CHAPTER THREE:

OPERATION OF AUTO RECLOSER AND SECTIONALIZER

3.1. Introduction:

Faults on overhead lines fall into one of three categories:

- *Transient.*
- *Semi-permanent.*
- *Permanent.*

80-90% of faults on any overhead line network are transient in nature. The remaining 10%-20% of faults are either semi-permanent or permanent. Transient faults are commonly caused by lightning and temporary contact with foreign objects. The immediate tripping of one or more circuit breakers clears the fault. Subsequent re-energization of the line is usually successful. A small tree branch falling on the line could cause a semi-permanent fault. The cause of the fault would not be removed by the immediate tripping of the circuit, but could be burnt away during a time-delayed trip. HV overhead lines in forest areas are prone to this type of fault. Permanent faults, such as broken conductors, and faults on underground cable sections, must be located and repaired before the supply can be restored. Use of an auto-reclose scheme to re-energize the line after a fault trip permits successful re-energization of the line. Sufficient time must be allowed after tripping for the fault arc to de-energize prior to reclosing otherwise the arc will re-strike. Such schemes have been the cause of a substantial improvement in continuity of supply. A typical single-shot auto-reclose scheme is shown in Figures 3.1 and 3.2. Figure 3.1 shows a successful reclosure in the event of a transient fault, and Figure 3.2 an unsuccessful reclosure followed by lockout of the circuit breaker if the fault is permanent. [6]

3.1.1. Application of Auto-Reclosing:

The most important parameters of an auto-reclose scheme are:

- Dead time.
- Reclaim time.
- Single or multi-shot.

These parameters are influenced by:

a. Type of protection.

b. Type of switchgear.

c. Possible stability problems.

d. Effects on the various types of consumer loads.

