

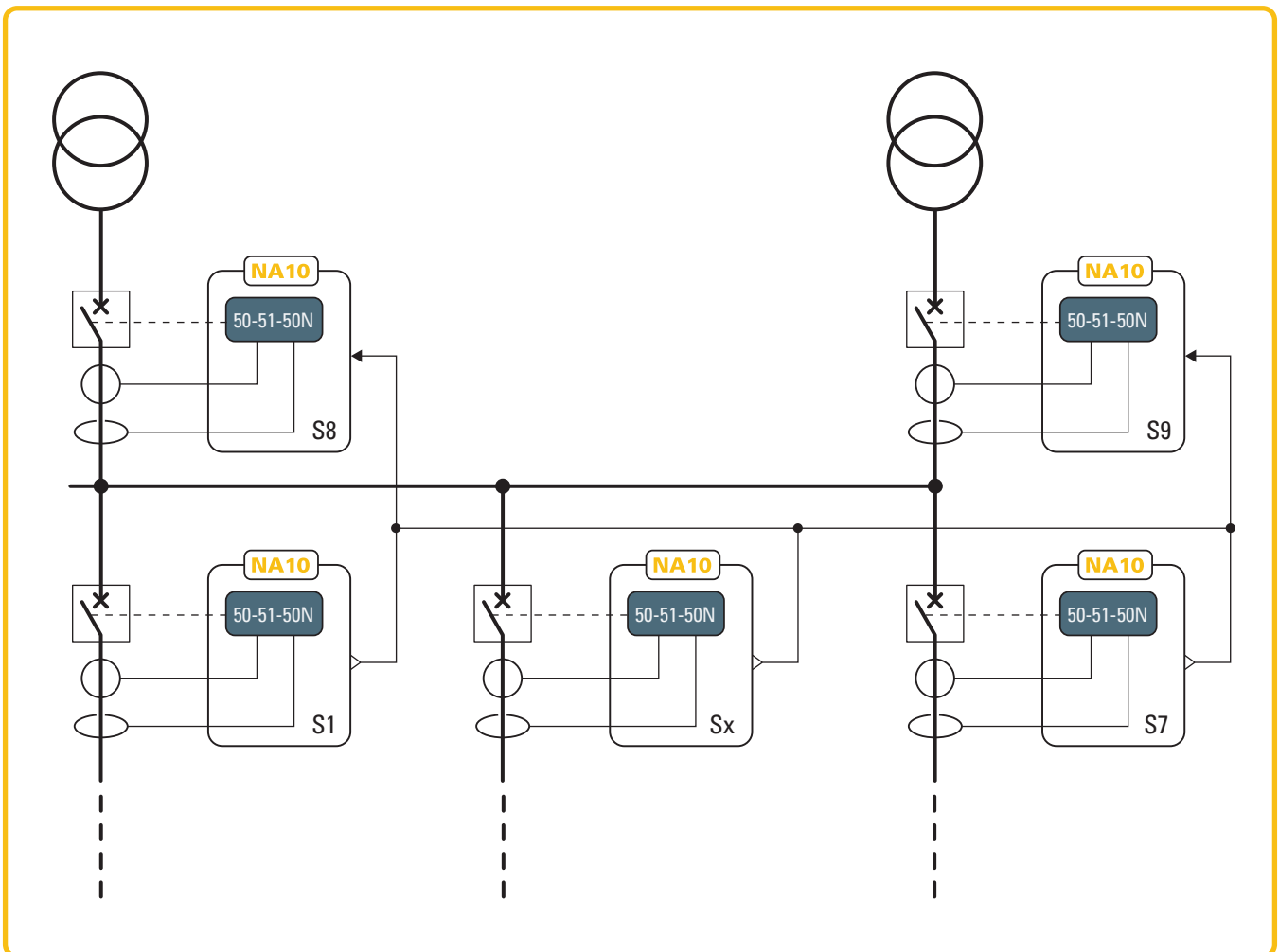


## LOGIC SELECTIVITY

### APPLICATION NOTES

#### Application

The protection scheme with logic selectivity system is shown in the following figure, where the two power transformers aren't in parallel service (the seven outgoing feeders are powered from a single transformer).



