Retrofit solutions
Circuit breaker retrofit
The Breaker Retrofit

Table of Contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Retrofit Concept

Retrofit Aim

RETROFIT means the implementation of modern components (primary switching devices and digital protection/control technology) in the existing MV installation with following benefits:

- Cheaper than a complete replacement
- Short implementation time for replacement
- Minimum shutdown of the switchboard
- Remaining service life extension
- Improved operator protection
- Minimisation of further maintenance costs
- Warranty on the conversion work
- Spare parts availability for long time
Retrofit Concept
The Benefits

Technology
- Magnetic actuator that increases mechanical life time
- Bus communication between breaker and control panel
- Individual pole release for a predictive switching
- Motorized rack-in rack-out operations

Safety
- Offer opportunity of eliminating oil and airblast insulation through use of SF6 or vacuum interrupting technology
- Dramatically reduce fire risk. (people & plants)
- Reduced insurance costs. (people & plants) Increasing making current capacity protects personnel and equipment from unexpected failures.
- Modern control circuits supports remote operations.
- Additional safety standards embedded in modern breaker increases installation safety (i.e. internal/external interlocks)

Reliability
- Lower maintenance requirements.
- Spare parts availability and delivery time for obsolete products can result in unexpected down time. (DOWN TIME)
- Modern breakers features:
  - Accumulated Switching Current Ctrl
  - Number of operations.
  - Gas Control interlock.
  - Modern breaker mechanism are lighter and have longer mechanical life
  - Opportunity to utilize spring or magnetic actuator

Quality of Supply
- Through advanced switching features.)
- Faster reclosing times
- Large communication option to downstream and upstream

Investment
- Where limited funds are available of capital investment
- Lets update equipment with lower investments
- Lets plan customer maintenance budget
- Reduction of insurance costs
- By using new technology
- Reduction of fire risk from old oil breakers
- Relay on operation performance and lose of production/time
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
  - Technical Specification
  - Necessary details for standard retrofit solutions
  - Manufacture Process
  - Certification
  - Other retrofit solutions
- Contact and Support
General Description

Retrofitting example

Minimum oil circuit breaker
- Manufacturer: Calor Emag
- Used in panel: ZP, ZE, ZW
- Productname: OD3

Retrofit solutions with vacuum circuit breaker
- Productname: ZP-VD4-24-truck
- Same characteristics as original breaker type
General Description

Retrofitting

- Based on the longtime service-experience and possible through the existing manufacturer know-how and access to the engineering drawings, ABB developed Retrofit solutions especially tailored to minimum oil circuit breakers.

- As the only authorized provider for retrofit solutions on ABB circuit breakers, ABB offers the exchange of the existing, technical outdated circuit breaker by a switch-truck equipped with state-of-the-art components.

- Due to the expertise and worldwide experience in retrofit, ABB can assure a smoothly run of your retrofit project.
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
  - Technical Specification
  - Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
## Technical Specification
### VD4 Ratings

<table>
<thead>
<tr>
<th>Standards</th>
<th>VDE 0670, part 10/IEC 60694 and VDE 0671, part 100/IEC62271-100 and IEC60068-2-30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating sequence</td>
<td>O – 0,3 s – CO – 3 s – CO</td>
</tr>
<tr>
<td>Rated frequency (HZ)</td>
<td>50 / 60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Typ</th>
<th>Rated current $I_r$ (A)</th>
<th>Rated voltage $U_r$ (kV)</th>
<th>Impulse withstand voltage $U_p$ (kV)</th>
<th>Rated breaking capacity $I_{SC}$ (kA)</th>
<th>Making capacity $I_p$ (kA)</th>
<th>Rated short time current $I_k$ (kA) 3 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>VD4</td>
<td>630 … 2500</td>
<td>12</td>
<td>75</td>
<td>16 … 40</td>
<td>40 … 100</td>
<td>16 … 40</td>
</tr>
<tr>
<td>VD4</td>
<td>630 … 2500</td>
<td>17,5</td>
<td>95</td>
<td>16 … 40</td>
<td>40 … 100</td>
<td>16 … 40</td>
</tr>
<tr>
<td>VD4</td>
<td>630 … 2500</td>
<td>24</td>
<td>125</td>
<td>16 … 25</td>
<td>40 … 63</td>
<td>16 … 25</td>
</tr>
</tbody>
</table>
Technical Specification
VD4 New Schematic Diagram – Circuit breaker
Schematic Diagram Based on Standard VD4
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Necessary Details for Standard Solution Retrofit Solution Development

