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1. **Basic Information**

Today's time increasingly carries new and technically more advanced machines and equipment in all branches of human activity. New technologies are incessantly improved and developed. The same situation is also in the branch of HV electric power production and distribution. The original compressed air, oil-poor and SF6 technique is continuously displaced by the switching vacuum technique. Today's modern design of HV switchgear has better technical parameters, higher reliability and safety in service, makes operation easier and has longer time periods to the revision of equipment. It is not possible for operational and economic reasons in view of technical progress to continuously replace the distribution equipment in service - HV switchgear by the latest variations. This situation has stimulated our firm to start the project “RETROFIT” and in its framework to offer all users of HV switchgear possibility for intensive modernisation of HV substations.

1.1 Project retrofit

What is the project „retrofit”? The majority of operated HV switchgear functions without any serious problem in service as a whole. Problems are with maintenance and repair of “heart” the switchgear - it is with the circuit breaker or other switching device. After a longer time of operation a need can also oft arise to replace obsolete apparatus (protective devices) of control and measuring circuits - this means the equipment of instrument box, or possibly to replace the instrument transformers. In regard to their obsoleteness and to the fact that they are not in production for a long time the necessary spare parts are sometimes not available. Therefore our technicians have developed and tested the replacement of existing HV switchgear withdrawable parts (which we have produced in the past and some selected foreign products) with obsolete devices by new one’s which use today’s modern available switching devices such as the circuit breaker, contactor, switch-disconnector or earthing switch and new types of instrument transformers. In the majority of cases it is then enough to replace the obsolete withdrawable part by the new one.

1.2 Application

The method of retrofit makes it possible to carry out modernisation of all switchgear types produced in the past and this can be done practically with switchgear in service, because the replacement of withdrawable parts including small modifications of the cubicle can be done without putting essentially all switchgear out of operation. The equipment modernisation of control instrument boxes is most advantageous to solve by the replacement with a fully equipped and wired instrument box.

![The vacuum interrupter of VD4 circuit breaker](image)

1.3 Expenses

The expenses on the modernisation of HV switchgear by means of project retrofit are considerably lower than when the whole switchgear is replaced. According to our experience this expenses are about 40 to 50 % of expenses connected with the purchase of new switchgear (without its installation). And the implementation of this modernisation carries also considerable timesavings.

1.4 Advantages

- Quick renovation of obsolete switching devices
- Increase of switchgear operating life
- Possibility of gradual replacement
- Minimal requirements for the maintenance of new switching devices
- Minimal shutdown time
- Considerable savings of expenses for the innovation of equipment
2. TECHNICAL DESCRIPTION

The retrofit withdrawable parts are produced and adjusted in special setting-up jigs. The process of production, setting and testing is carried out in accordance with the provisions of ISO quality standards, and therefore the same guarantees are given on the retrofits produced in this way as on the new HV switchgear.

The steel sheet frames are the basic element of withdrawable parts, which after the assembly create a truck of the withdrawable part. Individual components that depend directly on the switchgear cubicle (blocking, earthing, etc.) are produced according to original drawings, which assure a full exchangeability with the original withdrawable part. On the truck prepared in described manner the new type of switching device (circuit breaker, contactor switch-disconnector or earthing switch) is mounted. The terminals of the device are connected to contacts, which are of the same type as the original withdrawable part had.

In the same manner the outlet of electrical auxiliary and control circuits of switching device is carried out, which is terminated by a connector. The wiring diagram of internal circuits and connection to individual terminals of connector is a type one and complies with the wiring diagram of the original device. After assembly each withdrawable part is submitted to the routine tests and provided with a label as a guarantee for quality and completeness of the product.

In the majority of cases it is not possible to use the original type of the multi-pole plug (of connector) for connection of the withdrawable part with the socket in the switchgear cubicle, because the originally used types (TGL and etc.) are not available now into the market. In this case today’s used types of connectors are mounted and the appropriate counterpart including the mounting holder is supplied as a part of delivery.

2.1 Switching devices

For the retrofits, the up-to-date switching devices produced in ABB are used. These are the circuit breakers type VD4 and VM1, switch-disconnectors type NAL and NALF, vacuum contactors type V-contact or earthing switches type EK6.