Each of the seven NA10 outgoing feeder relays (S1...S7) must have an output signal that blocks both the two upstream incoming feeders relays (S8, S9) at their input.

The logic selectivity is programmable for overcurrent (protective function 50/51, all stages) and ground fault protections (protective function 50N/51N, all stages).

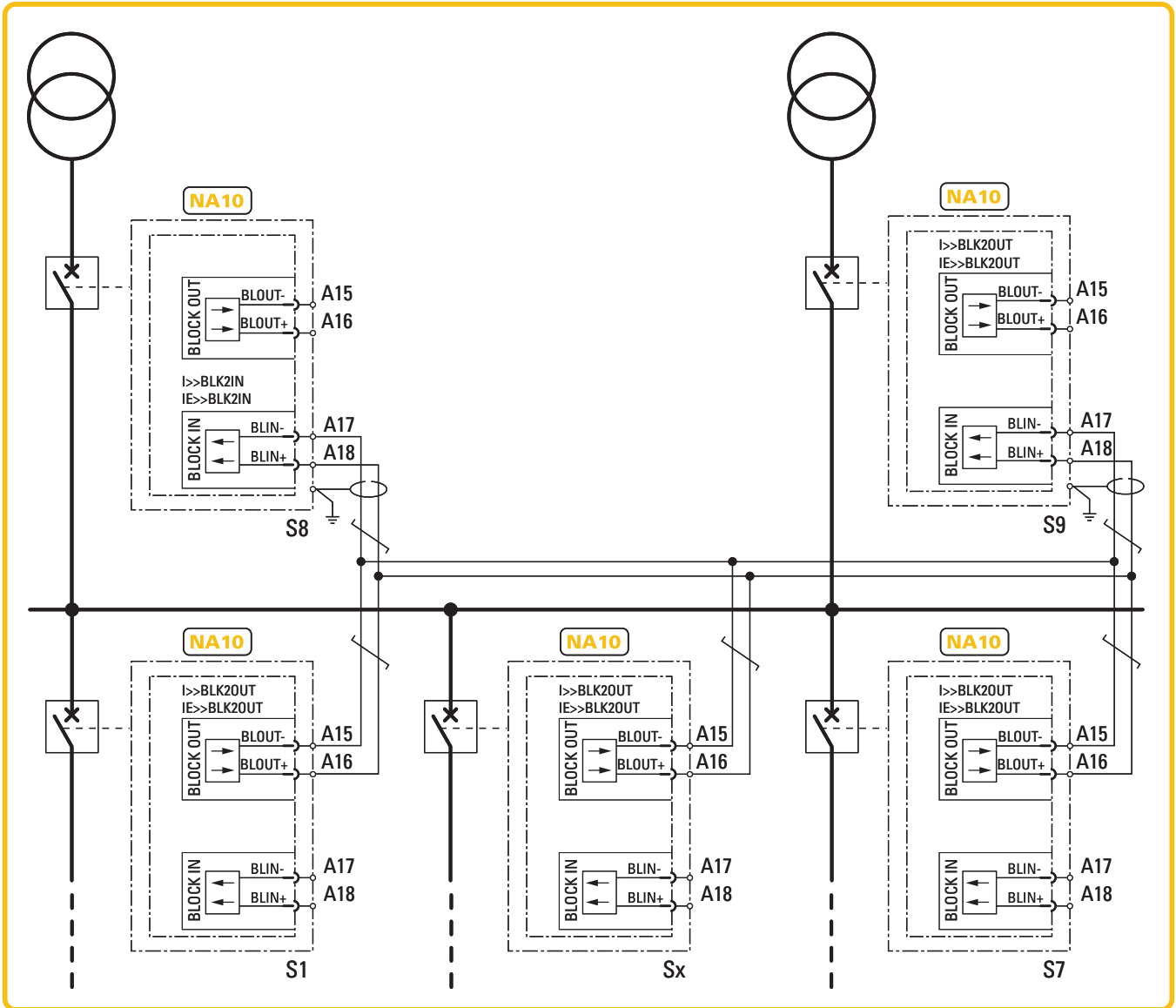
In this example, the lock for overload protection (protective function 51,  $I > \text{threshold}$ ) is not used; it is not required since the selectivity from incoming and outgoing protection relays is ensured by means of the current grading method.

