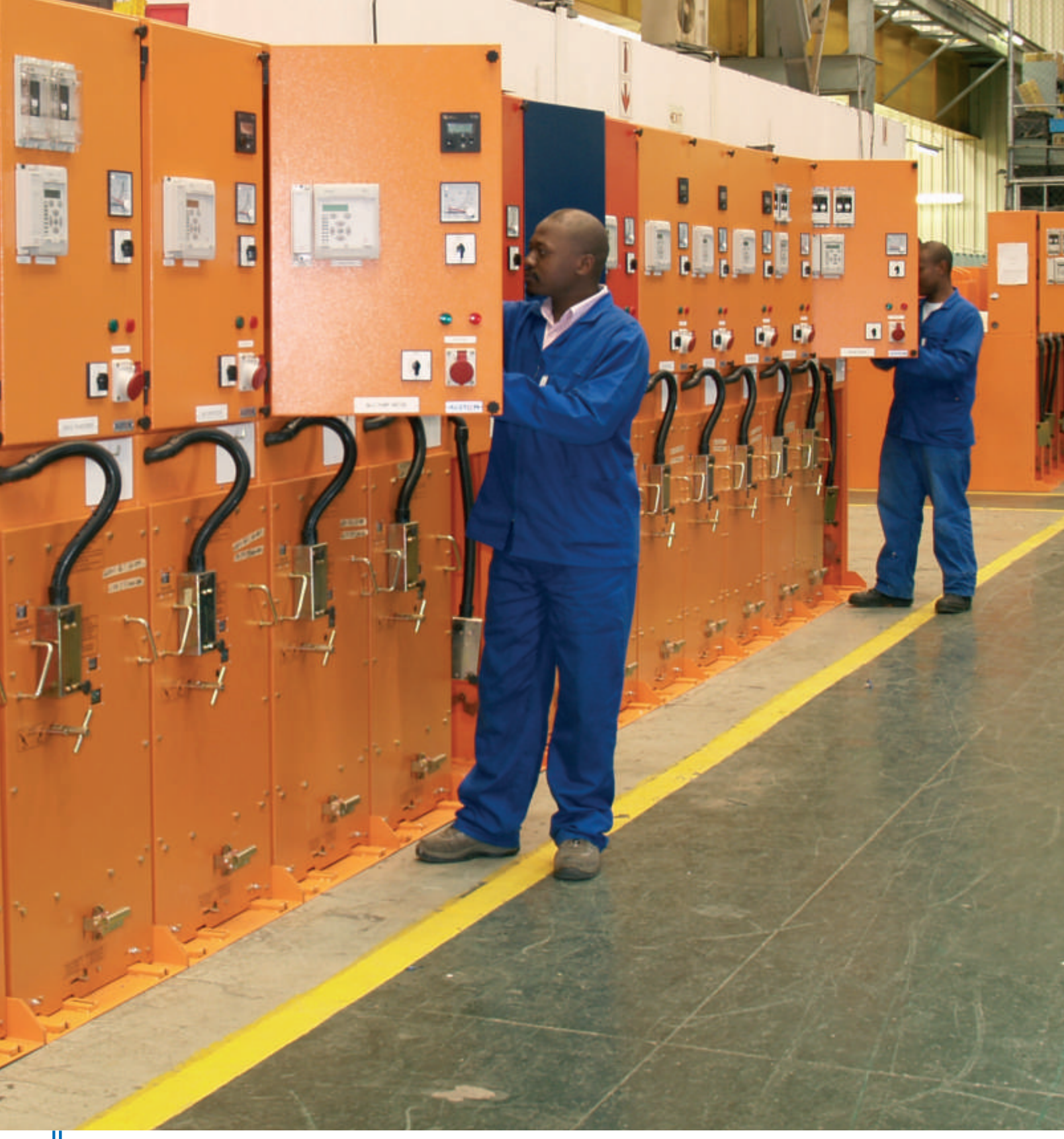


INDOOR MEDIUM VOLTAGE SWITCHGEAR - UP TO 24kV

A division of ACTOM Pty Ltd

ACTOM

Formerly ALSTOM South Africa

ACTOM Indoor Medium Voltage Switchgear

SBV range of products

Prior to 1980, ACTOM's indoor switchgear business centered around J&P designed AG and Statter designed ACO ranges of bulk oil circuit breaker equipment.

A requirement for modern technology switchgear was identified in the mid-1970s and in 1976, equipment based on the B-Vac fixed pattern vacuum circuit breaker was introduced. This equipment however, was not well accepted on the local market and by 1978 had made no significant inroads into the modern technology business. In 1978 it was realised that a more cost-effective range of draw-out pattern switchgear would have to be introduced. At that time no suitable designs in GEC distribution switchgear were available and the decision that would lead to the development of ACTOM's SBV range of switchgear was taken.

