Three Phase Vacuum in Air Circuit Recloser
Type ESVA

Advantages of Vacuum Interruption
The design of ESVA Vacuum Circuit Reclosers brings together all the advantages of the relatively new technology of power arc interruption in vacuum.

Maintenance
The absence of oil as an insulating and interrupting medium minimizes the maintenance and servicing required.

Installation
The forces generated during interruption are only those of the operating mechanism. This greatly simplifies foundation requirements.

Duty Cycle
No derating of interrupting capability is required regardless of the reclosing duty cycle.

Safety
The use of air as the primary insulation minimizes the hazard from fire or explosion.

Relay and Microprocessor Control
15.5 KV
560 thru 1120 Amperes
12 thru 20 KA
Capacitor and Reactor Switching
110 KV BIL

June, 1998
Supersedes DB 38-735
dated August, 1993

ABB Power T&D Company Inc.
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Application
The ESVA recloser provides three phase fault protection for substation and line applications.

This recloser is capable of interrupting either 12,000, 16,000 or 20,000 amperes symmetrical fault current at rated voltage, depending on the unit chosen.

Each recloser has a continuous current rating of 500, 800 or 1200 amperes. The duty cycle of each rating conforms to ANSI C37.60, Table 3A, where applicable.

The following data is applicable to all ESVA reclosers:
- Temperature Range -50°C to +70°C
- Minimum Reclose Time 26 cycles
- 15.5 kV Rated Maximum Voltage
- 110 kV BIL Bushings
- Frequency 50 or 60 Hertz
- Up to 600 Ampere Capacitive Current Switching Capability

Bushings 2-4-6, where the bushing current transformers are mounted, or bushings 1-3-5 may be used as line or load bushings and the recloser is operable regardless of current flow. This is especially important, and saves substations construction costs, where reverse power flow is desirable. The recloser under those conditions is operable without having to interchange the line and load bushing connections, saving the user several hours of labor costs.

The continuous current ampere ratings are based on a maximum temperature rise of 55°C.

The interrupting rating is not a function of phase or ground minimum trip. Trip values in the relayed ESVA are achieved by changing tap settings on relays, or multi-ratio bushing current transformers. Trip values on microprocessor controlled ESVA reclosers are changed by reprogramming the control.

Basic Construction Benefits
Each recloser consists of the following major components:
A. High Voltage Air-Filled Compartment
B. Mechanism and Control Compartment
C. Substation Frame

Interrupter Assembly
A standard feature of the ESVA recloser is that each unit is completely assembled at the factory into one package which minimizes the amount of time required for field installation.

In addition, every recloser is tested at the factory to insure that the control is functioning properly. Factory testing of minimum trip values, tripping times, reset and reclose times and contact resistance minimize the de-bugging problems that the user may encounter in the field. To correct these problems in the field, the user would most likely have to spend up to four hours of labor using over-volt equipment, timing devices, and a power supply. This design is intended to avoid these problems.

All components at line potential are contained in the high voltage section and are completely isolated from the control compartment. Porcelain entrance bushings are attached to the roof assembly by bolt and compression type clamps. Removal or replacement does not disturb existing breaker adjustments. Bushing current transformers mount on the entrance bushings. The accuracy class required determines the number that may be mounted.

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Internal Vacuum Interrupter Construction

A. Ceramic Envelope
B. Bimetal Contacts
C. Voltage Grading Shield
D. Main Shield – Suspended from the center seal, the metal shield provides a condensing surface for the vaporized contact material generated during the arcing period. This action prevents contamination of the internal ceramic surface.
E. Bellows – Brazed to the moving contact stem and end plate, the flexible stainless steel bellows allows the contact to move during operation while maintaining a perfect seal.
F. Anti-Twist Key – The moving contact is keyed to prevent twisting during handling assuring the integrity of the seal.

Vacuum Interrupter

The vacuum interrupter utilizes a ceramic envelope because of its high strength, good thermal properties and high density. The use of ceramic allows higher temperature processing during the brazing and degassing operation. The entire brazing and sealing operation is completed within the vacuum furnace assuring a high degree of reliability and longevity for the interrupter.

Two stand-off insulators provide a rugged mounting for the interrupter and operating linkage.

Flexible shunts transfer the current from the moving contact stem to the entrance bus.

The most effective way to switch an electrical circuit is to do it in vacuum. In normal operation the contacts of this alternating current vacuum interrupter are closed. Under fault conditions an interruption is required and the contacts are quickly separated. An arc is established between the two contact faces. Current flows between the contacts through ionic vapor until the alternating current passes through zero. Almost instantaneously, the vapor condenses and the dielectric between the contacts recovers to levels above the transient recovery voltage applied by the circuit. Such fast, reliable interruption has important advantages over other methods of circuit breaking.

