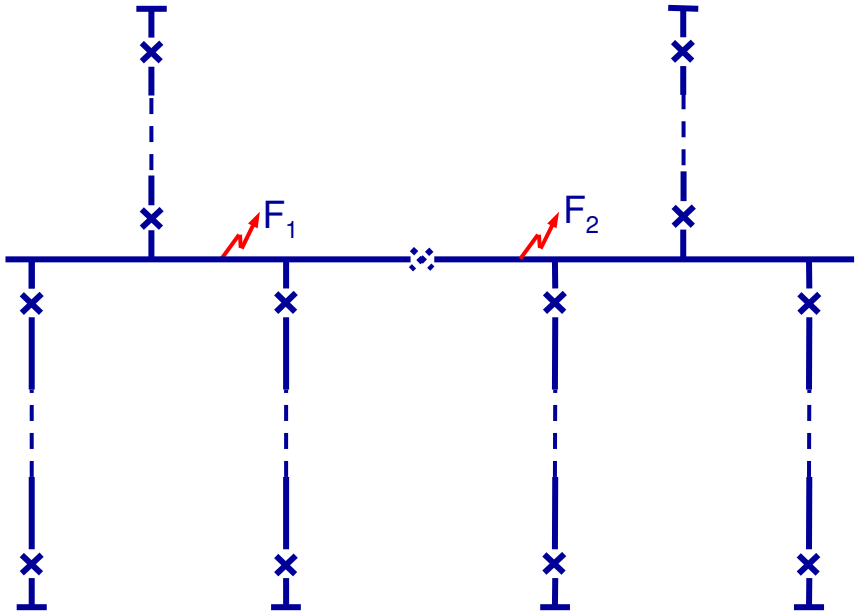
Busbar Protection

Protection & Contrôle / Application

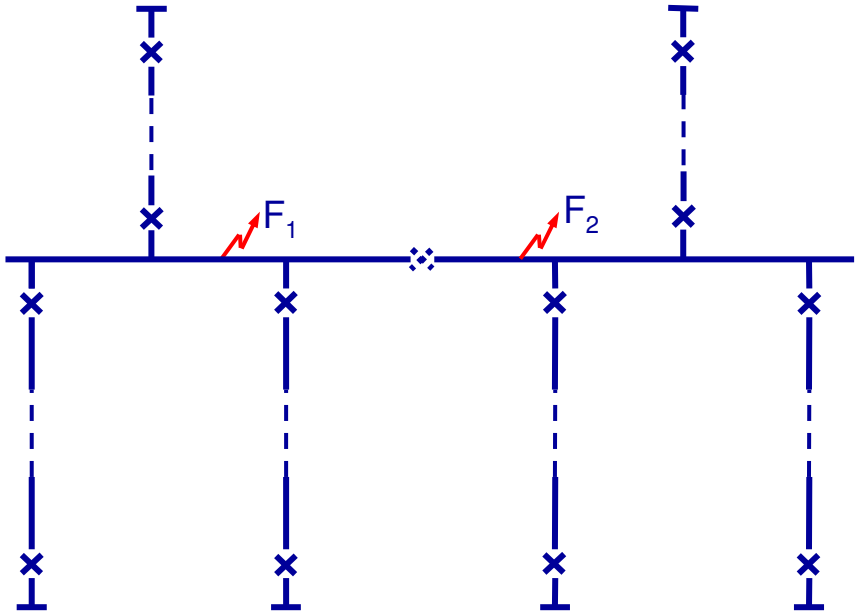
Without Busbar Protection



Argues

- There are fewer faults on busbars than on other parts of the power system.
- No risk of dislocation of system due to accidental operation of busbar protection.

Without Busbar Protection



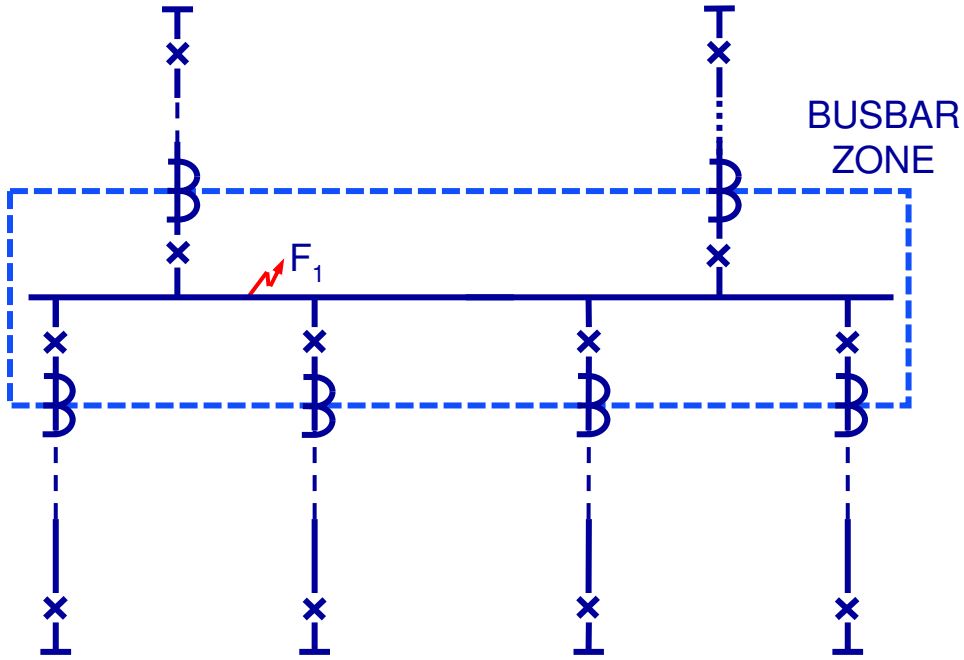
Drawbacks

- Slow fault clearance.

  Busbar faults at F1 and F2 are cleared by remote time delayed protection on circuits feeding the faults:

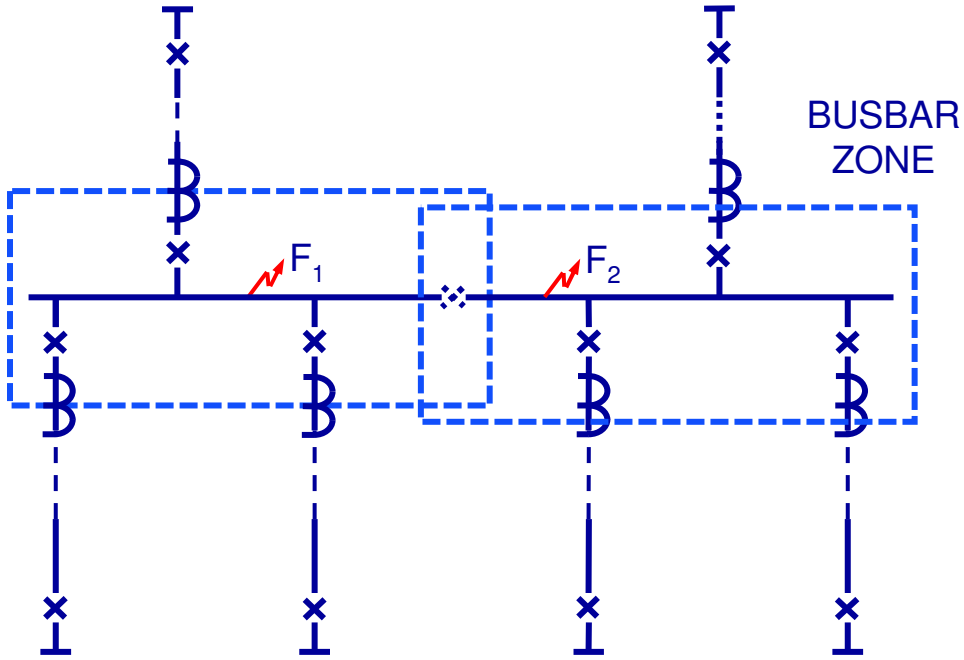
  Time Delayed Overcurrent or
  Time Delayed Distance Protection

With Busbar Protection



- Fast clearance by breakers at the busbars

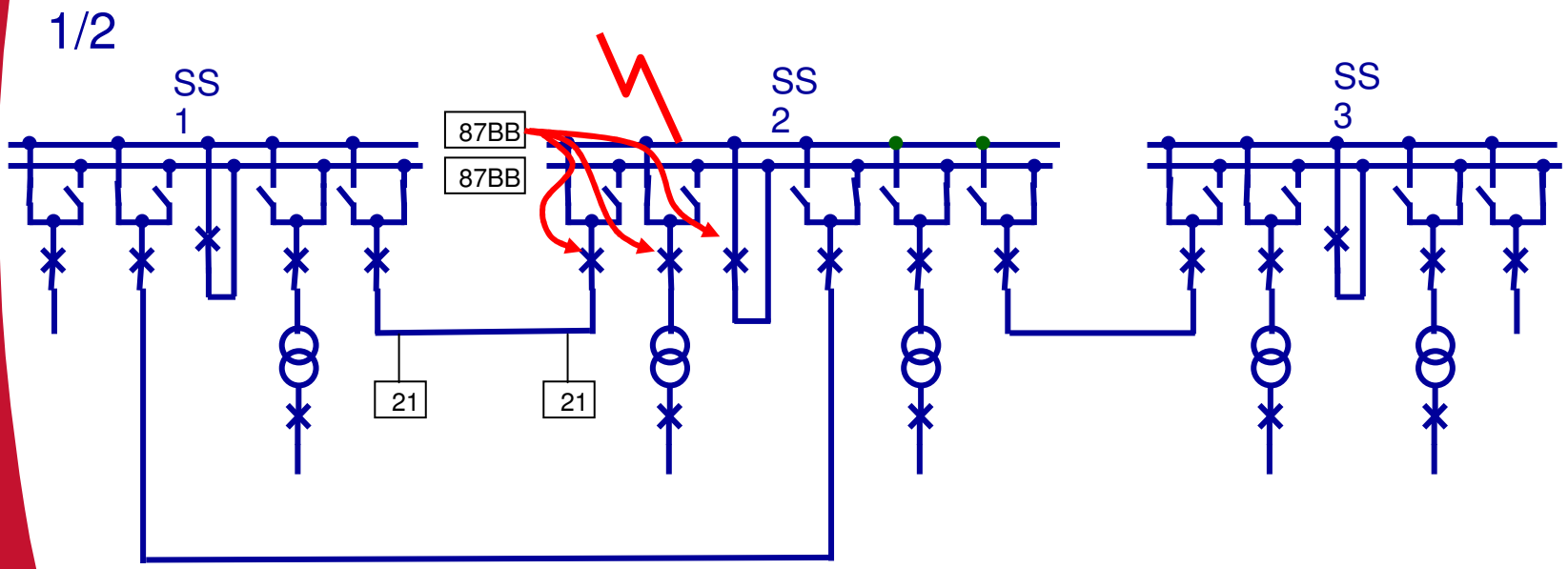
With Busbar Protection



- Where busbars are sectionalised,

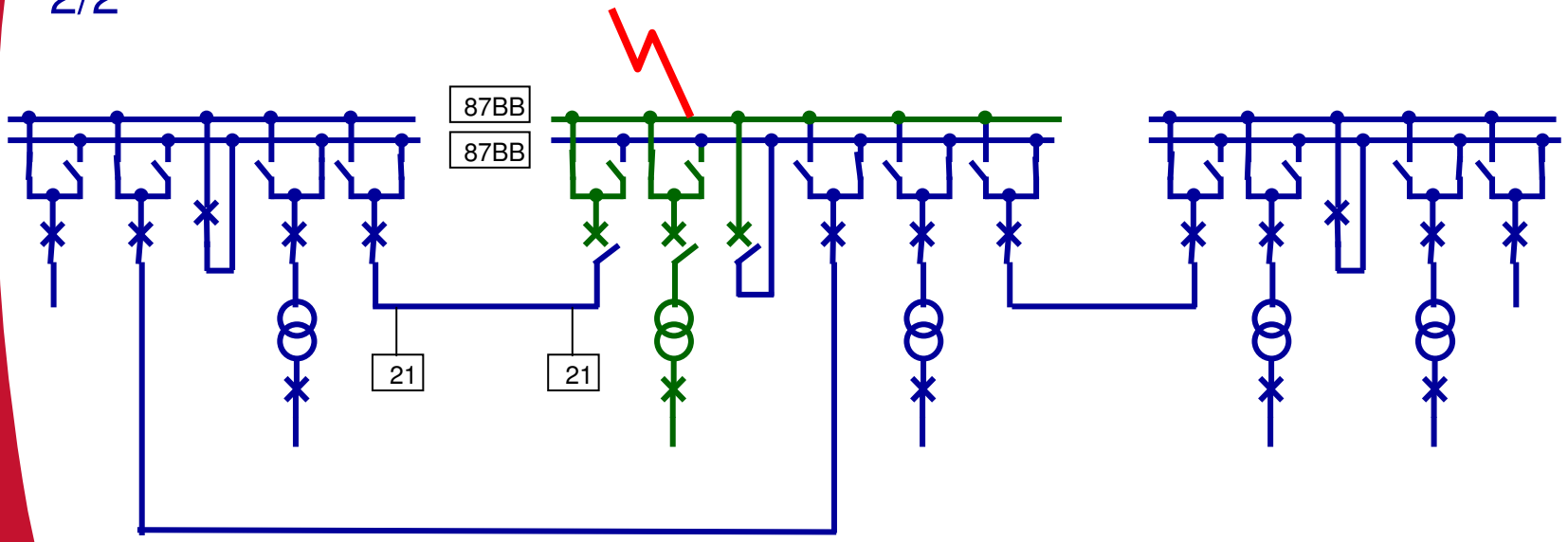
  Protection can limit the amount of system disruption for a busbar fault