Vacuum circuit breaker type VD4
with motor stored-energy operating mechanism

Vacuum circuit breaker type VM1
with magnetic operating mechanism

Vacuum contactor type V-contact
2.2 Instrument transformers

For the retrofits to a maximum extent, the transformers are used, the parameters of which comply with internationally recognized standards. These are the types TTR, TSR, TJP, TDP, TP, BZ, BB, PR, TDC, TPU. All these transformers have the type tests and certification. Our technicians are prepared to recommend the most suitable replacement variation of the original transformers according to particular conditions.
2.3 Summary review of withdrawable parts replacements

Withdrawable parts to 12 kV from the production of EJF

<table>
<thead>
<tr>
<th>Type of switchgear</th>
<th>Original switching device</th>
<th>New switching devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>VH111, VH111.1</td>
<td>HG 3-8/1250</td>
<td>VD4 12kV 1250A 31.5kA, VD4 12kV 1250A 40kA, VD4 12kV 1250A 50kA, VD4 12kV 1600A 25kA</td>
</tr>
<tr>
<td>VH112, VH112.1</td>
<td>HG 3-8/2500</td>
<td>VD4 12kV 2500A 25kA, VD4 12kV 1250A 50kA</td>
</tr>
<tr>
<td>VH136</td>
<td>VL 4-7, SVW 32.3, VF 12.08.31</td>
<td>V-Contact + fuse, V-Contact + fuse and latching device</td>
</tr>
<tr>
<td>VH136.1</td>
<td>HL 4-7, HG 4-8f, HK 4-6B, VF 12.08.31, SVW 32.3</td>
<td>V-Contact + fuse, V-Contact + fuse and latching device</td>
</tr>
<tr>
<td>VH151</td>
<td>HL 4-8, VF12.12.31, VF 12.12.40, OKJ43</td>
<td>VD4 12kV 630A 25kA, VD4 12kV 1250A 31.5kA, VD4 12kV 1250A 40kA, VD4 12kV 1250A 25kA</td>
</tr>
<tr>
<td>VH151.1</td>
<td>HL 4-8, HG 4-8f, VF 12.12.31, VF 12.12.40</td>
<td>VD4 12kV 1250A 31.5kA, VD4 12kV 1250A 40kA, VM1 12kV 1250A 25kA</td>
</tr>
<tr>
<td>VSM121</td>
<td>SVW 32.3, VMC10</td>
<td>V-Contact + fuse, VD4 12kV 1250A 31.5kA</td>
</tr>
<tr>
<td>VSM141</td>
<td>VMC 10/1000</td>
<td>VD4 12kV 1250A 31.5kA, VD4 12kV 1250A 40kA</td>
</tr>
</tbody>
</table>

Withdrawable parts to 24 kV from the production of EJF

<table>
<thead>
<tr>
<th>Type of switchgear</th>
<th>Original switching device</th>
<th>New switching devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR25</td>
<td>VF 25.08.25, VF 25.12.25</td>
<td>VD4 24kV 630A 25kA, VD4 24kV 1250A 25kA</td>
</tr>
<tr>
<td>V22</td>
<td>VMZG 22/1000, VMC 22/600, BAJ 22</td>
<td>VD4 24kV 1250A 25kA, VD4 24kV 1250A 25kA + TDC, NALF24kV</td>
</tr>
<tr>
<td>VH271</td>
<td>HL 6-9, VF 25.08.25, VF 25.12.25</td>
<td>VD4 24kV 1250A 25kA, VD4 24kV 1250A 25kA + TDP</td>
</tr>
<tr>
<td>RIO, RKM 644</td>
<td>HL 6-9, VF 25.08.25, VF 25.12.25 + TDP6</td>
<td>VD4 24kV 1250A 25kA, VD4 24kV 1250A 25kA + TDP</td>
</tr>
</tbody>
</table>
VH151 with switch-disconnector type NALFE

VH151 with contactor type V-Contact

SR with circuit breaker type VD4
## Withdrawable parts of the foreign production

<table>
<thead>
<tr>
<th>Type of switchgear - country</th>
<th>Original switching device</th>
<th>New switching devices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BA/BB - Switzerland</strong></td>
<td>SBS HB (VF)</td>
<td>VD4 12kV 630A 25kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VM1 12kV 1250A 25kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 17kV 1600A 25kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 17kV 2000A 25kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 24kV 630A 25kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 24kV 1250A 25kA</td>
</tr>
<tr>
<td><strong>CS – Yugoslavia</strong></td>
<td>HP 3/7</td>
<td>VD4 12kV 630A 25kA + TPU</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 12kV 630A 25kA + TPU, TSB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 12kV 1250A 31,5kA + TPU, TJC</td>
</tr>
<tr>
<td><strong>CIIL – Romania</strong></td>
<td></td>
<td>VD4 12kV 630A 31,5kA</td>
</tr>
<tr>
<td><strong>CSIM – the former East Germany</strong></td>
<td>SCI 1-20</td>
<td>VD4 24kV 630A 20kA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VD4 24kV 1250A 20kA</td>
</tr>
<tr>
<td><strong>NS4 - Yugoslavia</strong></td>
<td>HG 4/7</td>
<td>VD4 12kV 630A 31,5kA</td>
</tr>
<tr>
<td></td>
<td>HG 4/8</td>
<td>VD4 12kV 1250A 31,5kA</td>
</tr>
</tbody>
</table>