The logic selectivity system can eliminate the need for grading margins and thereby greatly reduce fault clearance times (the same operate time for all protective relays without delay for the incoming feeders protections)

Note that if the two power transformer are in parallel service (both supply the busbar), a short-circuit or ground fault on any transformer isn't selectively cleared because both the protection relays on the two incoming feeders trip their circuit breaker.  
With Pro-N protection relays, any of two following methods (binary inputs, output relays or committed pilot wires circuits) can be applied:

1) Use of committed pilot wire input and output BLIN-BLOUT:

By connecting a blocking output circuit (i.e. BLOUT at the A15-A16 screw terminals) of the seven NA10 outgoing feeder relays to the blocking input circuit (BLIN at the A17-A18 screw terminals) of the two NA10 transformer incoming feeders relays, according to the following connection scheme:



This method is highly recommended, because the blocking input circuits of the upstream relays are provided with a periodic monitoring function for the pilot wire continuity, by means of control pulses receiving that are transmitted by the blocking output circuits of a downstream relay. When this monitoring function detect a pilot wire breaking send a local or remote alarm signalling and can increase the trip time of the upstream protection relays so that a time grading selectivity method substitute the accelerated logic method. Moreover a backup timer  $t_B$  against blocking of the protections in case of pilot wire short-circuit is available.

For the seven NA10 outgoing feeders relays (S1...S7) the following settings must be provided:

- The information about phase and phase+earth output block must be select by setting the *ModeBLOUT1* parameter (*ON IPh/IE*) inside **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu.
- The second overcurrent element output selective Block must be enabled by setting *ON* the *I>>BLK2OUT* parameter inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menu (set the threshold *I>>* of the protection 50 to the output blocking circuits).
- The second residual current element output selective Block must be enabled by setting *ON* the *IE>>BLK2OUT* parameter inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>> Element \ Setpoints** menu (set the threshold *IE>>* of the protection 50N to the output blocking circuits).

Only for one of the seven NA10 outgoing feeders relays (S1...S7) the following setting must be provided:

- The diagnostic output pulses must be enabled by setting the Pulse period; the *PulseBLOUT1* parameter is available inside the **Set \ Pilot wire diagnostic** menu (set the period of the pulses to a value equal to the setting on the input block receiving device).