With Busbar Protection



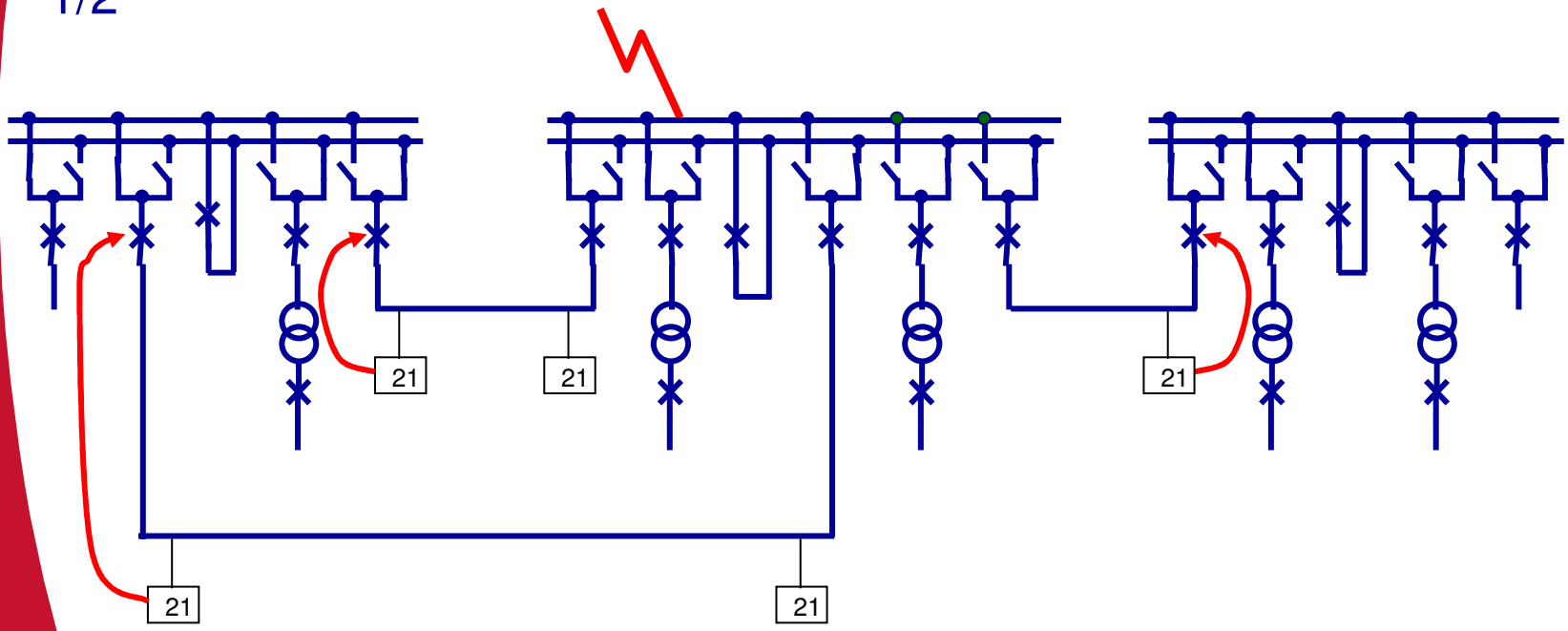
With Busbar Protection

2/2



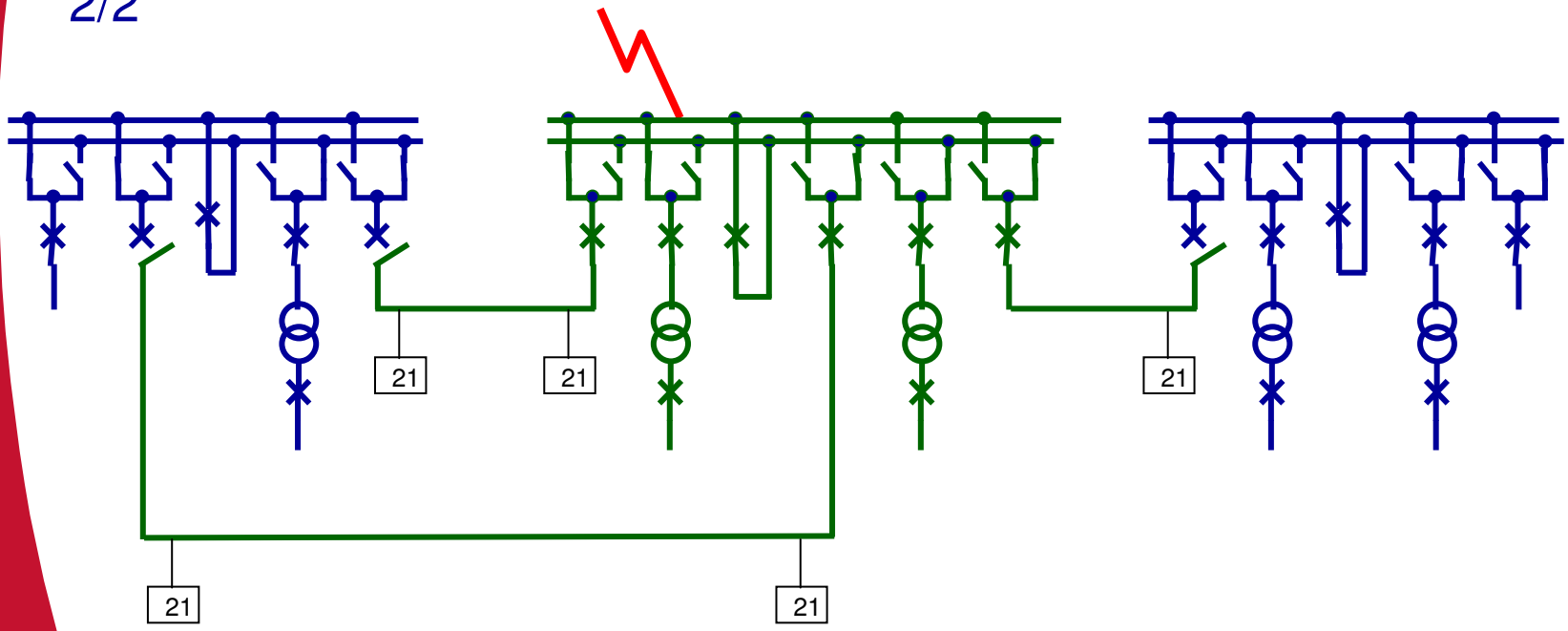
With No Busbar Protection

1/2



With No Busbar Protection

2/2



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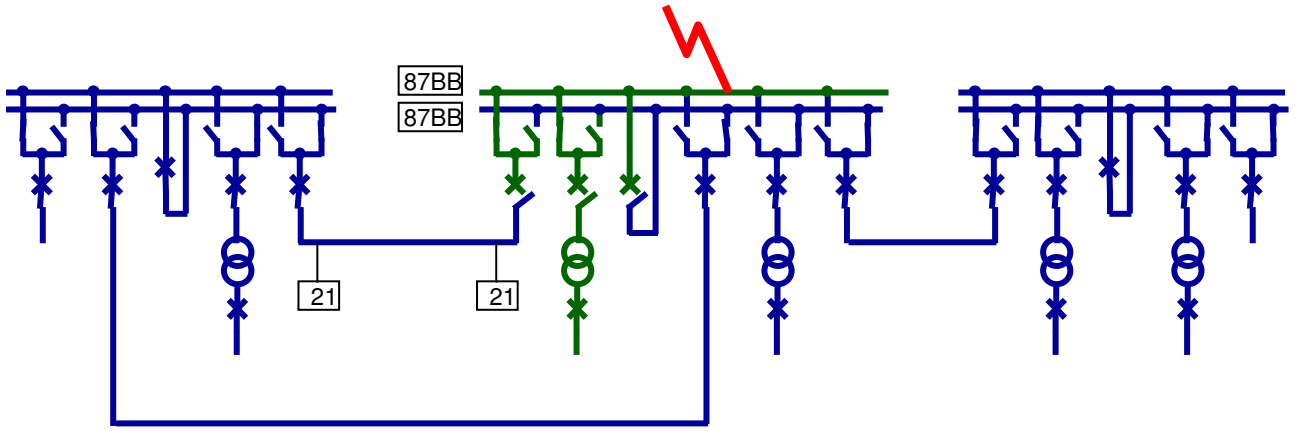
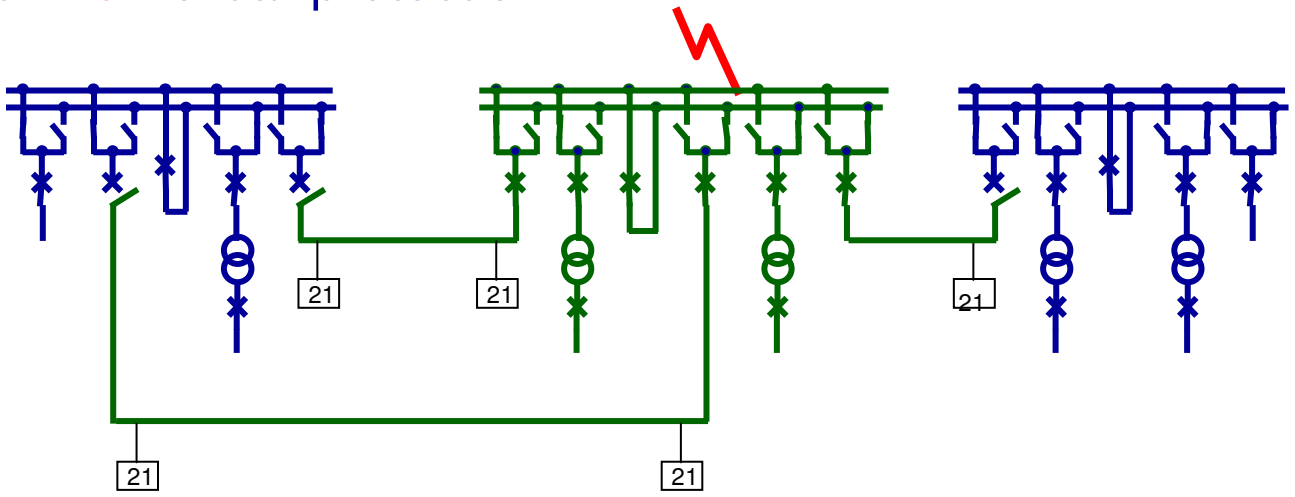
With Burbar protection



With No Burbar protection



T&D

Busbar Faults Are Usually Permanent

Causes of Busbar Faults :