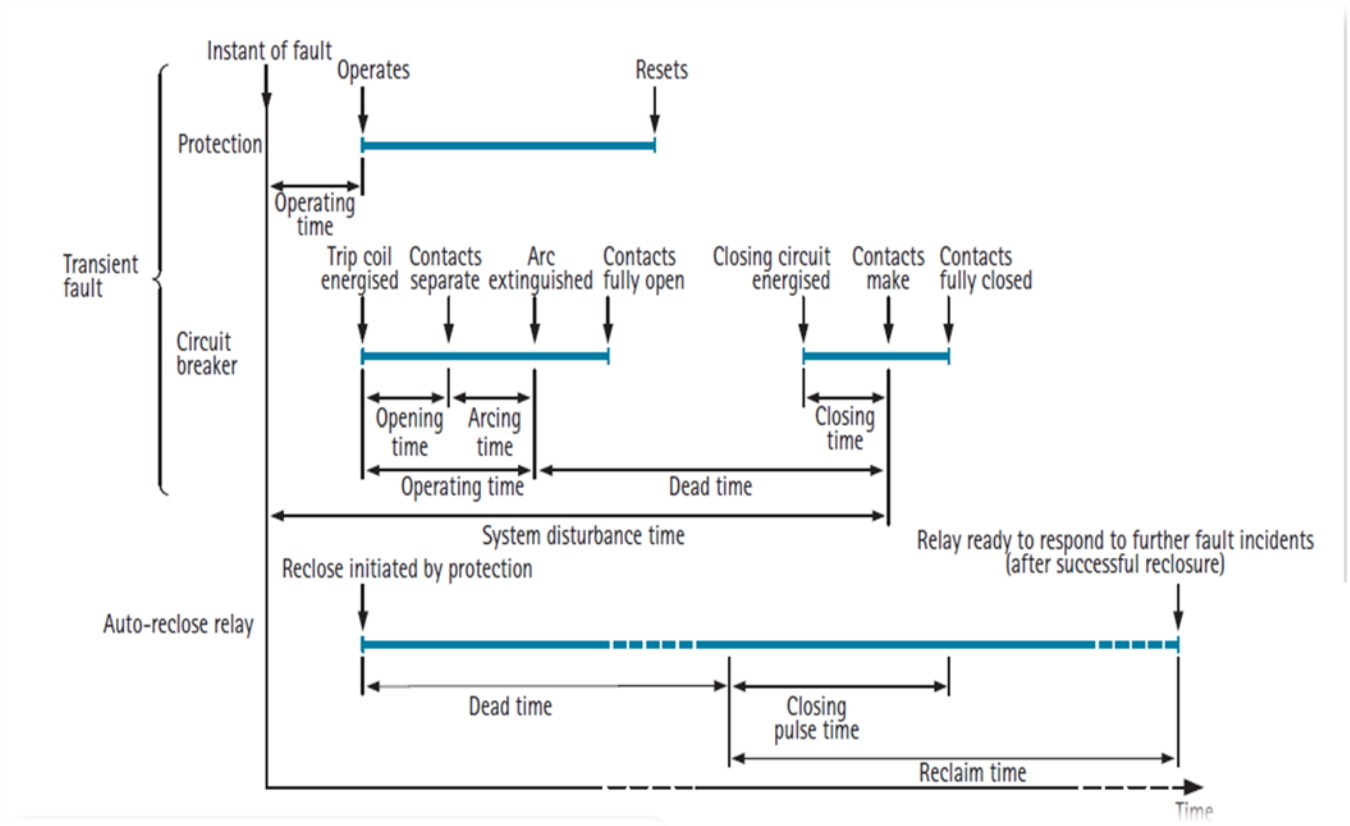


Figure 3.1: Single-shot auto-reclose scheme operation for a transient fault

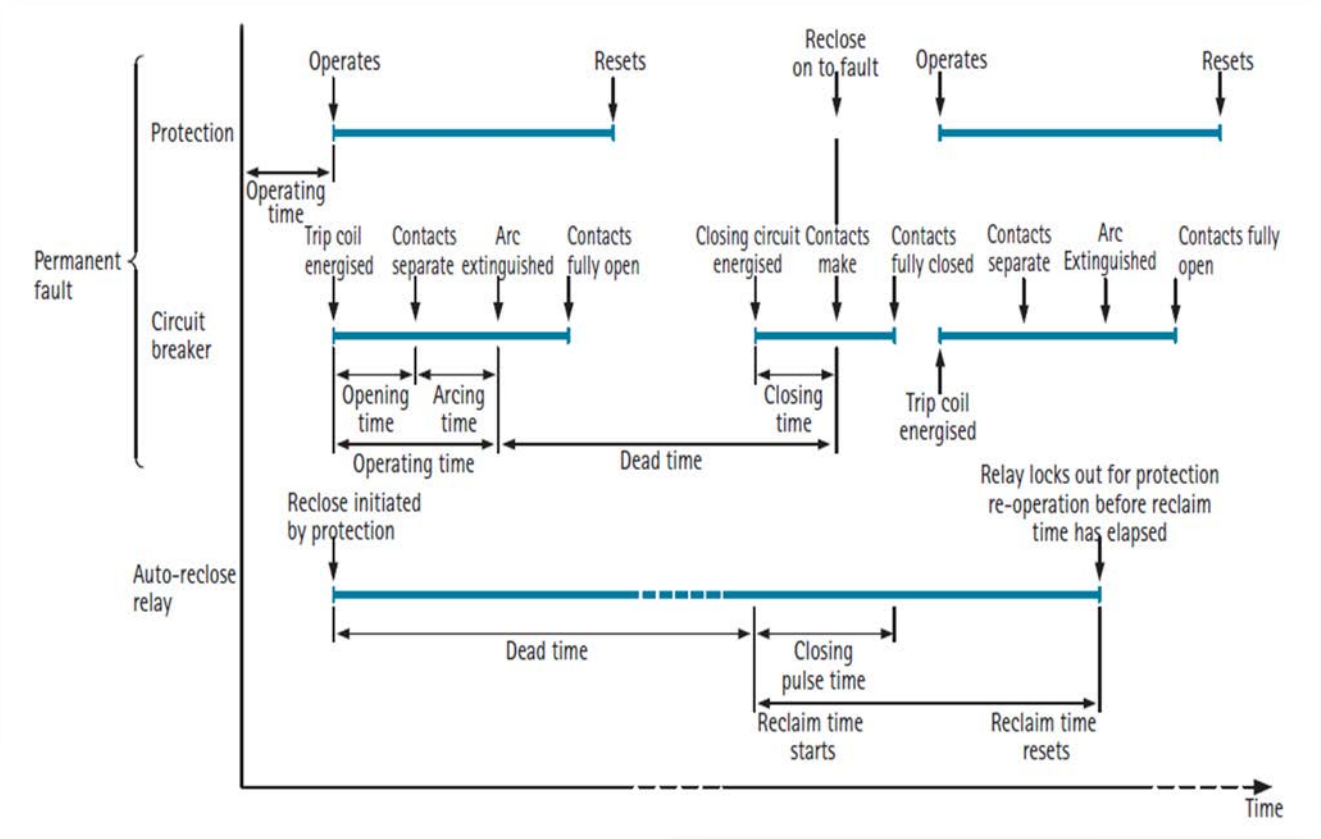


Figure 3.2: Operation of single-shot auto-reclose scheme on a permanent fault

3.2. Auto-Reclosing on HV distribution networks:

On HV distribution networks, auto-reclosing is applied mainly to radial feeders where problems of system stability do not arise, and the main advantages to be derived from its use can be summarized as follows:

I. Reduction to a minimum of the interruptions of supply to the consumer.

II. Instantaneous fault clearance can be introduced, with the accompanying benefits of shorter fault duration, less fault damage, and fewer permanent faults As 80% of overhead line faults are transient, elimination of loss of supply from this cause by the introduction of auto-reclosing gives obvious benefits through:

1. Improved supply continuity.
2. Reduction of substation visits.

Instantaneous tripping reduces the duration of the power arc resulting from an overhead line fault to a minimum. The chance of permanent damage occurring to the line is reduced. The application of instantaneous protection may result in non-selective tripping of a number of circuit breakers and an ensuing loss of supply to a number of healthy sections. Auto-reclosing allows these circuit breakers to be reclosed within a few seconds. With transient faults, the overall effect would be loss of supply for a very short time but affecting a larger number of consumers. When instantaneous protection is used with autoreclosing, the scheme is normally arranged to inhibit the instantaneous protection after the first trip. For a permanent fault, the time-graded protection will give discriminative tripping after reclosure, resulting in the isolation of the faulted section. Some schemes allow a number of reclosures and time-graded trips after the first instantaneous trip, which may result in the burning out and clearance of semi-permanent faults. A further benefit of instantaneous tripping is a reduction in circuit breaker maintenance by reducing pre-arc heating when clearing transient faults. [6]

