified the Telemetry System shall be equipped with surge protection devices of an approved manufacture and bearing the SANS mark.

The available incoming 230VAC supplies on each site shall be regarded as an industrial supply and as such shall be fitted with surge protection.

Equipment which is connected to signal lines of any type which run for any distance outside a building, shall be surge protected to survive twenty 8/20 microsecond current impulses with maximum amplitude of 10 kA when applied in common mode between the signal lines connected together and to the system earth. Ten of the test pulses shall be applied as positive pulses with respect to earth and the other ten as negative pulses.

In addition, the protected equipment shall be able to survive 8/20 microsecond current impulses with maximum amplitude of 2 kA when applied in differential mode.
The test pulses shall be at intervals of not less than one minute.

Surge protection devices shall be chosen in such a way that the protected circuit shall still function to specification despite the introduction of series and/or shunt impedances by the protecting devices.
The above test specifications are based on recommendations of the Council for Scientific and Industrial Research (CSIR report No Ek/85/6/1.)

8. RADIO ANTENNA

Remote Sites will utilize a Half Wave Dipole antenna mounted on a 6m pole.

Repeater sites will utilize Collinear 6db gain antenna mounted on a 2m pole.

Base Station equipment will utilize a Yagi specification antenna mounted on a 6m pole.

Different antennas have different terminations; the Contractor shall ensure that the correct N type fitting is used.

The antenna requirements listed should be based on the results of a computer based radio path study which is done prior to installation.

9. EXISTING TELEMETRY ROOM

9.1 FLOOR

The Contractor shall strip the existing floor coating where required and shall prepare the concrete surface in accordance with the floor coating manufacturer's recommendation to receive a screed coat, primer and two coats of a two component, solvent free, water dispersed, and polyamide-cured epoxy emulsion floor coating with a semi matt finish such as abe.cote 337 epoxy floor coating. The floor coating shall cover the entire floor and shall have a wet film thickness of 100µm.
The Contractor shall ensure that the final floor levels do not hinder door opening and closing. (colour)

9.2 PAINTING

After removal of all redundant brackets and fixtures lightly chip away and remove loose material. Patch using Prostruct 528 VO-MCI or similar. Protect patched from rapid evaporation.
The *Contractor* shall prepare the surface of the walls stripping loose any flaking paint completely and shall apply a suitable primer prior to painting all in accordance with the manufacturer's recommendation and specification.
The internal walls and ceiling of the Telemetry Room shall receive two coats of Dulux Weatherguard or similar approved acrylic polymer paint with a textured, matt finish. Each coat shall have a dry film thickness of 50 - 75µm and a spreading rate of 4-6m² per litre.
The paint colours are to match the current colours of the respective elements. (colour)

10. SECURITY SAFE DOOR

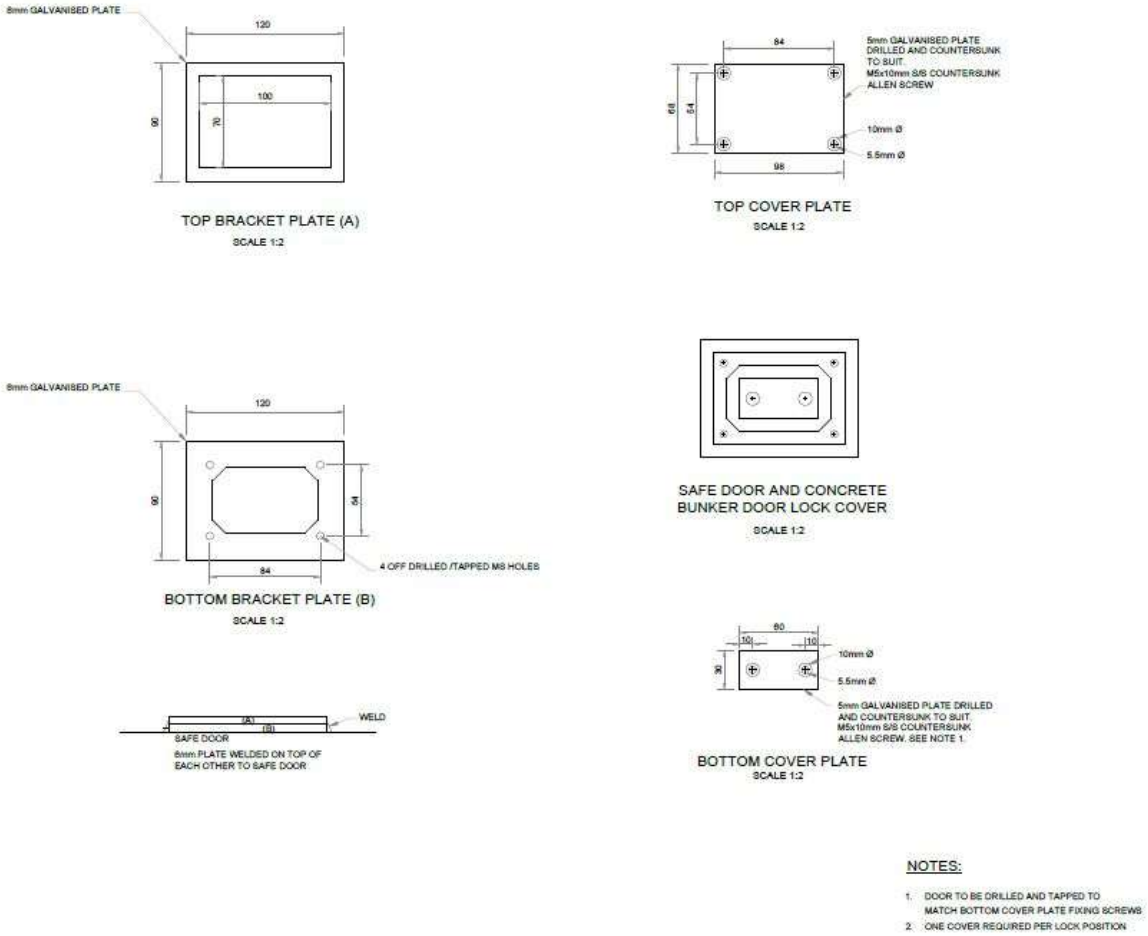
Each Telemetry room shall be fitted with a security type safe door. Doors are to be supplied and installed complete with outer frame. The door shall be fitted with an 8-bolt locking mechanism and shall have a removable door handle and a 7-lever security keylock. The keylock shall be fitted with a recessed cover plate secured by means of 4 countersunk Allen screws. The doors outer plate shall have a minimum plate thickness of 6mm. The door shall be hinged on the right-hand side. Both the door and frame shall be hot dipped galvanized.