Over 500,000 of these vacuum interrupters are now in successful operation. This represents only a small fraction of the new AC applications potentially available to industry. A continuing research and development effort which started in 1960, has resulted in improvements in metallurgical, vacuum processing and ceramic technologies which are steadily expanding the ratings and capabilities of our vacuum interrupters. The range of ratings available from ABB is one of the largest in the world.

Low Voltage Mechanism and Control Compartment

The low voltage compartment contains all relay, metering and mechanical functions and is completely insulated from the high voltage section. The mechanism and low voltage controls are located in the same compartment for substation mounted units. Pole-mounted units have a separate control cabinet for multiple installation options.

Control Wiring

Panels located in the low voltage compartment are used to mount terminal blocks and the 52X and 52Y control relays. Secondary voltage circuits are normally wired through fused knife switches for circuit protection and easy disconnect. The trip circuit is connected through a knife switch, but is not normally fused. Bushing current transformer leads are brought from the high voltage compartment and connected to shotting type terminal blocks.

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The recloser is tripped by a low voltage shunt trip coil which receives its signal from current transformers and an electronic or electro-mechanical relay in lieu of tripping by a high voltage series trip coil mounted in the oil-filled compartment carrying full line current at high voltage.

The shunt trip design provides the user with a source of tripping that is not sensitive to the temperature or the condition of the oil.

**Mechanism**

The operating mechanism is the stored energy type and is mounted in the low voltage compartment on the front of the recloser. Accessibility is gained through a quick release removable panel, and a removable top cover. This makes it possible for operating personnel to perform routine mechanism inspection without entering the high voltage compartment.

A small motor driving through a ratchet mechanism is used to change the main closing springs. The mechanism operates the recloser contacts by supplying a spring trip, spring close driving force to the crankshaft operating all three phases simultaneously. This allows the user one trip close trip operation even if control power has been lost. To prevent the release of stored energy into a pre-loaded mechanism linkage, which could result in excessive stress, a mechanical safety interlock is provided so that the closing springs cannot be manually discharged when the recloser is in the "closed" position.

A latch check switch, located on the mechanism, is provided as a standard feature to permit electrical closing only when the mechanism is fully reset.

A visible flag on the mechanism front cover plate indicates the spring condition as "SPRING CHARGED" or "SPRING DISCHARGED." This positive indication tells operating personnel whether the mechanism has properly stored the energy required to close the recloser during maintenance operations.

The operator can manually close the recloser by actuating the "PUSH TO CLOSE" button which discharges the closing springs. Stored energy makes the operating speed independent of operating personnel. This feature benefits the user in that the recloser can be manually closed into an energized circuit for load pickup when control power is not available.

A manual trip lever allows the recloser to be tripped quickly under emergency conditions.

As an added safety feature, a 60 device block automatic reclosing after manual trip by opening the electrical reclosing circuit.

A cycloconverter operations counter, which indicates the number of trip operations, is located behind the window in the mechanism cabinet permitting the user to determine if operations have occurred without having to incur the added labor cost of removing the housing door.

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Other Features Incorporated in the Mechanism Compartment of the Recloser Include:

- Anti-condensation heaters are mounted in the weatherproof mechanism cabinet as well as in the control cabinet of the pole mounted units. Combined with gasketed doors, the heaters provide a climate that protects the control components from moisture.

- Shorting type terminal blocks located in the mechanism compartment permit ratio changing of the bushing current transformers under load. This design provides a safety feature to operating personnel and eliminates the need to bypass and de-energize the recloser while ratios are being changed.

- Two spare auxiliary contacts are provided for the customer's use which eliminates the cost of purchasing a separate auxiliary switch when only one or two extra contacts are needed.

- Manual charging of the closing springs is accomplished by inserting the tool in the manual charging device and ratchetting approximately nine times. The tool is stored on the front of the mechanism in a set of clips.

- New motor cover bracket simplifies access to motor for maintenance or replacement.
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Design Features of the Control Cabinet

A microprocessor overcurrent and reclosing package can be provided that typically performs all the functions associated with the electro-mechanical relay control.

ESVA reclosers can also be provided with electro-mechanical overcurrent phase and ground relays. The reclosing relay is generally a solid state relay, type RCS-II although the electro-mechanical BC reclosing relay is available.

Among the many features of the relay control are the following:

- The hinged door of the mechanism compartment allows full access to the control panels and eliminates the time required to remove and replace a bolted cover every time access is needed. Provisions exist for padlocking the cabinet door to prevent entry or tampering by unauthorized personnel.

- A hinged panel is provided in the mechanism compartment in order to provide full access to all items mounted on and behind the panel. This decreases the time required to inspect or maintain control items mounted in the cabinet.

- Control wiring is installed at the factory by using a wiring harness that ensures uniformity of wiring and simplifies troubleshooting in the field.

- A fused knife switch in the control circuit provides overcurrent fault protection for the control circuit and makes a visible disconnect readily available for maintenance.