- Essential technical data
  - Name plate on the existing breaker with
  - Serial number
  - Type
  - Rated Voltage
  - Rated Current
  - Real operational current
  - Short Time withstand Current
  - Auxiliary voltage for coils and spring charging motor
- Clarification of electrical/mechanical interchangeability
  - Front, Rear, Side CB pictures (preferable bottom side and front top)
  - Internal view of the MV panel enclosure (preferable bottom side and rear side)
  - Shutters condition
  - Anti-introduction interlock position
  - Main contacts resin insulation
  - Existing CB panel schematic diagram

In case of Generator CB, to be filled the relevant data sheet.
Necessary Details for Standard Solution
Picture of Name Plate breaker

Positioned on the CB front for every breaker type.
Necessary Details for Standard Solution

Picture of Name Plate truck

Positioned on the truck front.
Necessary Details for Standard Solution

Picture of Name Plate panel

Name plate on the existing panel mounted inside the panel
Necessary Details for Standard Solution
Front, rear, side pictures of old breaker

Example:
Front and side details.
Necessary Details for Standard Solution
Internal panel view without breaker
Necessary Details for Standard Solution
Internal panel view with breaker
Necessary Details for Standard Solution

Front view panel door closed

Existing panels interlocking system (panel internal right side) must be adjusted with some additional slots.
Necessary Details for Standard Solution
Switch truck dimension

Please fill sheet with relevant data
Necessary Details for Standard Solution
Secondary connection

Please take some pictures of the existing secondary plug so that we are able to count the pins. In the past we used two different types of secondary plugs – one type was equipped with 40 pins, the other one with 22 pins.

We have to know the existing type at site.
Necessary Details for Standard Solution

Control board (single line) to find out the connected equipment
Necessary Details for Standard Solution
Secondary wiring diagram

Secondary wiring diagram to be copied at site. Please copy all relevant pages!

Installed secondary equipment inside the old existing minimum oil type breaker like motor drive (MO), shunt release "ON" (Y3) and auxiliary switches (S4)

Very important!!
Secondary plug pin numbers for instance X0:10, X0:11 and so on
In order to use a distribution breaker like VD4 correctly, we have to calculate the DC current in case of generator short circuit.

Why? The distribution breaker can only open when DC current is going to a reasonable low level where the energy can not destroy the breaker.

The opening time might be increased and sometimes capacitors could be requested at generator site.

! Please fill out the generator data request list!
# Necessary Details for Standard Solution

## Generator Breaker Data Sheet

### 2. Technical data of generator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>$U_r$</td>
<td>[kV]</td>
</tr>
<tr>
<td>Rated apparent power</td>
<td>$S_r$</td>
<td>[MVA]</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>$f_r$</td>
<td>[Hz]</td>
</tr>
<tr>
<td>Subtransient direct axis reactance (saturated)</td>
<td>$X_{d''}$</td>
<td>[%]</td>
</tr>
<tr>
<td>Transient direct axis reactance (saturated)</td>
<td>$X_{d'}$</td>
<td>[%]</td>
</tr>
<tr>
<td>Synchronous direct axis reactance (saturated)</td>
<td>$X_d$</td>
<td>[%]</td>
</tr>
<tr>
<td>Subtransient short-circuit time constant</td>
<td>$T_{d''}$</td>
<td>[ms]</td>
</tr>
<tr>
<td>Transient short-circuit time constant</td>
<td>$T_{d'}$</td>
<td>[ms]</td>
</tr>
<tr>
<td>Armature short-circuit time constant</td>
<td>$T_a$</td>
<td>[ms]</td>
</tr>
</tbody>
</table>

