Application Note

Substation Automation and Protection Division

REL 512 Reclosing Applied to Ring Bus

When applying the REL 512 reclosing to a ring bus configuration, it is important to understand that the recloser module performs the reclosing function using it's own I/O, independent of the protection function. The only exceptions are the reclose initiate and block signals developed in the protection which are passed internally to the reclose module. All other inputs, including bus and line system ac voltages and binary (status) dc voltage, are external inputs connected via termination blocks associated with the reclosing module. Thus, this system allows the protection functions to trip two breakers and the reclosing function to control one breaker. This method of protection and reclosing control is shown in Figures 1 and 2. For simplicity, all REL 512 protection functions are identified by 21 and reclosing functions by 79.
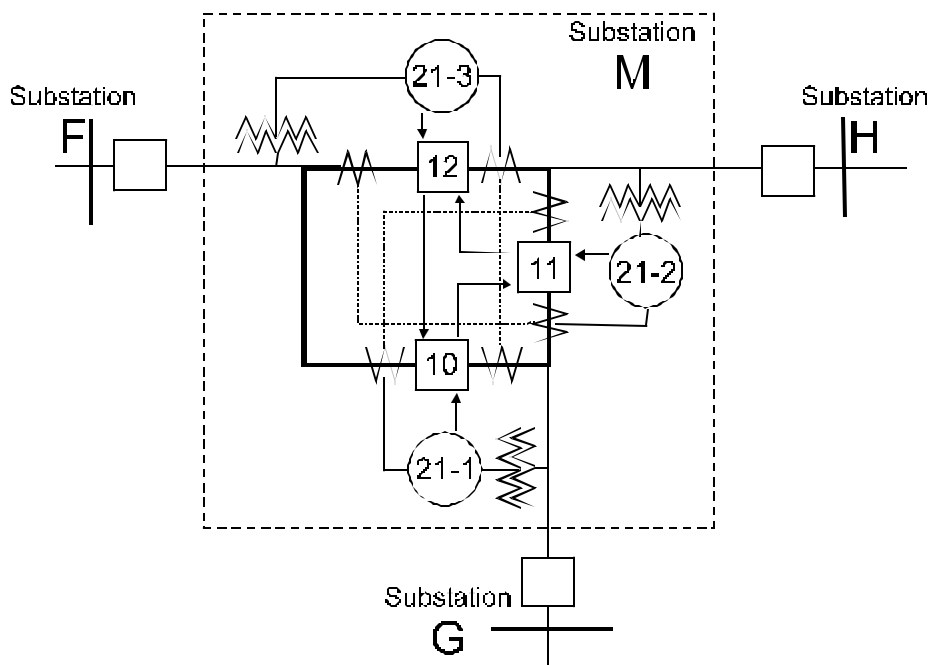

Figure 1 - REL 512 Protection Control of Ring-bus Circuit Breakers

Breaker Auxiliary Contact Connections

There are separate voltage and breaker auxiliary contact connections made to the protection and reclosing modules of the relay. For ring bus applications, both breakers common to the protected line should have their auxiliary contacts appropriately connected to the protection module via programmable inputs (middle row of terminal blocks). When the protection operates both breakers trip and provide their change of state information to the protection. The requirements for connecting 52a and/or 52b contacts are defined in the instruction book. They do not have to be the same as those used for reclosing.