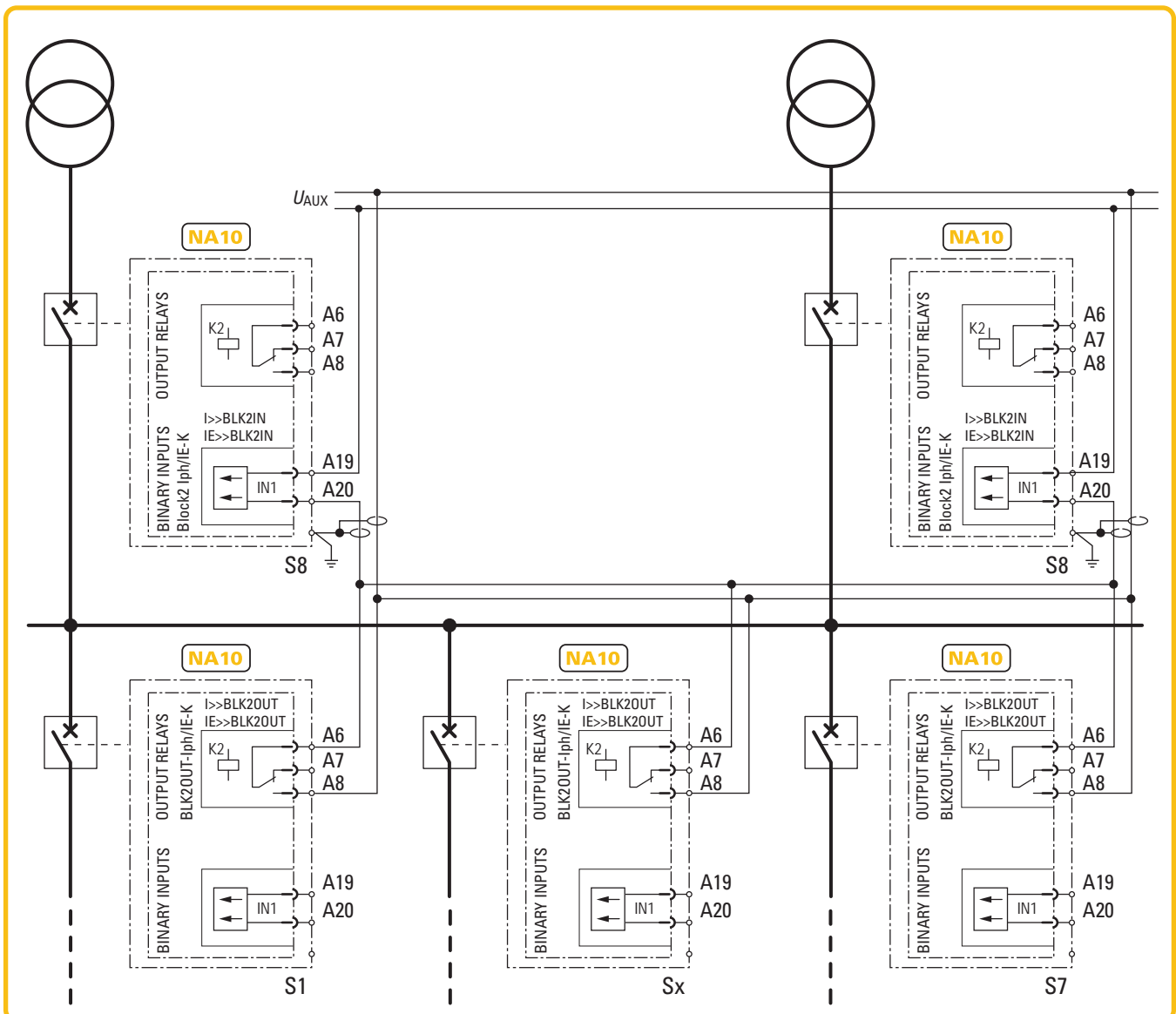
For the two NA10 incoming feeders relays (S8, S9) the following settings must be provided:

- The information about phase and phase+earth input block must be select by setting the *ModeBLIN1* parameter (*ON Iph/IE*) inside **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menu.
- The second overcurrent element input selective Block must be enabled by setting *ON* the *I>>BLK2IN* parameter inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menu (set the *I>>*threshold to the input blocking circuits).
- The second residual current element input selective Block must be enabled by setting *ON* the *IE>>BLK2IN* parameter inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>> Element \ Setpoints** menu (set the threshold *IE>>* of the 50N protection to the input blocking circuits).
- The maximum activation time for phase and ground protections must be adjusted by setting the *tB-Iph* and *tB-IE* parameters inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menu (backup timer *tB* against blocking in case of pilot wire short-circuit).
- The diagnostic input pulses must be enabled by setting the Pulse period; the *PulseBLIN1* parameter is available inside the **Set \ Pilot wire diagnostic** menu (set the period of the pulses to a value equal to the setting on the output block transmitting device).
- A recommended operating time for the protection that are receiving the blocking signal is 100 ms, the timer *tF-Iph* and *tF-IE* should be 200-300 ms greater and *tB-Iph* and *tB-IE* 50 ms greater than this value; the *tF-Iph* and *tF-IE* parameters are available inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu, whereas the *tB-Iph* and *tB-IE* parameters are available inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menu.