- Falling debris
- Insulation failures
- Circuit breaker failures
- Current transformer failures
- Isolators switchs operated on load or outside their ratings
- Safety earths left connected

Therefore :

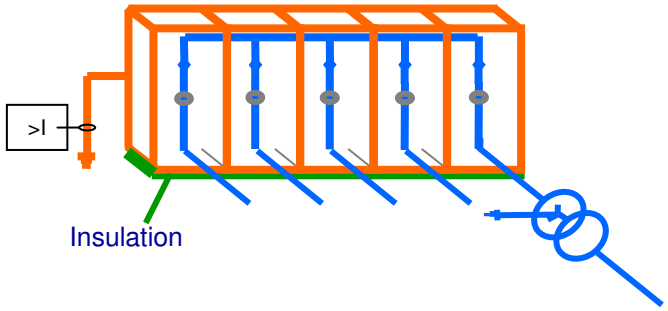
Circuit breakers should be tripped and locked out by busbar protection

Busbar Protection must be :

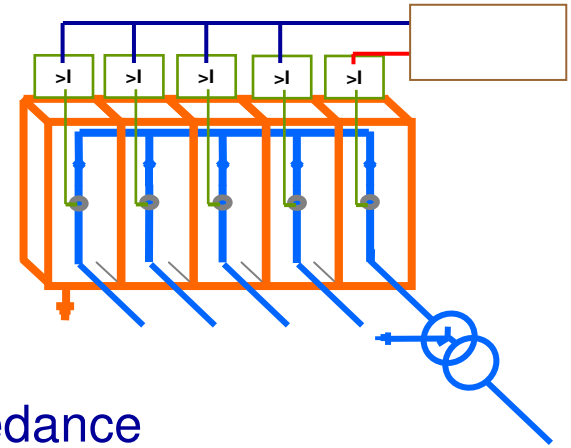
- RELIABLE
  - Failure to trip could cause widespread damage to the substation
- STABLE
  - False tripping can cause widespread interruption of supplies to customers / possible power system instability
- DISCRIMINATING
  - Should trip the minimum number of breakers to clear the fault
- FAST
  - To limit damage and possible power system instability

Methods of Providing Busbar Protection

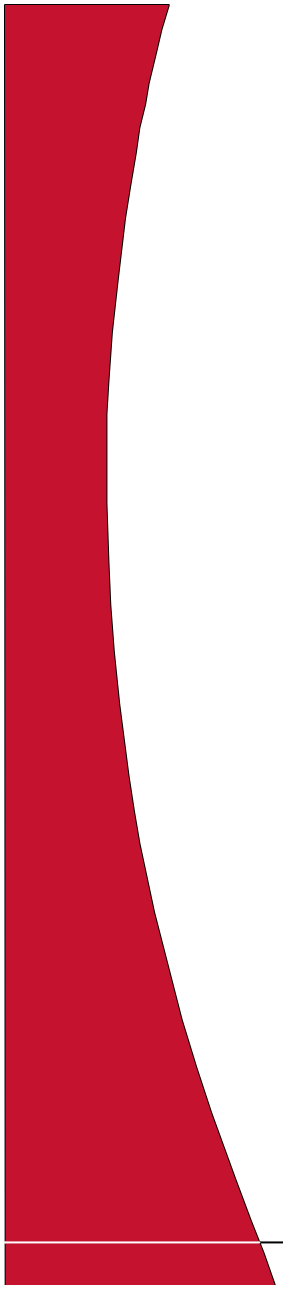
- Frame to Earth (Leakage) Protection



- Blocking Scheme Protection



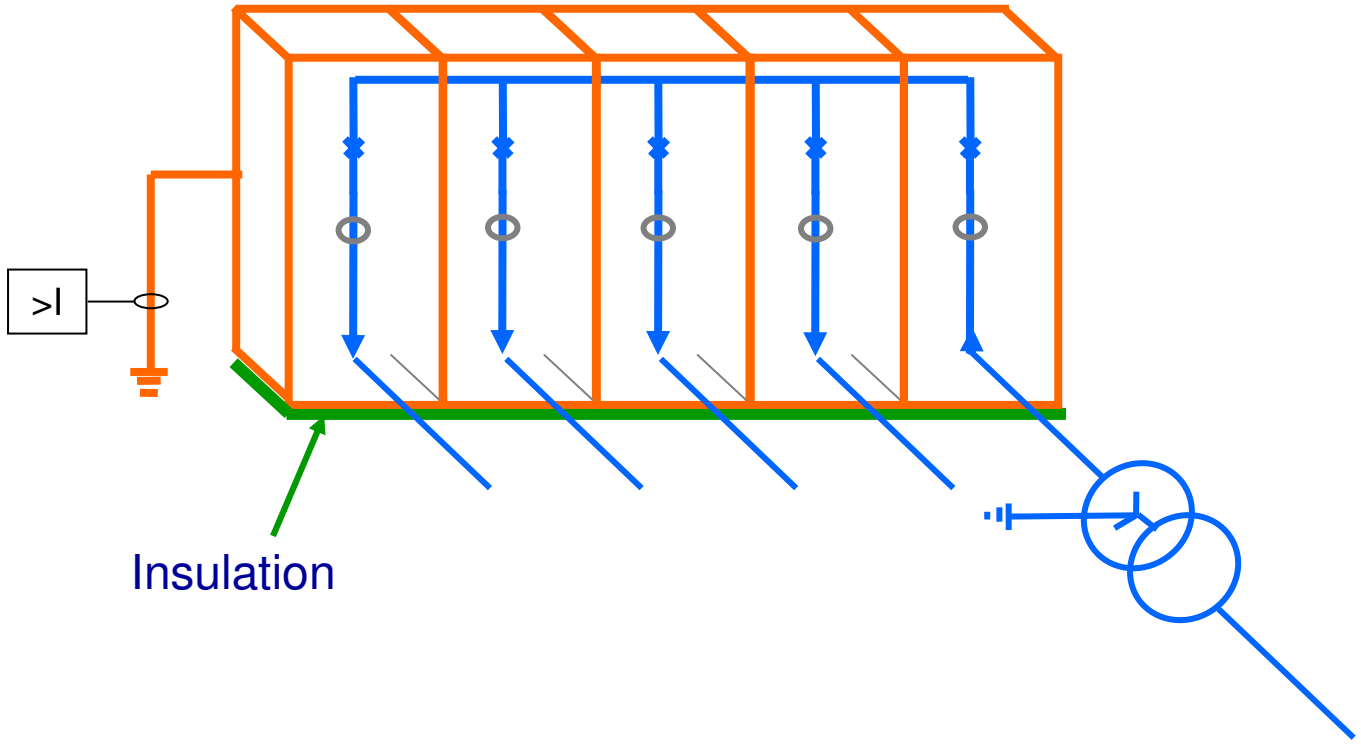
- Differential Protection : High Impedance
  Low Impedance