3.3. Factors Influencing Hv Auto-Reclose Schemes:

The factors that influence the choice of dead time reclaim time, and the numbers of shots.Several factors affect the selection of system dead time as follows:

- System stability and synchronism.
- Type of load.
- CB characteristics.
- Fault path de-ionization time.
- Protection reset time.

3.4. Auto Recloser:

Recloser is a Circuit Breaker along with protection system for overhead power lines & designed to reclose on to a fault. It is detect a fault and open for a pre-programmed time, before closing again automatically. This cycle can be repeated 4 times. And lockout typically on the fifth trip as shown in figure 3.3.

Reclosed can be used anywhere on a system where Recloser ratings are adequate for the system requirements logical location are:

- In substation as the primary feeder protection Devices.
- On the lines at a distance from a substation, to sectionalize Long feeders and thus prevent outage of the entire feeder when a permanent fault occurs near the end of the feeder.
- On the taps of main feeders to protect the main feeder from interruption and outages due to faults on the taps. [7]

Figure 3.3: Auto Recloser

3.5. SECTIONALIZER:

Sectionalizer is a switch along with control unit.It is used in conjunction with an upstream “Recloser” or “circuit breaker”.It counts the interruption created by a recloser during a fault sequence & trips during the dead time of the upstream recloser isolates a faulty network section as shown in figure 3.4 [7].

Figure 3.4.: Sectionalizer

3.6. Auto Recloser & Sectionalizer Control Unit Main Features:

Auto reloser & sectionalizer control unit has a very important Features which are:

- Measurement.
- Protection.
- History and recording.
- Communications.

3.7. Benefits of using Auto Recloser & Sectionalizer:

There are two benefits of using Auto Recloser & Sectionalizer: benefit to the distribution company and benefit to the customer.