### 3. Data of network

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short circuit power of high voltage network</td>
<td>$S_{k''}$</td>
<td>[MVA]</td>
</tr>
<tr>
<td>Rated power of main transformer</td>
<td>$S_r$</td>
<td>[MVA]</td>
</tr>
<tr>
<td>Impedance voltage of main transformer</td>
<td>$U_k$</td>
<td>[%]</td>
</tr>
<tr>
<td>Rated power of auxiliary transformer *)</td>
<td>$S_r$</td>
<td>[MVA]</td>
</tr>
<tr>
<td>Impedance voltage of auxiliary transformer *)</td>
<td>$U_k$</td>
<td>[%]</td>
</tr>
<tr>
<td>Rated power of connected medium voltage motor(s) *)</td>
<td>$P_r$</td>
<td>[MW]</td>
</tr>
<tr>
<td>Rated motor current related to motor starting current *)</td>
<td>$I_r/I_a$</td>
<td>[p.u.]</td>
</tr>
<tr>
<td>Single line diagram of network</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Manufacture Process
Production site Ratingen
Manufacture Process
Retrofit Customization & Routine Tests

**Retrofit Assembling**
- Bushings
- Customized Truck

**Routine test**
- Voltage drop test
- Insulation auxiliary circuit 2kV
- Schematic dgr. Check
- SF₆ leakage test
- Dimensional check
- Interlock check

**Routine test**
- Closing time
- Tripping time
- Contacts simultaneousness
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Certification

Type Test Availability

- Dielectric Test
- Mechanical Interlocks Operations Test
- Mechanical Operations Test
- Short Time Withstand Current Test
- Temperature Rise Test

Retrofit apparatus certification is covered by the type tests of the basic circuit breaker they are based on and by some specific tests performed by the retrofit device inside the original panel. Some non-destructive type tests can also be performed on customer request inside its own panel if available.
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Other Solutions
Retrofit for protection and control

- Retrofit solution for exchange SCU / REF542plus
- Only minor changes are necessary (door and plug connection)
- which results in short downtime
- To ensure optimum programming, only software update is required

Human machine interface of faced out SCU/REF542

Human machine interface of replacement solution with REF542plus
Other Solutions
Retrofitting of earthing switches

- In case switchgear does not have attached earthing switch and conversion work shall be avoided.
- Panel earthing can not be demounted without a check
- Increases security in case of revision work. Earthing truck is lockable. It can only be removed by person who is in charge of key.
- Earthing truck has an integrated voltage measurement. Earthing of outgoing cable can not take place in case of primary voltage. Advantage compared to a „regular“ earthing.
ABB has developed an extremely fast-acting earthing switch.

The goal: Achievement of the highest possible protection level for medium voltage switchgear in regard to destruction by internal arc faults.

The fast-acting earthing switch UFES is an innovative combination of the ABB technologies vacuum interrupter and $I_S$-limiter.

The reliable detection of current and light, in combination with the extreme short operation time, ensures immediate extinguishing of every internal arc within 4ms after detection.
The Breaker Retrofit
Table of contents

- Retrofit Concept
- General Description
- Technical Specification
- Necessary details for standard retrofit solutions
- Manufacture Process
- Certification
- Other retrofit solutions
- Contact and Support
Service Support and Contacts
Medium Voltage Service Contacts for Retrofit

Please contact us if you need more information or support for Medium Voltage Services

- Juergen Welling
  Manager MV Service
  Phone:  +49 (0) 2102 -12 – 1645
  Email: Juergen.Welling@de.abb.com

- Arnd Ickenroth
  Manager MV Retrofit
  Phone:  +49 (0) 2102 -12 – 1240
  Email: Arnd.Ickenroth@de.abb.com

- Quirin Hall
  Service Product Manager
  Phone:  +49 (0) 2102 -12 – 1858
  Email: Quirin.Hall@de.abb.com