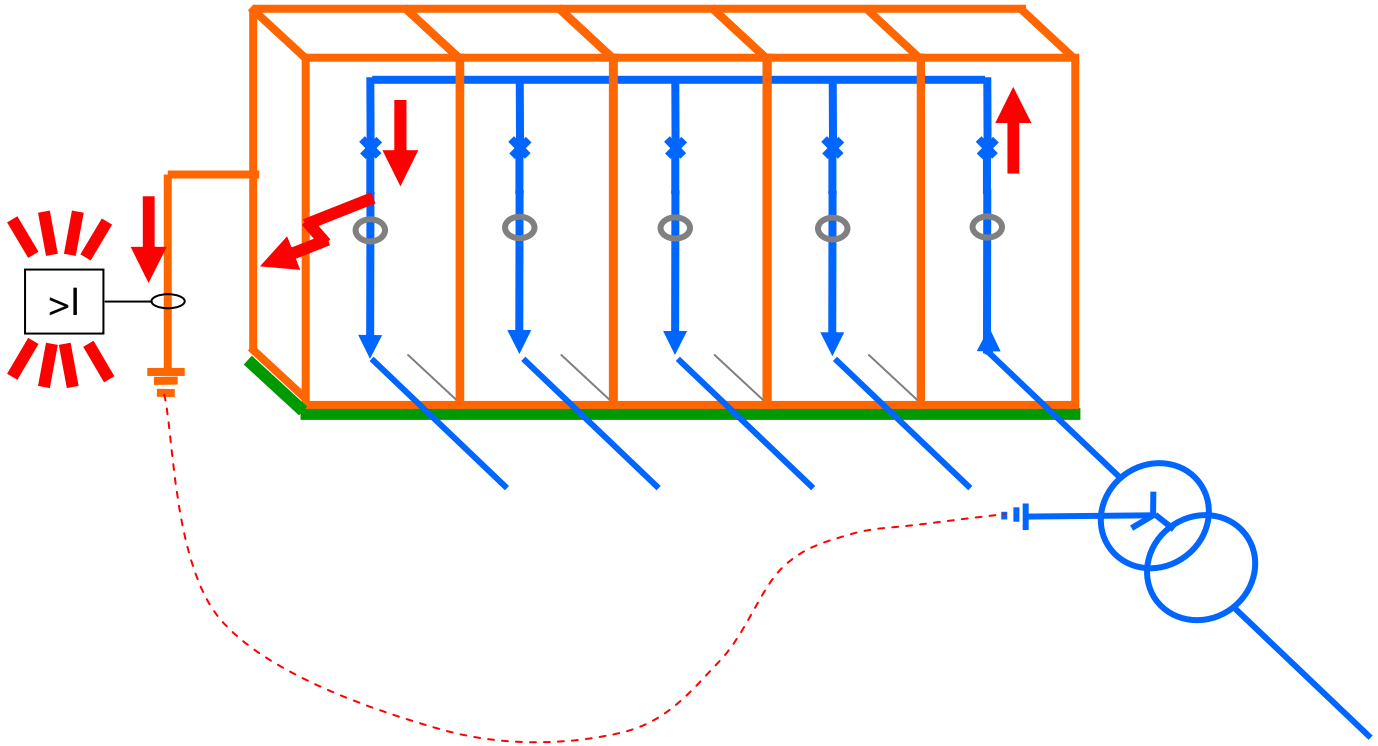
Frame Leakage Protection

Protection & Contrôle / Application

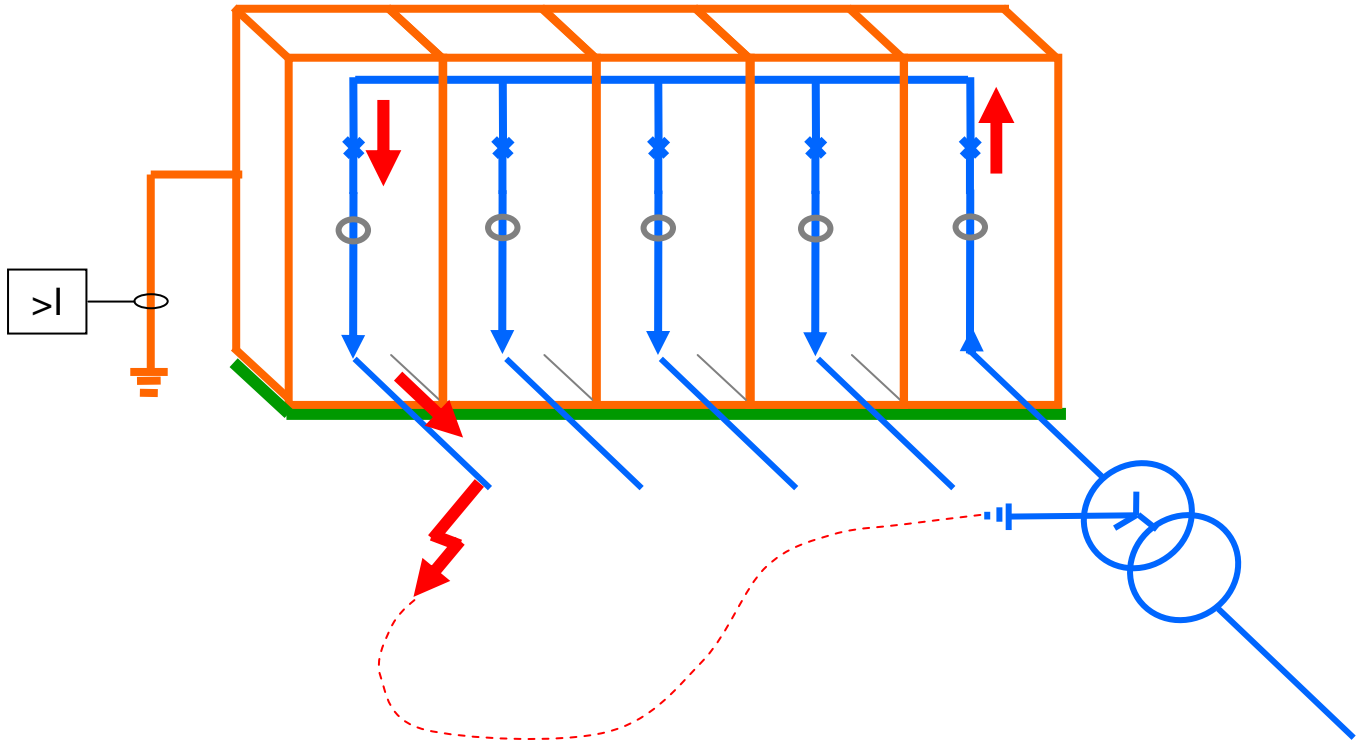
Frame Leakage Busbar Protection



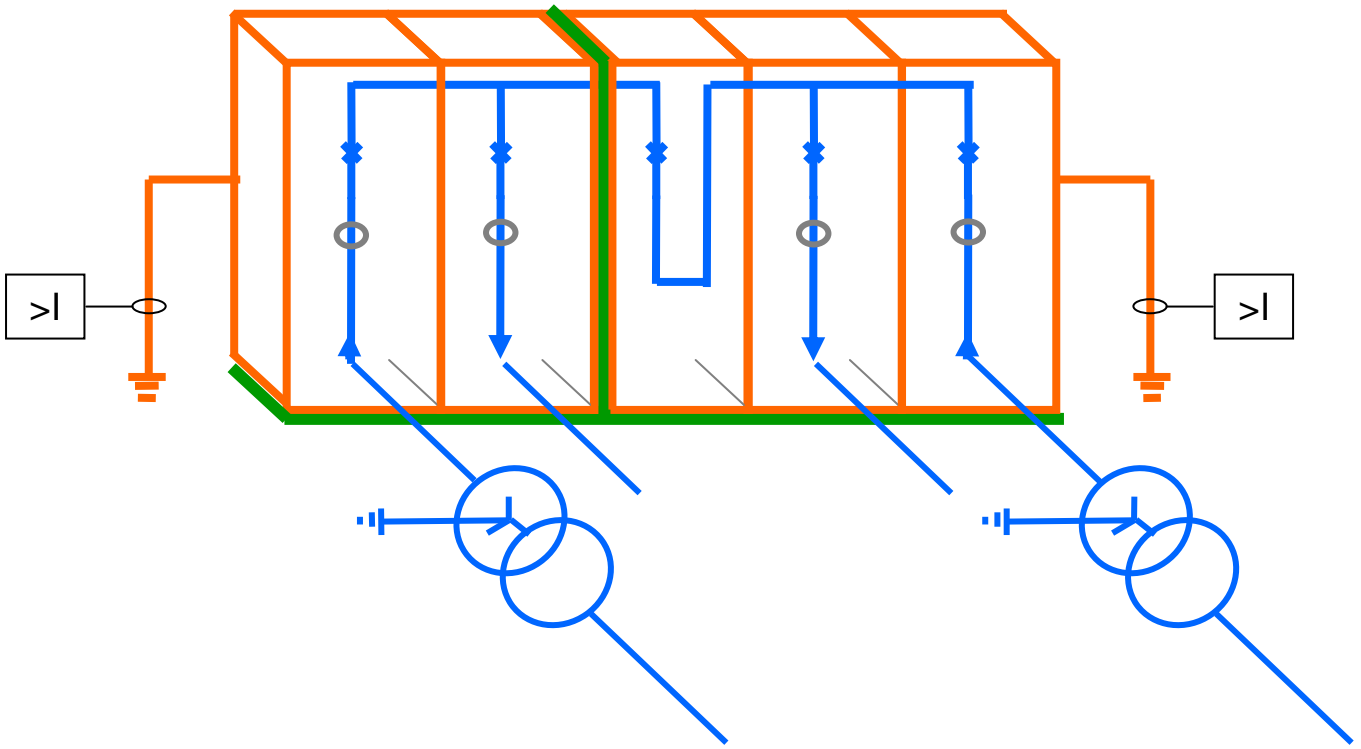
Frame Leakage Busbar Protection



Frame Leakage Busbar Protection



Frame Leakage Busbar Protection

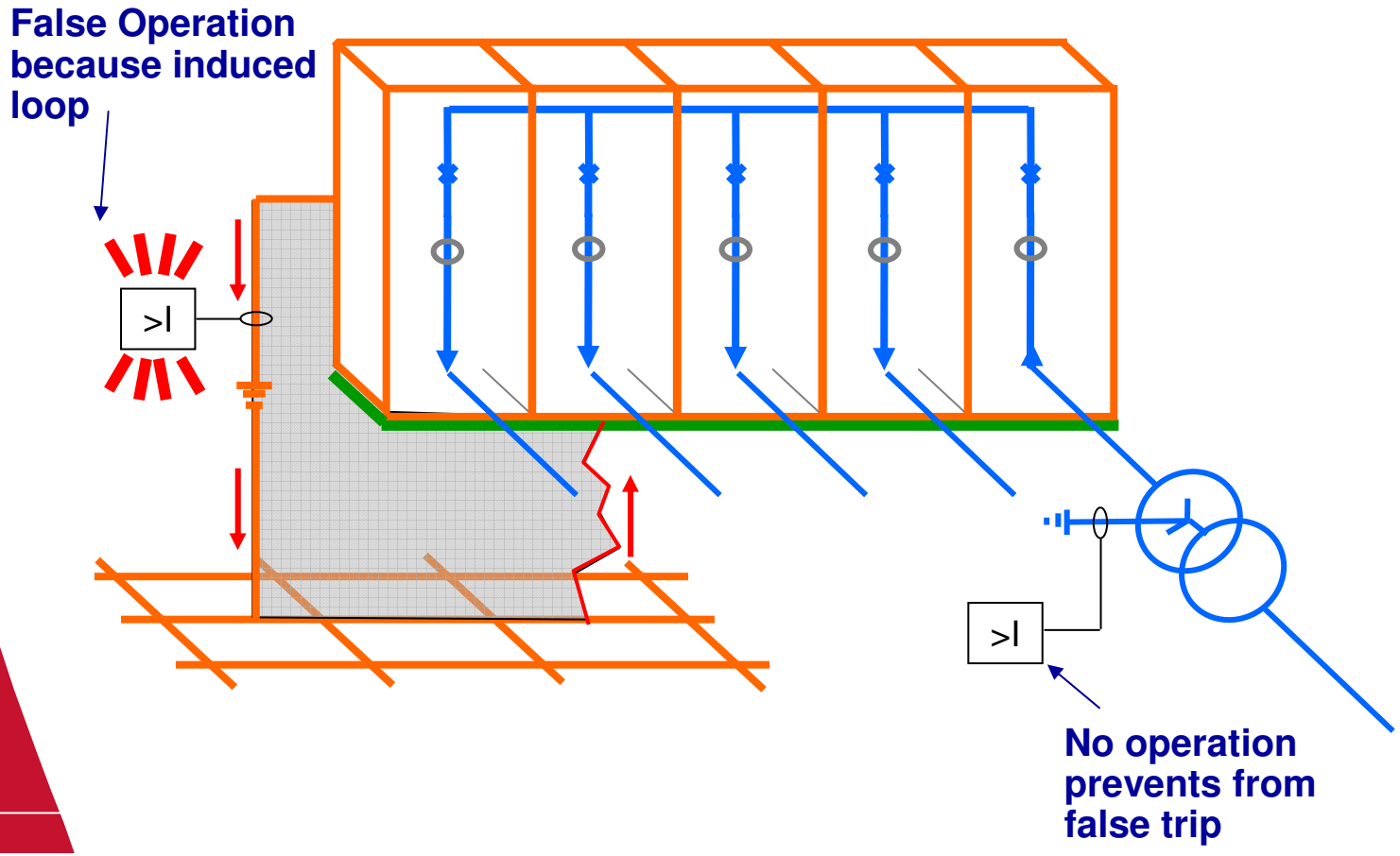


Frame Leakage Busbar Protection

- Can detect only earth faults
- Switchgear must be insulated from earth (by standing on concrete plinth)
- Only one single earth conductor allowed on switchgear
- All cable glands must be insulated
- Switchgear sections must be insulated