For reclosing, one of the line's breakers is designated as the lead breaker and the other is the follow breaker. Only the lead breaker's auxiliary contacts are connected to the reclosing module (top row of terminal blocks). It is recommended to use the 52b. Connecting the 52a is optional. 52b contact connections to the recloser are summarized in Table 2.
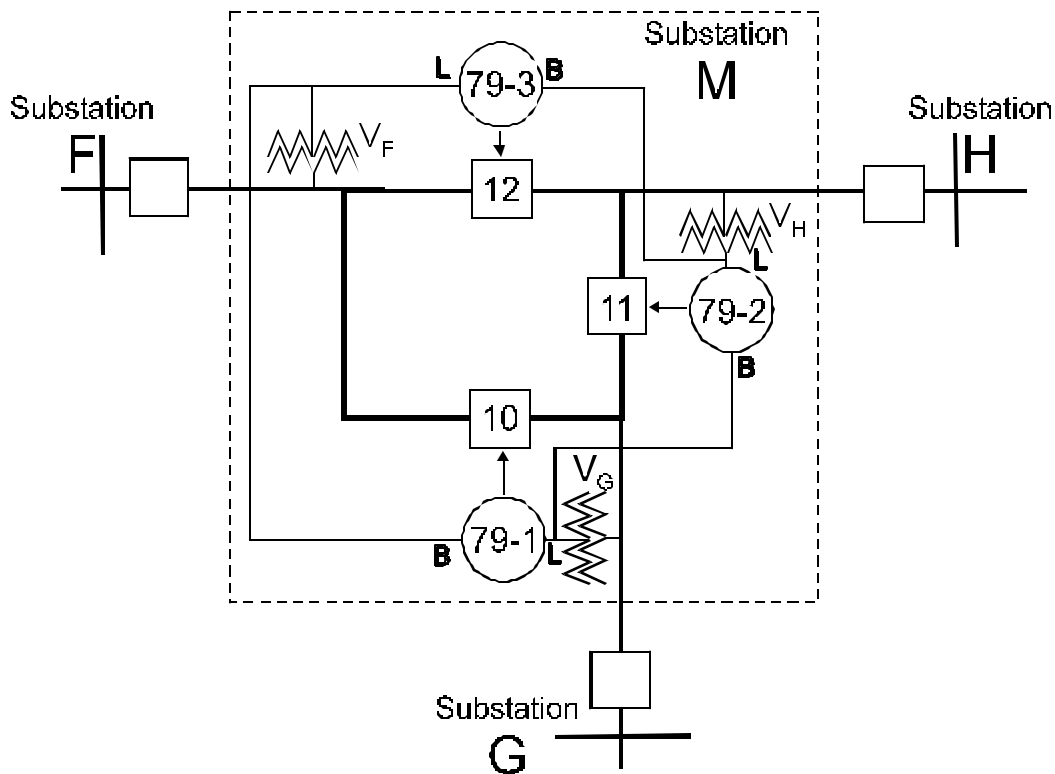
Figure - REL 512 Reclosing Control of Ring-bus Circuit Breakers.

Voltage connections

The protected line's voltage is connected to the protection on the lower row of terminations as defined in section 2 of IB 40-512. This voltage is also connected to recloser module as the *line* voltage as defined in section 8 of IB 40-512. It will be used to control the lead breaker. Furthermore, this voltage is also connected to the reclosing module of the adjacent relay that shares control of the follow breaker. It will be connected as the *bus* voltage there as defined in section 8 of IB 40-512. The voltage connections to the recloser module are summarized in Table 2.

Reclose Initiate

The REL 512 relay tripping for a fault on its protected line will provide a reclose initiate signal internally to the recloser module within its chassis. It also will provide an RI signal for the reclose module of the adjacent relay that controls the follow breaker. This RI signal will be in the form of a contact output and must be wired to the adjacent reclose module. In this application, the protection's HSRI output (terminals TB5-7/8) is connected to the adjacent relay's reclose module input #5, external reclose initiate #2 (terminals TB7-3/4). The reclose initiate connections are summarized in Tables 1 and 2.

Lockout

If the *lead* breaker fails to successfully reclose it will advance to 'lockout'. When in this state the reclosing module will need to lockout the other breaker associated with this line. This situation requires the use of the reclose module lockout output, relay #6 (TB6-5/6), to drive the adjacent recloser controlling the *follow* breaker, to 'lockout' via it's input #1, drive to lockout (TB7-11/12). The lockout connections are summarized in Table 2.

A failed reclose will be the result of either exceeding the maximum wait time waiting for the appropriate voltage supervision to be satisfied or by reclosing into a fault. In the latter condition a reclose-block signal will be generated. This signal will be passed internally to the recloser in the same chassis if the reclose shot # has the reclose-block enabled. The reclose-block signal can also be mapped to a protection programmable contact and used to 'lockout' the adjacent recloser. This connection to the protection is not shown below , but will assert the adjacent recloser input#1 (Table 2), drive to lockout.

Table 1 - 21 Protection Breaker Trip and Reclose Initiate Connections

| Protection | Line | Controlled Breakers | | Provides Internal RI to: | Provides External RI from TB5 – 7/8 to: |
		Lead	Follow		
21-1	G	10	11	79-1	79-2 (TB7 – 3/4)
21-2	H	11	12	79-2	79-3 (TB7 – 3/4)
21-3	F	12	10	79-3	79-1 (TB7 – 3/4)

Table 2 - 21 Protection (21) and Recloser (79) Interconnections

| Recloser | Controls Breaker | 52b Input (TB6-19/20) from Breaker | Voltage Connection | | Input # 5 External RI #2 (TB7-3/4) From | Input #1 Drive to Lockout (TB7-11/12) From |
			V_{LINE}	V_{BUS}		
79-1	10	10	V_G	V_F	21-3 (TB5-7/8)	79-3 (TB6-5/6)
79-2	11	11	V_H	V_G	21-1 (TB5-7/8)	79-1 (TB6-5/6)
79-3	12	12	V_F	V_H	21-2 (TB5-7/8)	79-2 (TB6-5/6)

Protection (21) Settings

Zone-1, high-set overcurrents (if enabled) and pilot protection should be set to high-speed reclose initiate for the desired fault types. Normally reclosing for all faults is recommended. All time delayed trip reclose initiations should be disabled. This includes zone-2, zone-3, and backup overcurrent units.

