ACB
MAINTENANCE, TROUBLE SHOOTING
TESTING OF RELEASES

LARSEN & TOUBRO LIMITED
AIR CIRCUIT BREAKERS

COMPLAINT  BREAKER IS NOT CLOSING

PROBABLE CAUSE
- a) Undervoltage release not connected with supply.
- b) Undervoltage release, Shunt release, Magneto thermal release connecting link not adjusted properly.
- c) Magneto thermal release removed from ACB, but trip bar of release kept free.
- d) Latch of the mechanism spring not in proper position or misplaced.
- e) Under voltage release coil burnt out or open circuited.
- f) Bimetal element of magneto thermal release bent permanently.
- g) After overload or short circuit fault, breaker not reset (ONLY FOR MANUALLY RESET TYPE ACB.)
- h) Sticking of tripping mechanism due to excess dust.

POSSIBLE SOLUTION
- a) Give rated voltage to under voltage release.
- b) Adjust the connecting linkage of releases correctly.
- c) Lock the trip bar at given position.
- d) Fix the spring correctly.
- e) Replace the under voltage release.
- f) Replace the magneto thermal release.
- g) Reset the breaker by pressing OFF / RESET button.
- h) Clean the tripping mechanism with CRC 2-26 & grease them, (refer section on greasing)

COMPLAINT  BREAKER IS NOT TRIPPING WITH UNDervoltage OR Shunt Release.

PROBABLE CAUSE
- a) Shunt release does not get supply.
- b) Supply of under voltage release does not get cut off.
- c) Link pins of Undervoltage or shunt release misplaced.
- d) Due to dust release becomes sticky.

POSSIBLE SOLUTION
- a) Check control wiring of shunt release & ensure that shunt release gets supply.
- b) Check control wiring.
- c) Ensure that pins are in position.
- d) Remove the dust from the release & clean it with CRC 2-26.
**COMPLAINT**

**BREAKER IS NOT TRIPPING BY MANUAL TRIP PUSH BUTTON**

► **PROBABLE CAUSE**

  a) Trip push buttons connecting link is short. (Not adjusted properly.)
  b) Latch of the mechanism jammed because of dust.

► **POSSIBLE SOLUTION**

  a) Adjust the push button link correctly.
  b) Clean the latch of the mechanism with CRC 2-26.

**COMPLAINT**

**ACB IS NOT TRIPPING IN CASE OF OVERLOAD OR SHORT CIRCUIT FAULT**

► **PROBABLE CAUSE**

  a) Connection between C.T. and magneto thermal release is loose or open circuit.
  b) Overload setting of magneto thermal release is more than actual load current.
  c) Magneto thermal release linkage not adjusted properly.

► **POSSIBLE SOLUTION**

  a) Tighten the terminals of C.T. in case of open circuit.
  b) Make the overload setting of ACB as per actual load current.
  c) Connect the linkage of magneto thermal release to trip bar properly & ensure its tripping operation.

**COMPLAINT**

**MAIN CONTACTS OF ONE OF THE POLE OF ACB NOT CLOSING**

► **PROBABLE CAUSE**

  a) Excessive dust accumulated in the pole assembly.
  b) Nylon rollers of the pole assembly are not rotating smoothly.
  c) Pole connector setting disturbed.
  d) Nylon rollers of the pole assembly are broken.

► **POSSIBLE SOLUTION**

  a) Clean the pole assembly mechanism with CRC 2-26. Remove grease and dust with brush & apply fresh grease.
  b) Clean the nylon rollers with CRC 2-26 and relubricate them. (refer section on greasing)
  c) Consult the manufacturer of Circuit Breaker
  d) Consult the manufacturer of Circuit Breaker.
COMPLAINT: PITTING ON MAIN CONTACTS

► PROBABLE CAUSE

a) Arcing contact gap is not adjusted properly.
b) Thickness of arcing contact is reduced below the specified limit. (> 0.5 mm)

► POSSIBLE SOLUTION

a) Adjust the gap of arcing contacts, it should be 0.9 + or -0.1 mm
b) Replace both fixed and moving arcing contacts.

COMPLAINT: EROSION ON ARCING CONTACTS

► PROBABLE CAUSE

a) Rough deion plates of arc chutes.
b) Breaker is operated without arc chute in position.