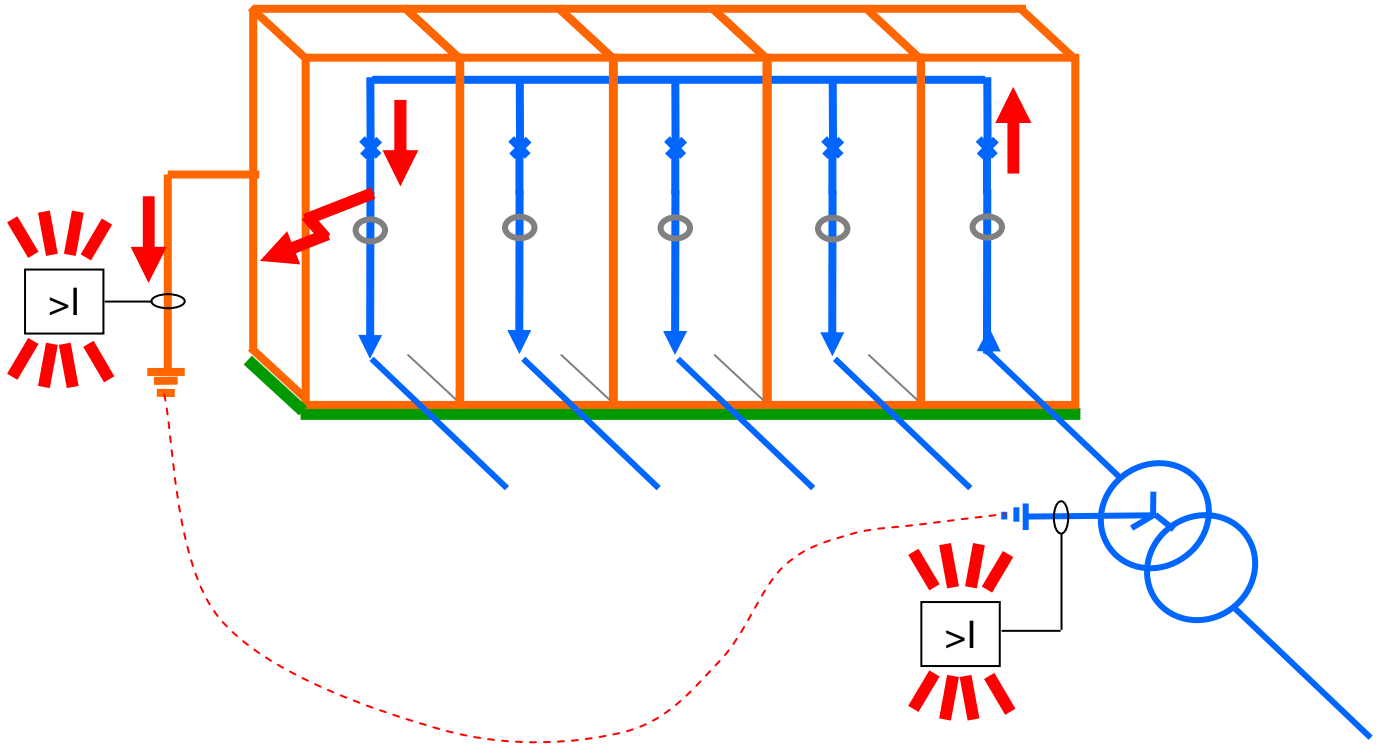
Frame Leakage Busbar Protection

Neutral Check



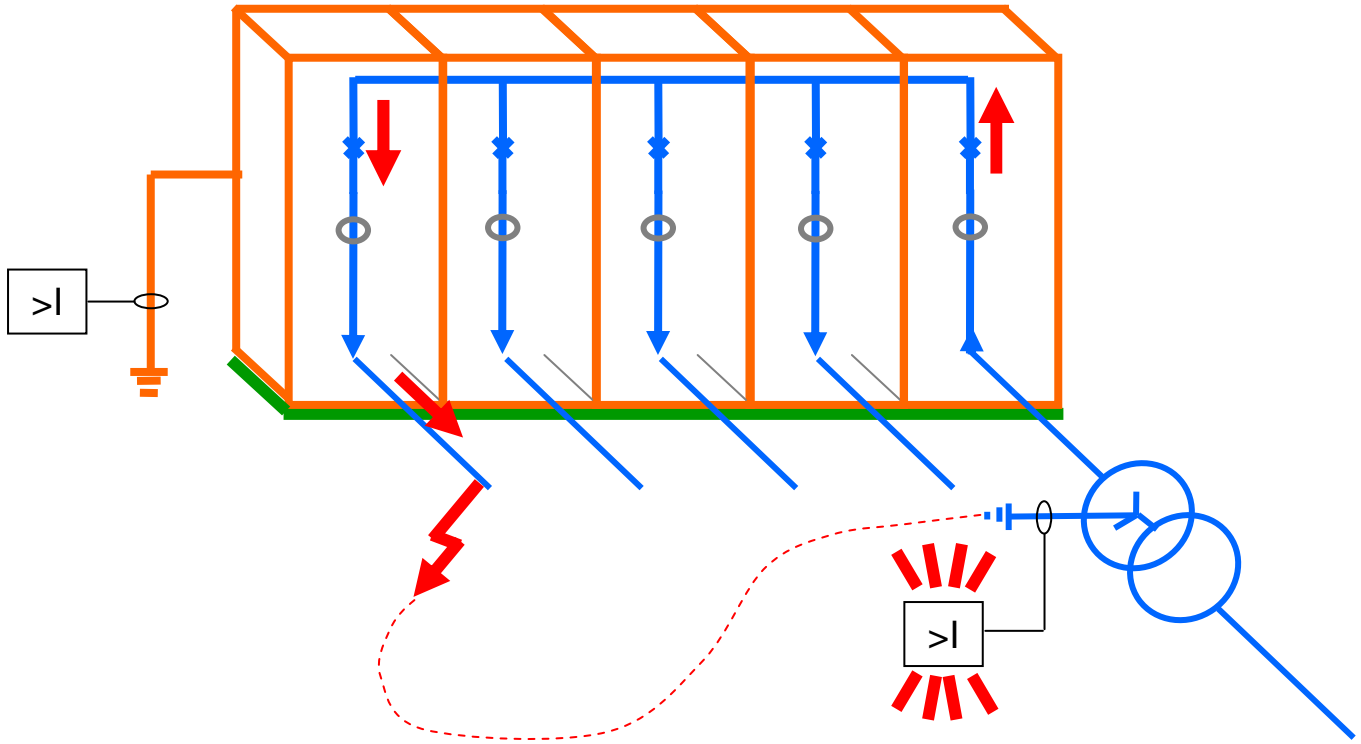
Frame Leakage Busbar Protection

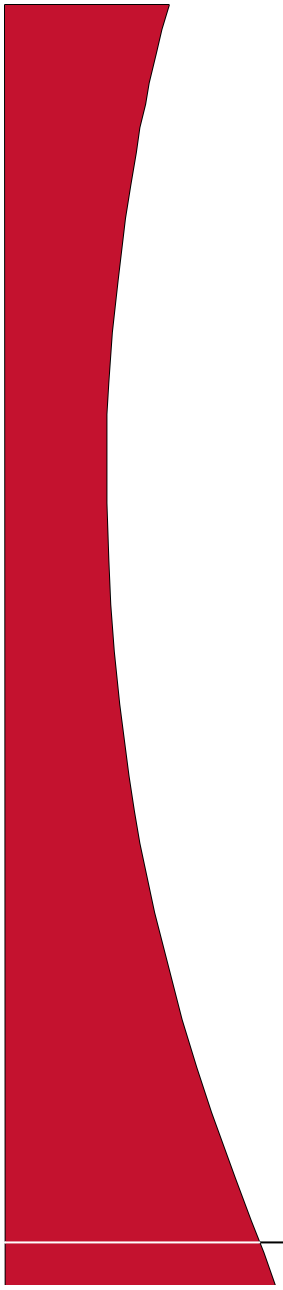
Neutral Check



Frame Leakage Busbar Protection

Neutral Check





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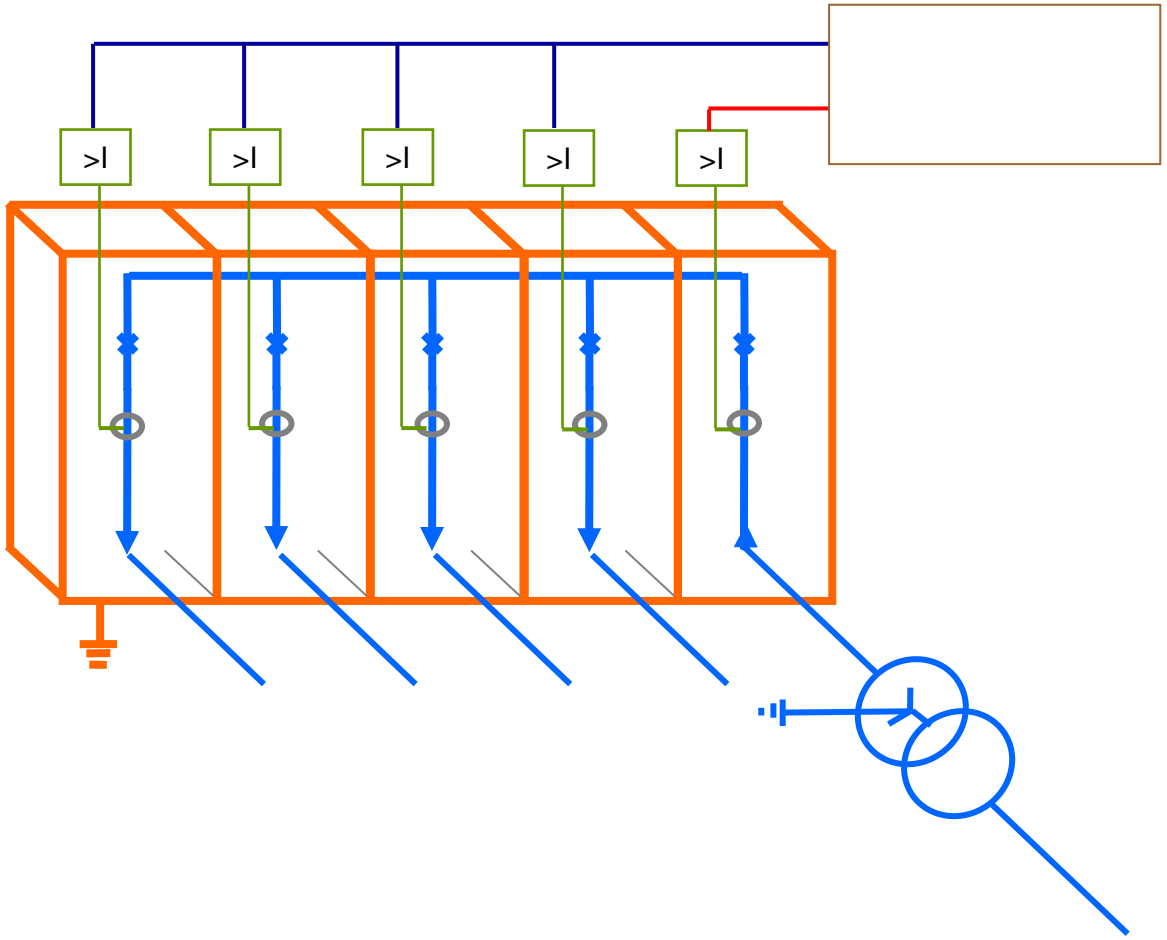
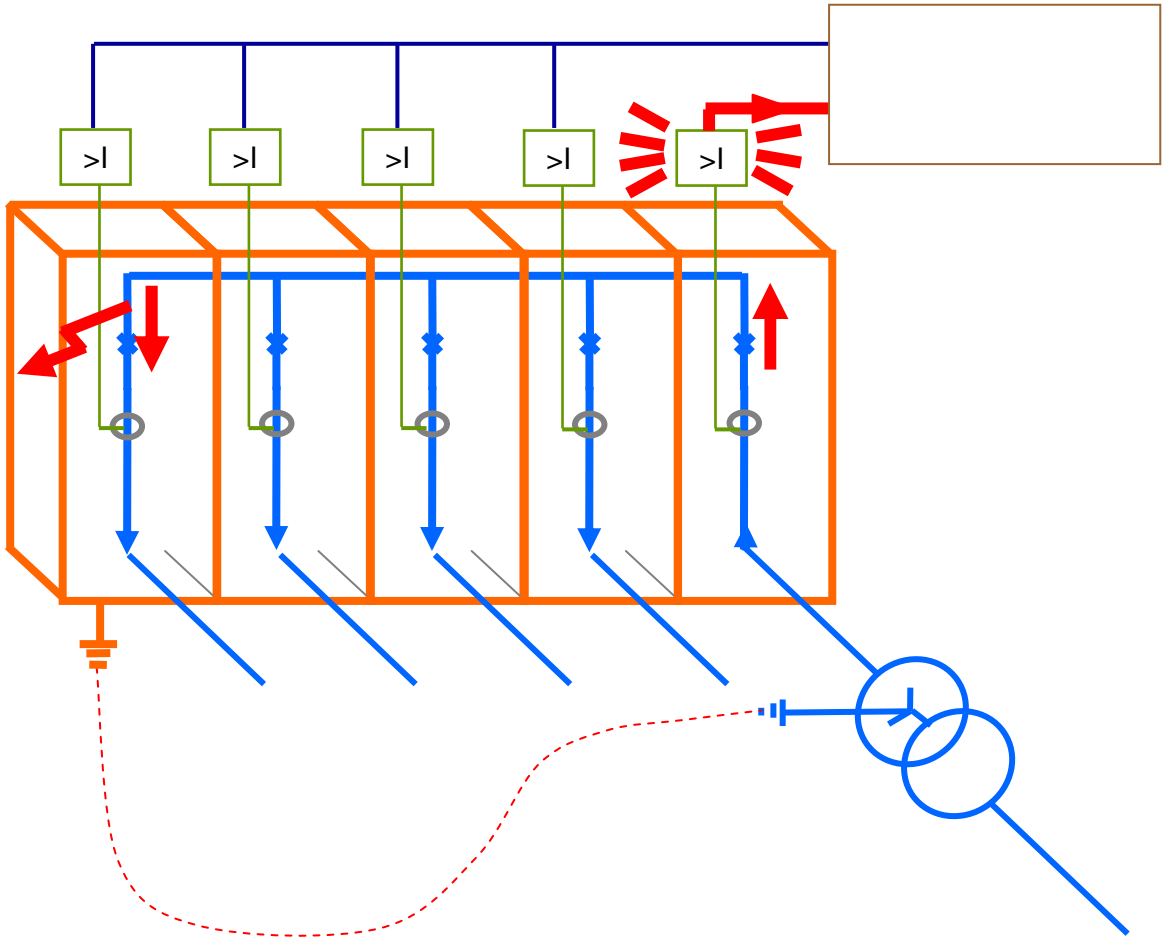
Blocking Scheme Protection

