Eskom	Standard	Technology

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CONTENTS

TABLES

1. INTRODUCTION

The quality of field installation of control and instrumentation equipment forms a vital part in the life cycle costing of the plant and in effective and efficient maintenance regimes.

2. SUPPORTING CLAUSES

2.1 SCOPE

The Standard covers the requirements for the layout, location, cabling and support of instruments that are not an integral part of the piping system.

2.2 BOUNDARIES

All Thermal, Hydro, Renewable Energy Installations but not Nuclear Installations.

2.2.1 Purpose

This document sets out the minimum standards for Field Equipment Installation.

2.2.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2.3 Generation

- C&I Maintenance.

2.2.4 Engineering

- C&I Engineering.
- C&I Contractors.

2.2.5 Projects

- C&I Projects.

2.3 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.3.1 Normative

[1] 240-56227443: Requirements for Control and Power Cables for Power Stations Standard.

[2] 240-89147446: Instrument Piping for Fossil and Hydro Power Plant Standard.

[3] ANSI ISA577.70-1994: Fossil Fuel Power Plant Instrument Piping Installation.

[4] 240-71432150: Plant Labelling and Equipment Description Standard.

[5] 240-56356396: Earthing and Lightning Protection Standard.

[6] SANS 10108: The Classification of Hazardous Locations and the Selection of Apparatus for use in such locations.

[7] SANS 61000–5–2:1997: Electromagnetic Compatibility (EMC).

2.3.2 Informative

None.

2.4 DEFINITIONS

None.

2.5 ABBREVIATIONS

Abbreviation	Description
ANSI	American National Standards Institute
C&I	Control and Instrumentation
DCS	Distributed Control System
IS	Intrinsic Safety
OEM	Original Equipment Manufacturer
SANS	South African National Standard

2.6 DISCLOSURE CLASSIFICATION

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.7 ROLES AND RESPONSIBILITIES

- The Lead Design Engineer shall be responsible to ensure that this standard is implemented on new projects.
- The Design Review Team checks compliance to this standard during the various stages of review as part of the project lifcycle model (PLCM).

2.8 PROCESS FOR MONITORING

This document will be reviewed as per the next review date or earlier if warranted.

2.9 RELATED/SUPPORTING DOCUMENTS

None.

3. FIELD INSTRUMENT INSTALLATION REQUIREMENTS

3.1 INSTALLATION REQUIREMENTS

3.2 INSTRUMENT, TRANSDUCER, TRANSMITTER AND JUNCTION BOX LOCATION AND SUPPORT

3.2.1.1 General

All field equipment shall be installed in accordance with the manufacturer’s instructions, the requirements of this specification, and good practices.

All field equipment shall be installed with due regard for the following:

- Passageways and the movement of people and equipment during maintenance activities,
- Ergonomics and maintenance access to the equipment,

- Field equipment supports shall not be welded to vessels or handrails, but shall utilise self-supported racks with integrated cable and tubing trunking,
- Instrumentation and transducers shall be grouped together in areas away from other maintenance activities and where the environmental conditions are more favourable for the equipment,
- All instruments and transducers on a rack and all racks throughout the plant shall be installed on the same level and with even spacing between instruments and transducers,
- All instrument and transducer installations shall be free from vibration,
- Junction boxes in close proximity of each other shall be installed on the same level and with even spacing between boxes.

Before installation work is started, pilot instrument and support installations shall be approved to demonstrate an adequate level of quality and shall be subject to Eskom approval.

All instruments shall be installed away from potential fire risks, spillage areas, hot environments, and sources of radiation. Indicating instruments shall be orientated to permit viewing from walkways or platforms. Instruments shall normally be accessible for adjustment or maintenance from the permanent walkways without the need for any temporary access equipment such as ladders, platform or scaffolding.

Brackets and supports of mild steel construction shall be galvanised. Where equipment is mounted at grade, the supports shall be grouted such that any water is shed.

Where symmetry exists between front/rear or left/right of plant, tubing, piping, cable and cable support installations shall be symmetrical between instruments in these locations.

3.2.1.2 Accessibility

All field equipment including instrumentation, transducers, transmitters and junction boxes shall be accessible for servicing from floor level, walkways, permanent ladders or platforms. Primary in-line devices such as orifice plates, thermocouples may be accessed by temporary means, but is subject to approval by Eskom for each individual case.

To be accessible from a platform the location must satisfy the following:

- The equipment shall be located on, next to, or above a platform.
- When the equipment is located next to a platform, the centre of the operating mechanism shall be less than 0.5m outside the handrail and be located between 150mm and 1.5m above the platform level.
- When the equipment is located above a platform, the top of the mechanism shall be located between 150mm and 2.1m above the platform level.

3.2.1.3 Connections

All instrument and transducer connections shall be 1/2” BSP parallel thread with suitable breakable seals.