Close into fault, CIFT, should be enabled to assure reclose blocking on the subsequent trip if the reclose attempt is into a fault.

Z1 RECL INIT = HIGH SPEED
Z1 RI FAULT TYPE = ALL FAULTS
Z2 RECL INIT = DISABLE
Z3 RECL INIT = DISABLE
TD 51 RI = DISABLE
PS RECL INIT = ENABLE
PS RI FLT TYPE = ALL FAULTS
If HS 50P TRP, HS 50Q TRP, or HS 50N TRP is enabled and reclosing for them desired then:
      HS 50 RI = HIGH SPEED
      HS RI FLT TYPE = ALL FAULTS
CIFT = ENABLE

Reclosing Settings

Voltage / Sync-check
Three-phase voltage checking is recommended. This will provide added security insuring that all phase

voltages are above the 'live' voltage threshold before synchronism check is attempted. Other settings should be set in accordance with section 8 of IB 40-512.

VOLT CHECK = 3 PHASE (requires 3 phase connection of bus and line voltages)

Reclosing

The number of recloses is set to 2. The successful reclose reset time delay should be set to 10 seconds. This time is arbitrary, but should be coordinated (reset time + margin < shot #2 dead time) with the shot #2 dead time. Other settings should be set in accordance with section 8 of IB 40-512.

RECLOSING = ENABLE
NO OF RECLOSES = 2
RESET TIME DLY = 10

Shot #1

The reclose shot #1 is set up for high speed reclosing as required. Generally the reclose will be set up with no voltage supervision or hot bus dead line, HBDL, supervision. If the remote end has closed first and voltage has been restored, then synchronism checking should also be enabled if HBDL is enabled. Otherwise reclose will not be attempted if the line voltage has been restored. The reclose initiate type recommended is 52b and RI. The reclose dead time is 0.5 seconds. Other settings should be set in accordance with section 8 of IB 40-512.

RC1 TYPE = 52B AND RI
RC1 BLOCK = DISABLE
RC1 DEAD TM = 0.5
RC1 MAX WAIT = 120 (default)
RC1 VOLT CHK = ENABLE
RC1 V CHK TYPE = HBDL
RC1 SYNC CHK = ENABLE
RC1 EXT SUPV = DISABLE (default)

Shot #2

The reclose shot #2 is required to provide the sync-check reclose. The reclose initiate type recommended is 52b and RI. The reclose dead time is 12 seconds. The maximum wait time should be set longer than the shot #1 maximum wait time. Reclose block is enabled. This will allow immediate blocking and by passing of shot #2 of the lead breaker for CIFT and advance the recloser to 'lockout'. Other settings should be set in accordance with section 8 of IB 40-512.

RC2 TYPE = 52B AND RI
RC2 BLOCK = ENABLE
RC2 DEAD TM = 12 (waits 12 seconds before attempting synchronism reclose)
RC2 MAX WAIT = 120 (default)
RC2 VOLT CHK = DISABLE
RC2 V CHK TYPE = HBDL
RC2 SYNC CHK = ENABLE
RC2 EXT SUPV = DISABLE (default)

Reclosing Sequence

Successful Reclose
1. A fault occurs on line H.
2. 21-2 trips breakers 11 and 12 and sends internal RI to 79-2 and external RI to 79-3.
3. 79-2 starts shot #1 0.5 sec. dead time count.

79-3 bypassed shot #1 (RI #2 input starts at shot #2) and starts shot #2 12.0 sec. dead time count.
4. 79-2 recloses breaker 11 after 0.5 seconds of dead time on HBDL.
   Recloses on synchronism check if line voltage has been restored from remote end.
5. 79-2 resets 10 seconds after reclose (this assumes HBDL was immediately satisfied).
6. 79-3 recloses breaker 12.0 seconds on synchronism check.
7. 79-3 resets 10 seconds later.

Failed Reclose
1. A fault occurs on line H.
2. 21-2 trips breakers 11 and 12 and sends internal RI to 79-2 and external RI to 79-3.
3. 79-2 starts shot #1 0.5 second dead time count.
   79-3 bypassed shot #1 (RI #2 input starts at shot #2) and starts shot #2 12.0 seconds dead time count.
4. 79-2 recloses breaker 11 after 0.5 seconds of dead time on HBDL into fault
5. 21-2 trips on CIFT and sends internal blocks reclose to 79-2
6. 79-2 advances to lockout and sends external signal to 79-3 to advance to lockout

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