Doors referred to as D1 in the BOQ shall be fitted with a Multilock A380AL lock.

Table 1: Door Specifications

Specifications	
Description	Zinga Door or similar approved by the Engineer
Door	Overall thickness – 120mm
Outer Plate	6mm
Corrosion Protection	Hot Dipped Galvanised
Boltwork	8 Bolts of 40mm diameter – 4 front and 4 back
Locking:	D1: A380AL Multilock D2: H4 Key
Approximate Weight	180kg
Finish Spec	Zinga Paint
Wall Opening	1970H x 870W mm
Door Opening (180°)	1883H x 760W mm
Over door frame	2032.5H x 1000W mm
Door Clearance Diameter (180°)	1617.5mm
Projection of Door (180°)	192.5mm
Locking:	D1: A380AL Multilock D2: H4 Key

Table 2: Door Locking Plate



11. NEW TELEMETRY ROOM

11.1 Foundation

Excavate a 3.5m x3.5m area to a depth of 630mm. Compact bottom of excavation to 93%Mod AASHTO. Spray bottom and sides of excavation with soil poisoning. Fill excavated area with 450mm deep G6 classified selected fill in 150mm layers, compacting each layer to 95% Mod AASHTO. 2 x 100mm PVC cable sleeves shall be cast into the slab and shall exit at right angles into an adjacent trench for cable entries through the slab and into the new security
Building.
Lay down 250micron damp proof membrane and cast 25 MPa foundation slab, 180mm thick. The foundation slab shall be cast with Ref 617 mesh placed 40mm from the top and bottom. Apply curing compound once the concrete has set and keep covered with a hessian cloth/sand for a period of 7 days.

11.2 Concrete Security Room

The contractor shall supply and install on the prepared concrete slab a pre-fabricated concrete Security Room complete with a Security Safe Door as described here in Item 10. The room shall have a minimum size of 2.04 x 2.04 x 2.4m high and shall have a flat overhanging roof and solid base. The walls, roof and base shall have a minimum thickness of 100mm. Two 100mm cable entry points shall be cast into the base of the room and shall align with the PVC pipes cast into the foundation. The Security Room shall be manufactured using 45 mPa concrete with 10mm re-enforcing bar in combination with high strength 42,5N power Crete

Doors on bunkers used for 'Low Power' remote telemetry units shall be fitted with a Multilock A380AL lock.
Doors on bunkers used for solenoid valve assemblies shall be fitted with a new H4 lock.

12. CONCRETE BUNKER

A secure concrete bunker shall be provided for remote mounted equipment which does not have mains power available.
The bunker shall be manufactured using 45Mpa concrete with 10mm reinforcing bar in combination with high strength 42,5N power Crete. The bunker shall be fitted with a stiffened 800 x 600 x 6 galvanized mild steel door. The door shall be fitted with a keyed double throw dead bolt lock. Hinges shall not be visible or exposed and shall be welded to the reinforcing cage. The bunker shall be fitted with a galvanized mild steel chassis plate for mounting of equipment. A galvanized steel gland plate shall be provided at the base of the bunker for cable entry.

13. EARTHING SYSTEM

A solid copper earth bar shall be provided inside each Telemetry room. The earth bar shall be supported on robust spacers.

The earth bar shall have a cross-section of not less than 40mm x 6mm and shall be drilled with the requisite number of holes for the individual connection of all cable ECC and other earth conductors.

High tensile phosphor bronze or cadmium plated nuts, bolts and lock washers shall be provided through the earth bar at each earth position and at least 5 additional holes shall be provided for future connections, each being fitted with nuts and bolts as above.

The earthing positions shall be evenly spaced along the length of the earth bar and the bar must be clearly identified as the earth.

All equipment shall be bonded, to prevent unequal potentials. As a minimum there shall be 2, 1.8 m copper rods spaced 2m apart.