3.2.1.4 Isolation

All instrumentation and transducer shall have individual instrument isolation valves within reach of the instrument to allow for on-line removal of the instrument or transducer.

3.2.2 Instrument Process Piping and Tubing

All impulse process piping and tubing shall comply with the requirements of Eskom standard 240-89147446: Instrument Piping for Fossil and Hydro Power Plant Standard and ANSI/ISA 77.70.02-2014: Fossil Fuel Power Plant Instrument Piping Installation.

Impulse lines shall be kept as short as possible consistent with good practice and ease of accessibility, after due consideration is given to the placement of the transducers. Continuous lengths shall be used wherever possible.

Tubing shall be run with minimum number of changes of direction consistent with good practice and neat appearance.

Impulse lines shall be run in parallel with even spacing between lines and shall not cross each other, and shall be supported to remain as such.

Tubing or piping shall not be supported from handrails.

Tubing shall not be supported from process lines except by agreement with Eskom.

Due consideration shall be given to cold/hot service installation that is subject to expansion/contraction, to ensure that sufficient flexibility is allowed.

Impulse lines shall be installed with due regard to maintenance of all plant in the vicinity and particularly where heavy objects are moved during maintenance activities.

Tubing shall be run behind or below any access ways and handrails. Crossing over or in front of access ways and handrails is not be permitted.

3.2.3 Piping and Tubing Supports

One or two single pipes or tubes may be supported by fastening to structural steel or pipe stands, provided the local ambient temperature is not excessive and tubing does not interfere with other equipment. Tubing shall not be fastened directly to process lines or other process equipment. Vibrating structures and equipment shall be avoided.

Piping and tubing supports shall not be welded to vessels or handrails.

One or two single pipes or tubes may be supported by dedicated heavy duty channel section if other support is not available.

The length of unsupported tubing to final destination (such as a transmitter) for single tubes shall not exceed 0.5m.

Tubing shall be fastened to supports at regular intervals with non-corrosive fixings to prevent sagging, or misalignment. Suitable fasteners i.e. tubing support blocks, with the approval by Eskom, shall be used for the clamping of tubing. The use of plastic cable ties in fastening tubing is not acceptable.

Where three or more single tubes are run parallel to each other, galvanised mild steel cable tray vertically orientated, as used for instrument cables, shall be used for support.

Care shall be taken to avoid stainless steel tubing coming into direct contact with galvanised supports to avoid galvanic corrosion.

3.2.4 Instrument Cabling

3.2.4.1 General

All instrument cabling and cable racks shall conform to the requirements of 240-56227443: Requirements for Control and Power Cables for Power Stations Standard.

Instrument cabling shall be installed with due respect for safety, reliability, access, maintenance, environmental conditions and best practise.

All cabling shall be suitably protected against mechanical damage, chemicals, dust build-up and heat. It is therefore required to fit suitable canopies/roofs over the C&I cable racking exposed to the elements.

Cables shall only be terminated in instruments, junction boxes or other approved equipment. No intermediate cable joints are permitted.

Cables connected to instruments shall be installed with a loop of cable to provide sufficient slack for re-making the cable connection if the instrument is removed and to allow for removing the instrument without electrical disconnection.

Field cabling and the placement of equipment shall be identical for duplicate plant. For example the routing and placement of racking, truncking, conduits and junction boxes for each mill shall be exactly the same for one unit and between units.

Instrument cables shall be routed separately from electrical power cables and crossovers that bring signal and power cables into close proximity shall be made at right angles. As a guide the physical separation of signal and power cables on parallel runs shall be as in **Table 1** below:

Table 1: Physical Separation of Signal and Power Cables on Parallel Runs

Power Cable Voltage (V)	**Minimum Seperation Between Power and Signal Cable (mm)**
115	250
240	450
415	580
3300	1100
6600	1250
11000	1400

Power Cable Current (A)	**Minimum Seperation Between Power and Signal Cable (mm)**
5	240
15	350
50	500
100	600
300	850
600	1050

Failing to follow the guide set out in **Table 1** the cable segregation should then follow the guidelines as set out in SANS 61000–5–2:1997.

3.2.4.2 Underground cable installation

Trunk cabling between the equipment rooms and the control rooms, and from the equipment rooms to the Junction Boxes/Local Panels shall be run on cable trays in tunnels or trenches where above ground cable routes cannot be utilised. Cables may only be run in direct buried trenches on the approval of Eskom for each individual case. Crossings beneath roads or access ways shall be by means of concrete sleeves or culverts.

On approval of Eskom, buried cables in pre-formed trenches shall be laid on a bed of sand 150mm deep. After installation, cables shall be covered with a layer of sand, 150mm deep. Finally, trench shall be back-filled with stone-free material. Concrete covers (removable pre-cast slabs preferred) shall be coloured and/or marked for route identification.

