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1 Introduction

This document will attempt to provide a specification for standard Control, Selector, Isolation and test switches within the Transmission protection environment.

2 Supporting Clauses

2.1 Scope

This specification describes Eskom requirements for standard Control, Selector, Isolation and test switches within the Transmission protection environment.

2.1.1 Purpose

The purpose of this document is to provide a specification for standard Control, Selector, Isolation and test switches within the Transmission protection environment.

2.1.2 Applicability

This specification shall apply throughout Eskom Transmission, its divisions, subsidiaries and entities wherein Eskom has a controlling interest.

2.2 Normative/Informative References

Parties using this specification shall apply the most recent edition of the documents listed below

2.2.1 Normative

- NWP 1575 Standard Specification for control, selector, isolation and test switches
- NWP 3031 Performance testing and test result recording of control, selector, isolation and test switches

2.2.2 Informative

- BS 9563 Specification for rotary switches of assessed quality, generic data and methods of Test, general rules for the preparation of detail specifications
- BS 2011 Basic environmental testing procedures
- IEC 68 Basic environmental testing procedures
- EPDG 21 Electrical protection design guide
- DST 34-462 Standard design for Distribution protection schemes
- EST32-333 Standard for electronic protection and fault monitoring equipment for power systems

2.3 Definitions

Switch: A mechanical device which, by manual operation (through rotation, pressing, pulling or axial movement), will either close or open contacts forming part of an electrical circuit.

2.4 Implementation Date

The implementation date is when the document is published.

2.5 Related / Supporting Documents

- NWP 1575 Standard Specification for control, selector, isolation and test switches
- NWP 3031 Performance testing and test result recording of control, selector, isolation and test switches

3 Document Content

3.1 Switch Identification

Switches used on relay/control panes shall be allocated an Eskom designation code. Standard sketches are available showing contact arrangement and sequence, type of handle, type of mechanism, escutcheon plate engraving and terminal markings. These requirements shall be adhered to in every detail as all Eskom standard key and wiring diagrams are prepared on this basis

It is particularly important that the sequence in which the cells or poles are shown and lettered is followed on switch assembly. Only lower case letters shall be used for lettering of the terminals. Standard sketches are contained in Eskom EPDG 21.Copies are available to suppliers of approved switches and to manufactures of control/relay panels.

3.2 Coding of switches

For ease of reference, each switch will be allocated a 5 character code which will identify the type of switch, number of positions, number of poles, function and language preference to be employed on the escutcheon plate.

For the purpose of this code one “pole” has been taken as a pair or group of contacts performing a single function, even though, in the case of a simple “ON – OFF” function, 2 pairs of contacts may be accommodated in one “cell” of the switch. In the case of push buttons and similar devices, where the contacts are mounted in a “block” each contact bock is considered as a “pole” irrespective of the number of contacts incorporated therein.

The code will be created as follows:

3.2.1 First Character

Identifies the type of switch;

C = Control S = selector

D = Isolator T = Test

P = Push Button

3.2.2 Second Character

States the number of handle positions.

3.2.3 Third and Fourth Character

Identifies the number of poles or cells on a switch.

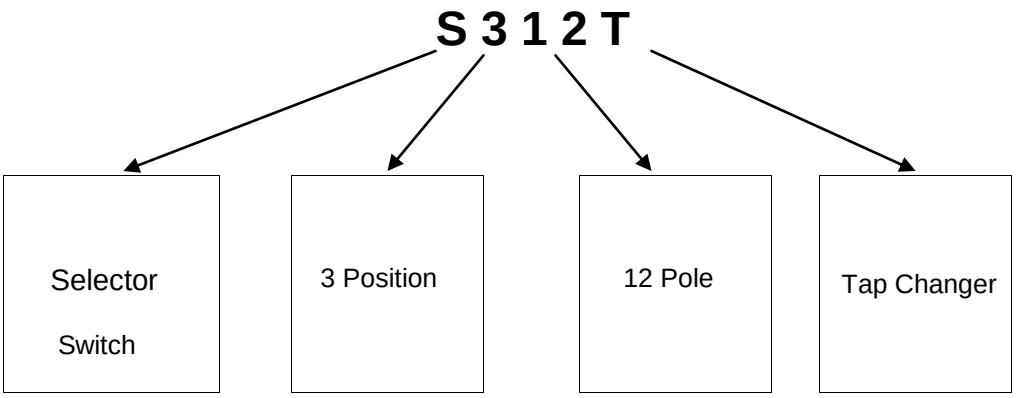
N.B. The third character will be zero if number is less than 10

3.2.4 Fifth Character

Qualifies the function or panel equipment with which the switch is associated:

A = Auto Reclose	L = Indicating Lights
B = Bus Zone	M = Metering
C = Carrier	P = Protection
D = Disturbance Recorder	R = Breaker Control
F = Phasing	T = Tap Changer
G = General	X = Special Purpose

Example :



Details of contact arrangement, engraving, type of mechanism and handle shape may be found by reference to the individual sketches.