► POSSIBLE SOLUTION

a) Clean the deion plates and side insulating strips of arc chutes with CRC2-26.
b) Always operate ACB with arc chute in position & keep the arc chutes clean.

COMPLAINT: BREAKER IS NOT RACKING IN THE CRADLE FREELY

► PROBABLE CAUSE

a) Threads of mechanical indicating assembly worn out.
b) Shutter assembly is not properly set in the cradle.
c) Secondary isolating contacts not matching properly.
d) Dovel pin broken.
e) Telescopic rail becomes jammed.

► POSSIBLE SOLUTION

a) Replace the mechanical indicating assembly.
b) Fix the shutter assembly properly in the cradle.
c) Match the fixed and moving secondary isolation contacts properly.
d) Replace the dovel pin.
e) Clean the telescopic rail with CRC 2-26. Remove dust, grease & relubricate it.

COMPLAINT: OVERHEATING

► PROBABLE CAUSE

a) Poor termination (High Milli-Volt drop across termination on ACB.)
b) Dusty atmosphere.
c) Use of undersized cable or bus bars.
d) High ambient temperature.

► POSSIBLE SOLUTION

a) Clean the terminals with CRC 2-26 and do proper retermination. Ensure that milli volt drop within specified limits.
b) Do periodic cleaning of circuit breaker.
c) Use cables or bus bars of adequate rating.
d) Reduce load current or select & install correct rating of ACB.
COMPLAINT

BRAKER IS NOT CHARGING WITH MOTOR

- **PROBABLE CAUSE**
  - a) Motor is not getting supply.
  - b) Loose connections in secondary isolating contacts.
  - c) Motor is burnt out.

- **POSSIBLE SOLUTION**
  - a) Check the limit switch of motor. Replace it if it is damaged.
  - b) Fix the secondary isolating contacts properly.
  - c) Replace the motor.

COMPLAINT

BRAKER IS NOT CLOSING REMOTELY

- **POSSIBLE SOLUTION**
  - a) Breaker is not in service position
  - b) Closing coil is not getting supply,
  - c) Closing coil burnt out or open circuited.

- **POSSIBLE SOLUTION**
  - a) Take the breaker in service position.
  - b) Check control circuit and ensure that coli gets supply.
  - c) Replace the closing coil,
SERVICE OF ACBs

COMPONENTS TO BE GREASED
P) PINS
1) ROLLER ASSEMBLY
2) POLE LATCH SPRING RETAINER
3) STAINLESS STEEL PROFILE
4) SLOTTED GUIDE
5) POLE LATCH NYLON ROLLERS
6) CRANK
7) PLATE

GREASE TO BE USED
1) LITHON 2 OF HINDUSTAN
   PETROLEUM OR SYNTHOLUBE
   10 OF H.J. LEACH
   (FOR COMPONENTS SHOWN IN CIRCLE)
2) BALEMEROL MOLY GREASE ML OF
   BALEMER LAWRIE & CO.
   (FOR COMPONENTS SHOWN IN SQUARE)

SCHEDULE FOR GREASING
EVERY 500 OPERATIONS OR 6 MONTHS

SECONDARY ISOLATING CONTACTS
SLIDING SURFACE OF FIXED & MOVING
CONTACTS WITH PETROLEUM JELLY
**GREASING**

A Breaker normally greased and operating in a dust-free and non-corrosive atmosphere over a period of two years can undergo its normal cycle of mechanical endurance without greasing. As ideal service conditions are hardly encountered, it is recommended to **regrease the breaker after a cycle of 500 operations or six months, whichever is earlier.**

**COMPONENTS TO BE GREASED**

All rubbing surfaces in the mechanism, poles etc. are to be greased except the contacts (copper on copper) and sintered bearings. Prior to greasing, these surfaces should be throughly cleaned. Excess grease must be wiped out.

Recommended grade of grease.

1. Lithon 2 of Hindustan Petroleum (Yellow) for pole parts FRCD gears in electrical breakers.
2. Balmerol Moly grease ML (Black) of Balmer Lawire & Co. for mechanism in mechanical & electrical breakers.

