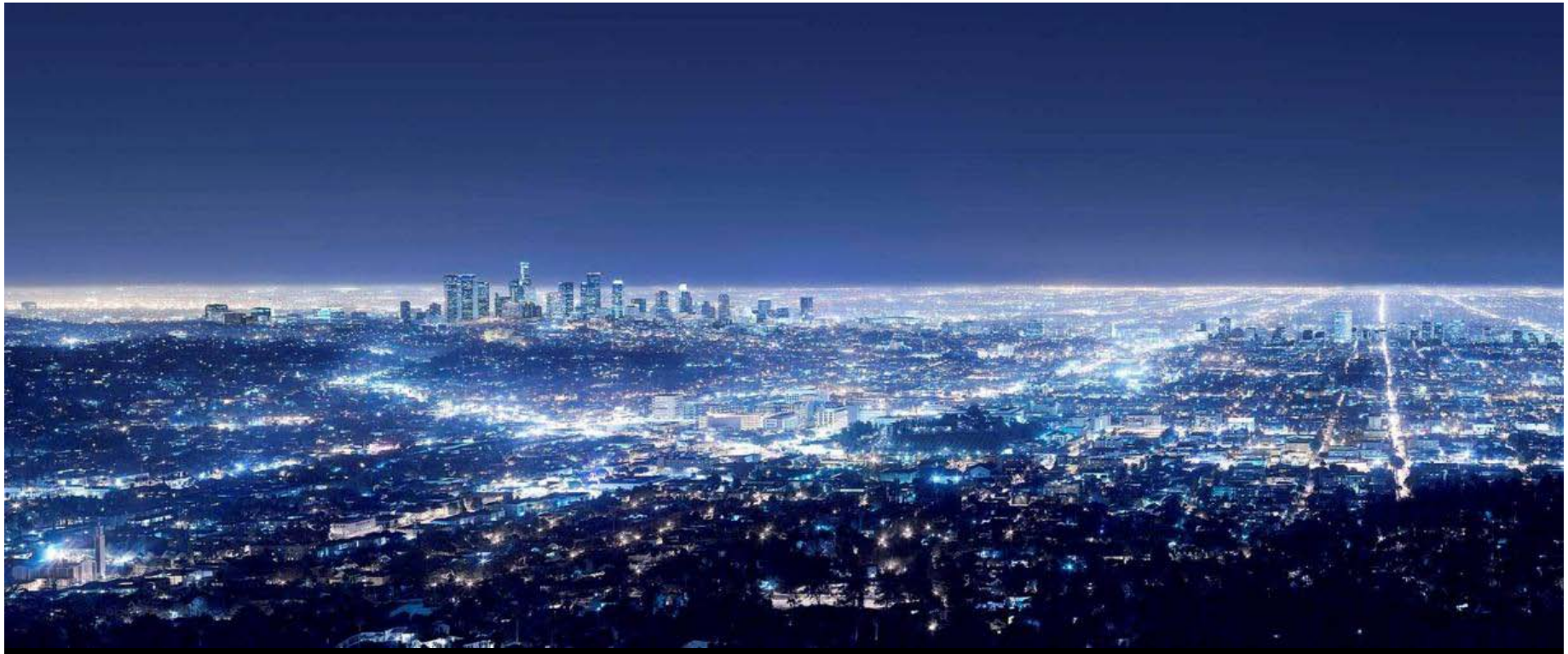


Alejandro Schnakofsky, ABB inc. **Presented by Roger Hedding ABB Inc.**

Understanding the challenges and application of auto reclosing in HV multi breaker line terminals

Applying auto reclosing to HV multi breaker line terminals

- Overview of reclosing
- Synch Check
- Energizing Check
- Preferred terminal
- Master – Slave coordination
- Reclosing in multi breaker line terminals
- Building an auto reclosing scheme for a 230kV line
- Conclusions

Overview or reclosing and restoration

- Reclosing is the act of closing a circuit breaker that was previously in service and closed
- Auto reclosing is the act of closing a circuit breaker that was previously in service and closed automatically, it is not a protection function but rather an automation/control function
- Restoration is the act of re-establishing service or certain system conditions such as positions of breakers

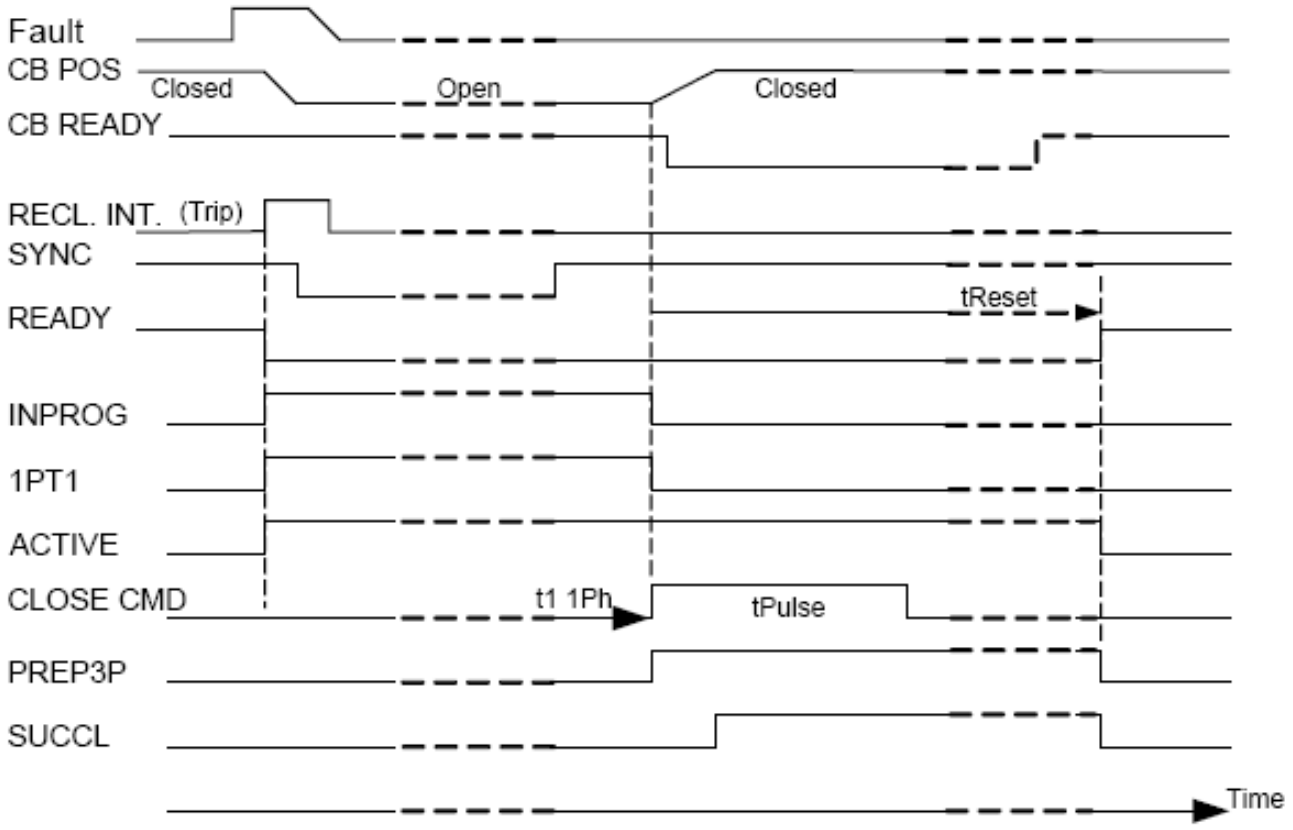
Overview or reclosing and restoration

- Auto reclosing is a function that's initiated with the goal of restoring service.
- As such, auto reclosing is typically initiated by the operation of protection functions or the open position of the circuit breaker
- Auto reclosing takes advantage of the fact that most faults on overhead lines are temporary
- Upon its initiation, auto reclosing typically follows a sequence of one or several attempts to close the circuit breaker