3.7.1. Benefit to the DISTRIBUTION COMPANY:

- ✓ Continuity of power supply for the consumers resulting in less complaints from citizens.
- ✓ Reduce the time of power supply disconnection in cases of transient faults.
- ✓ Reduce the unsold energy due to faults.
- ✓ Reduce the cost of manpower operating in managing disconnected lines.
- ✓ Maximum utilization of the network components.
- ✓ Raising operators efficiency and using Hi-Tech in networks.
- ✓ Ability to connect to SCADA system.
- ✓ Event Log and Remote control.
- ✓ Reduce cost of fault finding.
- ✓ Better knowledge of the network.[7]

3.7.2. Benefit to the Customer:

- ✓ Improved reliability of power supply.
- ✓ Quality of supply.
- ✓ Automatic - Recloser function - supply restoration after temporary faults.
- ✓ Reduced outage time.
- ✓ Minimise revenue loss.
- ✓ Reduction in the number of customer complaints.[7]

3.8. Feeder Selection to install sectionalizing devices:

The selection of feeder which wanted to install sectionalizing devices based on:

- Number of faults During a Year.
- The Average interruption time per fault.

- Unserved Energy and unsold Energy due to tripping of the line .
- Length of the line / as well as the laterals and nature of its right of way.
- Weather Condition.[7]

3.9. Various Types of Distribution Line Faults:

There are two types of faults in distribution system which are transient faults & permanent faults as shown in figure 3.5

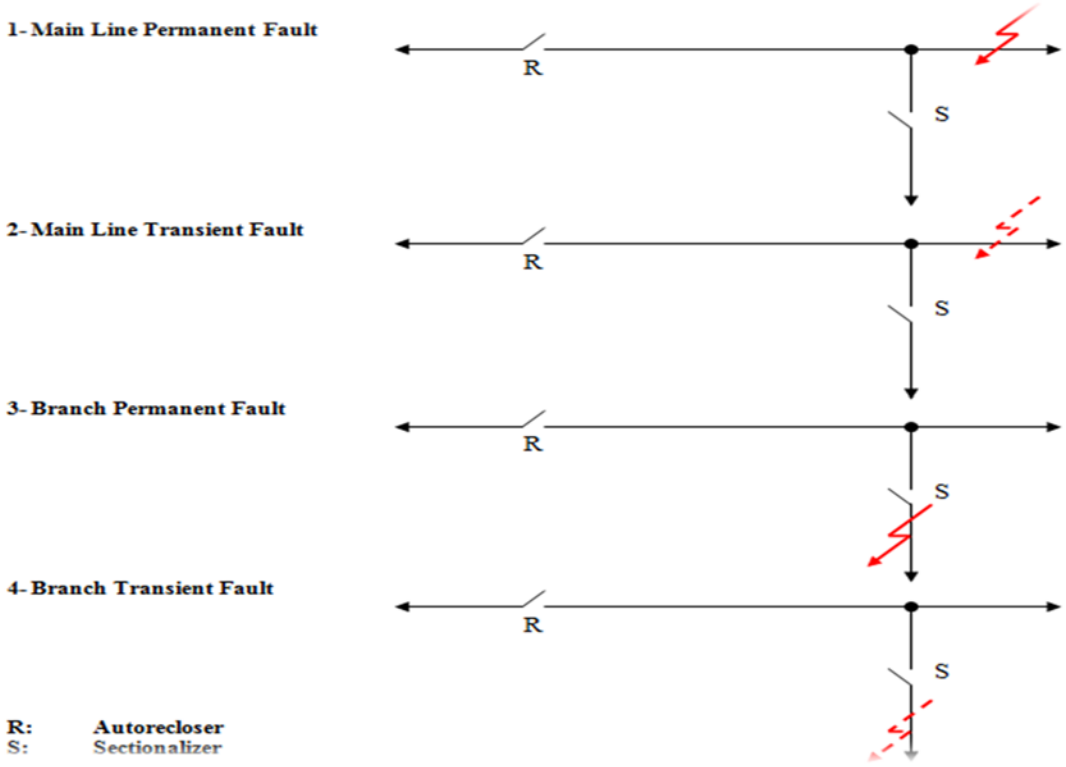


Figure 3.5: Various Types of Distribution Line Faults

Almost 80% of faults occurring on distribution lines are of transient (temporary) nature. Hence the importance of automated autoreclosers and sectionalizers installed in selected locations.