Figure 3: Earth Feed into room

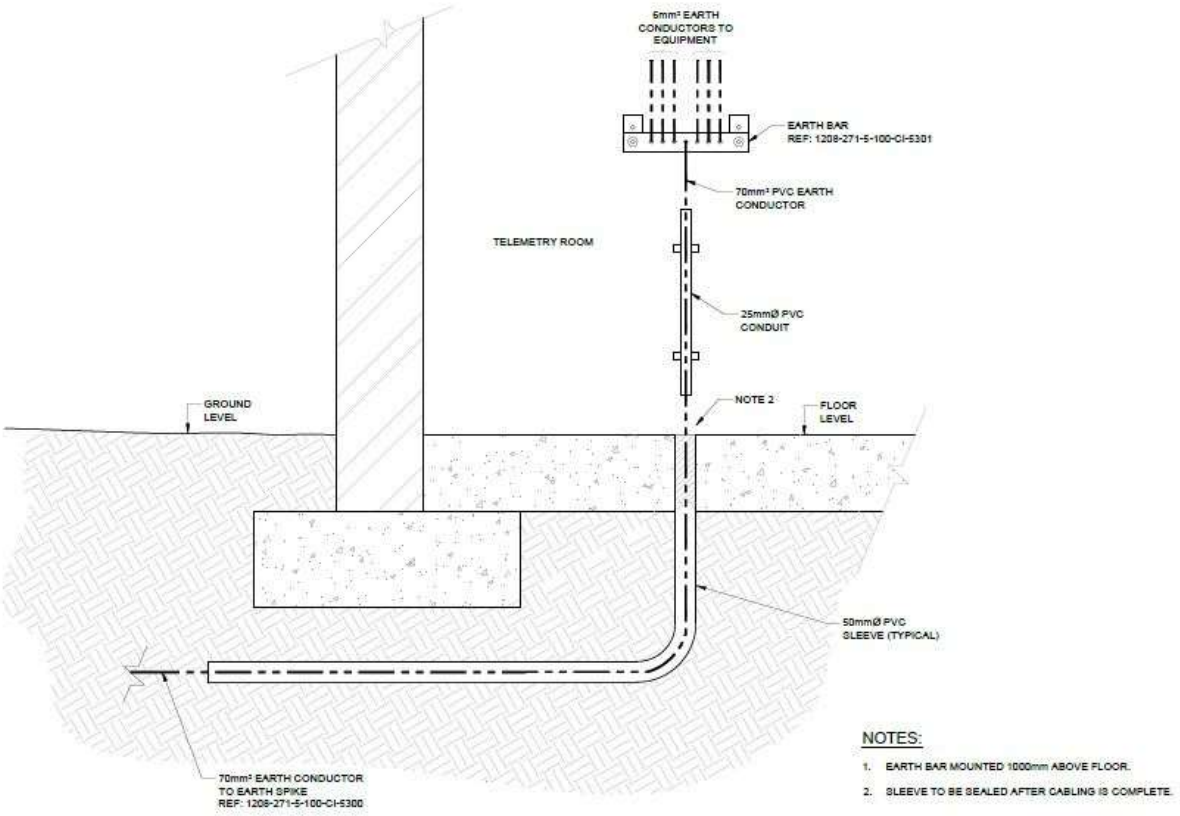
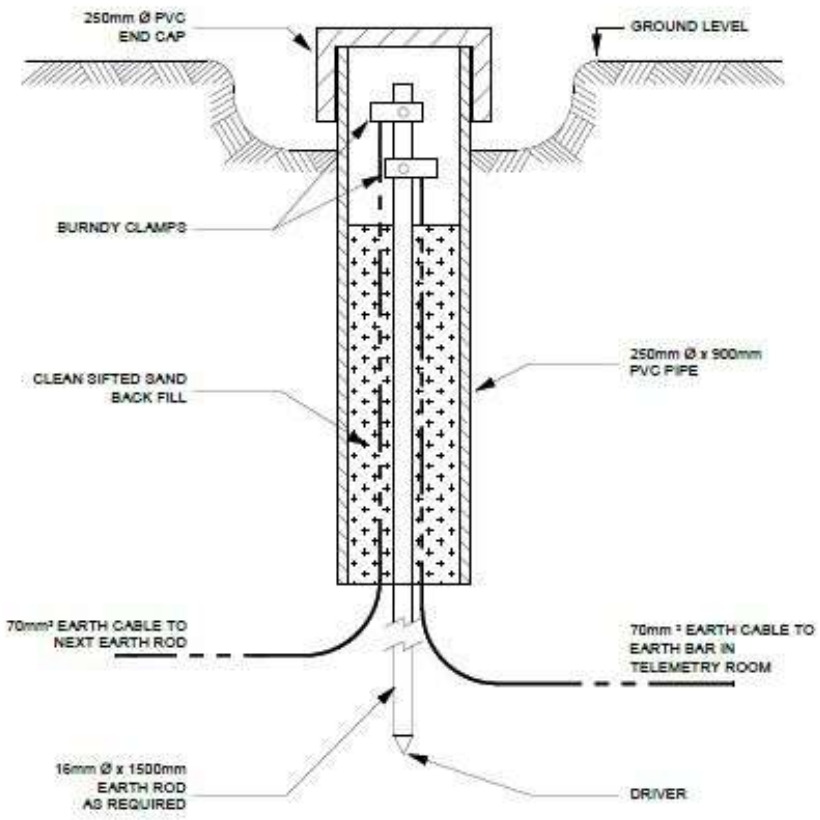