3.3 Brackets / Support bars

Where the length of the assembled switch cells or poles, irrespective of the switching mechanism, measures more than 150 mm support brackets and bars shall be provided. Ganged switches shall be subject to Eskom approval**.**

3.4 Rating

Except where otherwise specified, single cells or contact assemblies of al switches shall be rated to carry a continuous current of not less than 10 amperes at a maximum system voltage of 440 volts AC/DC. The short time rating shall be make and carry 30 amperes for 20 ms. Switches with paired cells connected in parallel to achieve this rating are not acceptable.

3.5 Manufacturers type test

All switches shall have been type tested by a recognised short circuit testing authority and assigned a rated making, breaking and through fault capacity. Manufacturers shall furnish copies of type test certificates for specific types of switches.

3.6 Switch mechanisms

Switches shall be fitted with one of the following types of mechanisms:

3.6.1 Quick make and break type

A mechanism in which the operation of the contacts is assisted by a spring action or other means, so that the speed of the operation is independent of the speed of the operation handle or lever. Positive operation of the contacts in the event of a broken or damaged spring shall be ensured even if the quick make/break action is lost.

3.6.2 Slow make and break type

A mechanism, either cam operated or spring assisted, or both, to provide snap action and positive position indexing in which the contact operating speed is, to a certain extent, dependent on the speed of the operating handle or lever.

3.6.3 Spring return type

A mechanism which, when released, returns the handle or actuator to a predetermined position by action of a spring. The handle or actuator shall not remain in any other than the predetermined position except when held by the operator. Control and test switches will usually be fitted with this mechanism.

Mechanisms, except where otherwise stated, shall switch to the 10 ‘o’ clock and 2’o’ clock positions as generally depicted in EPDG 21.Switching to 9’o’clock and 3’o’clock positions will only be permitted ,in special cases, subject to Eskom approval.

3.6.4 Escutcheon plates

All switches shall be fitted with escutcheon plates lettered in accordance with the standard switch sketches. Square escutcheon plates, approximately 75mm x 75mm,are acceptable but alternative patterns ad sizes will be considered. Escutcheon plates with fitted cases up to 100 mm x 100 mm are also acceptable.

Exceptions shall be made in the case of small lever operated switches, when a manufacturer’s standard escutcheon plate may be acceptable. An exception shall also be made in case of an approved switch having an escutcheon plate integral with the body of the switch or handle, for example, circuit breaker control switches.

Lettering on escutcheon plates shall be horizontal and 3mm in overall height. Where the escutcheon plate forms an integral part of the device (i.e. OCB control switches), lettering deviating from the horizontal by not more than 45 degrees will be accepted. Where lettering cannot be accommodated on the escutcheon plates in the above size of lettering, switch positions shall be numbered and a separate label mounted adjacent to the switch to designate each position.

The way in which the escutcheon plates are fixed to the panel shall be independent of the fixing methods used for mounting the switch.

3.6.5 Operating handles / Control Knobs

Every operating handle or lever shall be provided with a pointer or other approved means, indicating clearly the position to which the switch has been selected. The handle shapes in the sketches indicate general types of handles. The sketches detail dimensions or design. Manufacturer's standard designs conforming generally to these shapes will be acceptable. Handle designs shall be subject to Eskom approval**.**

Control knob design shall be such that they cannot be removed without the aid of a tool and that they shall be positively fixed to the drive spindle in such a manner that they cannot slip. The latter requirement also applies to coupling devices associated with control knobs and shafts. Control knobs shall be keyed so as to allow only one orientation when fitting to the shaft.

If, for ease of handling, a relatively large knob is fixed to a relatively small rotary component, care shall be taken to ensure that the end stops on the control are not damaged by normal rotation of the control knob. The end stops shall be designed so that they are not damaged by any torque which may be applied to the knob.

3.7 Types of switches

3.7.1 Discrepancy switches

Discrepancy switches shall be subject to Eskom approval in accordance with EPDG 21.