Protection & Contrôle / Application

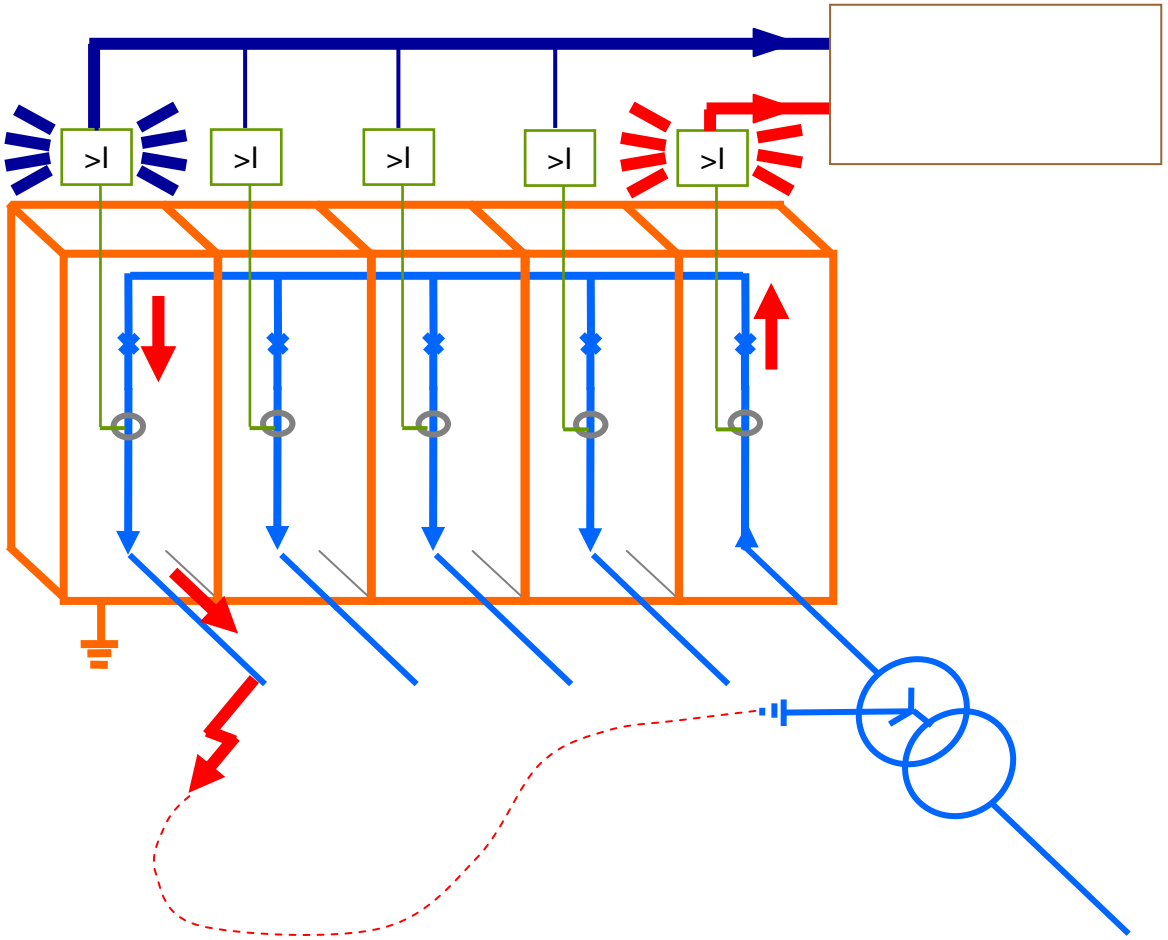
Blocking Scheme Busbar Protection

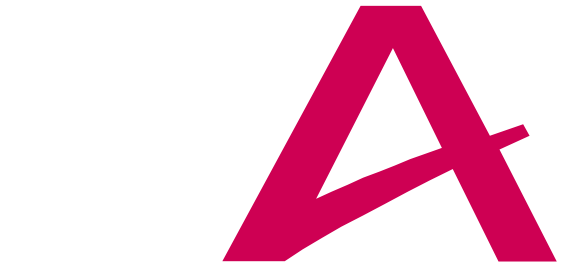


Blocking Scheme Busbar Protection



Blocking Scheme Busbar Protection





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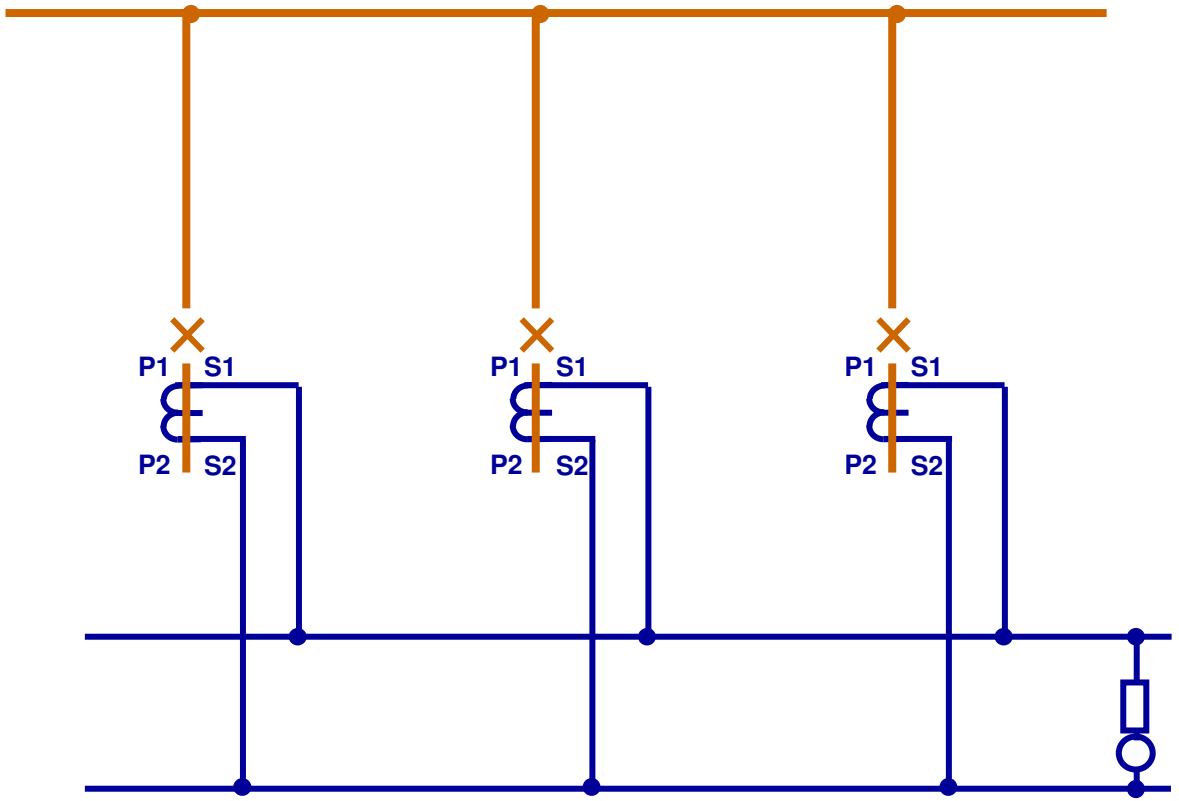
High Impedance Protection