Figure 4: Main Earth Electrode

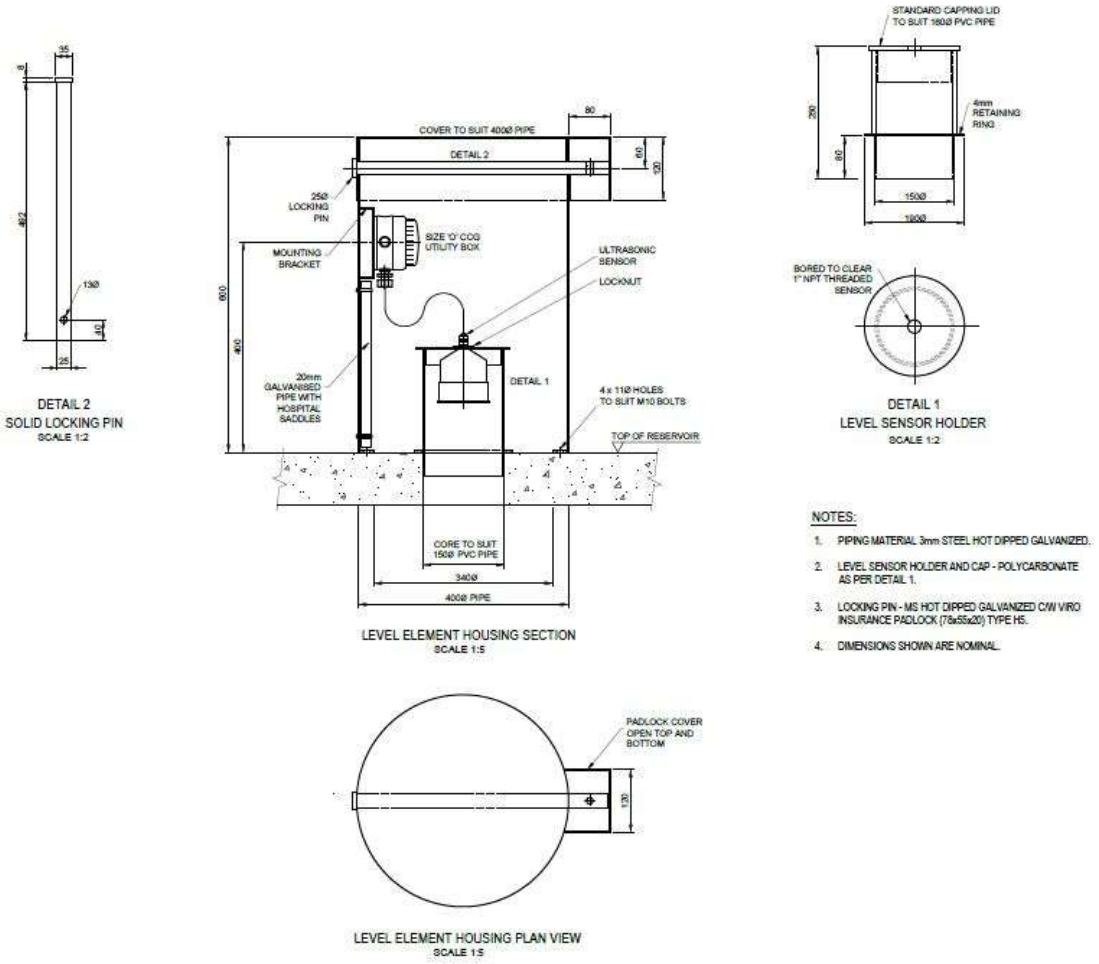


14. INSTRUMENT TRANSDUCER CORING (WHERE APPLICABLE)

Transducer coring shall be 150 mm in diameter, and shall be cut no less than 1.5m from reservoir walls, clear of any internal obstructions, and near to the outlet to minimize turbulence. Before coring commences the position shall be approved by an EWS appointed engineer. The coring shall be enclosed with a galvanized lockable Top Hat as per general arrangement drawing.

A 20mm Size ‘0’ CCG box shall be installed inside the Top Hat for termination of transducer and corresponding outgoing cable.

Figure 5: Transducer housing and Layout



15. INSTRUMENT LABELS

Each instrument shall be fitted with a label giving the function and tag number as detailed in the label schedule. Field mounted instruments including final control elements shall have labels mounted on a bracket which is fixed independent of the instrument and stays in position if the instrument is removed. The label must be in a clearly visible location.

Labels shall be made of laminated trafolite and have black letters on a white background.

The size of the labels shall be:

Type 1	Field Instruments/ Transmitters/ Control Valves	80mmW x 30mmH
Type 2	Cabinets/ Field Junction Boxes	200mmW x 30mmH
Type 3	Terminal Rails	39mmW x 18mmH
Type 4	Power Supplies	70mmW x 20mmH
Type 5	Power Rails	15mmW x 10mmH
Type 6	Marshalling Cubicles	150mmW x 50mmH
Type 7	Distribution Boards	150mmW x 50mmH

The type number shall be included in the label schedule with the letter size.

16. INSTRUMENT NUMBERING

The instrumentation shall be tagged according to the following system:

- Prefix: Site Number
- Instrument type: modified ISA abbreviation
- Instrument number: sequential number e.g. 55-LT-02
- Site Number, level transmitter, 2nd instrument in that area.

17. LEVEL INSTRUMENTS

17.1 Where there is a concrete Water Tower:

- A Hydrostatic Level Instrument will be utilized
- Appropriately earthed surge arrestors to be installed on both ends of the cable.
- Any derived control will be done within the PLC

17.2 Where there is a Steel Water Tower:

- An Ultrasonic Level Instrument will be utilized

- Control will be direct from the Instrument

17.3 Where there is a Reservoir:

- An Ultrasonic Level Instrument will be utilized
- Control will be direct from the Instrument

18. LAYING CABLES IN PREPARED TRENCHES

Before the cables are laid, the bottom of the trench shall be covered with a 75mm layer of earth which shall have been passed through a sieve with a maximum mesh of 4mm.

The cables shall be laid on the prepared bed carefully to avoid cuts and damage. Dragging along the ground shall be avoided wherever practicable. Cable rollers shall be used.

Where more than one cable is laid in a trench, the cables shall be spaced apart at a nominal 75mm centres, and in straight run trenches, cable crossing shall not be permitted except where cables may have to branch from the main run. At every draw-in point or joint box, the cables shall be snaked.

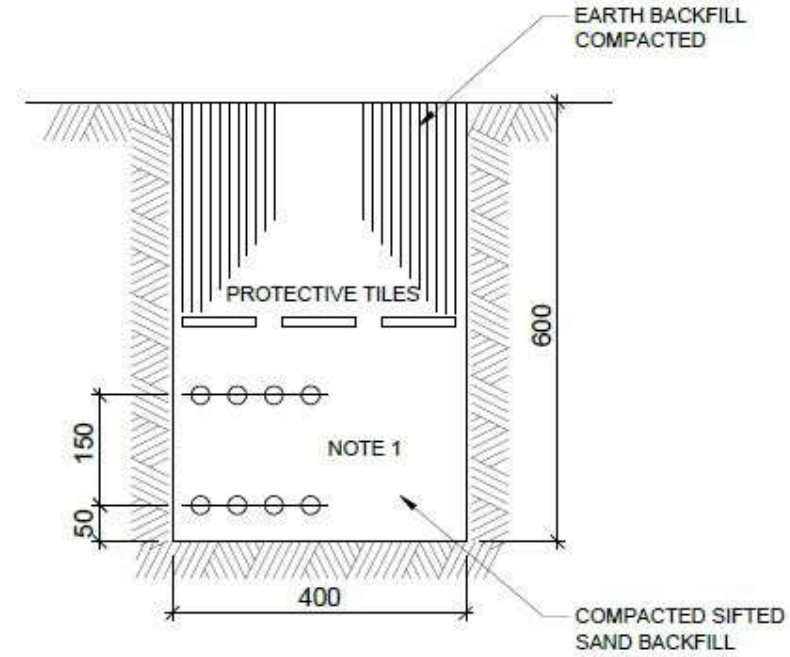
The trench shall be back-filled as soon as possible after cable has been laid. To prevent theft and possible damage, long lengths of cable shall not be left exposed in an open trench overnight.

Water shall not be allowed to accumulate at any part of the works. The Electrical Contractor shall ensure that no cable laying is carried out until the trenches are free from water.

All side channels, sumps or temporary excavations for dewatering purposes shall be filled in after use.

Cables shall be covered with a layer of 75mm min. depth of earth which shall have been passed through a sieve with maximum mesh of 4mm.