**COMPONENTS GREASED FOR LIFE**

The following components are provided with self-lubricating sintered rings impregnated with grease for life.

- Trip rod
- Intermediate shaft of manual control
- Free-return charging device for electrical operation.

**COMPONENTS NOT TO BE GREASED**

- All releases
- Main isolating contacts and cradle terminals
- Earthing terminal
- Secondary isolating contacts
**PROPER TERMINATION TEST**

**TEST**

Proper termination test of Cables, Busbars and Crimping of Cables can be tested by measuring Milli-Volt drop across them. If the termination is not good, i.e. loose/unclean/less contact area then the joint resistance increases. The voltage drop across such joints will be more as compared to a good joint.

Condition of contacts of any switchgear can be tested by measuring mV drop, across them. If the contacts are pitted/unclean then contact resistance increases, so we get high mV drop across them.

**Typical Milli-Volt Drop Values**

<table>
<thead>
<tr>
<th>Joint Location</th>
<th>Test Current Amp.</th>
<th>Max. mV Drop Permissible</th>
<th>Good mV Drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal to Bus Barbar/Link</td>
<td>100</td>
<td>2.5</td>
<td>0.5 to 1</td>
</tr>
<tr>
<td>Terminal to Lug</td>
<td>50</td>
<td>8.0</td>
<td>1 to 2</td>
</tr>
<tr>
<td>Terminal to Lug</td>
<td>100</td>
<td>5.0</td>
<td>1 to 2</td>
</tr>
<tr>
<td>Cable to Cable Lug (across crimping joint)</td>
<td>Rated</td>
<td>5.0</td>
<td>2</td>
</tr>
</tbody>
</table>
8. OVERLOAD AND SHORT CIRCUIT TESTING OF ACB