Examples of Transient Faults:

- Conductors clashing in the wind.
- Tree branches falling on overhead conductors.

- Animals or birds getting curious.
- Lightning strikes.

Examples of Permanent Faults:

- Careless motor vehicle drivers.
- Operating error: leaving earths connected etc.
- Equipments Failure.

3.9.1. Trip Sequence Arrangements:

The following example show how the autorecloser and the sectionalizer coordinate to deal with the various types of faults as listed above. For our example, we have used the following time settings:

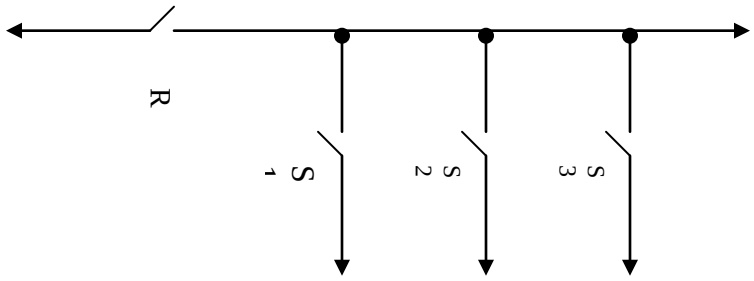
A. Autorecloser Number of operations before lock out R.OP = 3.
B. Autorecloser's Dead Time one = 0.5 sec. Autorecloser will open for a short time of 0.5seconds allowing the downstream sectionalizers to count.
C. Autorecloser's Dead Time two = 10 sec. Autorecloser will open now for a longer time to allow the sectionalizer to trip in case of permanent fault.
D. Sectionalizer Counter S.OP = 2 (R.OP -1). Having counted 2 times, the sectionalizer will trip if the downstream fault is permanent.
E. Sectionalizer opening time = 1.05 sec. If the sectionalizer has counted 2 down times, it will trip 1.05 seconds after the autorecloser's opening.

3.9.2. Connection of one autorecloser and 3 sectionalizers:

There is two configurations of connections of autoreclosers and sectionalizers which are Parallel configuration and series configuration.

❖ ***Parallel configuration:***

It can install indefinite number of sectionalizers. The sectionalizer's opening time can be selected freely as long as it does not exceed the second dead time of the autorecloser. As shown in figure 3.6.



R: Autorecloser
S: Sectionalizer

Figure: 3.6: parallel configuration of one autorecloser and 3 sectionalizers

In our example of one autorecloser and 3 sectionalizers, the settings can be as follows:

A. Autorecloser number of operations before lock out R.OP = 3
B. Autorecloser's Dead Time one = 0.5 sec. Autorecloser will open for a short time of 0.5seconds allowing the downstream sectionalizers to count.
C. Autorecloser's Dead Time two = 10 sec. Autorecloser will open now for a longer time to allow the sectionalizer to trip in case of permanent fault.
D. Sectionalizer Counter S.OP = 2 (R.OP -1). Having counted 2 times, the sectionalizer will trip if the downstream fault is permanent.
E. Sectionalizer opening time = 1.05 sec. If the sectionalizer has counted 2 down times, it will trip 1.05 seconds after the autorecloser's opening. This falls within the autorecloser second dead time of 10 seconds.

The line trip sequence will be as shown in figure 3.7.