Figure 6: Prepared Trench



NOTE:

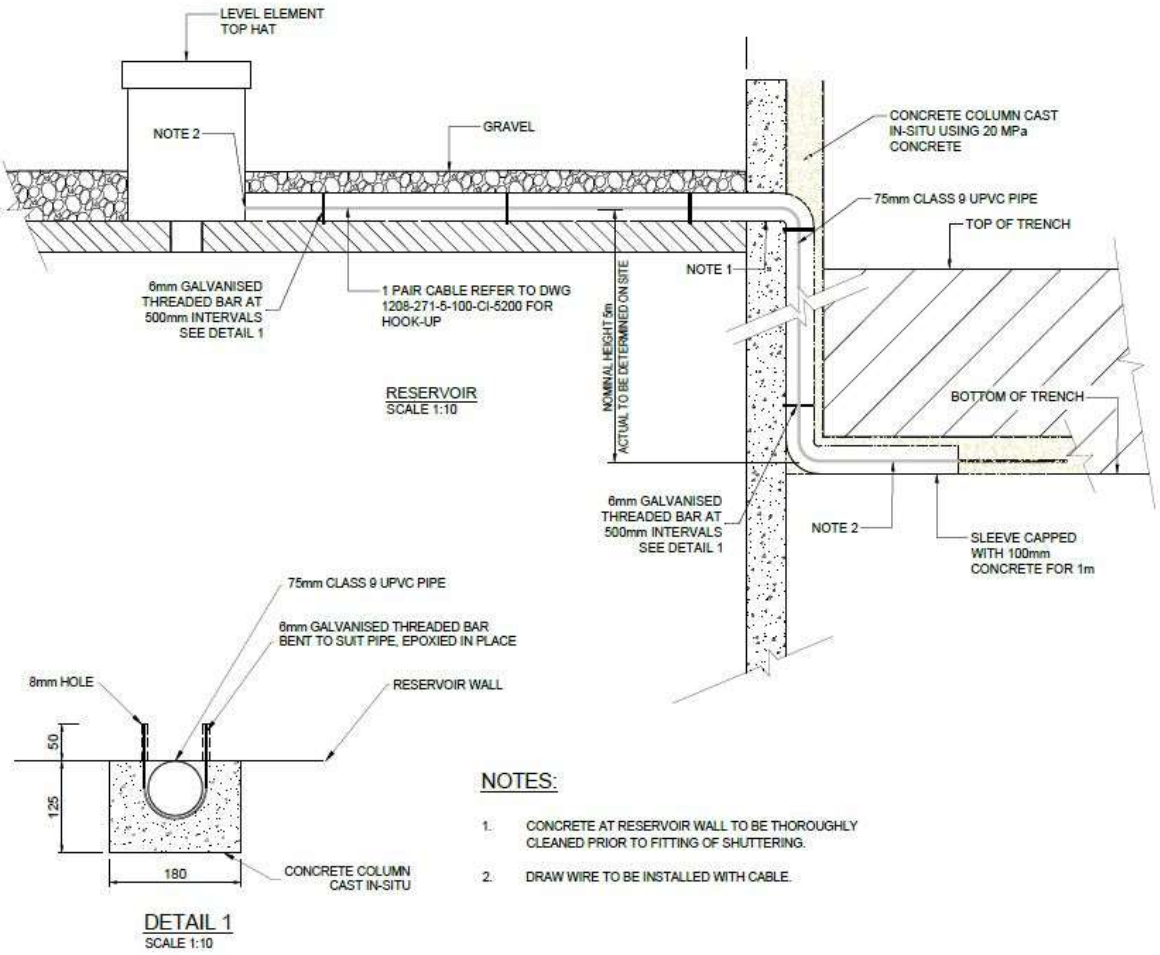
1. POWER CABLES TO BE LAYED ON TOP LAYER

CABLE TRENCH IN SOFT GROUND

Cables shall be concrete encased, 2 meters from ground exit points.

Where cables run up or over a reservoir they should be neatly encased in concrete with no parts visible.

Figure 7: Cable Protection



Trenches shall be a minimum of 600mm deep and 400mm wide.

Unless otherwise noted, all cables shall be covered with a light-yellow plastic warning sheet of approved design with the skull and cross bones insignia together with the words "DANGER, GEVAAR, INGOZI" printed in black at regular intervals. The warning shall be placed 300mm above the top of the cable.

19. 10 WAY DISTRIBUTION BOARD

One light fitting shall be installed on the ceiling of the Telemetry room and wired back to the local DB in PVC conduit.

A one lever one-way light switch shall be installed inside the Telemetry room near the door at a height of 1.4 meters above FFL.

One double 16 Amp socket outlet shall be installed within one meter of the Telemetry panel at a height of 1.2 meters above FFL.

All lights and plugs shall be wired using GP wire in 20mm PVC conduit in accordance to SANS 10142-1.

All circuits must be clearly marked on the DB face panel.

The Telemetry panel shall be supplied by a 6A CB which is not on Earth Leakage.

The incoming supply shall be fitted with a Surge Protection unit.

20. INTRUDER ALARM

The contractor shall supply and install a dual technology Microwave and PIR motion detector in the Telemetry Room or Pump Station building mounted between 2 – 3 m on the wall facing the access door. The motion detector must have a 180-degree detection beam with a minimum range of 10 (ten) metres. The power supply for the detector shall be 24 V DC with a dry contact alarm output.

21. EQUIPMENT LIST

To list all equipment supplied on any one site. The list shall include a detailed description of the type of equipment supplied, the make, model and serial number as well as forming an index to loop diagrams and data sheets.

22. INSTRUMENT DATASHEETS

To gather and co-ordinate all information from process, mechanical and electrical disciplines related to a particular instrument. This document shall be used for procurement purposes as well as by the RTU/Scada programmers, Commissioning personnel and maintenance personnel. Each Instrumentation and equipment shall have a data sheet.

23. HOOK-UP DRAWINGS

Each type of instrument shall have a typical drawing showing installation details including the termination of cables and process connections. This shall also list the instrument tag numbers that are applicable to the specific hook-up as well as all the materials required for installation.

24. SITE NETWORK DIAGRAM

This shall show the overall site network design including all telemetry, HMI, PLC, standalone controllers, motor control centres, fibre optic converters, masters and all nodes on the network.