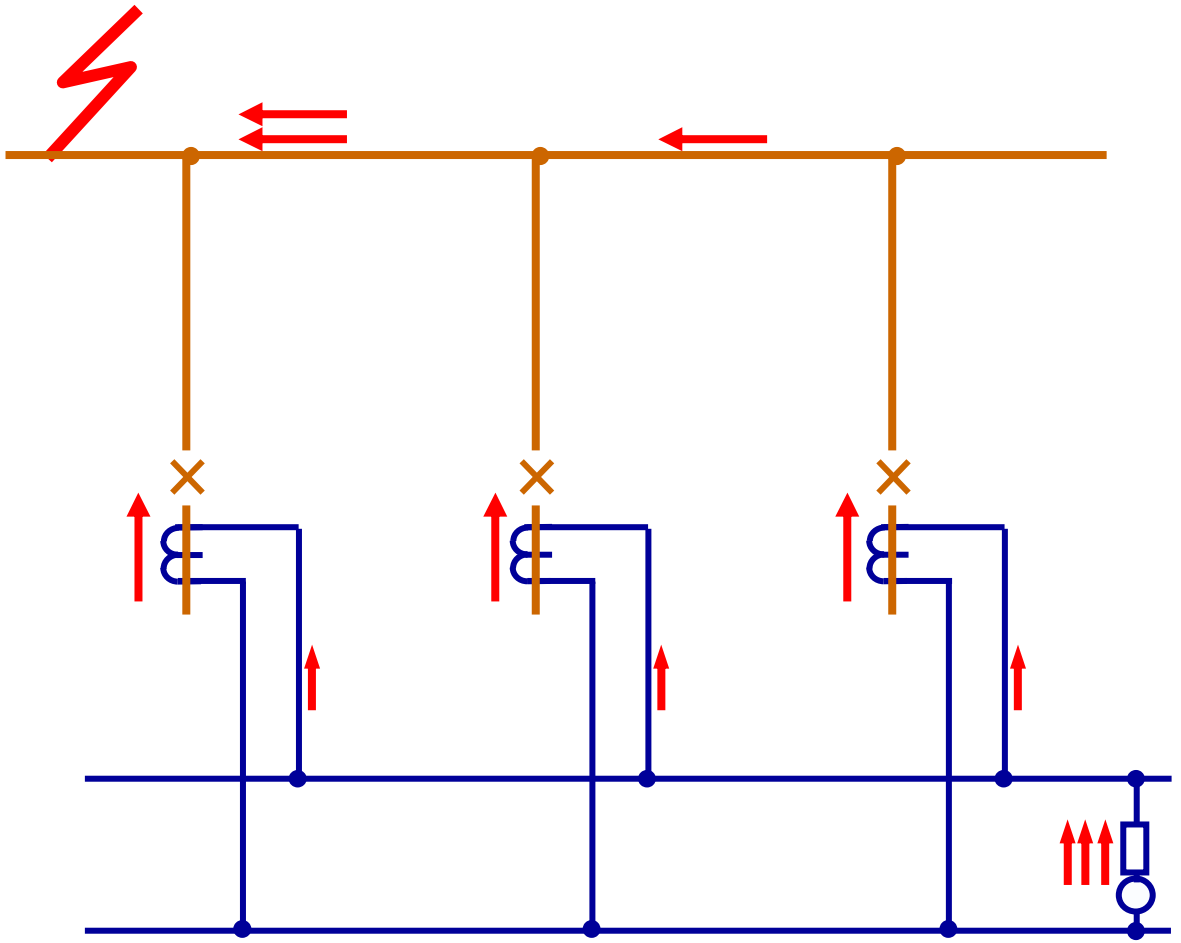
Protection & Contrôle / Application

Single Bus Substation

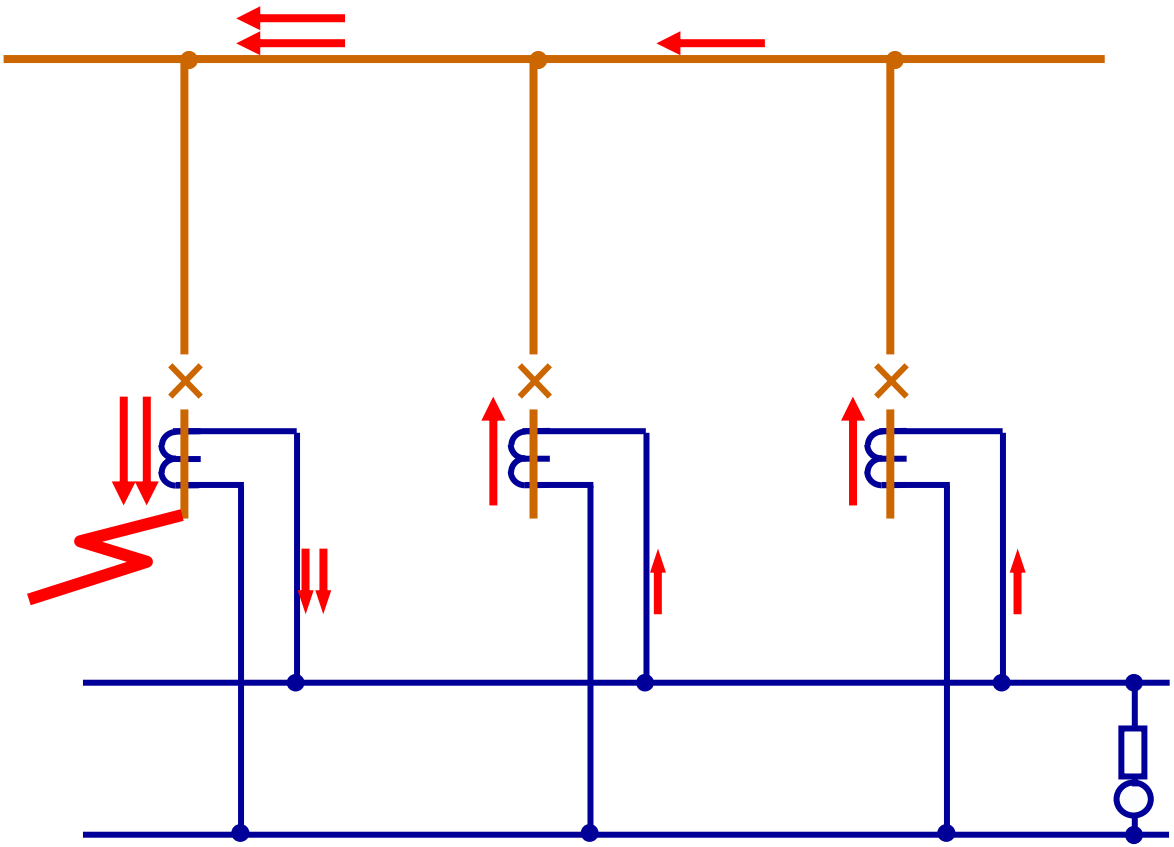
Single Bus Substation



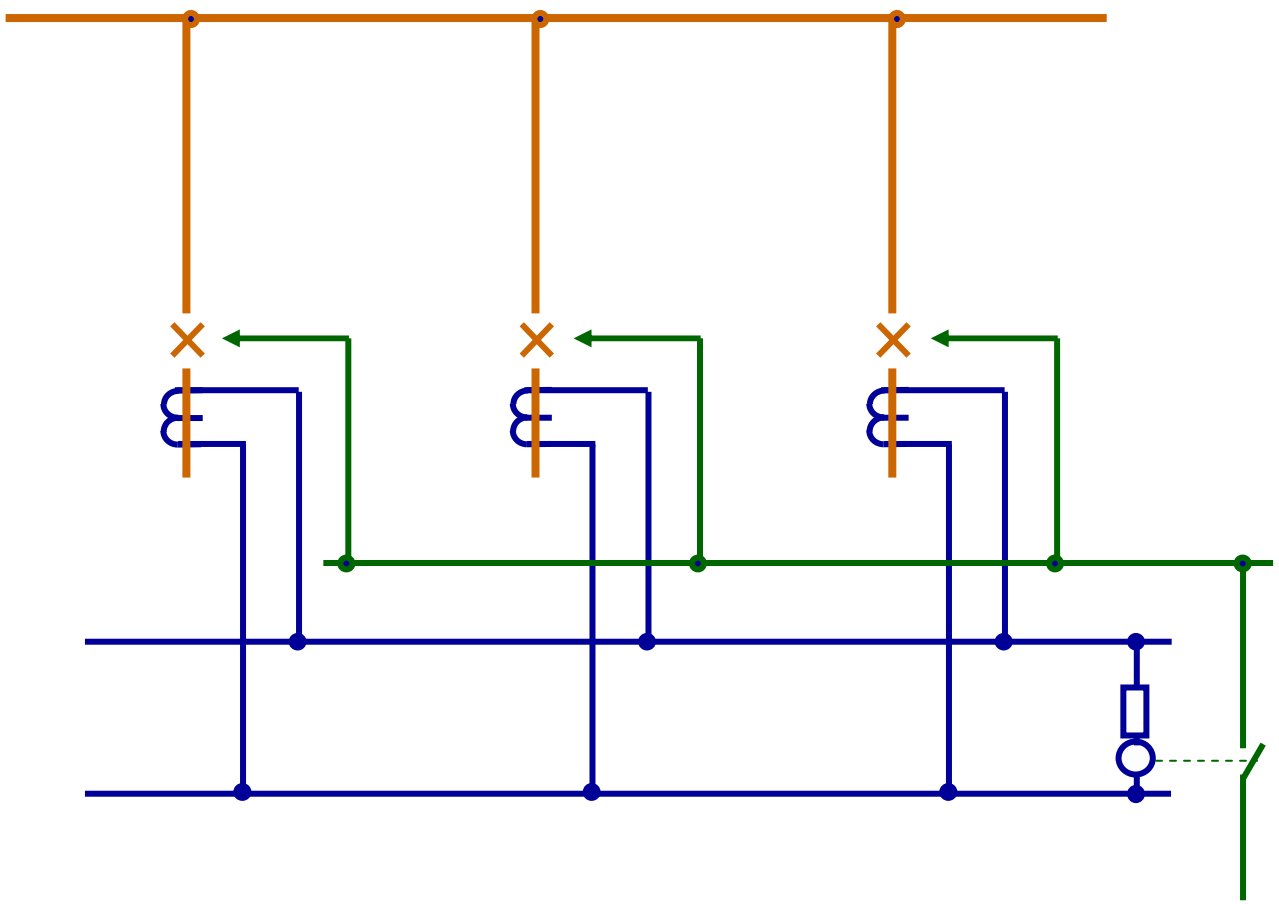
Single Bus Substation



Single Bus Substation

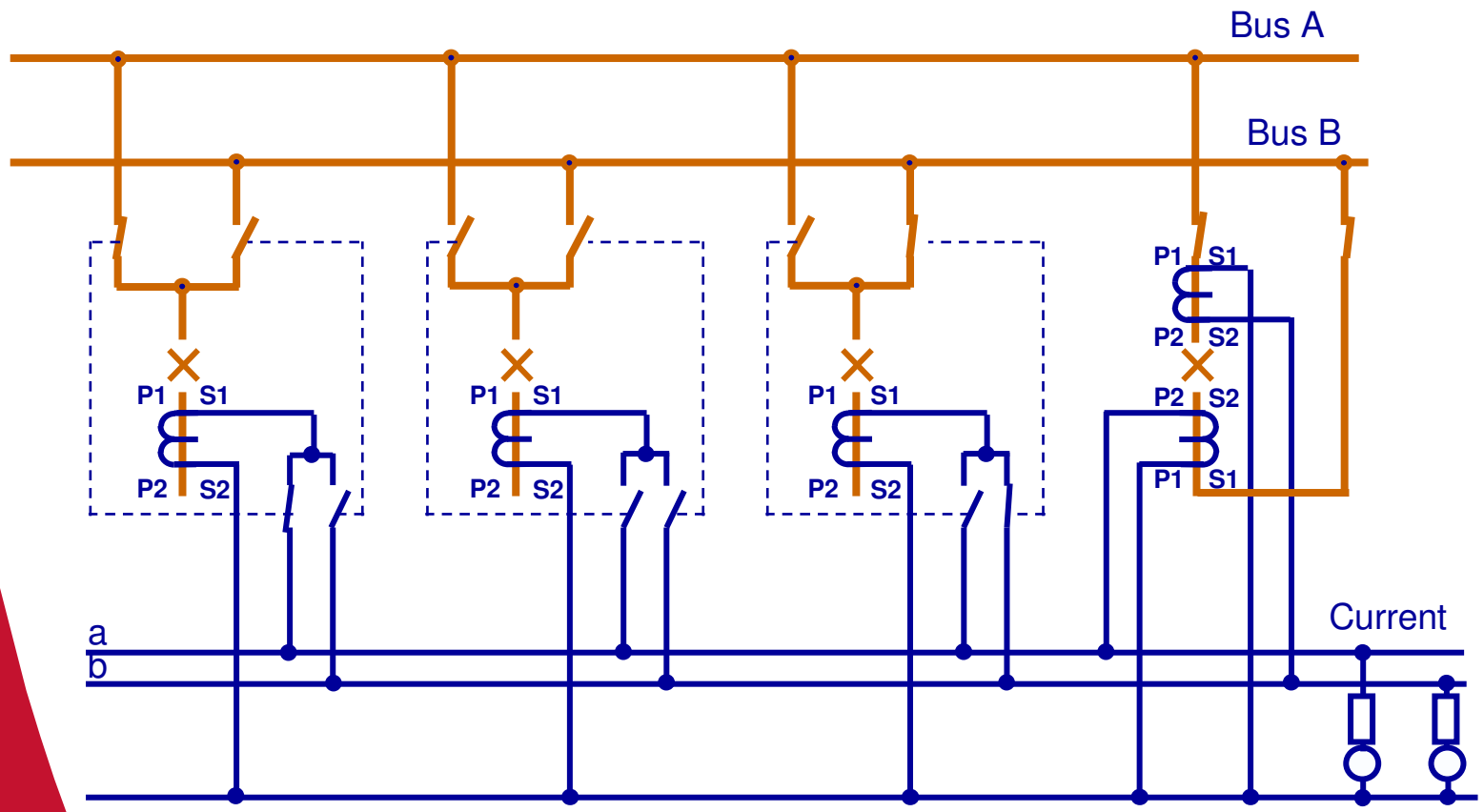


Single Bus Substation