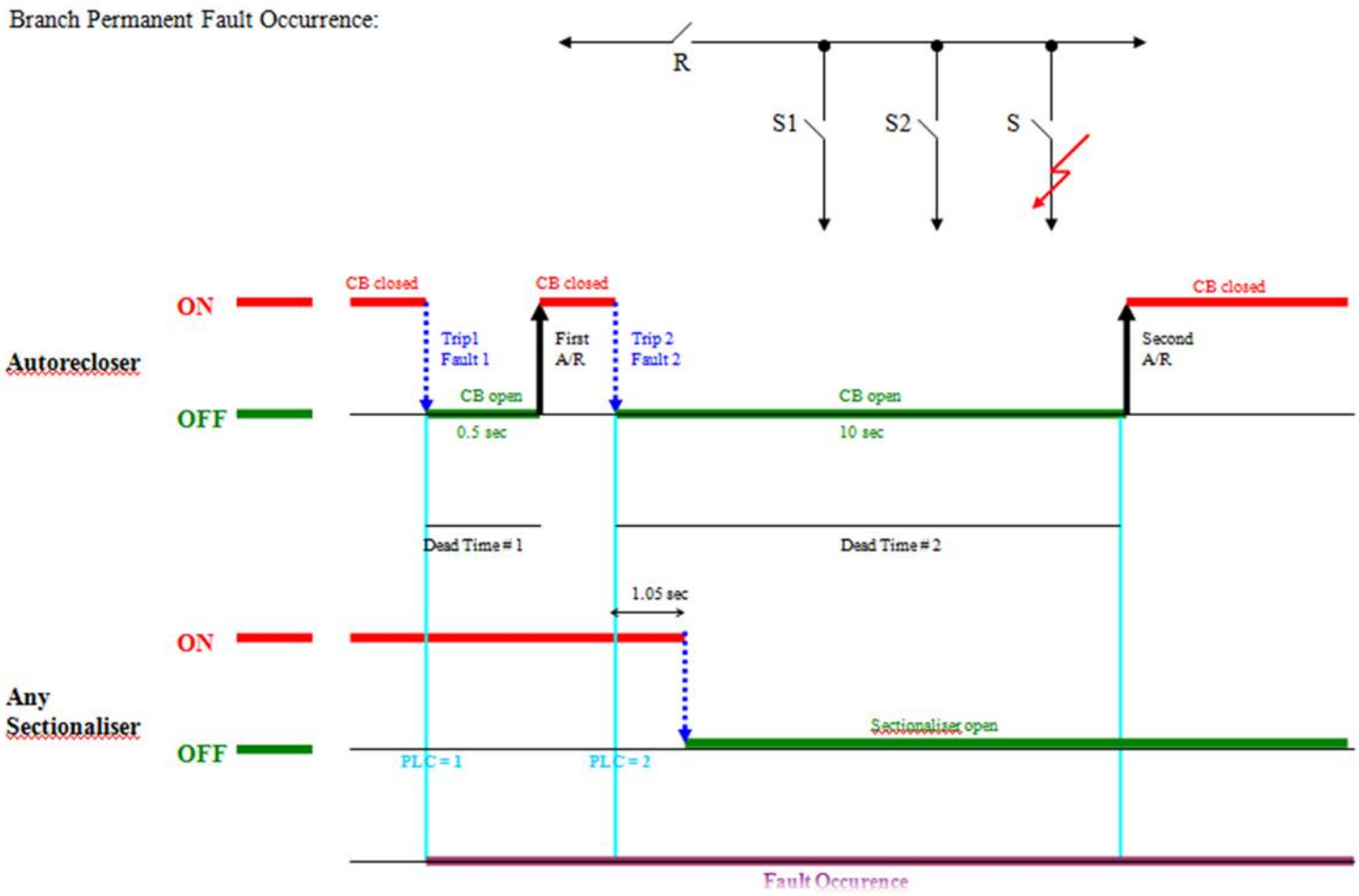
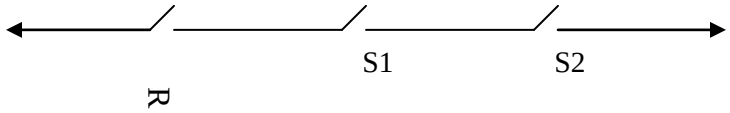


Figure 3.7: Example of one autorecloser and 3 sectionalizers In parallel connection.

❖ ***series configuration:***

In series configurations, we can install only 2 numbers of sectionalizers to ensure proper coordination. This is because the lock out counter of the autorecloser is limited to 4. As shown in figure 3.8.



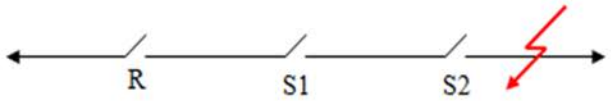
R: Autorecloser
S: Sectionalizer

Figure: 3.8: series configurations of one autorecloser and 2 sectionalizers.