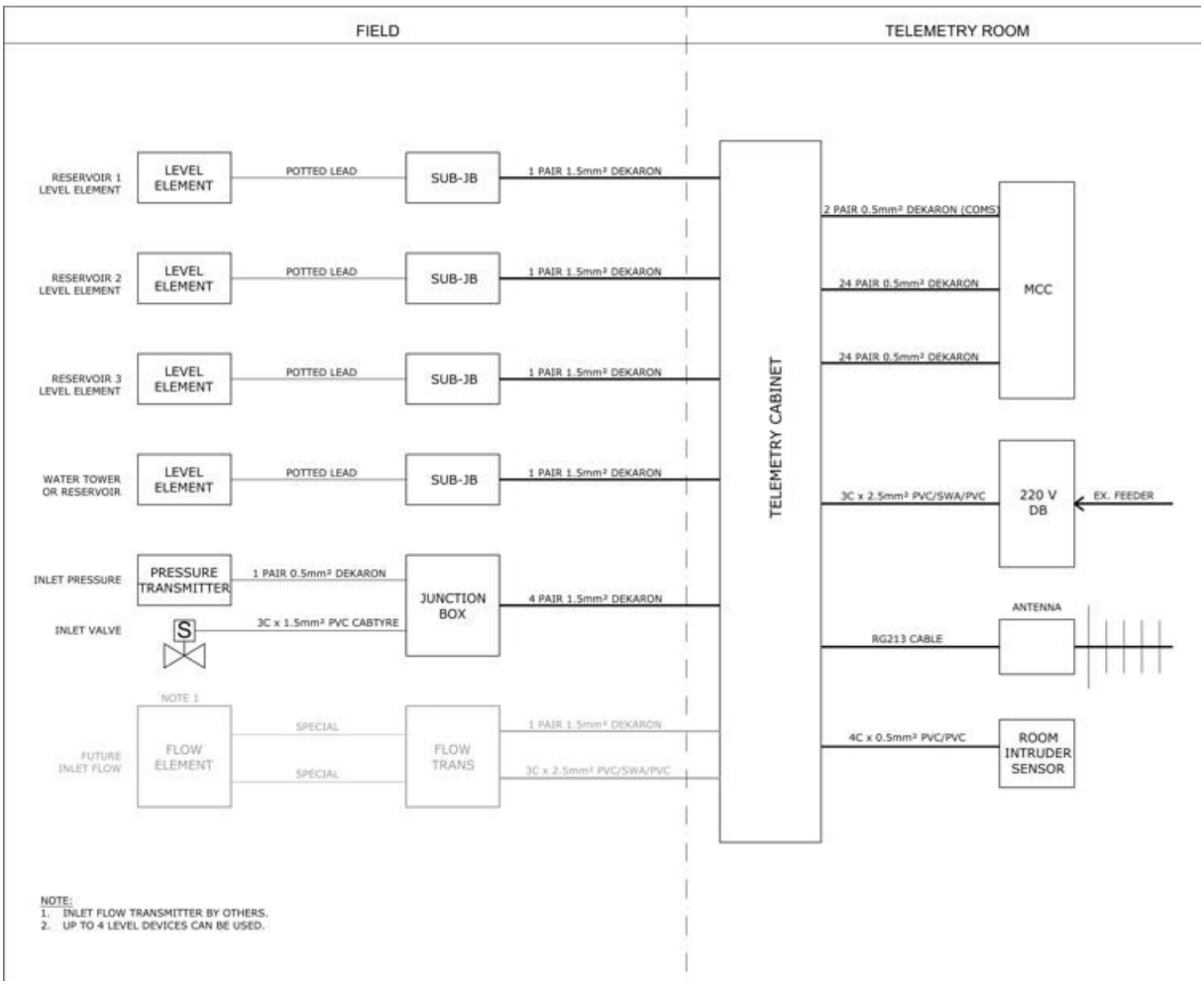
25. INSTRUMENT LOCATION DRAWING

This as-built site layout drawing shall be generated by the Contractor to physically locate all field instruments, junction boxes, control panels, and cable trenching routes.

26. CABLE BLOCK DIAGRAMS

This is used to allocate instruments to junction boxes/equipment and lay out the flow of signals between components. This document shall show all equipment as well as cabling.

Figure 8: Block Diagram



27. CABLE SCHEDULES

This is to list all cables, cable types, sizes and number of cores. This shall also indicate from where and to where the cable runs as well as the length of the cable run. The contractor shall develop the as-built schedule from the tender cable schedule provided.