## 2) Use of binary inputs and output relays

By connecting an output blocking contact of the seven NA10 outgoing feeder relays (S1...S7) to a binary input (i.e. IN1 at the A19-A29 terminals or IN2 at the A21-A22 terminals) of the two NA10 transformer incoming feeders relays, according to the following connection scheme:

- If the *I>>BLK2IN* parameter is set to *ON* and a binary input is designed for selective block (Block2), the protection is blocked off by any protection element (Block2 Iph/IE) according to the selectivity block criteria. The enable *I>>BLK2IN* parameter is available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menus, while the *Block2 Iph/IE* function must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input IN1(2)** menus (IN1 or IN2 matching).
- If the *I>>BLK2OUT* enable parameter is set to *ON* and a output relay is designed for selective block (Block2), the protection issues a block output by phase elements by any protection element (BLK2OUT-Iph/IE), whenever the given element (StartI, StartI>>e/oStartI>>) becomes active. The enable *I>>BLK2OUT* parameter is available inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menu, while the *BLK2OUT-Iph/IE-K* output relay and LEDs (*BLK2OUT-Iph/IE-L*) may be select inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu.



This method is provided to apply logic selectivity scheme between THYTRONIC protective relays and protective relays of others manufacturers. It have not a periodic monitoring function for the continuity of the pilot wire and a backup timer  $t_B$  against blocking of the protections in case of pilot wire short-circuit.

The output blocking contact for the seven NA10 outgoing feeder relays (S1...S7), can be derived by one of the six available output relays K1...Kx, programmed with BLOCK OUT function (i.e. K2).

The binary input of the two NA10 incoming feeder relays (S8, S9) must be programmed for Block2 Iph/IE function.

For the seven NA10 outgoing feeders relays (S1...S7) the following settings must be provided:

- The information about phase and phase+earth output block must be select by setting the *ModeBLOUT1* parameter (*ON Iph/IE*) inside **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu.
- The second overcurrent element output selective Block must be enabled by setting *ON* the *I>>BLK2OUT* parameter inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menu (set the threshold *I>>* of the protection 50 to the output blocking circuits).
- The second residual current element output selective Block must be enabled by setting the *IE>>BLK2OUT* parameter inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>> Element \ Setpoints** menu (set the threshold *IE>>* of the protection 50N to the output blocking circuits).
- The phase and ground protection output selective block relay must be select by setting *K2* for the *BLK2OUT-Iph/IE-K* parameter inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block OUT** menu (set the block-out function to the K2 output relay).

For the two NA10 incoming feeders relays (S8, S9) the following settings must be provided:

- The information about phase and phase+earth input block must be select by setting the *ModeBLIN1* parameter (*ON Iph/IE*) inside **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menu.
- The second overcurrent element input selective Block must be enabled by setting *ON* the *I>>BLK2IN* parameter inside the **Set \ Profile A(or B) \ Phase overcurrent-50/51 \ I>> Element \ Setpoints** menu (set the threshold *I>>* of the protection 50 to the input blocking circuits).
- The second residual current element input selective Block must be enabled by setting *ON* the *IE>>BLK2IN* parameter inside the **Set \ Profile A(or B) \ Residual overcurrent-50N/51N \ IE>> Element \ Setpoints** menu (set the threshold *IE>>* of the protection 50N to the input blocking circuits).
- The maximum activation time for phase and ground protections must be adjusted by setting the *tB-Iph* and *tB-IE* parameters inside the **Set \ Profile A(or B) \ Selective block-BLOCK2 \ Selective block IN** menu (backup timer *tB* against blocking in case of pilot wire short-circuit).
- The *Block2 Iph/IE* function must be assigned to the selected binary inputs inside the **Set \ Inputs \ Binary input IN1(2)** menu (*IN1* matching for the example).