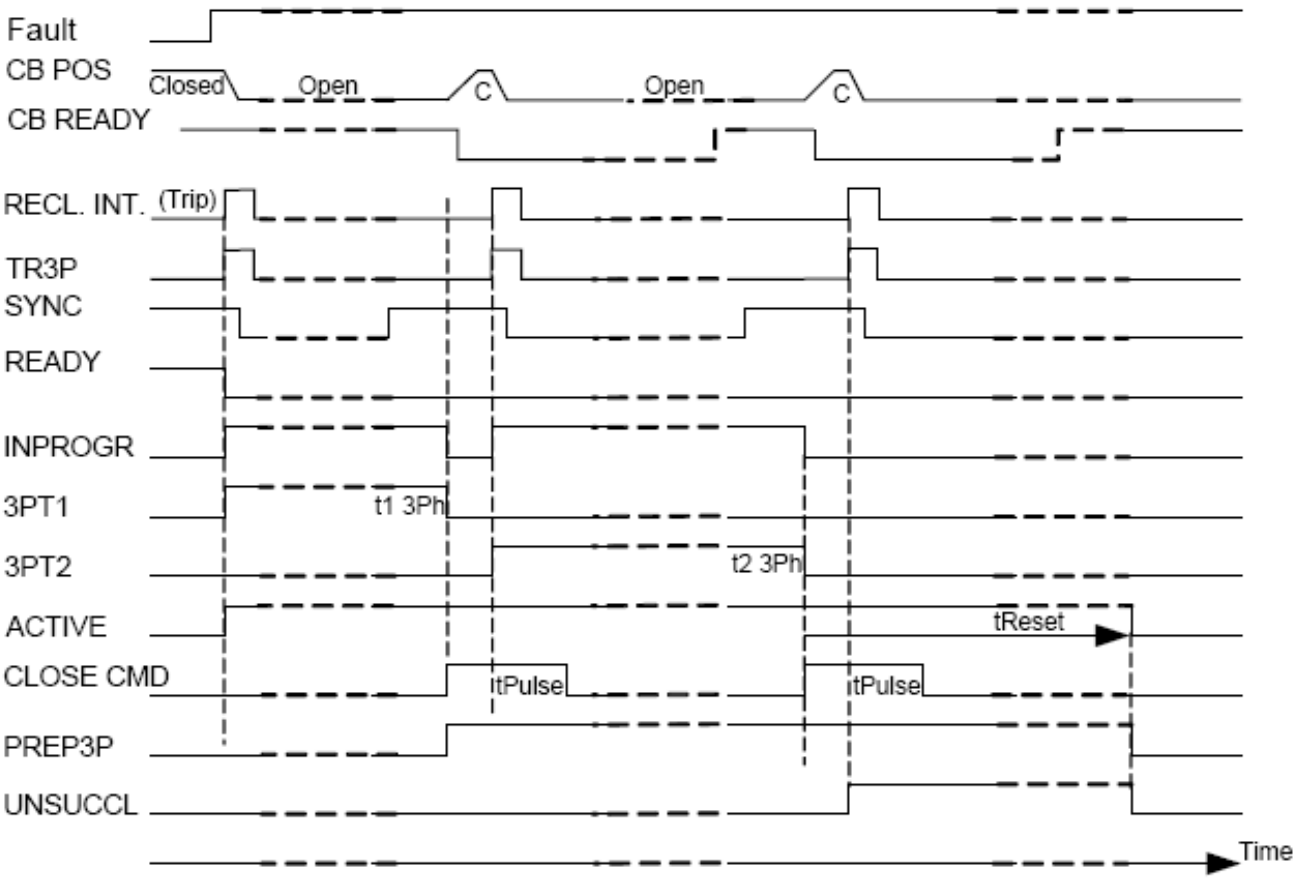
Overview or reclosing and restoration

- An auto reclosing sequence is composed of the following elements:
  - Initiate signal
  - Dead time
  - Block signals
  - Permissive signals
  - Close command
  - Auto reclosing shots
  - Lockout

Successful sequence

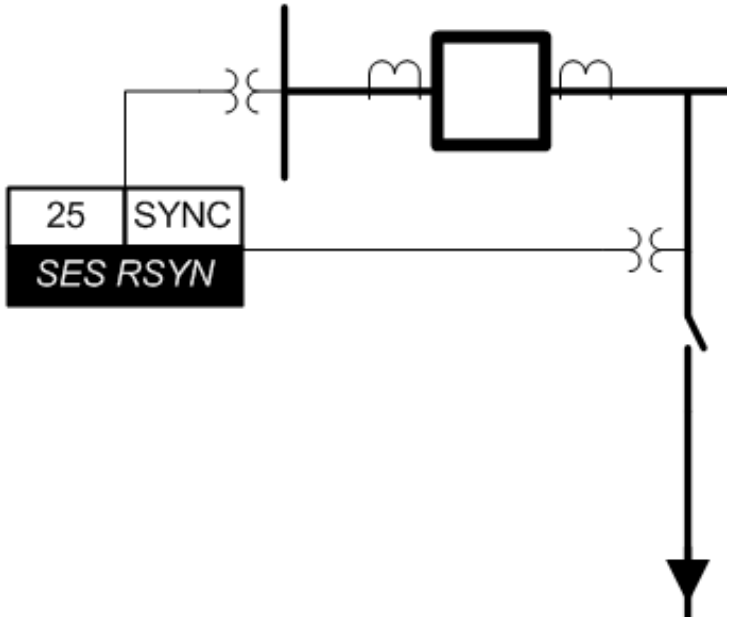


Unsuccessful sequence



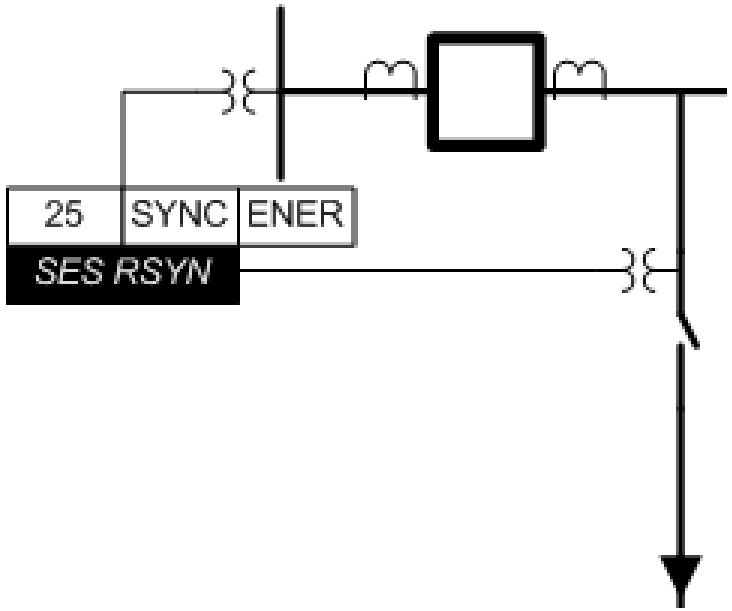
Synch Check

Synch Check is a function that evaluates the voltages across the contacts of the circuit breaker. It evaluates the difference between the magnitude, frequency, and phase angle between these 2 voltages and verifies that they are within pre established settings



Energizing Check

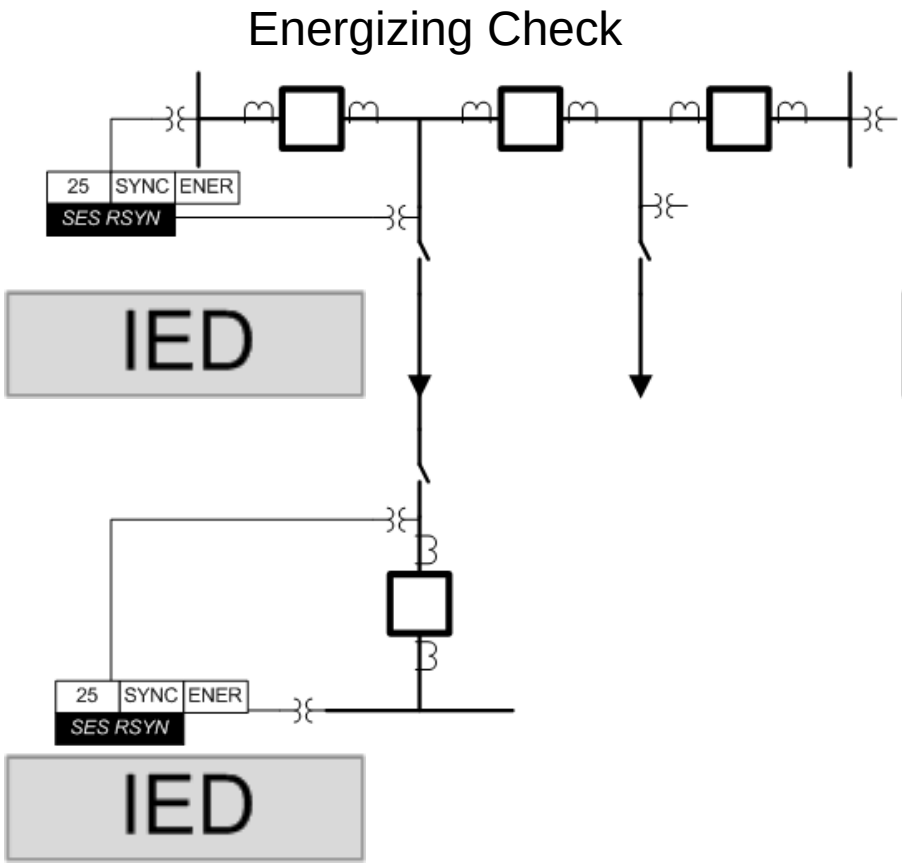
Energizing Check is a function that evaluates the voltages across the contacts of the circuit breaker, specifying one as the bus side, and the other as the line side. Specifically it verifies if either voltage is dead (below a specified threshold) or live (above a specified threshold).