- The spring changing and the close and trip components can be supplied to operate on 120 or 240 VAC. (Trip function requires capacitor trip.) These components may also be supplied to operate on 24, 48 or 125 VDC. The various options of control voltages permit the user some flexibility by allowing the use of the most convenient source or existing station supply, saving the cost associated with providing a new or different source of control power.

Typical Control Cabinet with Hinged Panel Open

PCD Microprocessor Control

The recloser can also be tripped from a capacitor trip device located in the control cabinet. This device stores DC that is available for tripping when close-in faults could drop the station AC control voltage below the level required for AC tripping. This device has the reliability of a battery, but eliminates the maintenance normally associated with batteries as well as the cost of a small station battery.

Control Options

Overcurrent relaying can be supplied either with electro-mechanical, electronic or microprocessor relays.

Electromechanical Relay Package

The extended range III-LO overcurrent relays provide the user with a wider range of built-in current settings which may permit standardization on one control package minimizing applications problems.

Typical Hinged Panel with Microprocessor DPU 2000R Control

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be coordinated with maximum trip time at minimum trip setting. This feature also provides cold load pickup.

Options and Accessories
Three Type GA-332 mini-anemometers with a 0-5 amp scale can be mounted on the hinged control panel. This feature provides built-in indication of instantaneous load current. Each hinged panel is punched to mount these meters either at time of purchase or at a later date by the user. This benefits the user since it eliminates the need for separate installation which adds labor costs and material expense.

Thermal demand ammeters are also available instead of mini-anemeters.

PCD 2000 Power Control Device
The Power Control Device (PCD) is a state of the art electronics device for Power Automation and Control Systems. The PCD is the core device used in Recloser, Breaker, Switch and Capacitor Bank Controls. It provides a common communication solution for Power Automation needs.

The PCD offers unique protective, monitoring, metering, and programmable control features for use in Power Equipment.

The oscillographic waveform capture and playback, combined with extensive event records, make it a valuable tool for disturbance and power quality analysis.

Features
- Multiple communication protocol support, as well as an open protocol communication structure
- Hardened electronics, protective relay standard device
- Oscillographic data with 32 Sample-cycle recording
- Easy-to-use HMI (Human Machine Interface) that displays all metered values and programmable settings
- Extensive protection function selections
- ANSI or IEC standards
- ANSI, IEEE, Recloser or programmable time overcurrent characteristic curves provide greater flexibility
- Three user-programmable curves accommodate special coordination requirements
- Calendar clock keeps time, even during power-down
- Event records and logs are not lost by target resiting
- From panel user programmable switches for additional flexibility
- Rear communication ports for simultaneous local and remote access
- Front mounted optical port allows local communications, while providing sealed front panel
- Programmable logic inputs and outputs with time delays
- Acts as RTU for remote communications
- Internal battery charger and control provides local battery monitoring and temperature compensated control
- Anti-pump scheme

Other Controls
If required, most available controls can be adapted to operate with this recloser.

DPU Distribution Protection Unit
The ABB Distribution Protection Unit can be included as a microprocessor recloser control with a full family of programmable curves. The flexibility of multiple curves along with simple to use programming make this an excellent recloser control. Zone sequencing, fault recording, remote communication, full word programming, phase and ground metering, demand metering, SCADA interfacing, and other features all combine to make this the recloser control of the future.

The DPU recloser control shares completely wired and mounted in a control cabinet. This cabinet includes X and Y relays, fused knife switches for AC and DC power, heater and the necessary terminal blocks for all wiring. The standard control package will include a trip-close control switch, 4-pole test block, red and green indicating lights, ground trip block switch, reclose block switch and DPU self diagnostics alarm light on the front panel. The RS-232C port will be easily accessible either by swinging the DPU control open.

The DPU recloser control operates from 5 amp secondary bushing current transformers mounted in the compartment. In addition, a 25 volt DC or 48 volt DC control power source will need to be available. For pole mounted reclosers and substation applications where DC power is not available, a 120 or 240 volt AC Uninterruptible Power Supply can be supplied. Since all of the ABB reclosers have a "stored energy" mechanism, control power will need to be available for the charging motor.

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Specific Ratings and Catalog Numbers

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>ESVA 1512</th>
<th>ESVA 1516</th>
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<tr>
<td>Rated Maximum Voltage, KV</td>
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<td>Maximum Interrupting Capacity, RMS Symmetrical Amps*</td>
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*Interrupting capacity is not a function of phase or ground minimum trip selection.

Duty Cycle

The ESVA recloser is designed to conform to applicable sections of ANSI C37.50 with duty cycles as shown below.

<table>
<thead>
<tr>
<th>Rated Maximum Voltage, KV rms</th>
<th>Percent of Interrupting Rating</th>
<th>Minimum X/R</th>
<th>Number of Unit Operations</th>
<th>Minimum X/R</th>
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</table>

Total Number of Unit Operations: 116

*This duty represents half life measured by contact erosion.

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