## GUIDELINES FOR ACCELERATED LOGIC WIRES

In the selectivity logic scheme with the input and output blocking circuits (method 1), the connections must be carried out using a twisted and screened twin cable, with the screen only connected to ground at the end located on the blocking input circuit.

In the selectivity logic scheme with the digital input and output blocking contact (method 2), the digital input should preferably be supplied by the auxiliary voltage of the switchgear and the connections must be carried out using two screened wires with the screens only connected to ground at the end located on the digital input.

For reliability reasons, the use of these wires with a section no lower than 1 mm<sup>2</sup> and length no longer than 5 km is recommended.

## BREAKER FAILURE PROTECTION

The circuit breaker function (BF) issues a back-up trip command to trip the incoming feeders circuit breakers when a short-circuit or ground fault on an outgoing feeder occur and the relevant circuit breaker fail to be open.

The breaker failure protection can be implemented with one of three following methods:

1) By means of a backup threshold

The *I>>>* and *IE>>>* thresholds of the 50 and 50N protective functions on the two incoming feeders (not used in the logic selectivity system) can be used as time-backup thresholds.

The trip time of the backup thresholds must be greater than the trip time of the thresholds *I>>* and *IE>>* used for the logic selectivity system by means of a time grading.

No pilot wire is required further than those already used for the logic selectivity system.

2) By means of the drop-out timer  $t_F$

The blocking output circuit BLOUT1 or the K2 output relay for the outgoing feeders protective relays, have the drop-out timer  $t_F$  which is started by the starting of a protective function assigned to blocking output circuits. If the outgoing circuit breaker fail, the blocking signal to the upstream relays is deactivated and the upstream relay can open the incoming circuit breaker.

The delay of the  $t_F$  timer must be set to a value no lower than the sum of:

- the greater of the trip time for the 50-50N protective functions
- the circuit breaker opening time with arc suppression
- the maximum resetting time of the protection functions
- a safety margin.

No pilot wire is required further than those already used for the logic selectivity system.