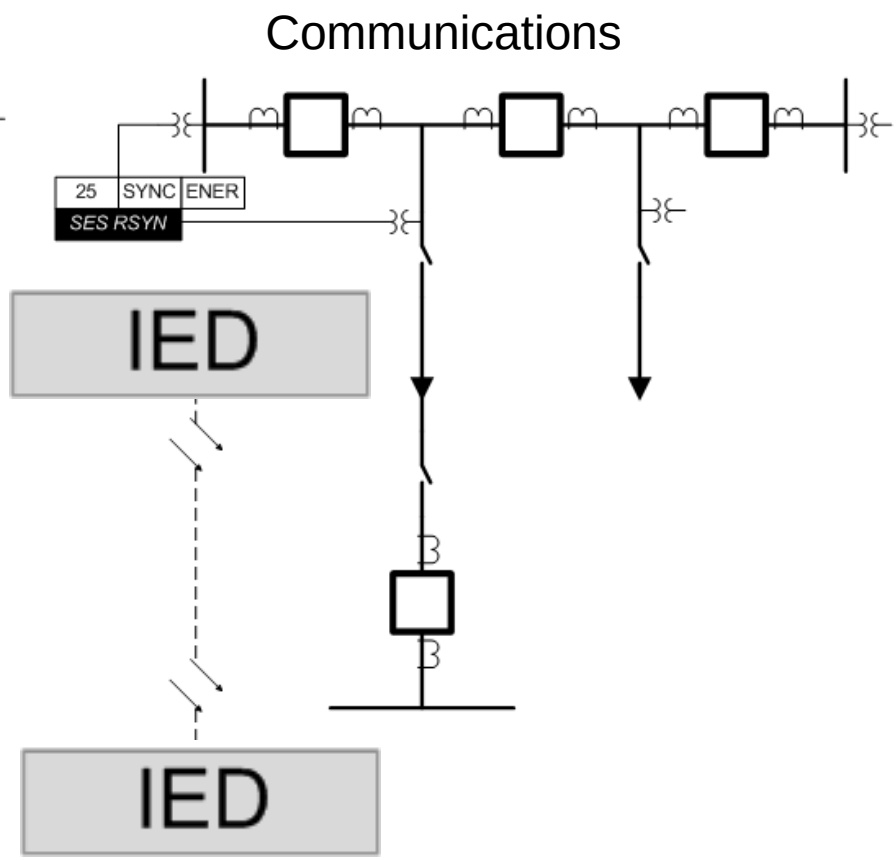


Preferred terminal

- In an auto reclosing scheme there is typically a terminal that is selected as the preferred terminal (transmission / sub transmission)
- The preferred terminal is the one that energizes the line
- The reclosing of the other terminals of the line is only allowed once the preferred terminal has successfully reclosed
- Verifying that the preferred terminal successfully energized the line is checked in one of two ways:
  - Synch/Energizing Check
  - Permissive signal via communications

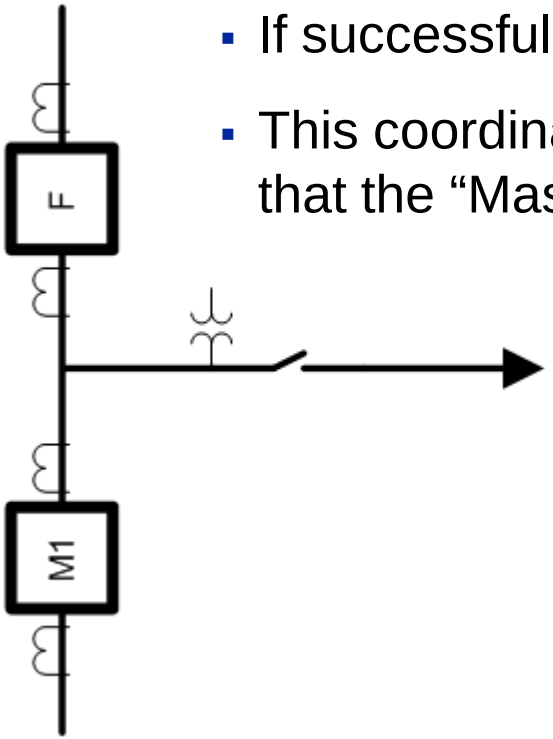
Preferred terminal



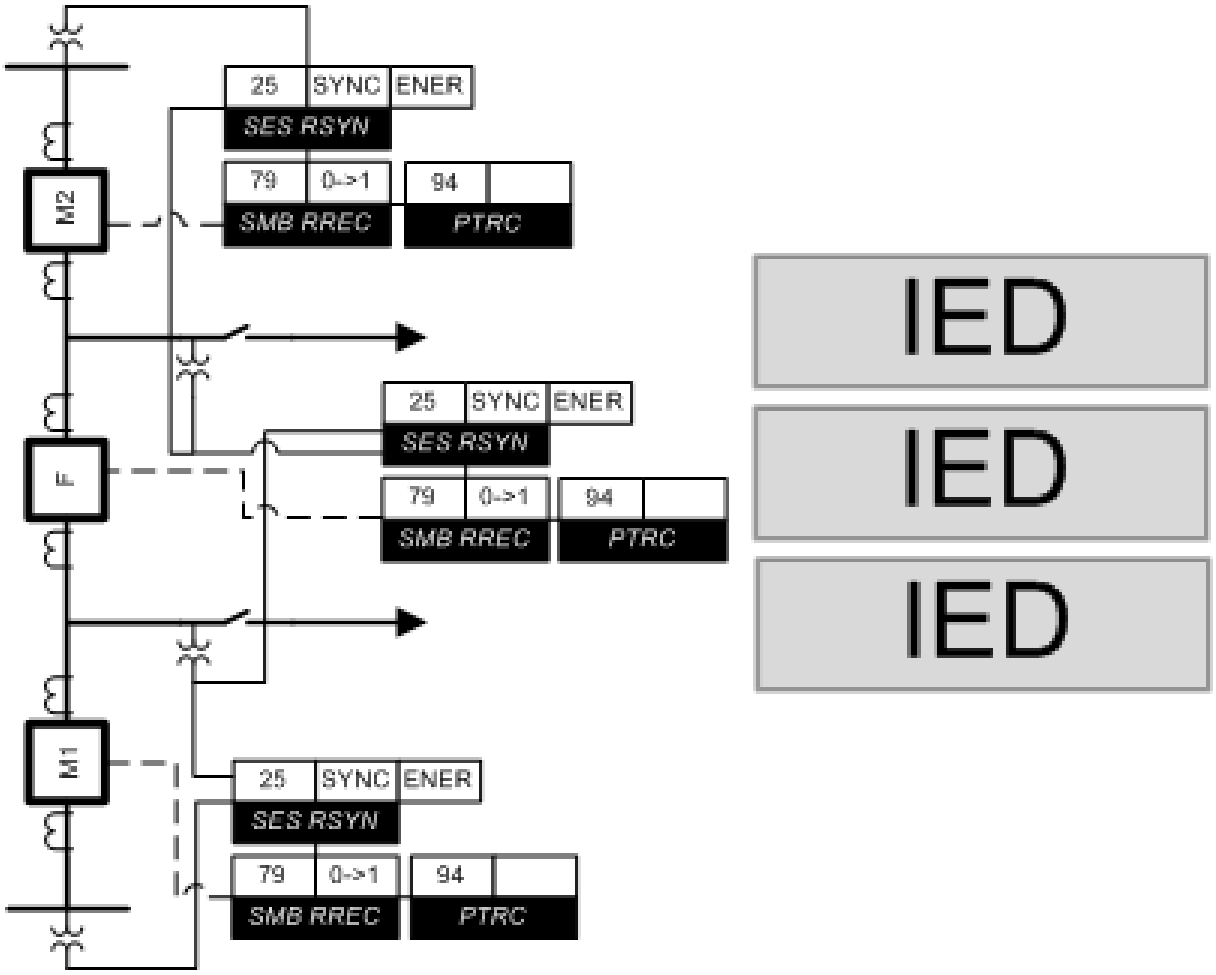


Master – Slave Coordination

- In multi breaker terminals reclosing needs to be coordinated between the 2 breakers that are involved in the sequence
- The “Master” breaker is the one that closes first in the terminal
- If successful the “Slave” will go ahead and close
- This coordination is enabled via a permissive signal that the “Master” applies to the “Slave”

