

Using SVERKER with ERTS for Reclose Element Testing

Introduction

Auto-Reclosers shorted “AR” are most commonly found in overhead air insulated power lines and they are useful because, in such networks, only around 7% of faults are permanent. In fact, most of the faults – around 80% – are transient, caused by events like lightning strikes and arcing, and will disappear in less than a second if the power line is de-energized. The remaining 13% of faults are semi-permanent and are typically caused by animals or branches bridging the power lines. Even these faults, however, usually burn away and clear in a relatively short time.

A lot of unnecessary time will be lost if the protection scheme simply isolates the section of a network where a fault occurs and then waits for someone to go out into the field, check the fault status and close the breaker. A much more effective strategy is to isolate the affected part of the network and then, after a short delay, re-energise it to determine whether the fault has cleared. If it has, the network can operate normally but if it hasn't, the affected area can once again be isolated.

This isolation followed by re-energisation process is exactly what the protection relay together with the auto-recloser does. In principle the autorecloser is a simple device. Essentially, it receives a start signal from the protection relays, and after the breaker has tripped the “AR” system sends a closing order to the breaker after a predefined time (also called “Dead Time”)

Commented [DB1]: Capitalize to show it is part of the acronym

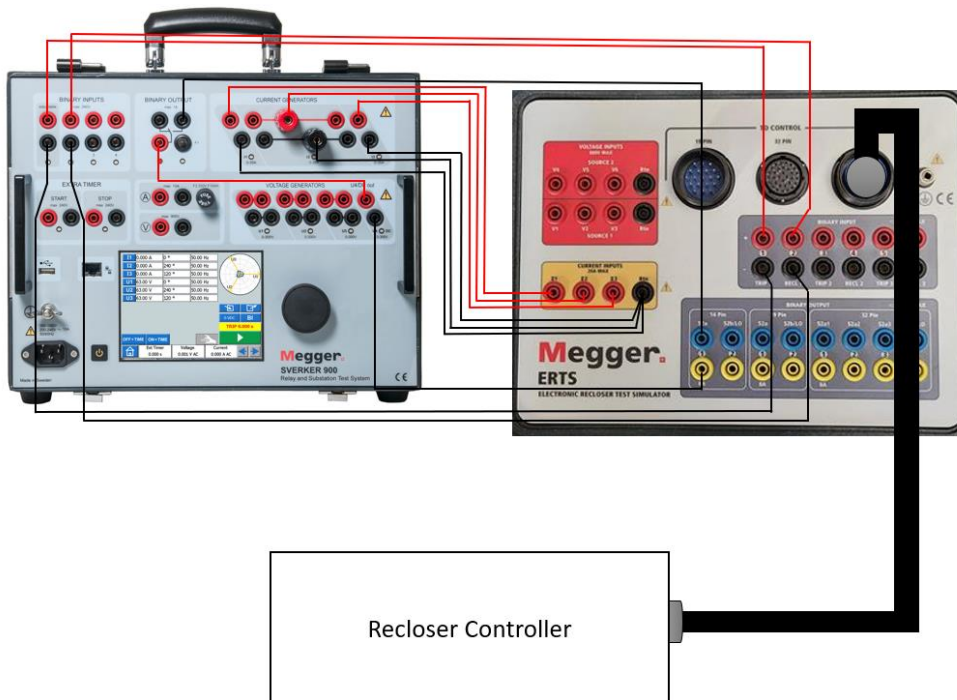
Application Note

Testing AR with SVERKER and ERTS

When using secondary injection, testing a recloser is typically done by creating a set of power system states. Each of these corresponds with a state during the recloser's operation e.g. prefault, trip or fault, reclose, second trip, second reclose and so on. Change from one state to the next is achieved by sensing the operation of the recloser's outputs. When breaker status from the recloser tank or breaker is not available, breaker status is usually provided to the recloser by means of a binary output from the test set.

In this example, all states are set to generate three phase current, but the relay can also be tested using single phase current as well. Binary Input 1 and Binary Input 2 is activated in all state dry contact closing.

Protection setting: $I >= 1A$, $t >= 1s$, Auto reclose times are $t1 = 500ms$, $t2 = 2s$, $t3 = 4s$



Commented [DB2]: This is a large sentence. Can be broken into two maybe.

Commented [DB3]: Why is this paragraph underlined?

Commented [DB4]: Added comma

Commented [DB5]: What does this stand for?

Commented [DB6]: This reads a little weird..

- If recloser needs to be connected to the test set-up for validation, do not use binary outputs from the test set.

Commented [DB7]: Maybe put this point first then list the other points after this one since the others relate to not using a recloser for the test.

Application Note

- If breaker status is needed, use "Binary output" and set "BO" to "ON" (orange) right position in "Prefault" state, all "Fault" states and "No fault" state.
- Set "BO" to "OFF" (blue) left position for all "Reclose" states.
- Auxiliary supply is connected if needed.

Commented [DB8]: Not following... The position of the breaker could be on it's side or upside down.. Maybe use "If breaker status (52A, or 52B) is needed..."