3.7.2 Phasing switches

Phasing switches shall be of the rotary pattern with spring return to the OFF position from any intermediate position.

3.7.3. Circuit breaker control switches

Circuit breaker control switches shall be of the rotary pattern with spring return to neutral. Control switches for relay/control panel mounting shall be fitted with an operation interlock to prevent accidental operation of the switch. A sequence interlock whereby the switch shall be turned to TRIP before it cane be turned to CLOSE is not required.

The contact arrangement shown in the sketches shall be arranged in such a way that the neutral contacts break before any other contacts in the switch make. LAZY contacts are lost motion devices arranged so that they are open in the TRIP position, remain open in the NEUTRAL position after return from TRIP, close in the CLOSE position and remain closed in the NEUTRAL position after return from CLOSE. Control switches for junction box mounting shall not be fitted with NEUTRAL and LAZY CONTACTS or a sequence device.

3.7.4 On load tap changer raise and lower switches

Raise/Lower control switches shall be of the rotary pattern with spring return to neutral. The contact arrangement shall be identical to circuit breaker control switches for junction box mounting.

3.75 Main isolating switches

Main isolating switches shall be of the two position pattern equipped with quick make/break mechanisms.

3.7.5.1 Supervisory Isolating Switch (SIS)

The SIS shall isolate supervisory control of the circuit-breaker, SEF, ARC, and AVR functions. The SIS shall have two positions, labelled "OFF" and "ON". The “OFF” position shall be on the left, and the “ON” position on the right when viewed from the front of the switch. The "OFF" position shall isolate all the supervisory control functions only. The "ON" position shall not isolate any function. The “OFF” position of the switch/integrated function shall be provided to supervisory for alarming purposes. The SIS shall preferably be provided as an integral function of the protection IED that executes the supervisory control functions.

3.7.5.2 Protection/Control function isolating Switch

Isolating switches/functions shall be provided for each scheme to isolate certain protection functions as required. Typical functions that must be isolated are SEF, ARC, AVR, over current protection, and teleprotection. The latter two functions are described in further detail in the sections to follow.

The SEF and ARC functions shall have their own amber status indication lamps, as these functions could be isolated for extended periods. SEF protection shall be isolated through the Sensitive Earth-Fault Selector Switch (SEFSS) and the ARC function shall be isolated through the Auto-reclose Selector Switch (ARCSS). The "OFF" position of these switch/integrated functions shall energize its own indication lamp and give a supervisory alarm. Where provided using an IED’s internal latching logic, the statuses of the protection functions (“ON” or “OFF”) shall be stored in non-volatile memory such that they are maintained at the previous position upon power-up of an IED following a loss of auxiliary supply. The status of the protection functions shall be maintained using mechanically latching, electrical reset auxiliary relays if they have to be provided outside of the protection IED/s.

3.7.5.3 Teleprotection Isolating Switch (TIS)

The TPIS isolates the permissive and direct intertrip signalling both to and from the associated scheme. The TPIS may isolate the communication channel to the remote relay to allow local testing. The TPIS shall have two positions, labelled “OFF” and “ON”. The “OFF” position shall be on the left, and the “ON” position on the right when viewed from the front of the switch. The “OFF” position shall isolate all permissive, intertrip and direct transfer trip signalling both to and from the associated scheme/s.The “ON” position shall not isolate any function. The “OFF” position of the switch/integrated function shall be connected to supervisory for alarming purposes. The TPIS shall raise the “Protection not healthy” alarm at both/all ends of the line when in the “OFF” position.

3.7.6 Indicating light isolating switches

Indicating light isolating switches shall be of the lever operated miniature type, rated for 5 Amps 250 V operation. Long yellow levers shall be fitted. The contact blocks shall preferably be interchangeable with those fitted to push buttons.

3.7.7 Selector switches

Selector switches shall be of the rotary pattern, having 2, 3 or 4 positions as required and equipped with slow make/break mechanisms.

3.7.7.1 Protection Selector Switch

A PSS is provided on bus coupler and bus section protection schemes, and serves to disable the over current and earth fault protection functions. The PSS is usually selected to “OFF” under normal operating conditions. The protection selector switch shall enable the protection of the scheme to be selected to the “ON” or “OFF” positions. The “OFF” position shall be on the left, and the “ON” position on the right when viewed from the front of the switch. When the PSS is in the “OFF” position, all over current and earth fault protection functions shall be disabled, but the circuit-breaker fail function and trip indications shall still operate as normal. This selection shall be made in the software through a binary input/programmable logic of the IED. The scheme shall include an automatic override function whereby the over current and earth fault protection is enabled for a settable time immediately upon the closure of the circuit-breaker, irrespective of the position of the PSS. In the “ON” position, the PSS shall not isolate/disable any function. The “ON” position shall be alarmed to the supervisory system.