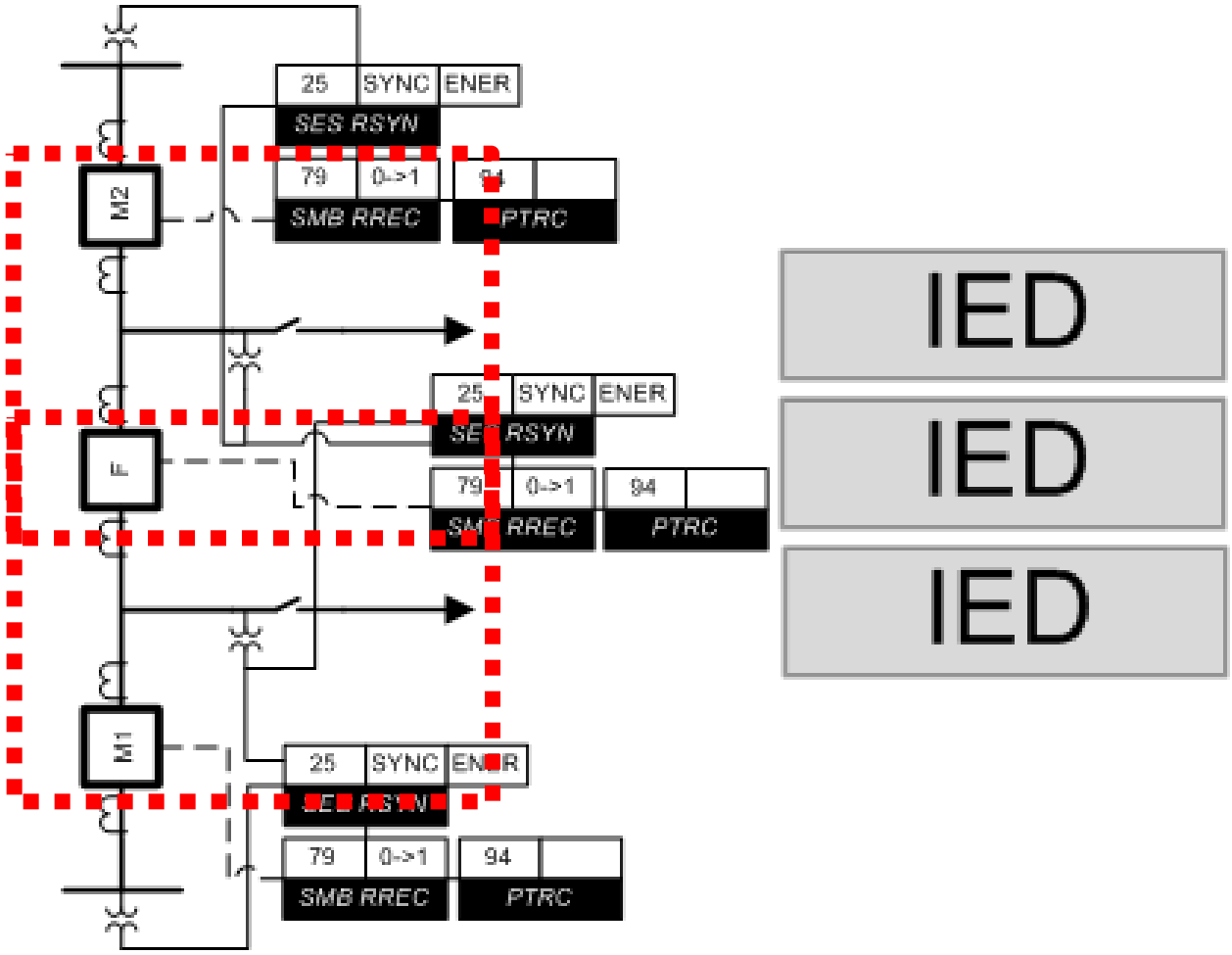


Reclosing in single and multi breaker line terminals



- Reclose tie or not
- Allocation of functions in physical devices
- Connections between protection and control devices

Reclosing in single and multi breaker line terminals



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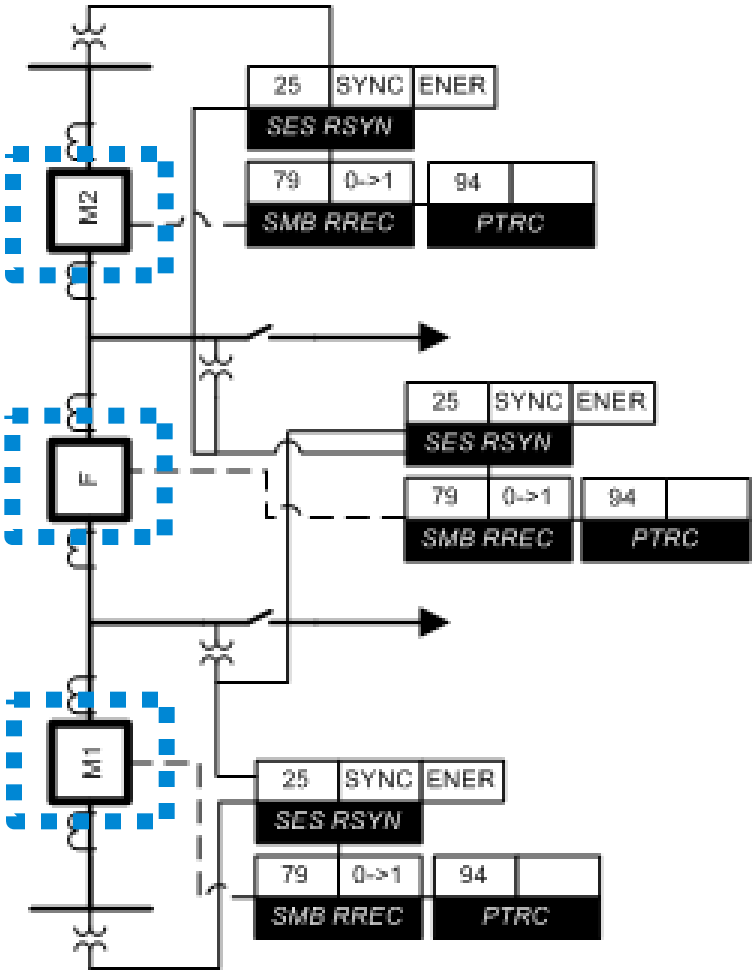
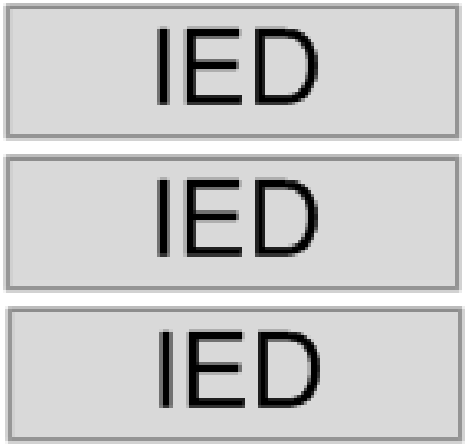
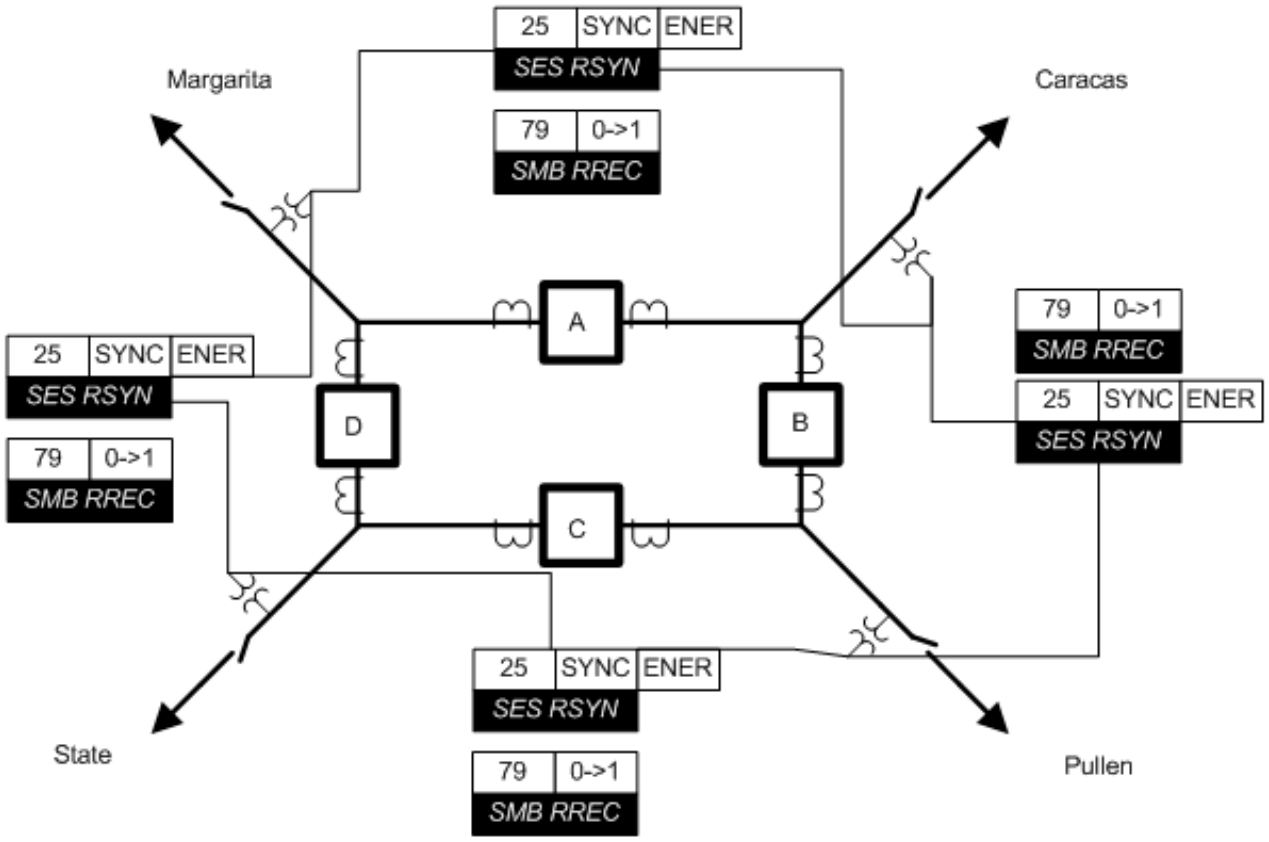
Reclosing in single and multi breaker line terminals