On approval of Eskom, cables in direct buried trenches shall be laid on a bed of sand 150mm deep. After installation, cables shall be covered with a layer of sand, 150mm deep. A protective covering of red PVC tiles (nominal size 1000x250x6mm), suitably embossed (e.g. "Instrument Cables") shall be laid over the sand. Finally the trench shall be back-filled with stone-free material. GPS reference points should be added to the drawings in order to be able to trace the cables in future.

The following general requirements shall apply to all underground cable installations:

- Route should be chosen to avoid obstructions and maintain access to buried cables. A minimum clearance of 300mm shall be maintained between cables and parallel runs of underground piping. Trenches shall not be located close to parallel runs of grade level piping.

- All crossings under roads, railways, access ways or load bearing surfaces shall be by means of concrete sleeves or culverts. The detail design of these crossings shall ensure that vertical loads (including those experienced during construction of the plant) will not damage cables.
- Where instrument and electrical cables cross, separation shall be maintained by permanent means e.g. cable tiles or ducts enclosed in concrete.
- Where cables emerge from under the ground they shall be protected by UPVC ducts set in concrete. Ducts shall extend a minimum of 150mm above and below grade. Ducts shall be sealed after installation of cable.

3.2.4.3 Above ground cable installation

Cabling to/from the equipment rooms and cabling from the Junction Boxes to individual instruments may be routed above ground wherever possible and shall be supported by a suitable cable support system. Ladder rack shall be used for the larger routes and cable tray for the smaller (below approx. 200mm width). The use of wire mesh cable racking is not allowed.

Individual cable runs near to the final termination point, such as an individual instrument, shall be run in galvanised conduit piping or galvanised enclosed truncking.

Ladder rack and cable tray shall be heavy duty, galvanised mild steel. They should incorporate return edge flanges for personnel and cable protection and additional strength. They should be equally suitable for use in the field or in buildings. The preferred ladder rack and cable tray mounting method is vertical, to minimise fire hazard due to accumulation of combustible materials. Cable tray covers shall also be installed to minimise accumulation of combustible materials on cables.

Strapping of cables to cable trays or ladder racks shall be by means of corrosion resistant metal straps.

Detail design, using the typical principles shown in the drawing, shall be subject to Eskom approval before cable installation.

Cables shall be run in parallel on all racking and in all truncking. Cables shall be secured on the racking and in the truncking by suitable permanent means. Crossing of cables on racks shall be avoided.

3.2.5 Earthing

The following standard 240-56356396 - Earthing and Lightning Protection Standard should be used.

- All equipment containing electrical signals or power supply shall be earthed for personnel safety reasons and for minimising electrical interference. This includes enclosures, cable, armour, cable tray and conduit.
- Cable screens shall be electrically continuous throughout the cable run and shall be earthed at both ends. The field side is the normal earth point for the instrument junction box and the the panel reference bar of the panel or cabinet to which the cable is connected for measurement i.e. DCS side.
- The design of the earthing system shall avoid the creation of earth loops caused by duplication of earthing paths. Particular attention shall be paid to the isolation of panel reference bars within panels and cabinets and their final earthing to a point of zero potential.

3.2.6 Hazardous Area Requirements

Equipment for use in potentially hazardous atmospheres shall be selected in accordance with SANS 10108: The Classification of Hazardous Locations and the Selection of Apparatus for use in such locations.

The type of protection selected shall be as follows:

Zone II- Type EEx N or EEx d where EEx N is not available

Combination of EEx N and EEx e components

Zone I - Type EEx d

Zone 0 - Type EExia

Type 'p' equipment shall not be used where a viable alternative exists.

IS equipment shall be used in Zone I and II areas where a viable alternative does not exist. Where IS equipment is used, barriers shall be galvanic “active” type.

IS calculations shall be compiled for the worst case scenario for each type of IS loop. Each installed loop shall be compared against this calculation and shall not exceed the worst case scenario.

A Certificate of Compliance shall be issued for each instrument loop based on worst case calculations. Alternatively a certificate may be issued either on a listed group basis or in another acceptable way provided that traceability to a certificate of compliance is maintained. This applies to intrinsically safe, flameproof or any other form of hazardous area protection.

3.2.7 Labelling and Tagging

All labelling shall comply with the requirements of 240-71432150: Plant Labelling and Equipment Description Standard.

3.2.8 Spare Capacity in Truncking, Racking and Conduits

All truncking and racking shall have 20% space after Project Completion. All Conduits shall have 50% spare space after Project Completion.

3.3 MEASUREMENT AND VERIFICATION

See quality control checksheets.

4. AUTHORISATION

This document has been seen and accepted by:

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5. REVISIONS

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February 2017	1.1	J. Geustyn	Final Draft Approved for Publication after Reviews
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6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- ET Motsoatsoe.

7. ACKNOWLEDGEMENTS

- P du Plessis.