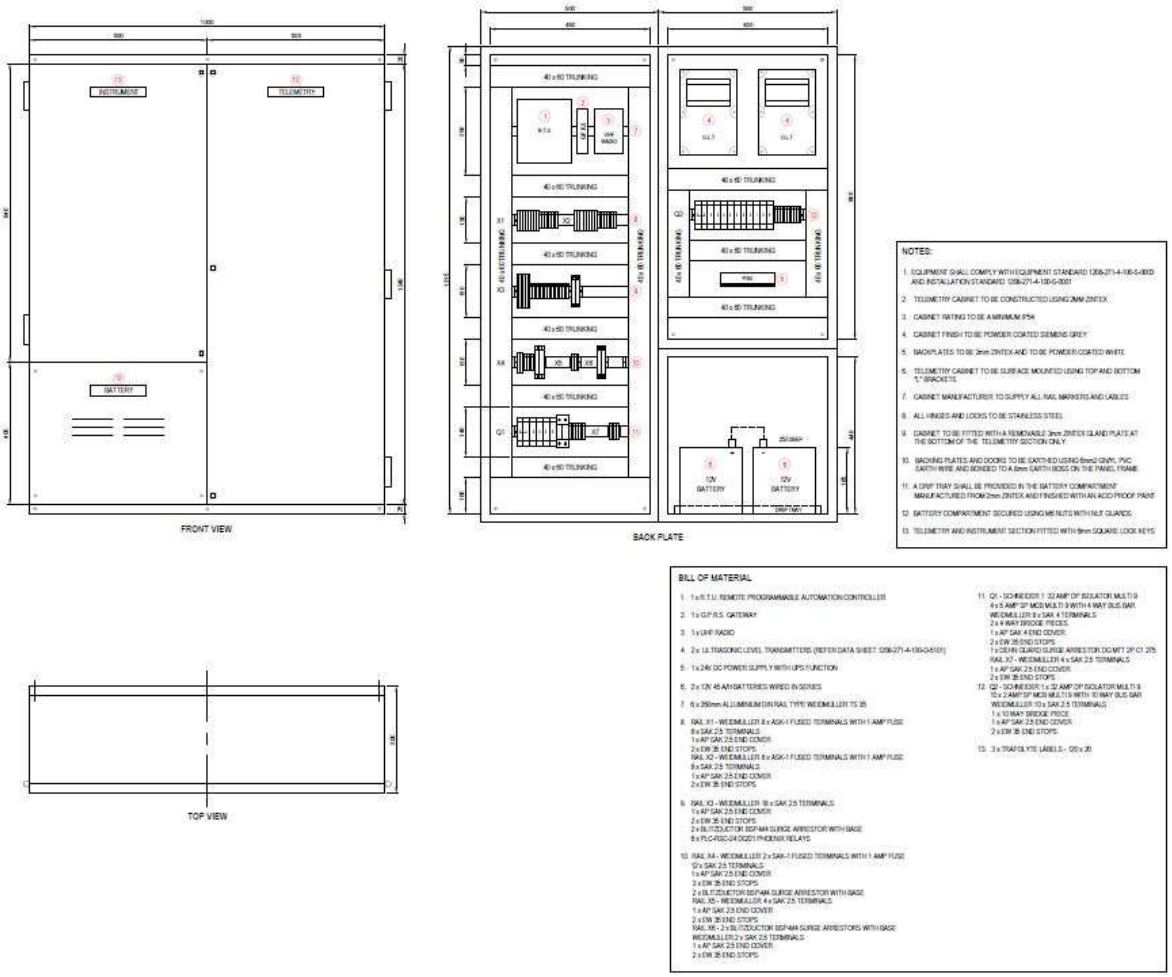
28. INPUT OUTPUT SCHEDULES

This is a list of all the inputs and outputs to the RTU's listed according to type and arranged per I/O card. This shall be for use by the panel manufacturers for panel construction as well as by the RTU programmers. The contractor shall develop the as-built schedule from the tender IO list provided.

29. TELEMETRY PANEL GA

This document shall be used for manufacturing the Telemetry Panel and shall include sufficient detail for the manufacturing together with the back plate lay out and assembly. All materials and equipment shall be fully itemized and listed on the drawing together with quantities.

Figure 9: Telemetry Panel GA



30. WIRING DIAGRAMS

Instrument wiring diagrams shall provide detailed information of all wiring contained within a panel or junction box and shall include such things as RTU I/O, 24V DC and 220V AC power, relays and any other auxiliary equipment wiring. The diagrams shall be comprehensible enough to fully construct and test the equipment.

31. LOOP DIAGRAMS

The instrument loop diagram shall be used as a maintenance and fault-finding document. Various bits of information for a particular loop shall be summarized onto a single document. The contractor shall be responsible for the development of the as-built loop drawings.