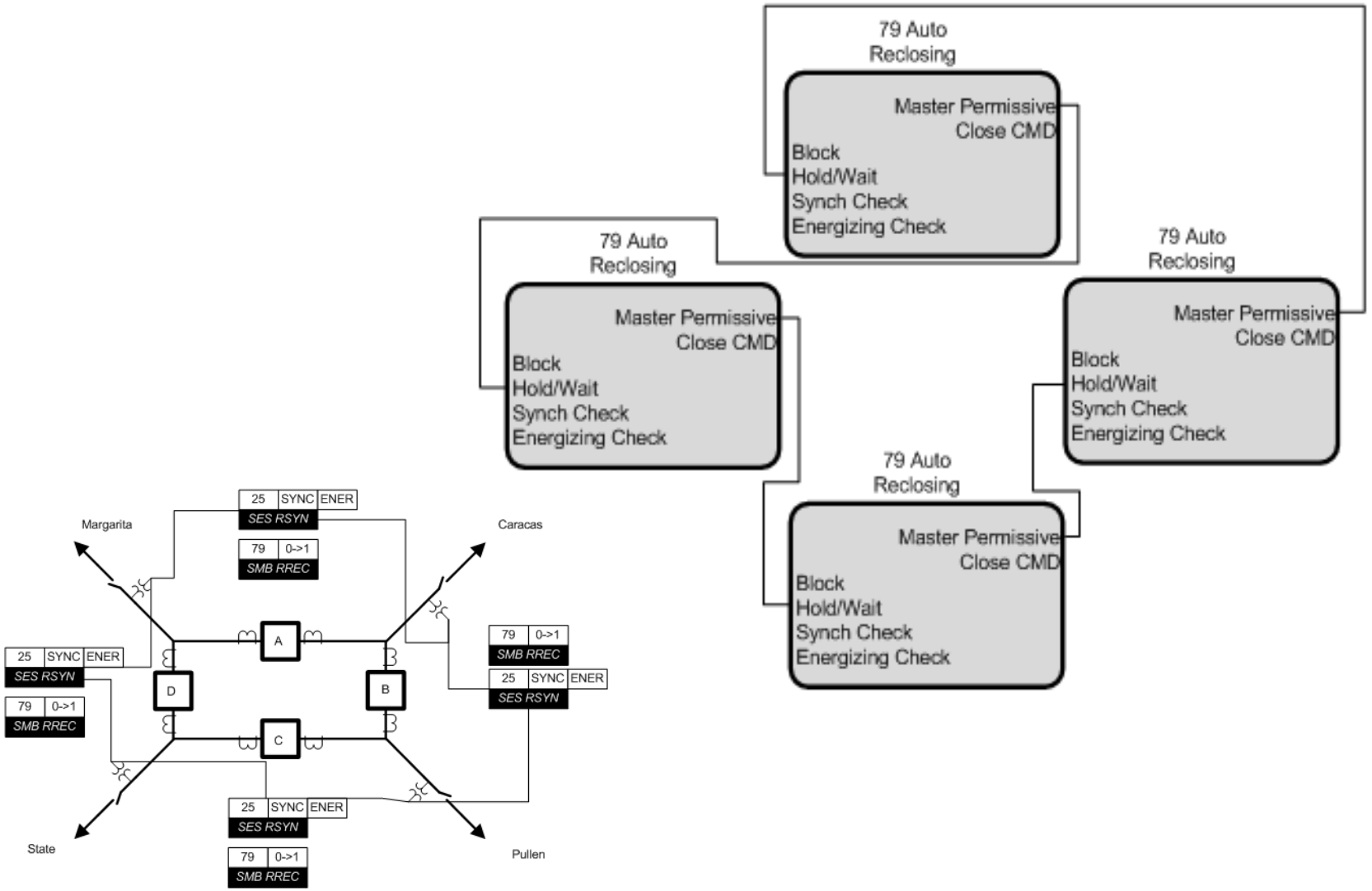


- Define Mater and follower
- Reclose tie or not
- Allocation of functions in physical devices
- Connections between protection and control devices