3.7.8 Instrument selector switches

Ammeter and voltmeter selector switches are not covered by this specification.

Switches forming an integral part of the static rack mounted equipment shall not be required to conform to the requirements of this specification.

3.7.9 Test Normal Switch (TNS)

The TNS provides isolation of the trip outputs to the circuit-breaker and bus zone panel for test purposes. Where the TNS only isolates the circuit-breaker fail bus strip / bus zone trip output, it shall be termed the Breaker Fail Isolate (BFI) switch. On a bus zone panel, the TNS is termed the Bus Zone Isolate (BZI) switch.

A TNS shall be provided on all schemes that include bus strip outputs, as well as on Under Frequency Load Shedding schemes. The TNS shall be provided via a discrete switch that physically interrupts the applicable circuits, rather than an integrated function in an IED disabling certain relay logic.

On HV feeder and capacitor bank protection schemes using segregated main and back-up protection this switch shall have three positions labelled "Normal", "Main", and "Back-up". The "Main" position shall isolate the main protection trip/output(s) to the circuit-breaker and the circuit-breaker fail bus strip initiate and trip output(s). The "Back-up" position shall isolate the back-up protection trip output(s) to the circuit-breaker and the ”circuit-breaker fail” bus strip initiate and trip output(s). The TNS shall not isolate communications between the local end and the remote end; this function is catered for by the TPIS.

The TNS provided on busbar arc detection and bus zone schemes shall have three positions, labelled "Normal", "Breaker Fail Isolate" (BFI) and "Bus Zone Isolate" (BZI). The BFI position shall isolate the circuit-breaker fail bus strip input contacts from being actioned by the scheme and the BZI position shall isolate the trip outputs, the circuit-breaker fail circuitry being restored to normal. It shall be acceptable for the BFI and BZI functions to be provided on two separate two-position switches.

The TNS function provided on Transformer schemes shall have two positions, labelled “Normal” and “Breaker fail isolate” (BFI). The main and back-up protection functions shall not be affected by the position of the BFI. In the BFI position the HV and MV circuit-breaker fail bus strip contacts to the busbar protection schemes are isolated.

The TNS provided on the Under Frequency Load Shedding scheme shall have two positions, labelled “Normal” and “Test”. The "Normal" position shall not isolate any function, while the trip outputs from the scheme shall be isolated in the “Test” position. The TNS shall raise the “Protection Not Healthy” alarm when selected to any position other than “Normal”.

Banana plug test points shall be provided in conjunction with a TNS. The function of the test points is to facilitate testing, under live conditions, of the various protection functions' output contacts. The test points shall be wired to either the "Main" or "Back-up" position on the TNS, depending on the function from which access is being provided. Where possible, the test points shall be accessible from the front of the panel.

On certain line differential schemes the communications channel is an inherent feature of the scheme and cannot be interrupted because the channel must be in-service to test the scheme. On such schemes, a facility shall be provided whereby a signal is sent to the remote IED to inhibit it from tripping when the TNS on the local panel is switched to the "Main" position.

3.7.10 Push Button

3.7.10.1 Lamp check push button (LCPB)

The function of the former Lamp Check Switch (LCS) was to limit the drain on the substation's batteries, to increase lamp life and to check the integrity of all the indication lamps. Cluster-type LED indication lamps are typically rated at 3 Watts with a 100,000 hour lifespan (i.e. 10 years) although the light intensity may diminish over time. This represents significantly reduced power consumption and extended life when compared to the old incandescent technology. The traditional isolating function of he LCS is thus no longer required. The lamp test function may be provided using a Lamp Check Push Button (LCPB) on the scheme.

The pulsed control type push-button switch/integrated function shall cause all indication lamps on the scheme to be energized. This includes both D.C. and A.C. powered lamps. Where possible, the LCPB shall also provide test facilities for the IED's integrated indications. The LCPB may be integrated with an indication Reset Push Button (RST) (where provided).

3.7.10.2 Trip test push button (TTPB)

A trip test push button is provided so as to allow protection field technicians an easy means to test the operation of the ARC function on a scheme. The TTPB is seldom used to perform on-load trip testing as was common practice in the past. A TTPB/integrated function shall be provided on all schemes that include an ARC function.