3) By means of Breaker-Failure BF function

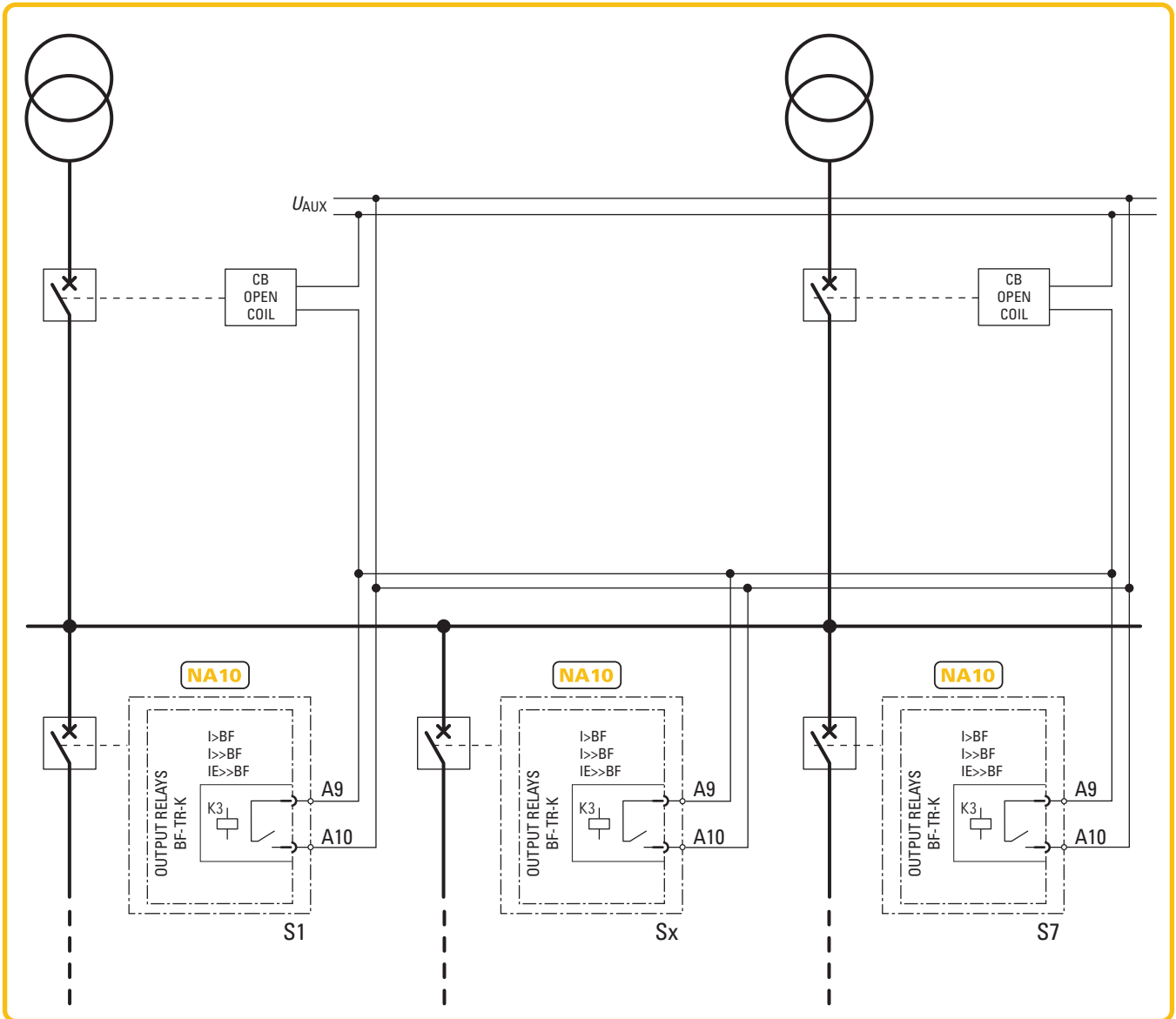
One output relay (i.e. K3) for all the seven NA10 outgoing feeder relays must be programmed with BF function, and their output contacts must command the upstream circuit breakers according to the following connection scheme:

The  $t_{BF}$  timer starts when a protective function on an outgoing feeder trips; at the end of the  $t_{BF}$  delay a trip command is send to the upstream circuit breakers by the contact of the K3 output relay.

The  $t_{BF}$  delay must be greater than the sum of:

- the circuit breaker opening time with arc suppression
- the maximum resetting time of the protection functions
- a safety margin.

For the seven NA10 outgoing feeders relays the following settings must be provided:



- The Breaker Failure element must be enabled by setting *ON* the *BF Enable* parameter (Breaker Failure enable).
- The BF time delay must be set by adjusting the *tBF* parameter (Set the Breaker failure timer).
- The BF phase current threshold must be set by adjusting the *IBF>* parameter (set the *I>* threshold of the protection 51 to the breaker failure function).
- The BF residual current threshold must be set by adjusting the *IEBF>* parameter (set the *IE>* threshold of the protection 50N to the breaker failure function).
- The BF output relay must be select by adjusting the *BF-TR-K* parameter (set the breaker failure function to the K3 output relay).

All the parameters are available inside the **Set \ Profile A(or B) \ Breaker failure** menu

No wires are required further than those already used for the logic selectivity system.

If additional wires are not accepted and the breaker failure protection against overloads is not required, the method 2 is recommended. For more details of the logic selectivity system, breaker failure protection and NA10 settings see the instruction manual.