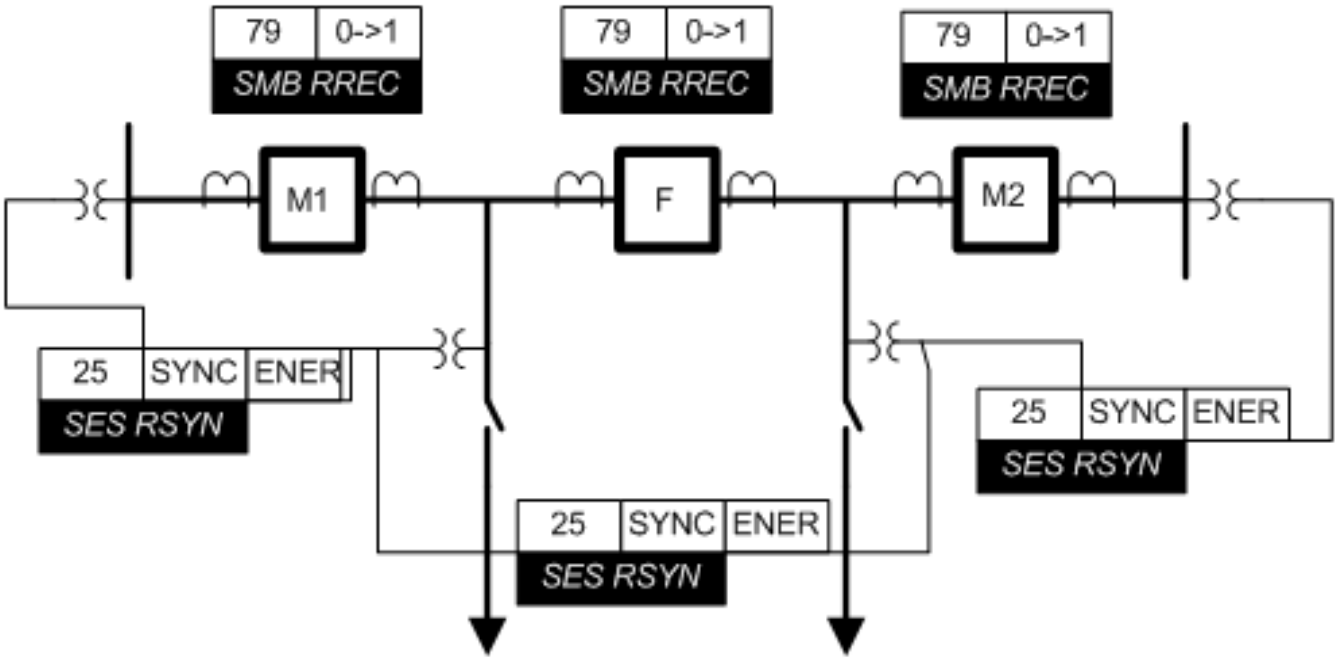
Reclosing in single and multi breaker line terminals
Ring Bus



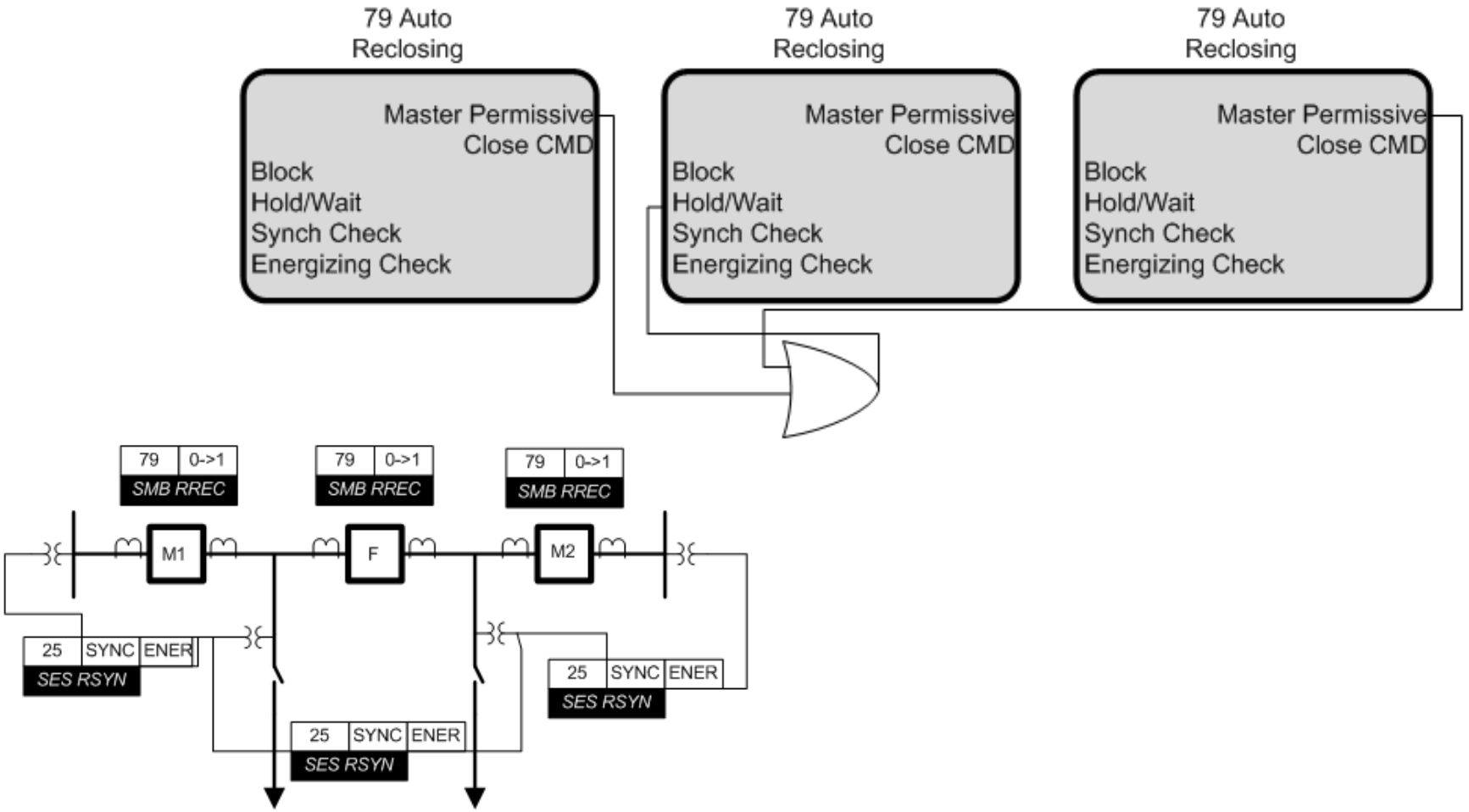
Reclosing in single and multi breaker line terminals
Ring Bus



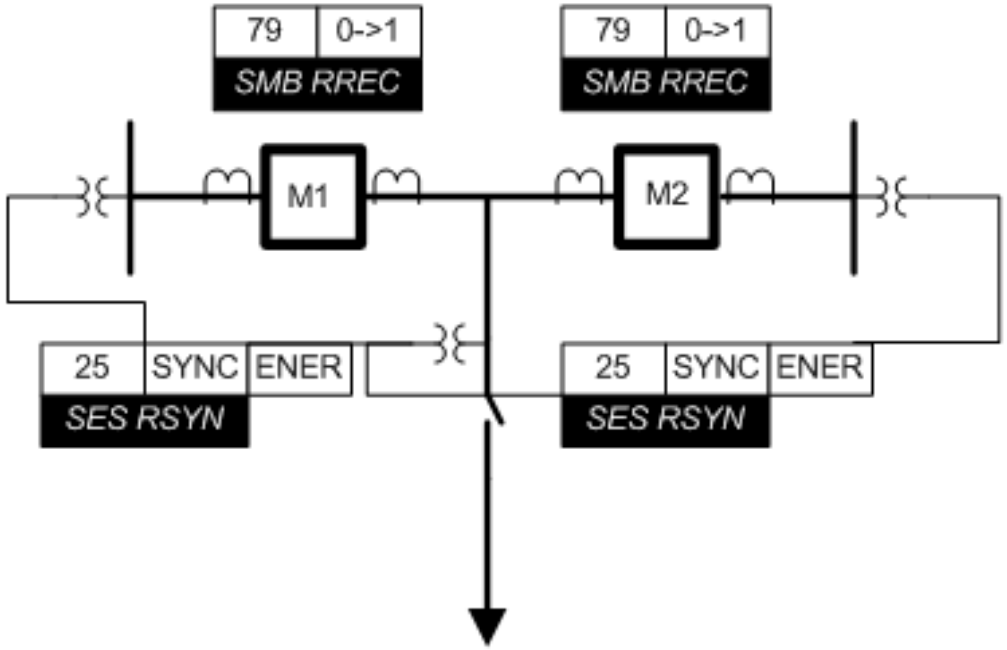
Reclosing in single and multi breaker line terminals
Breaker and a half



