Eskom	Standard	Technology

Title: **PRESSURE RELIEF DEVICES (PRD) FITTED TO TRANSFORMERS AND REACTORS SPECIFICATION**

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1. Introduction

Pressure relief devices (PRD's) are employed as safety valves to limit the pressure rise inside the main tank. This is achieved by the PRD opening and equalising the oil / gas mixture when the pressure has reached a pre-defined level.

2. Supporting clauses

2.1 Scope

This specification covers the technical requirements for the selection and purchase of pressure relief devices fitted to Transformers and Reactors. The purpose of this document is to ensure that the requirements of these devices are standardised within Eskom during the procurement stage.

This document shall be used as a minimum requirement for the purchase and selection of pressure relief devices fitted to transformers and reactors.

- PRD's fitted to new Transformers and Reactors
- PRD's fitted to in-service Transformers and Reactors
- PRD's purchased as Spare Parts.

2.1.1 Purpose

This document was produced in order to record the standardized requirements that shall be applied across-divisional Transmission, Generation and Distribution.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

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

2.2.1 Normative

[1] ISO 9001, Quality Management Systems.

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

None

2.3.2 Disclosure classification

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

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2.4 Abbreviations

Abbreviation	Description
°C	Degrees Celsius
ID	Internal diameter
kV	Kilo volts
L	Litres
mm/s	Millimetre per second
mm	Millimetre
MVA	Mega Volt Ampere
OD	Outside diameter
PRD	Pressure relief device
UV	Ultra violet

2.5 Roles and responsibilities

Not applicable.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Requirements

3.1 General

Transformers rated below 80 MVA shall be equipped with one spring operated PRD. Transformers and Reactors rated 80 MVA(r) and above shall be equipped with two PRD's.

The PRD operating pressure shall be calculated that it shall relieve over-pressure in the transformer or reactor before damage is done to the tank.

Pressure relief devices shall be fitted to the side walls of the transformer tank at a level as near as possible to the top cover – this is a requirement to enable replacement of a defective PRD by performing a partial drain without exposing solid insulation material to atmosphere.

Where one device is fitted it shall be positioned as close as possible to the centre phase. Where there are two devices they shall be arranged on opposite sides of the transformer, i.e. between 'A' and 'B' phases on one side and between 'b' and 'c' phases on the other.

PRD's shall be provided with a single air vent plug to release trapped air. The air vent plug shall be situated on the opposite side of the oil direct cover opening.

Pressure relief device shall not operate due to vibrations or magnetic fields emanating from normal operation and earth tremors.

Expected design life of the PRD shall match the design life of a transformer, at least 40 years.

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3.2 Environmental Conditions

Outdoor installation

Altitude above sea level – 1800 m

Ambient temperatures

- Maximum + 40°C
- Monthly average + 28°C
- Yearly average + 25°C
- Minimum – 10°C

Average relative humidity 90%

Solar radiation 2500 W/m²

Atmospheric UV radiation - High

Seismic conditions at a maximum of 3g

Pollution level – High marine and industrial (C5)

3.3 Corrosion Protection

Corrosion shall be eliminated by the use of non-corrodible materials, and by avoiding the contact of dissimilar metals. All fasteners shall be stainless steel grade 304 or better. Electro galvanising or electro plating of parts and fasteners is not acceptable. Thread lubrication shall be applied to all threaded areas on bolts, studs and screws. Any good quality high temperature grease is acceptable.

Where cast components are used they shall be of high quality and non-porous castings. Bare metal or aluminium castings shall be epoxy powder coated (exterior grade) or anodised.

Corrosion protection used shall be suitable for use in high marine and industrial polluted environments with a C5 classification.

Fasteners used shall be metric hexagon or Allen key type. All fasteners shall be stainless steel – grade 304 is acceptable. Electro galvanising or electro plating of parts and fasteners is not acceptable.

3.4 Construction and operation

The pressure relief device shall withstand full vacuum at sea level and maintain its oil tightness under a static oil pressure.

A visual operation indicator shall be clearly visible from ground level, and arranged for manual resetting.

A combined weather guard and oil deflector shall be fitted to ensure free deflection of the oil towards the ground. A non-corrodible mesh covering the PRD opening vent shall be fitted to prevent birds form nesting inside the oil direct cover. The mesh covering shall be designed not to restrict oil flow during pressure relief operation.