Commented [DB9]: A little hard to follow. Made me re-read it multiple times to understand what you are telling me. Needs re-wording.

Commented [DB10]: What are you talking about here.. not following. The color of the button in the software??

Commented [DB11]: Maybe list these steps in numeric order.. "1.) Prefault
2.) Fault..."

Step 1: Make four basic state settings, Pre fault / Fault / Reclose / No Fault.

Prefault

I1	0.500 A	0.0 °	50.000 Hz
I2	0.500 A	240.0 °	50.000 Hz
I3	0.500 A	120.0 °	50.000 Hz
U1			
U2			
U3			

0 VDC BI

STATE BI NO TRIP 1000 ms

TRIP BO END SEQ

Fault

I1	2.00 A	0.0 °	50.000 Hz
I2	2.00 A	240.0 °	50.000 Hz
I3	2.00 A	120.0 °	50.000 Hz
U1			
U2			
U3			

0 VDC BI

STATE BI NO TRIP 5000 ms

TRIP BO END SEQ

Reclose

I1	0.000 A	0.0 °	50.000 Hz
I2	0.000 A	240.0 °	50.000 Hz
I3	0.000 A	120.0 °	50.000 Hz
U1			
U2			
U3			

0 VDC BI

STATE BI NO TRIP 15000 ms

TRIP BO END SEQ

No fault

I1	0.500 A	0.0 °	50.000 Hz
I2	0.500 A	240.0 °	50.000 Hz
I3	0.500 A	120.0 °	50.000 Hz
U1			
U2			
U3			

0 VDC BI

STATE BI NO TRIP 15000 ms

TRIP BO END SEQ

- The above sequence makes 1 fault, 1 reclose then no fault, back to normal.
- To make more reclose cycles in one sequence just copy state2 "Fault" and state3 "Reclose".
- By copying "state2" into states 4 and 6 and "state3" into states 5 and 7 we get one AR test for 3 reclose cycles and then "cleared fault".
- To copy state2 into state4 and 6, select state 2 and push on name field and then on Select state 4 and push name field and then on to past state2 into state4
- To copy state 4 select state 6 and repeat above.
- Rename state 4 and 6 to "Fault 2" and "Fault 3".
- Do the same for state3 to copy it into states 5 and 7 and then rename to Reclose 2 and 3.

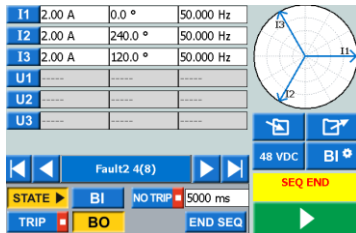
Commented [DB12]: Correct this wording.

Application Note

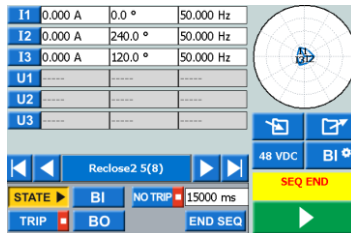
Now you have four more states Fault 2 and 3, Reclose 2 and 3 as shown below.

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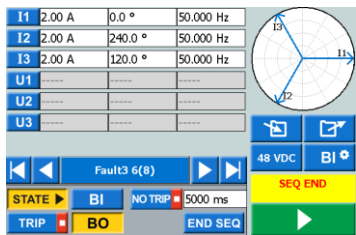
Fault 2



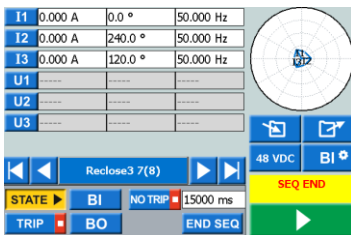
Reclose 2



Fault 3



Reclose 3



Result from SVERKER900 three reclose times.

Result from relay protection

#	I1: A	I2: A	I3: A	BI	Time...	BO
1	0.500	0.500	0.500	1	1000	1
2	2.000	2.000	2.000	1	1010	1
3	0.000	0.000	0.000	2	537	0
4	2.000	2.000	2.000	1	1010	1
5	0.000	0.000	0.000	2	2035	0
6	2.000	2.000	2.000	1	1011	1
7	0.000	0.000	0.000	2	4036	0
8	0.500	0.500	0.500		15000	1
Σt-S1					24639	
Σt					25639	

Message	Information
CLEARED FAULT	
CYCLE 3	Phase fault
PHASE FAULT	Phases 1, 2, 3
CYCLE 2	Phase fault
PHASE FAULT	Phases 1, 2, 3
CYCLE 1	Phase fault
PHASE FAULT	Phases 1, 2, 3

Commented [DB14]: Add the "900" here since you have it listed this way everywhere else.

Repeat the same to get more auto-recloses if needed, do not forget to set maximum trip time in fault state above maximum trip time in your relays and reclose state time above maximum reclose time set in your relays. Save test and use as default.

Commented [DB15]: Does not work when you read this with your acronym spelled out.

For more information about "Sequence Instrument" and "Saving" procedure see chapter 4.6 and 4.9 in SVERKER 900 "User manual"