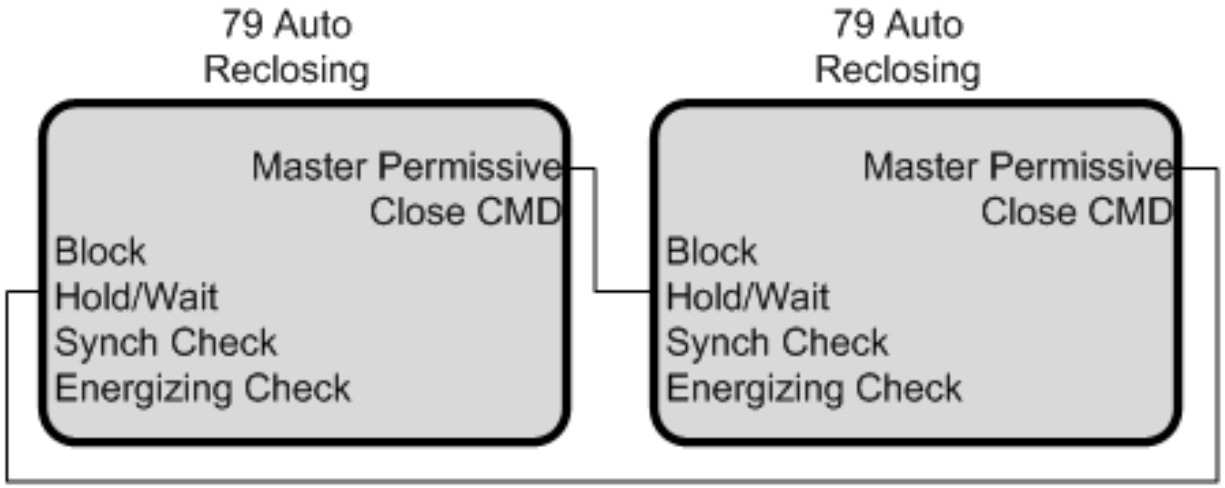
Reclosing in single and multi breaker line terminals
Breaker and a half