SBV vacuum switchgear

The SBV equipment was designed to meet virtually all known customer requirements. It includes single and double busbar units. Integral circuit (cable) earthing is offered as an option. Busbar earthing via the circuit breaker is also an available option.SBV equipment is designed for horizontal isolation and withdrawal, offering inter alia, the following advantages:

- Natural venting of the circuit breaker compartments is permitted and, subsequently, higher continuously rated currents.
- Pressure relief vents, fitted as a standard to all equipment, are accommodated at the top of the circuit breaker panels. The purpose of the relief vents is to open and relieve over-pressure that will result from the unlikely event of an internal arc fault – thus affording inherent operator safety. In the case of the duplicate busbar compartment, venting of the lower busbar compartment is effected at the longitudinal end of the switch board.

Freestanding SBV 5 capacitor feeders.

Vacuum interrupters are employed as a switching medium. The advantages of switching in vacuum are considerable.
They include:

- Small interrupter gaps (as low as 6 mm for 12 kV applications) result in low-energy mechanisms, ensuring long mechanism life.
- Low-peak arc voltages result in very low arc energy – which in turn ensures a long electrical life for the vacuum interrupter and a no-maintenance device. In 1965 three outdoor, fixed-type vacuum circuit breakers, fitted with auto-reclose facilities, were installed on Great Britain's Eastern Electricity Board 11kV networks to assess their performance. Five arduous years of service were insufficient to evaluate the contact wear and loss of vacuum integrity, as none could be detected.
- The current chopping level of vacuum arc switching is the lowest of all switching media.
- Of the four switching media (air, oil, SF6 and vacuum), vacuum has by far the best dielectric recovery properties after short-circuit interruption.
- Vacuum arc switching produces no adverse environmental products, precluding harmful characteristics either towards people or materials.
- Increased safety due to the absence of oil products in the equipment make-up.

Tests

The relevant international and national type tests applicable to the ACTOM range of switchgear have been carried out by accredited testing authorities such as KEMA and the SABS. Copies of these tests are available on request. It can be stated that, among SouthAfrican manufacturers of indoor switchgear, ACTOM Switchgear has been a leader in implementing internal arc testing and actively promotes internal arc testing of switchgear. SBV switchgear has been internally arc tested at 25 kA for 200 milliseconds, as per Eskom requirements.

TYPES OF SWITCHGEAR

Type SBV 3 & SBV 3E

This version is available in single or duplicate busbar arrangements. Circuit and busbar earthing via the circuit breaker are available options. The operating mechanism allows for hand charged spring or motor charged spring application. The mechanism design allows for the following optional features:

- second shunt trip facility
- under voltage (no-volt) trip facility

Medium voltage switchboard undergoing preparations for acceptance testing.

Rating characteristics

- Rated voltage: up to and including 12 kV
- Rated normal current: up to and including 2 500 A
- Rated short circuit capability: up to and including 40 kA for 3 seconds
- BIL: 95 kV

Type SBV4 & SBV4E

The SBV4 equipment is available in single busbar configuration only and is of low-profile construction, permitting overall height reduction of the switchgear. Circuit and busbar earthing via the circuit breaker are available options. The operating mechanism allows for hand charged spring or motor charged spring application. The mechanism design allows for the provision of the following optional features:

- second shunt trip facility
- under voltage (no-volt) trip facility
- direct acting (series) trip facility

Rating characteristics

- Rated voltage: up to and including 12 kV
- Rated normal current: up to and including 2 000 A
- Rated short circuit capability: up to and including 31,5 kA for 3 seconds
- BIL: 95 kV

Type SBV5 & SBV5E

The SBV 5 circuit breaker was designed for utilisation in the low-profile SBV4 housings and is interchangeable with the SBV4 circuit breaker and vacuum contactors. Circuit and busbar earthing via the circuit breaker are available options. The operating mechanism is of the magnetic actuator type, using closing and tripping coils with the plunger being held magnetically in the closed or open positions by permanent magnets. The material used for the magnets is neodymium-iron-boron, the field strength of which is almost twice that of samarium cobalt and up to 280 times that of steel. The circuit breaker has been type tested in excess of 100 000 no-load mechanical operations without discernable component wear. The combination of magnetic actuators with long-life vacuum interrupters has resulted in circuit breaker life that was previously not possible. Further features include a low component count, reliability and minimal maintenance.

Rating characteristics

- Rated voltage: up to and including 12 kV
- Rated normal current: up to and including 1 250 A
- Rated short circuit capability: up to and including 25 kA for 3 seconds
- BIL: 95 kV

Type SBV24

This version is for 22 kV indoor utilisation and is of single busbar configuration. Circuit and busbar earthing via the circuit breaker are available options.
The operating mechanism allows for hand charged spring or motor charged spring application. The mechanism design allows for the provision of the following features:

- second shunt trip facility
- under voltage (no-volt) trip facility
- direct acting (series) trip facility.