In our example of one autorecloser and 2 sectionalizers, the settings can be as follows:

A. Autorecloser Number of operations before lock out R.OP = 4
B. Autorecloser's Dead Time one = 0.5 sec. Autorecloser will open for a short time of 0.5seconds allowing the downstream sectionalizers to count.
C. Autorecloser's Dead Time two = 10 sec. Autorecloser will open now for a longer and second time to allow sectionalizers S2 to trip in case of permanent fault.
D. Autorecloser's Dead Time three = 10 sec. Autorecloser will open now for a third time to allow sectionalizers S1 to trip.
E. Sectionalizer S1 Counter S.OP = 3 (R.OP -1). Having counted 3 times, the sectionalizer will trip if the downstream fault is permanent.
F. Sectionalizer S2 Counter S.OP = 2 (R.OP -2). Having counted 2 times, the sectionalizer will trip if the downstream fault is permanent.
G. Sectionalizers opening time = 1.05 sec. If the sectionalizer has counted 2 down times, it will trip 1.05 seconds after the autorecloser's opening. This falls within the autorecloser second dead time of 10 seconds [7].The line trip sequence will be as shown in figures 3.9 & 3.10.

2.a- Fault after S2:



Sectionaliser S2 should be the only sectionaliser to trip and isolate the fault:

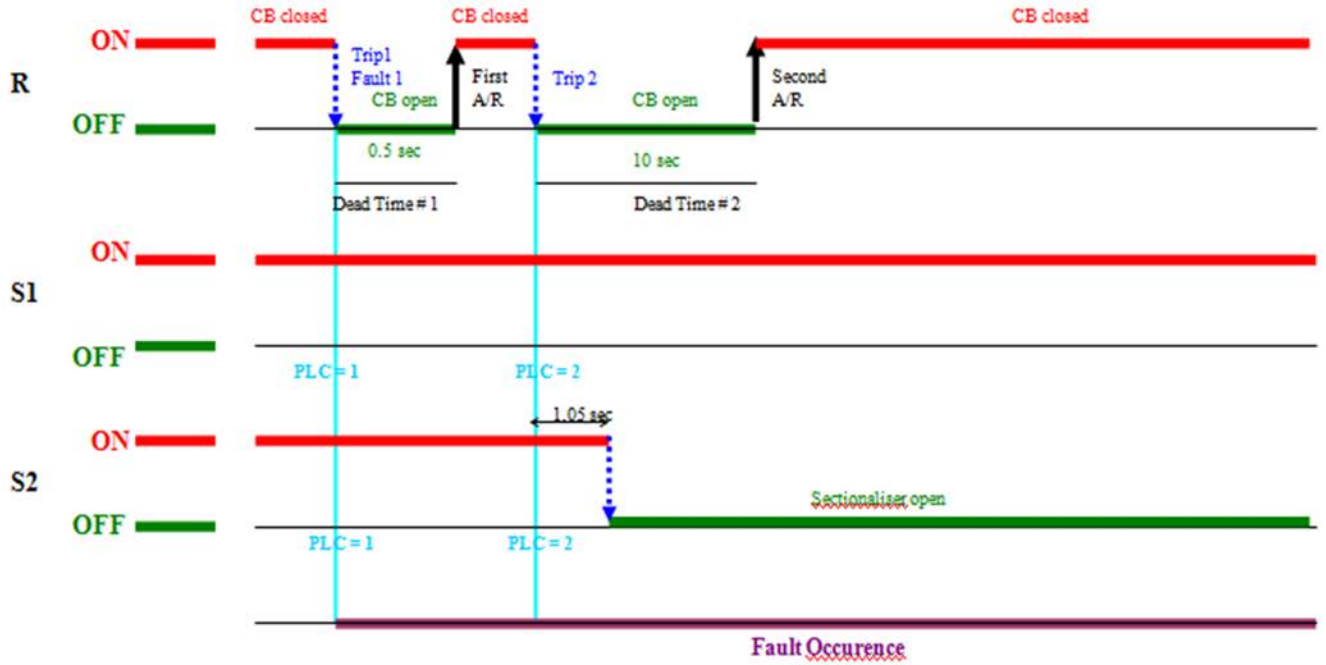


Figure 3.9: Example of one autorecloser and 2 sectionalizers In series connection(fault after s2).