Our technicians are prepared to process the retrofits, which are not given in these reviews.
3. **INSTALLATION**

3.1 Replacement of withdrawable parts

Newly produced withdrawable parts are identical in regard to they dimensions, contact system and all other elements, which depend on the switchgear cubicle, with the original replaced withdrawable parts. For these reasons the replacement is carried out by the disconnection of connector for control and signalling circuits and with an ordinary withdrawal of the old original withdrawable part from the cubicle. The new withdrawable part is drawn in with a reverse procedure and the connector is connected.

In case that in the cubicle the old type of connector is used, which already is not available into the market, the part of delivery of new withdrawable part is the needed number of connector counterparts used on the supplied withdrawable part including the corresponding holder for replacement in the cubicle. The bottom cover sheet of the instrument box is replaced. The original socket (of connector) including the holder is disassembled, connected wire ends are professionally disconnected and connected to the corresponding number of plug of the new socket. After completion the socket is fixed into the new holder and the holder is drilled with the instrument box. If it is necessary the bottom cover sheet of the instrument box is adapted and remounted. After testing and carrying out of the starting revision it is possible to put into operation the whole switchgear. If the withdrawable part with VD4 is used, it is necessary to take into account the change of protection parameters of the motor operating mechanism compared with the original withdrawable part. The respective protection circuit breaker is given in the catalogue documentation of this circuit breaker. By request it is possible to deliver requisite protection circuit breaker as separate packed accessories. In case of DC voltage it is necessary to use two-pole protection circuit breaker.

![Original design](image1.png)  
**Original design**  
**Example of replacement**  

**VH151 with circuit breaker type HL**  
**RETOFIT VH151 with circuit breaker type VD4**
3.2 Other equipment

The replacement of control instrument boxes is similarly simple as the replacement of withdrawable parts. After the disconnection of instrument box outgoing wires (to measuring transformers, sensors of short-circuit protection and similarly), dismounting of connecting bolts and earthing strips it is possible to remove the original instrument box. In the reverse manner the new instrument box is fitted on the original switchgear. The box is fastened with bolts to switchgear frame; the disconnected wires and earthing strips are reconnected. After setting up of protective devices and functional tests it is possible to put again the switchgear cubicle in operation. The problems of possible measuring transformers replacement are dependent of the particular type of switchgear and type of used transformer. The description of mounting procedure goes therefore beyond the scope of this catalogue. In case that the replacement of measuring transformers is required in the switchgear in service we recommend to consult out technicians.

4. SERVICES

Besides service in the guarantee and after guarantee period, which we take for granted for all deliveries, we can also offer other services:
- Working out of complete project documentation for the reconstruction of HV switchgear
- Deliveries and installation of retrofit devices in the switchgear including adjustment
- Setting up and adjustment of protective devices
- Other deliveries or activities according to the agreement

All activities can be carried out both the turnkey solution and installation with supervision.
5. DATA FOR ORDER

So as to execute an order accurately and promptly we need to know the complete data from the nameplate of existing switchgear. In case of atypical switchgear or cubicles of foreign producers a supplementary photograph is suitable. Before the order acknowledgement the personal visit of technician is usually necessary.

**Example:**

**Type of cubicle**  
VH151

**Year of production**  
1978

**Original order number**  
39-12345

**Number of cubicle**  
2,3

**Type of new device**  
VD4

**Parameters of new device**
- Rated voltage 6,3 kV
- Rated current 1250 A
- Rated breaking current 31.5 kA
- Voltage of control circuits 230 V AC
- Voltage of operating mechanisms motor 230 AC
- Blocking magnet

**Number of cubicle**  
10,12

**Type of new device**  
NALF

**Parameters of new device**
- Rated voltage 12 kV
- Rated current 630 A
- Shunt release OFF 230 V AC
- Auxiliary switch 2/2
- Fuses 63 A