Rating characteristics

- Rated voltage: up to and including 24 kV
- Rated normal current: up to and including 1 250 A
- Rated short circuit capability: up to and including 25 kA for 3 seconds.
- BIL: 125 kV

Type SBV-C

These are fused vacuum contactors mounted on withdrawable Carriages and are extensible on SBV3 and SBV4 switchgear. A manually operated “cable” discharge switch is an available option. Operating mechanisms are electrically “held” or mechanically latched options. Mechanical life of the vacuum contactors is in excess of 3 x 106 operations; electrical endurance in excess of 106 operations. Fused contactors have an advantage over circuit breakers in that the fuses greatly limit the magnitude and duration of short-circuit currents. Where the equipment is used in switching of motors, cables can be sized to carry load and starting currents only. Possible fault damage to motors can thus be restricted.

Rating characteristics

(of contactor unit only)

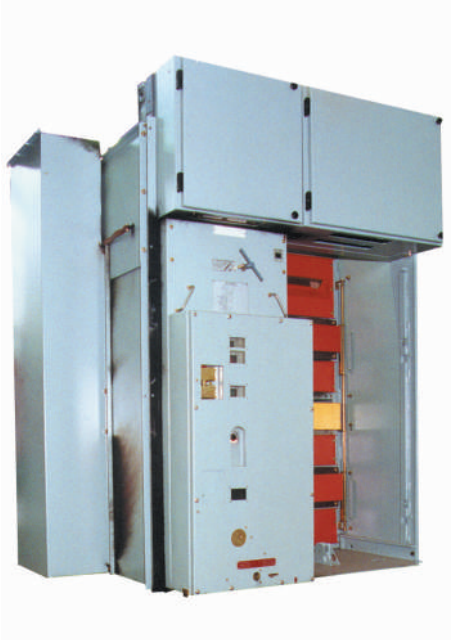
- Rated voltage: up to and including 12 kV
- Rated normal current: up to and including 400 A
- Rated short circuit capability: 4kA

Internal arc testing of MV switchgear

A major hazard of electrical medium voltage installations is the danger of an internal arc fault. The most common causes of an internal arc fault are tools left on the busbars after the initial installation or during maintenance, and binding wire used during commissioning tests, not having been removed prior to energising. An internal arc condition constitutes a potentially dangerous situation for the operator.

Internal arc testing requirements were initiated by the German PHELA organisation. A procedure for internal arc testing was then developed, resulting in Appendix "A" of the IEC 60298 standard.

Arc duration of 0,1 second is considered sufficient to prove the operation of pressure relief devices. Internal arc faults are normally simulated by a thin copper wire of approximately 0,5 mm in diameter stretched across two or more phases inside the various switchgear compartments, and in the case of segregated phase conductors, between one phase and earth. All the relevant compartments must be individually tested to ensure the integrity of the complete switch panel, not just one particular section. For the effects of the explosion to be monitored under actual conditions, two walls, a ceiling and the floor are required to be simulated. As operator safety is of prime importance, indicators are positioned both horizontally and vertically in metal racks 300 mm from the switchgear being tested. The above indicators are positioned front and sides, facing all the points where gas is likely to be emitted, and positioned in such a way that hot gas escaping in slant directions can be monitored.



SBV3 double busbar switchpanel after internal arc test.

These indicators consist of metal frames covered with black cretonne cloth of 150 g/m².

To successfully complete the internal arc tests the equipment needs to meet the criteria set out in IEC 60298 Appendix "A" as repeated below:

1 – Whether correctly secured doors, covers, etc, do not open.

2 – Whether parts (of the metal-enclosed switchgear and control gear), which may cause a hazard, do not fly off - including large parts or those with sharp edges, e. g. inspection windows, pressure relief flaps, cover plates, etc, made of metal or plastic.

3 – Whether arcing does not cause holes to develop in the accessible external parts of the enclosure as a result of burning or other effects.

4 – Whether the indicators arranged vertically do not ignite. Indicators that ignite as a result of paint or stickers burning are excluded from this assessment.

5 – Whether the indicators arranged horizontally do not ignite. Should they start burning, the assessment criterion may be regarded as having been met if proof is established that the ignition was caused by glowing particles rather that hot gases. Highspeed camera pictures should be produced in evidence.

6 – Whether all the earthing connections are still effective.

It is advisable to record the tests in a high-speed video of up to 1 000 frames per second in order to analyse the physical phenomena. The ever increasing safety needs call for switchgear manufacturers to comply with international and national standards.

Internal arc fault testing in accordance with IEC 60298

The design of the SBV range of vacuum switchgear commenced in 1978. Even at that early stage the importance of internal arc fault venting and safety was recognised. The design of the horizontal withdrawable switchgear was chosen so as to incorporate top venting. Following ACTOM's success at KEMA in 1997 when the SBV4 was successfully internal arc fault tested for 20 kA at 12 kV for 0,1 second, more onerous tests were carried out at the SABS high power laboratory. The tests provided for side access in addition to front access and the internal arc was for 25 kA with a duration of 0,2 sec.

Internal arc classification in accordance with IEC 62271-200

The introduction of IEC 62271-200 and internal arc classification (IAC) lead to ACTOM enhancing its proven SBV range of circuit breakers (i.e. SBVE). The SBVE range is presently classified as BFL-AR 25 kA 0.2 sec in accordance with IEC 62271-200. Development and testing with SBVE is ongoing, ensuring safer and more reliable products.

Notes

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