Figure 10: Transducer wiring

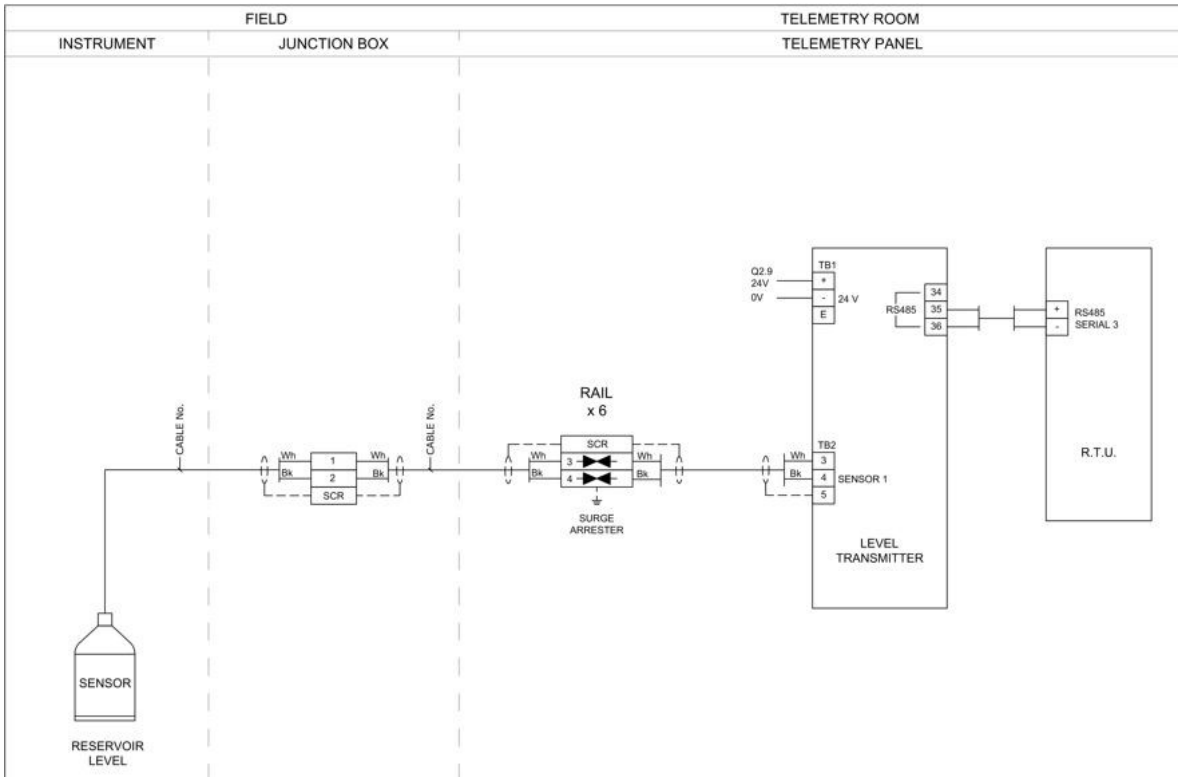


Figure 11: Pressure TX Loop Diagram

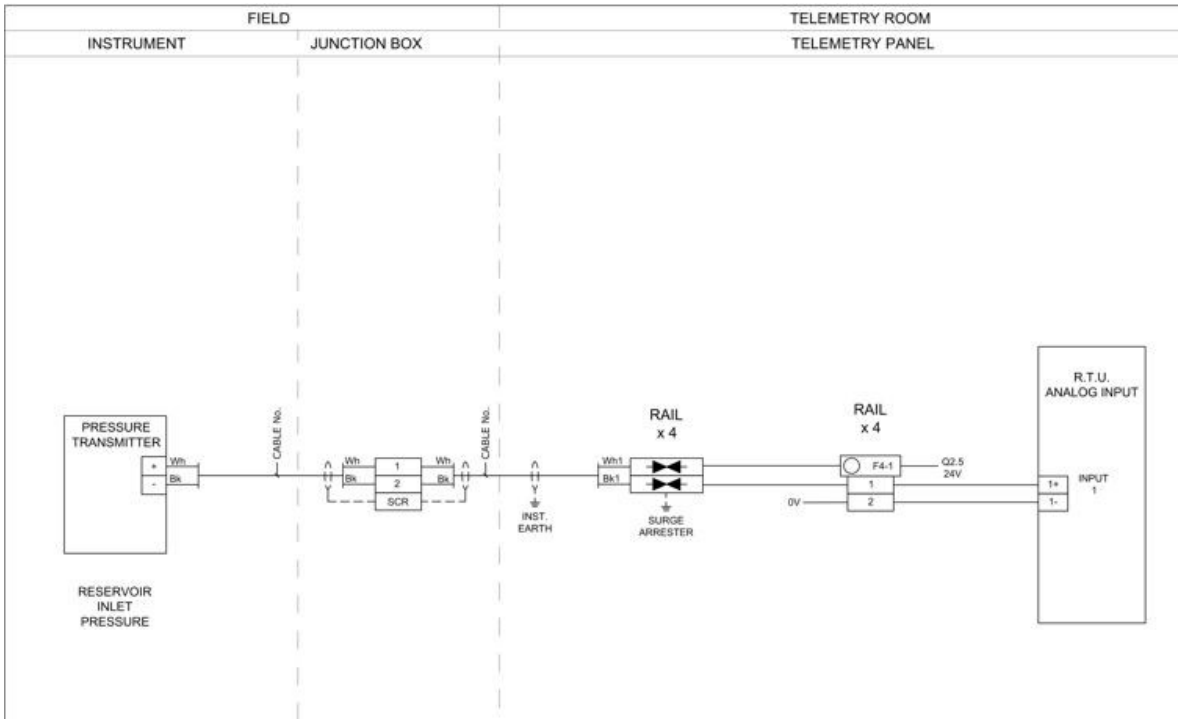
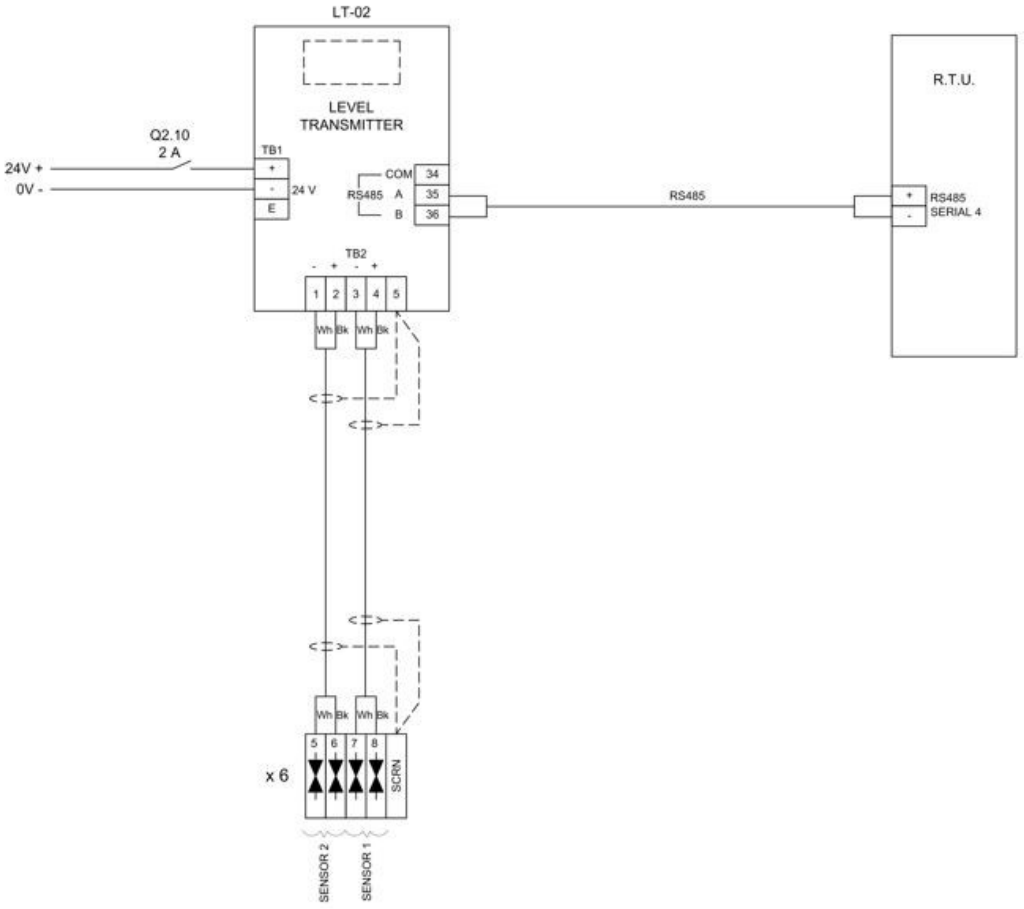


Figure 12: Multiranger wiring



32. CONTROL SYSTEM OPERATION MANUAL

This document shall define the actions which the operator is required to take to fully utilise the control system to operate the pump station and/or reservoir. The operator manual is intended to document how to use the control system and not as a manual for running the pump station. A separate Operations Manual shall be produced by the mechanical system designers depending on the type of equipment.

33. RETURN OF REDUNDANT EQUIPMENT TO EWS STORES

All existing equipment that becomes redundant because of site upgrades shall be properly documented and handed over to a person designated by EWS at a location designated by EWS. The format of the documentation and detail contained therein shall be agreed with the designated EWS representative before work starts.