The TTPB function shall include a check of the ability of the circuit-breaker to ARC before issuing a trip command to the back-up trip coil of the circuit-breaker. The ARC checks shall typically include: spring charged and the absence of circuit-breaker alarms (SF_6 gas low etc.).The TTPB function shall not initiate circuit-breaker fail.

4 Type and performance tests

4.1 Visual inspection

The switch shall be visually examined, including a check on the contact arrangement and mechanical operation against Eskom XXXXX. If it is not possible to examine the contact arrangement visually, a functional test as specified in clause 4.2 of this document shall be performed. If the full size and type of termination does not appear to be suitable then the temperature rise test as specified in clause 4.4.3 of this document shall be implemented.

4.2 Functional test

The switch shall be connected to a suitable monitoring circuit and operated through all contact positions for one cycle of operation. The switching function shall be in accordance with the type designated in XXXX.

4.3 Dimensioning procedure

The switch shall be checked for compliance with the relevant detail drawings.

4.4 Electrical test procedures

4.4.1 Contact resistance

Contact resistance shall be measured with a direct current not exceeding 25 mA. The open circuit voltage of the measuring circuit shall not exceed 50 mV. The resistance shall be measured between appropriate terminals completing a circuit through closure of their contacts. Tests shall be performed on all pairs of terminals.

Tests shall consist of, and be recorded as follows:

- contact resistance as received

- After 100 A for 0.5 seconds

- After 100 operations at a power factor of 0.7

4.4.2 Insulation and voltage proof

The switch shall be mounted on a rigid metal plate using its normal fixing device. Tests shall consist of and be recorded as follows:

An AC test voltage of 2kV 50 Hz shall be applied for 1 minute between:

(a) All contact terminals and earth

(b) Open contacts

(c) Adjacent contact pairs

The BEAMA 219 or IEC 255-5 impulse test of 5kV 1/50 microsecond pulse 0.5 coulomb shall be applied in the same sequence as (a), (b) and (c) above. The 2 kV and 50 Hz test shall then be repeated to ensure that no permanent damage has occurred during the impulse test.

The insulation is satisfactory if there is no evidence of breakdown or flashover.

4.4.3 Temperature rise test

The switch shall be mounted as in clause 4.4.2 and set to a position in which at least three pairs of contacts are made. A suitable load shall be connected, using leads 1 metre long and interconnecting loops of not less than 1 metre so that the switch is caused to carry its rated current through those contacts connected in series for a period of 5 hours. he leads used shall be of maximum diameter that the switch terminations are designed to accept. A temperature measuring device shall be attached to each termination to be tested in such a way that it will accurately measure its temperature and will not significantly affect the temperature of the termination. This measurement shall be taken under standard laboratory conditions at the end of the 5 hour period.

The test is satisfactory if the temperature rise at any termination in the series circuit does not exceed 20 degree Celsius.

4.5 Environmental test procedures

4.5.1 Clean atmosphere test

The switch terminals shall be wired in series and connected via a computer to monitor contact resistance on every operation. The switch shall be mounted in an environmental chamber and subjected to a series of operations through all contact positions at the following set temperature.

- 300 operations at 27 degree Celsius

- 300 operations at 75 degree Celsius

- 300 operations at -5 degree Celsius

These temperatures shall be kept constant for at least 30 minutes before each set of operations.

4.5.2 Dirty atmosphere test

Before commencement of the operational test, 1 ml of SAE oil shall be applied to the switch shaft bearings and the switch allowed to stand with the shaft vertical for 48 hours at room temperature.

The switch shall be mounted in an environmental chamber and a quantity of dust (fly-ash) shall be blown for 1 minute. After 5 minutes the switch shall be operated through all contact positions for 500 cycles of operation. This sequence of operations shall be repeated 5 times.

4.6 Flammability test

The switch shall be mounted on a rigid metal plate using its normal fixing device.

An alcohol lamp or Bunsen burner with a non-luminous flame 13-19 mm in height shall be placed under the moulding of the switch so that the top of the flame just touches it. The flame shall be removed after 10 seconds.

The rate of burning is expressed as the distance travelled by the flame in 15 seconds. If the flame travels less than 25 mm in 15 seconds before going out, the material is reported as resistant to flame propagation but if the material does not burn and shows no after-glow 5 seconds after the flame is removed, it shall be reported as self-extinguishing.

5 Authorization

This document has been seen and accepted by:

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6 Revisions

Date	Rev.	Remarks
August 2010	0	New Document

7 Development team

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