1. Trip the circuit breaker by pressing the trip push button of the release as shown below.

```
<table>
<thead>
<tr>
<th>T1</th>
<th>M1</th>
<th>T2</th>
<th>M2</th>
<th>T1</th>
<th>M1</th>
<th>T2</th>
<th>M2</th>
<th>T1</th>
<th>M1</th>
<th>T2</th>
<th>M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.75</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Trip push button

This is necessary to check the mechanical setting of the release.

2. As we will be testing circuit breaker by Secondary Injection Method, disconnect all the wires from magneto thermal release.

3. Set the release at point 1.0 for all three phase as shown below.

4. Wire normally open (NO) auxiliary contact of ACB in series with test panel's auxiliary contact. (This is to cut off the current flowing through the release as soon as ACB trips.)

5. Find out the rated CT secondary current. For L & T ACB rated CT secondary current is 8.75 Amp.

Calculate the test current as follows:

* For 2 times overload (200%)
  Test current = Rated CT secondary current x No. of times of overload
  = 8.75 x 2
  = 17.50 amps

* For 3 times overload (300%)
  Test current = Rated CT secondary current x No. of times of overload
  = 8.75 x 3
  = 26.25. amps
OVERLOAD TESTING

Internal connections of the DN release with CT is shown in the following diagram.

Note: For testing overload pass current between T1 % T2.
For testing short-circuit pass current between S & M1 or M2.

INTERNAL WIRING DIAGRAM OF NEW DN RELEASE

For overload testing we have pass current between T1 % T2 terminals of the release. Contact the output terminals of the panel to T1 and T2 terminals of releases as shown below (use 2.5 sq. mm copper wire).
Current vs Time (I-T) characteristic of DN type release is given below. Find out the minimum and maximum trip time for 200% and 300% overload the curve and note it down in table 1.
Switch on the supply and adjust the test current. **Immediately switch off the current.** Keep the variac at adjusted position. Reset the time counter. Cool the release for about 10 minutes.

Release setting = one

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Test Current (Amp)</th>
<th>Trip Time in Seconds</th>
<th>Remark OK / Not OK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>Y</td>
</tr>
<tr>
<td>1.</td>
<td>17.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>26.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1

Switch on the current and check trip time of the ACB. Fill up the data in above table.

**SHORT CIRCUIT TESTING**

i) For short circuit testing, connect the output terminals of current control panel to S and M1 or M2 terminals of release.

ii) When M1 is connected test current should be 45 Amp and for M2 the test current should be 57 Amp. *(M1 and M2 magnetic threshold are of the order 500% to 700% of CT secondary.)*

iii) Close the breaker.

iv) Switch on the current and check for instantaneous tripping operation of breaker.

**Note**: Connect the wires of magneto thermal release as per wiring diagram.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Test Current (Amp)</th>
<th>Trip Time in Seconds</th>
<th>Remark OK / Not OK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Actual</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>Y</td>
</tr>
<tr>
<td>1.</td>
<td>M1</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>M2</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>
The self powered SR 21 release has four zones of protection:

1. Protection against overload: Long Time
2. Protection against short circuit: Short Time
3. Protection against short circuit: Instantaneous
4. Protection against Earth fault: Ground fault

The release is fed by three current transformers with nominal CT secondary current 750 mAmp.

The release provides choice of characteristics suitable to load characteristics.

It is provided with thermal memory switch.

On changing the position of this switch to ACTIVE POSITION the release provides COLD & HOT characteristics.

The release also displays the type of fault under which the breaker trips through its indicators. The indicators reset when breaker is reclosed and a current of about 15% of breaker rating starts flowing.

Remote & Separate fault indication can be achieved through annunciation module.

The settings must be changed only with the release is in OFF condition. Any change during ON condition will not be recognised by the release.

Breaker with SR 21 releases can be interconnected for Zone Selective Interlocking (ZSI), which provides discrimination between upstream & downstream breakers during short time (short circuit) & earth fault conditions.

Recommended wiring between ACBs for ZSI: PVC sheathed shielded twisted pair wire 7/0.2 tinned copper. SICs SI (for short time) & GI (for ground fault) of the upstream breaker are to be wired to SICs SO (for short time) & GO (for ground fault) respectively of the downstream breaker.

**Wiring between two breakers for Zone selective interlocking:**

A & B are ACBs interconnected for ZSI. For fault at location X ACB B trips instantaneous & A Trips after delay if B fails to trip. For fault at location Y ACB A trips after default delay of 60 ms plus breaker operating time instead of time delay set on release.
1. Long Time Current Pick-up switch.
2. Long Time Delay switch.
4. Short Time Delay switch.
5. Instantaneous Current Pick-up switch.
7. Ground Fault Delay switch.
8. Trip function test connector
9. Power ON LED
10. Long Time Trip indicator (LT)
11. Short Time trip indicator (ST)
12. Instantaneous trip indicator (INS)
13. Ground Fault trip indicator (GF)
14. Thermal Memory ACTIVE/BLOCKED switch (Sliding switch type)

In — Nominal Current i.e. C.T. tap value
Ir — Rated current i.e. selling of pick up current for long time in the release.
LONG TIME DELAY FOR SR 21

TRIP TIME in sec.

MULTIPLES OF RATED CURRENT
MICROPROCESSOR BASED RELEASE SR 61 C

The microprocessor based, communication capable release gives following protections.

1. Protection against overload: Long Time
2. Protection against short circuit: Short Time
3. Protection against Earth fault: Ground fault

The release continuously measures & displays in scrolling way:

a] The 3 phase RMS Current.
b] Earth leakage current.

The non-volatile memory of release stores & displays:

i] Last 5 trip data i.e. trip cause & current values.
ii] The number of tripping due to a particular fault.
iii] The RMS values of current measured during switch-on of feeder.

The fault indication is through 4 LEDs which indicates the phase in which fault has occurred. LEDs starts flashing while sensing the fault & go steady when the trip has occurred. The indication is reset manually through reset push button.

SR 61 C Release has five outputs contacts:

R1 Used for trip output. It actuates the flux shift device which directly actuates the tripping mechanism. (R1 can be programmed for manual/auto reset and is not available outside for writing)

R2 It is an instantaneous output element, which can be used as blocking output, to avoid nuisance tripping of upstream ACB.

R3 It is used for closing the ACB, through closing coil. (R3 & R4 are used to operate the ACB from remote location in communication mode say, through computer)

R4 This release use for internal fault condition. It de-energizes when the control supply fails or internal malfunction occurs. The release automatically checks its.

Under internal fault, the error LED glows, fault code in seven segment is displayed.