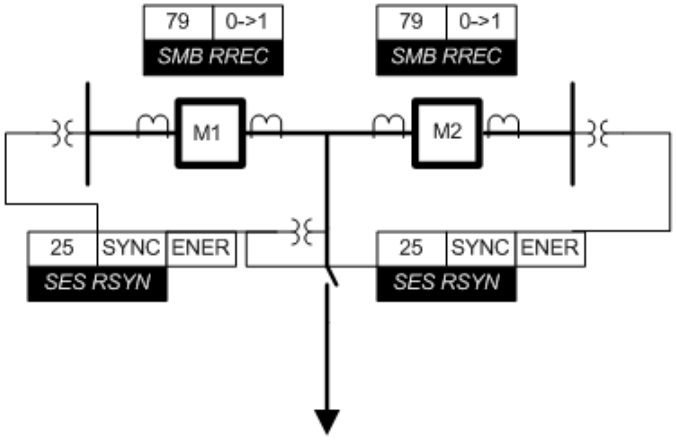


Reclosing in single and multi breaker line terminals
Double Breaker Double Bus

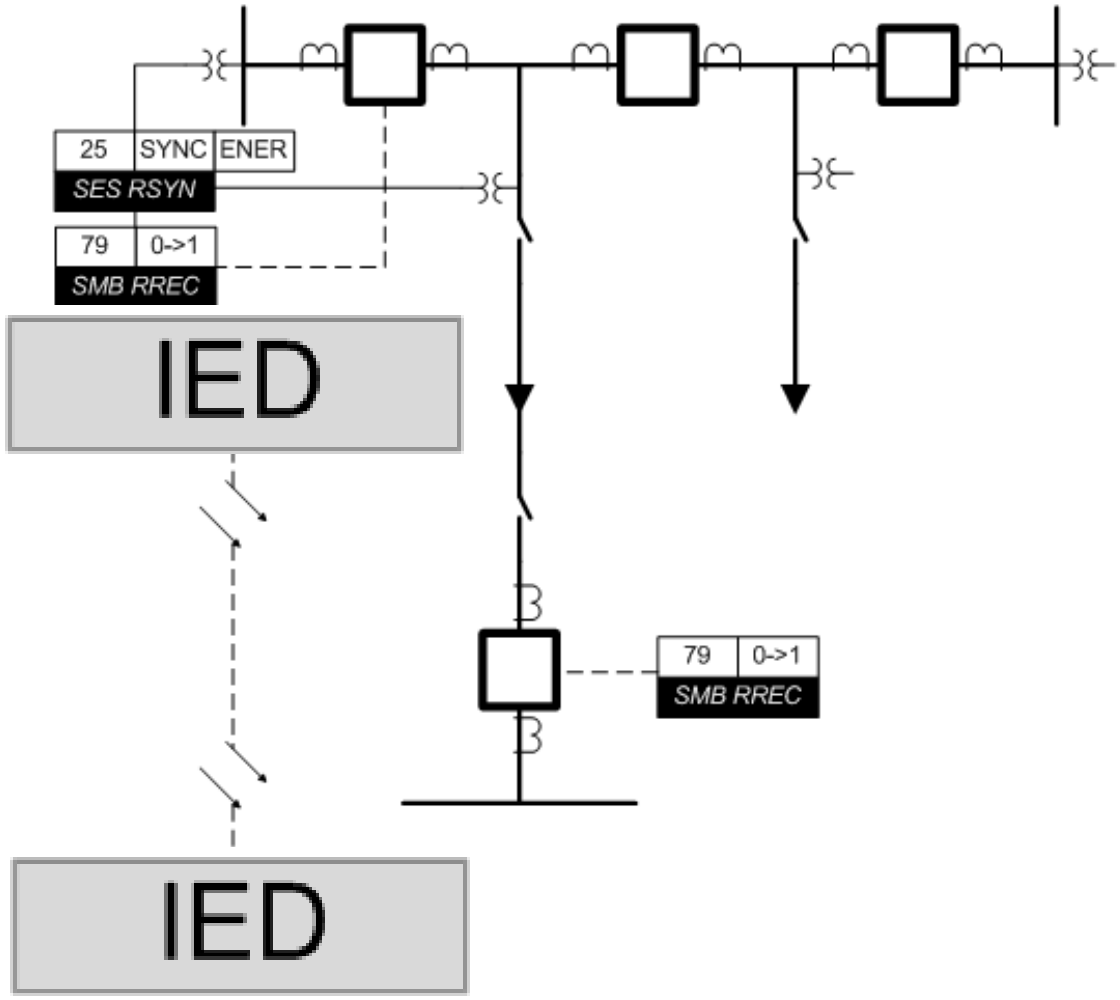


Reclosing in single and multi breaker line terminals
Double Breaker Double Bus



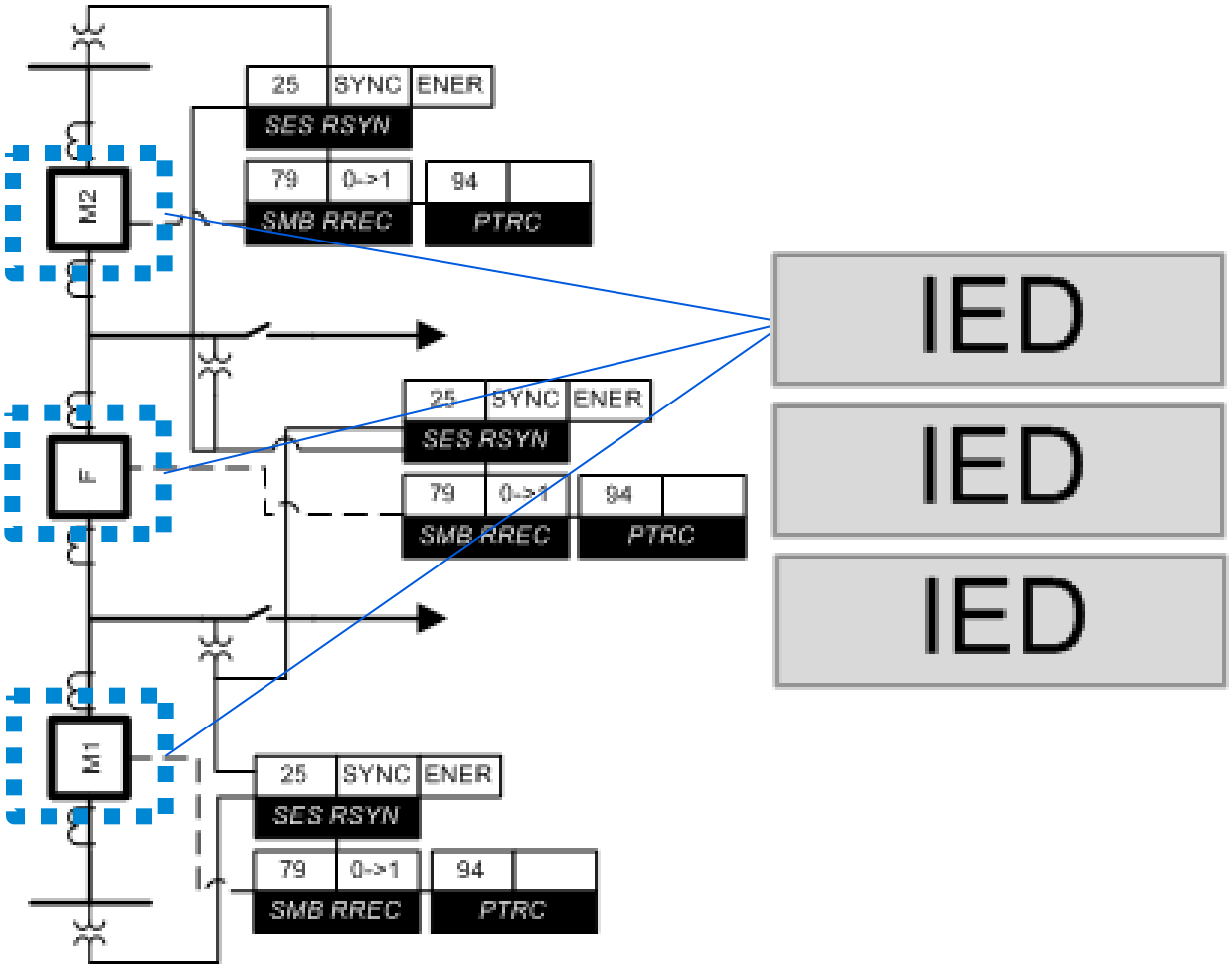


Building an auto reclosing scheme for a 230kV line



- Communication channel to indicate preferred terminal
- Non preferred terminal will not be allowed to reclose until receiving the permissive signal
- May or may not have VT for Synch Check or Energizing Check
- Fuse failure

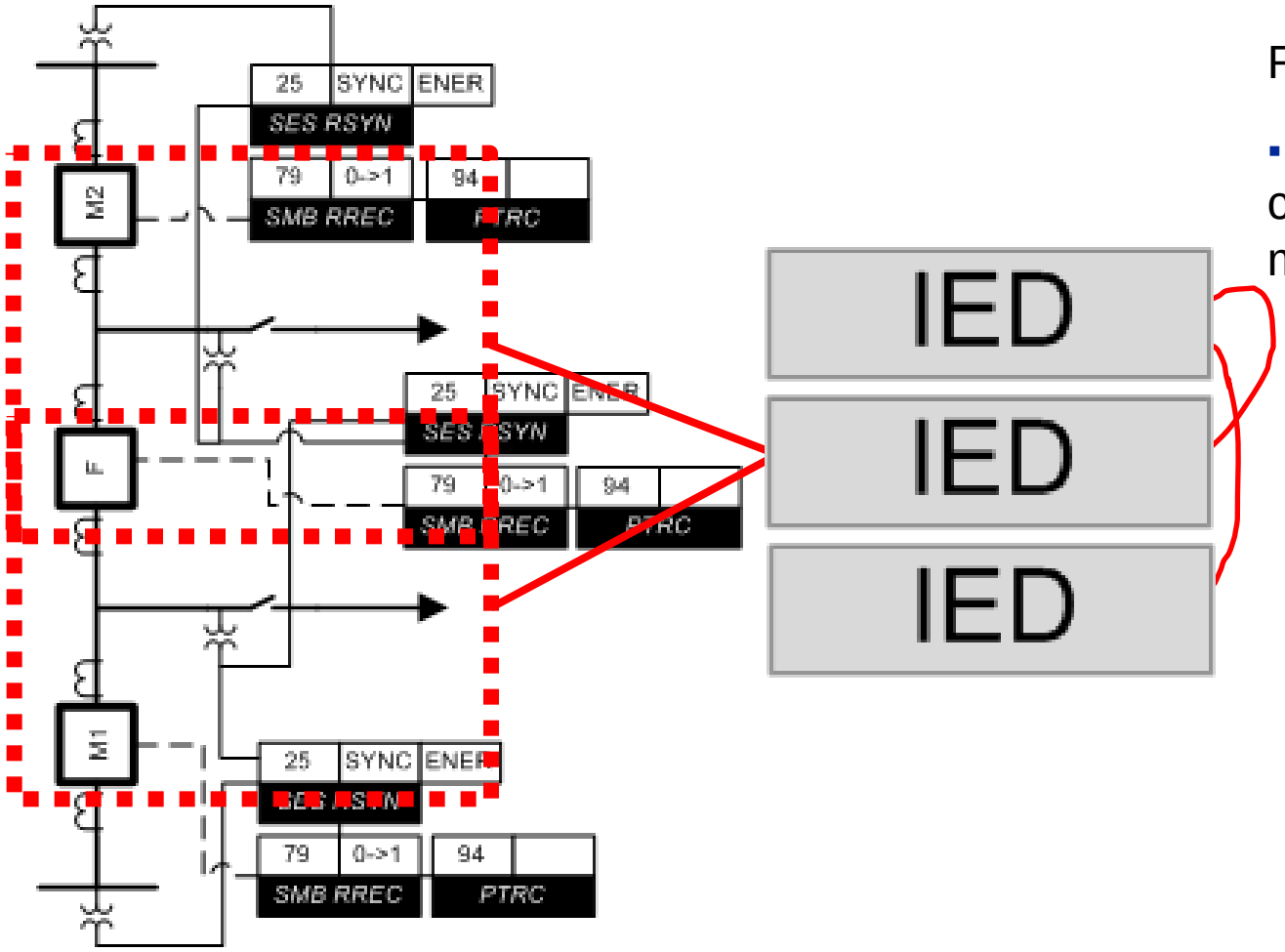
Building an auto reclosing scheme for a 230kV line



Preferred terminal

- 1 auto reclosing function per breaker
- Bus side breakers are masters
- M1 / F coordination
- Logic to coordinate the reclosure of the tie breaker during simultaneous faults

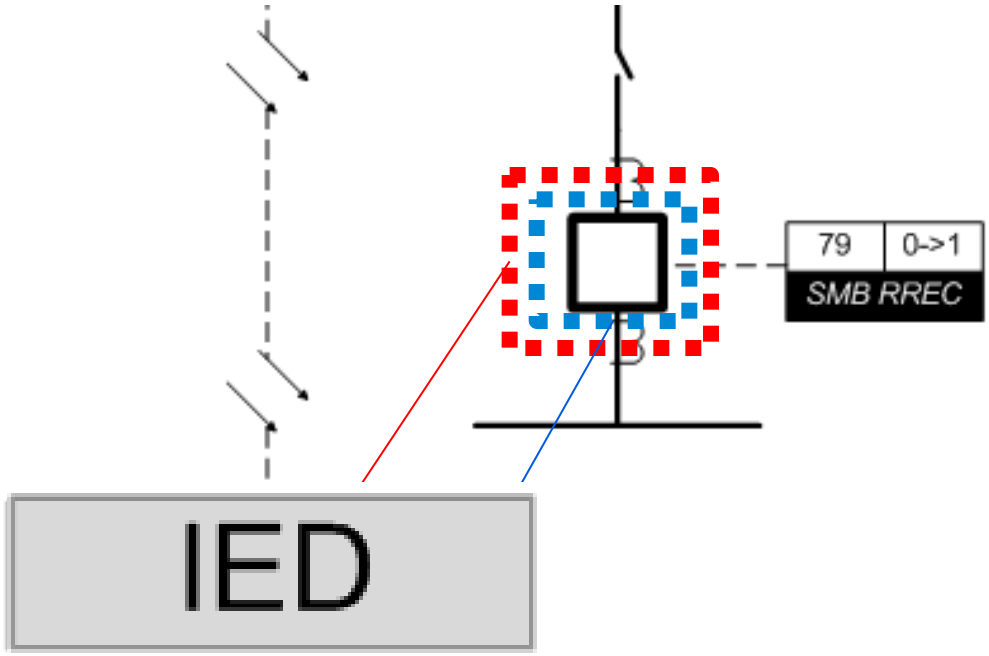
Building an auto reclosing scheme for a 230kV line



Reclose Initiate

- Signals routed to controller via GOOSE messages

Building an auto reclosing scheme for a 230kV line



Non Preferred terminal

- 1 Breaker terminal with 1 reclosing function
- Permissive signal from preferred terminal

Conclusion

- Auto reclosing is an efficient and fast way to restore service
- Requirements must be clearly defined
- Consider possible scenarios, define the desired behavior, and design the logic for this purpose
- Communications can help you achieved the desired sequence

QUESTIONS?