Oil shall be deflected towards ground and no oil ducting or piping shall be fitted to extend the PRD opening to ground level.

The pressure relief device shall be supplied with a permanent engraved nameplate of non-corrodible material with the following information: Make, Type, Operating Pressure and Serial Number.

3.4.1 NEC/NER/AUX Transformers – Oil volume less than 5000 litres

All NEC's or combination units shall be provided with a single PRD with an opening diameter of not less than 80 mm. It shall attain its full opening in not more than 2.5 milli seconds when subjected to an internal pressure impulse at the designed operating pressure.

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NER's and Auxiliary transformers shall not be fitted with PRD's.

Flange dimensions:

Opening diameter	≥ 80 mm
Flange OD	200 mm
Bolt PCD	160 mm
Bolt holes	4 x 15 mm diameter

3.4.2 Transformers and Reactors – Oil volume equal or greater than 5000 litres

The opening diameter of the PRD shall not be less than 150 mm. It shall attain its full opening in not more than 2.5 milli seconds when subjected to an internal pressure impulse at the designed operating pressure.

Flange dimensions:

Opening diameter	≥ 150 mm
Flange OD	260 mm
Bolt PCD	235 mm
Bolt holes	6 x 15 mm diameter

3.5 Alarm Signalling

The pressure relief device shall be equipped with two normally open contacts which may be used to give electrical indication that the device has operated or tripped. These contacts shall be rated for 1 A at 220 V DC.

The device's electrical circuits shall withstand an applied voltage of 2 kV DC for 60 seconds, applied in turn between each electrically independent circuit and the casing of the device, and between the separate independent electrical circuits.

A suitable watertight and weather resistant electrical conduit threaded cable entry shall be provided. Each instrument shall be provided with at least one compression type gland for fitting of control wiring. Stoppers shall be provided to block the glands when not in use. Terminal boxes shall be mounted to allow cable entry from the side or the bottom with the oil direct cover facing vertically down – cable entry from the top is not acceptable. The terminal box cover shall be provided with a proper gasket and rated at IP 55. Plug-in connectors are not acceptable.

Terminal boxes and terminal strips shall allow sufficient space for fitting and securing of lugged 2.5 mm control wiring and cabling. Termination strips shall be numbered and basic wiring diagrams shall be provided inside the lid of the terminal box and in the installation instructions.

The units contacts shall be cabled to the Marshalling Kiosk by means of steel wire armoured cabling that is heat, oil and UV resistant.

Manual operation of the trip signalling contacts for testing purposes shall be possible without having to remove the oil direct cover or shorting of electrical circuits.

All terminal boxes shall be provided with an earth connection point and shall be effectively earthed.

3.6 Documentation and Packaging

Each pressure relief device shall be individually packed inside a cardboard box. The device shall be securely packed and protected against mechanical damage and moisture ingress during shipping and storage.

Original and fully detailed instructions for installation, wiring and maintenance shall be included. Each pressure relief device shall be shipped with a calibration certificate stating actual operating pressure, calibration date and calibration centre information.

Nitrile rubber seal for installing the PRD shall be included in the packaging.

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3.7 Technical Evaluation and Final Approval

The OEM / Supplier shall be responsible to supply a PRD for technical evaluation. The equipment shall be supplied to Eskom and will be subjected to destructive testing. The sample shall be supplied in accordance with this specification and it will remain the property of the supplier.

This specification serves as a minimum requirement for manufacturers that supply pressure relief devices. Any deviation from this specification has to be approved by Eskom Transmission in writing before ordering or manufacturing of the PRD.

Final written approval shall be provided once a technical evaluation has been completed and equipment found in compliance with this specification and Eskom Transmission requirements.

Any changes to the approved product will be subjected to re-evaluation and approval.

4. Authorization

The stabilisation of this document was seen and accepted by the following experts:

Name and surname	Designation
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5. Revisions

Date	Rev	Compiler	Remarks
April 2024	3	M. Hlakudi	Document stabilised with updates on corrosion requirements.
Feb 2018	2	M Ngubane	Upgraded corrosion protection application.
May 2009	1	A Smit	Document revised to cater for Gx, Tx and Dx requirements.

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7. Acknowledgements

Final document compiled by Generation, Transmission and Distribution

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