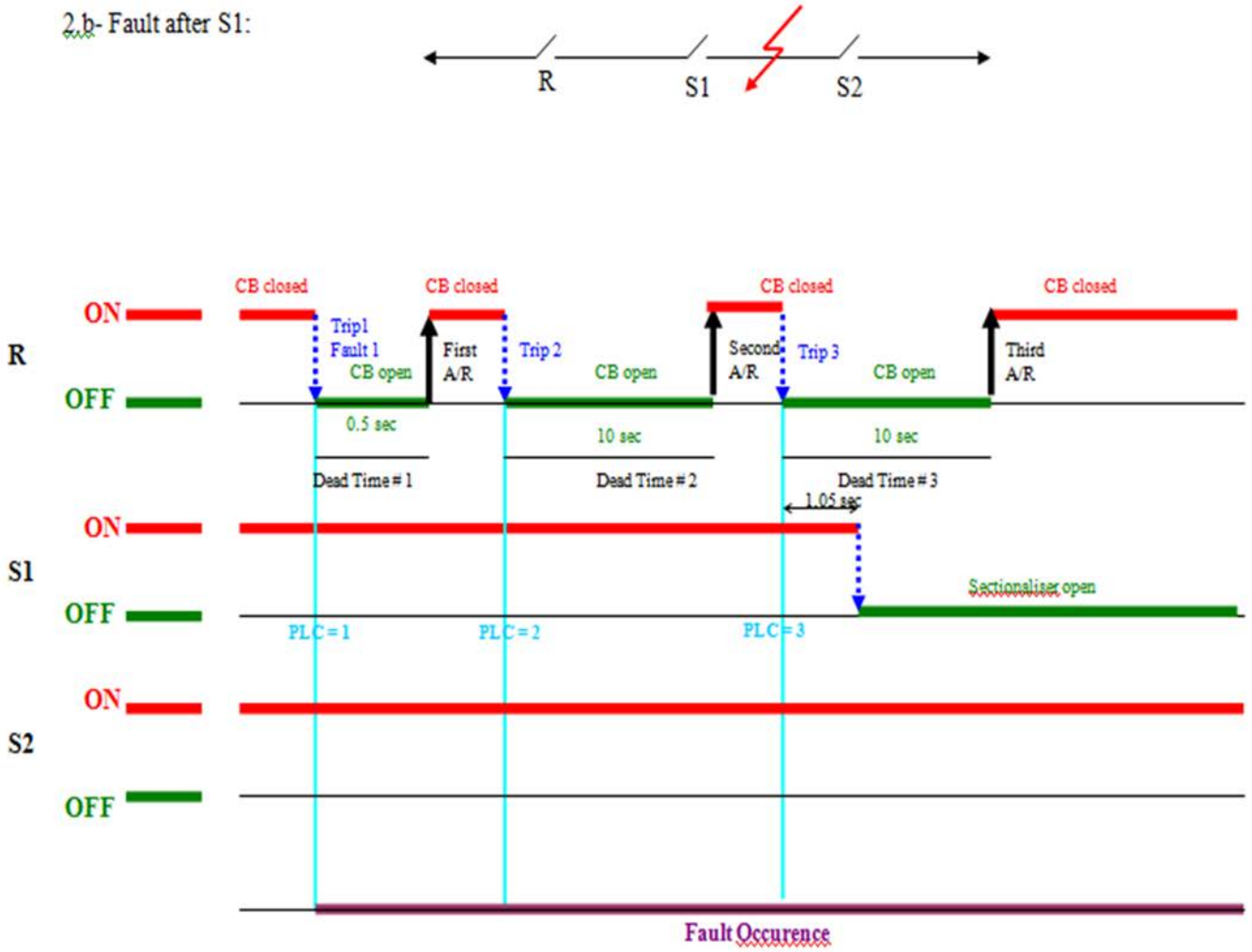


Figure 3.10: Example of one autorecloser and 2 sectionalizers In series connection(fault after s1).