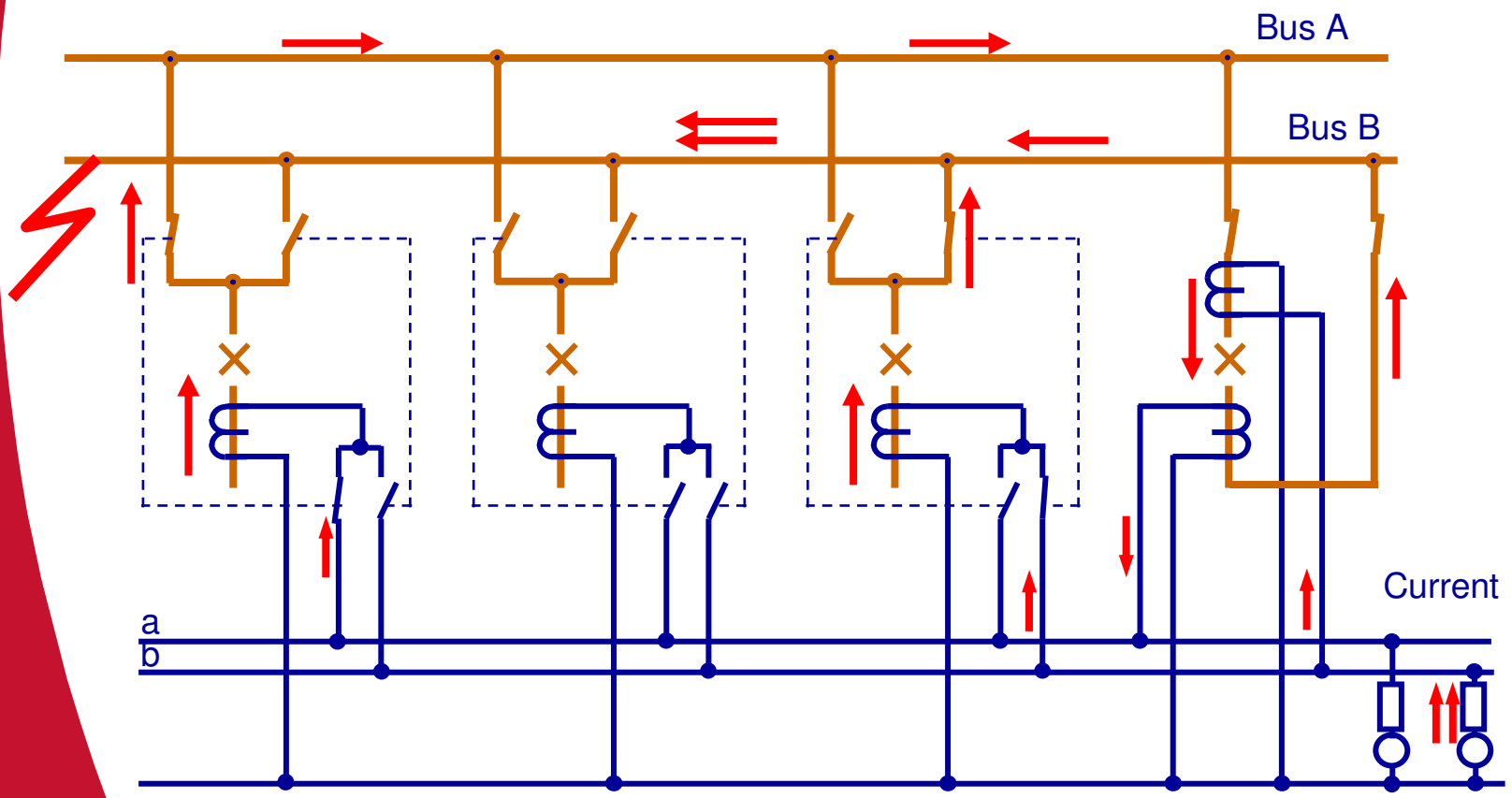


Double Bus Substation

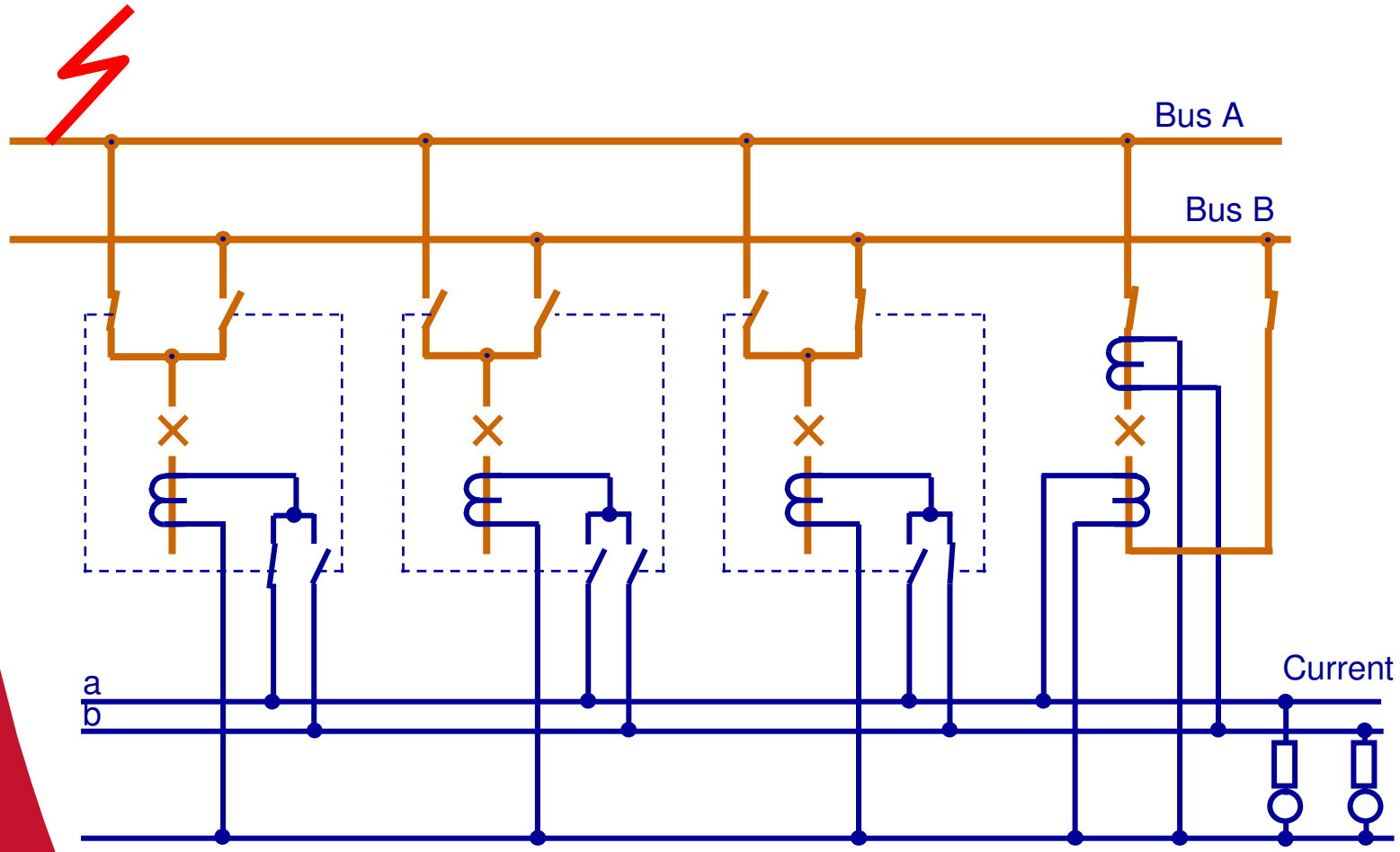
Isolator Auxiliary Switches
Current switching



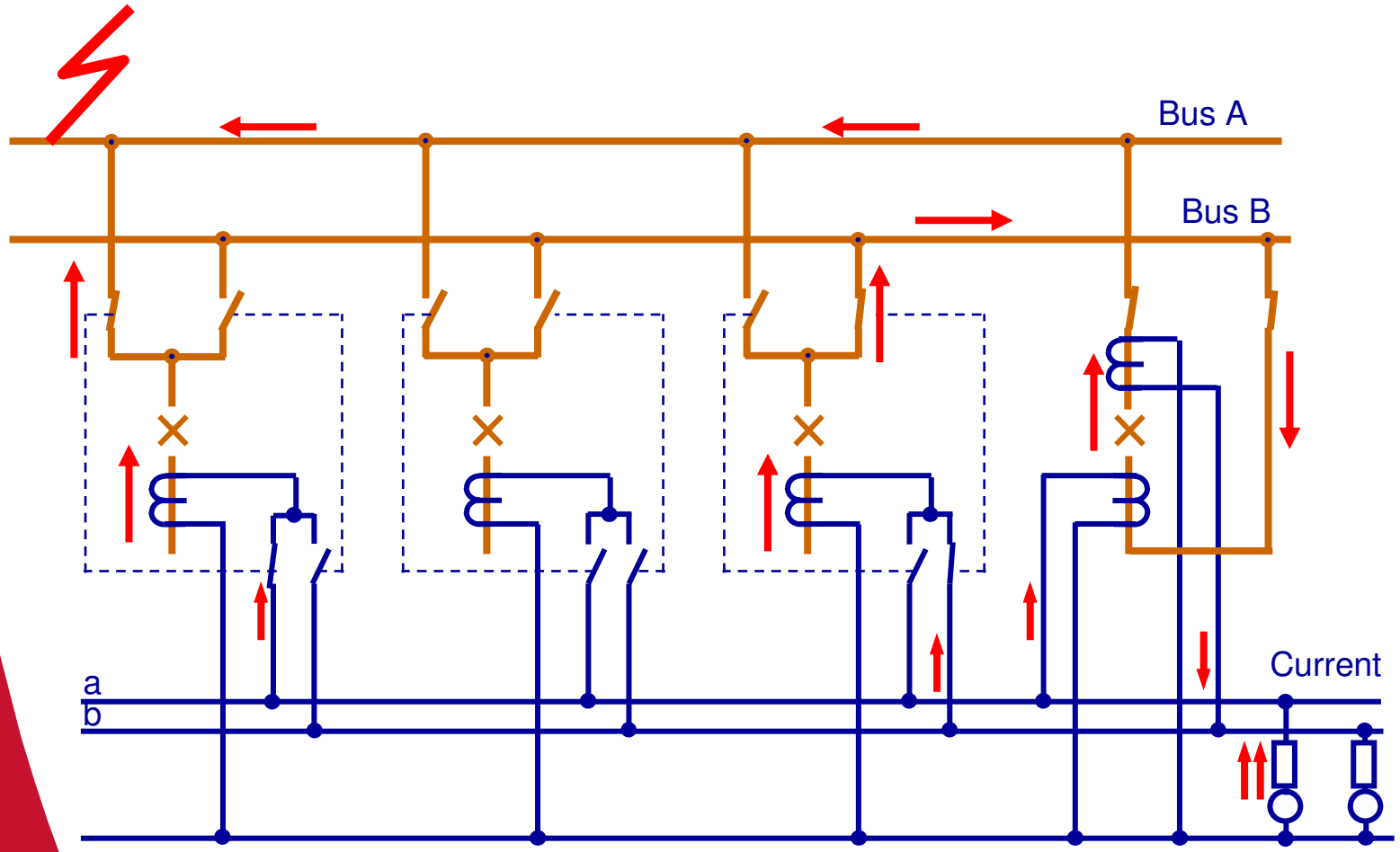
Isolator Auxiliary Switches
Current switching



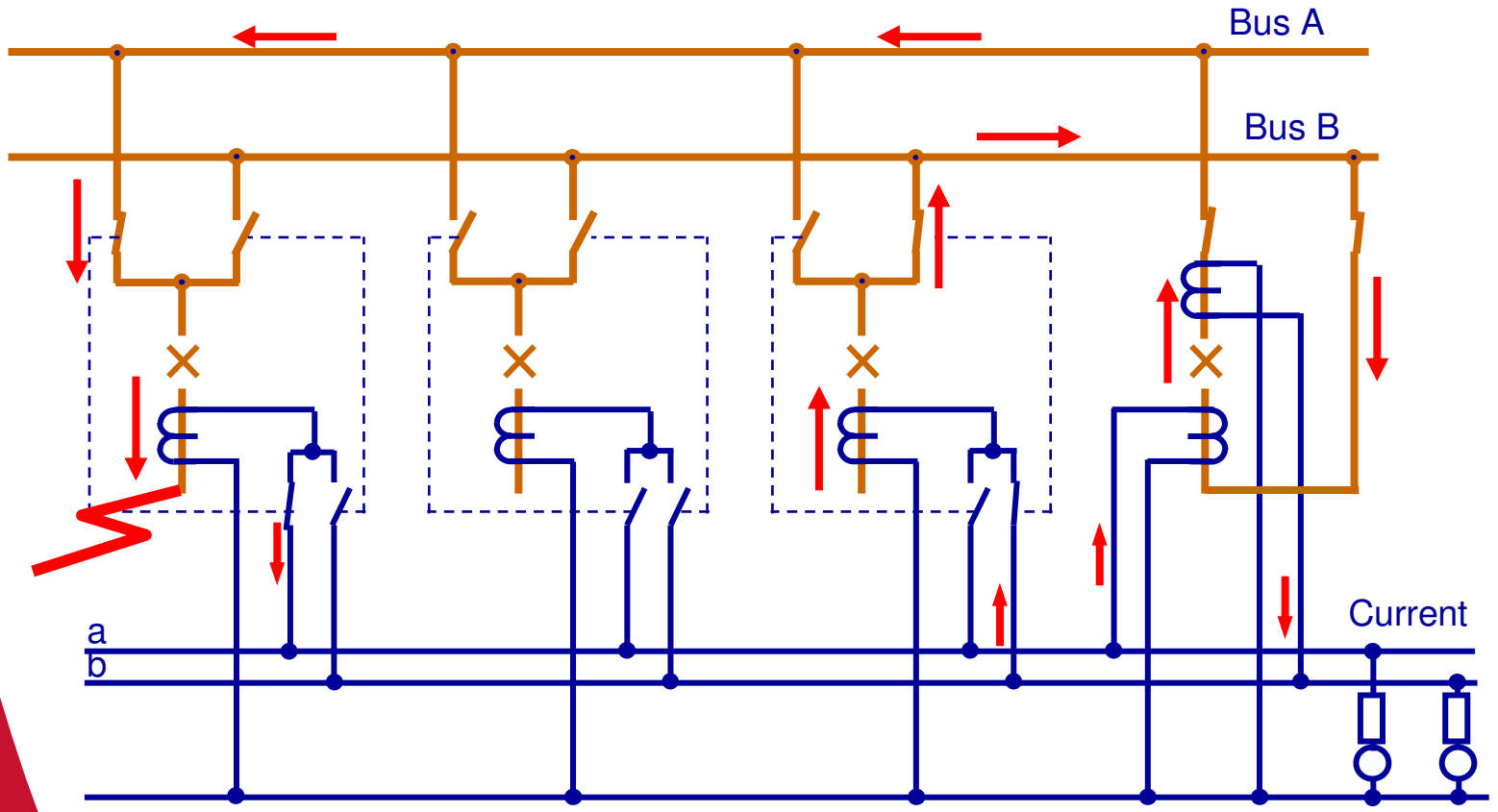
Isolator Auxiliary Switches
Current switching



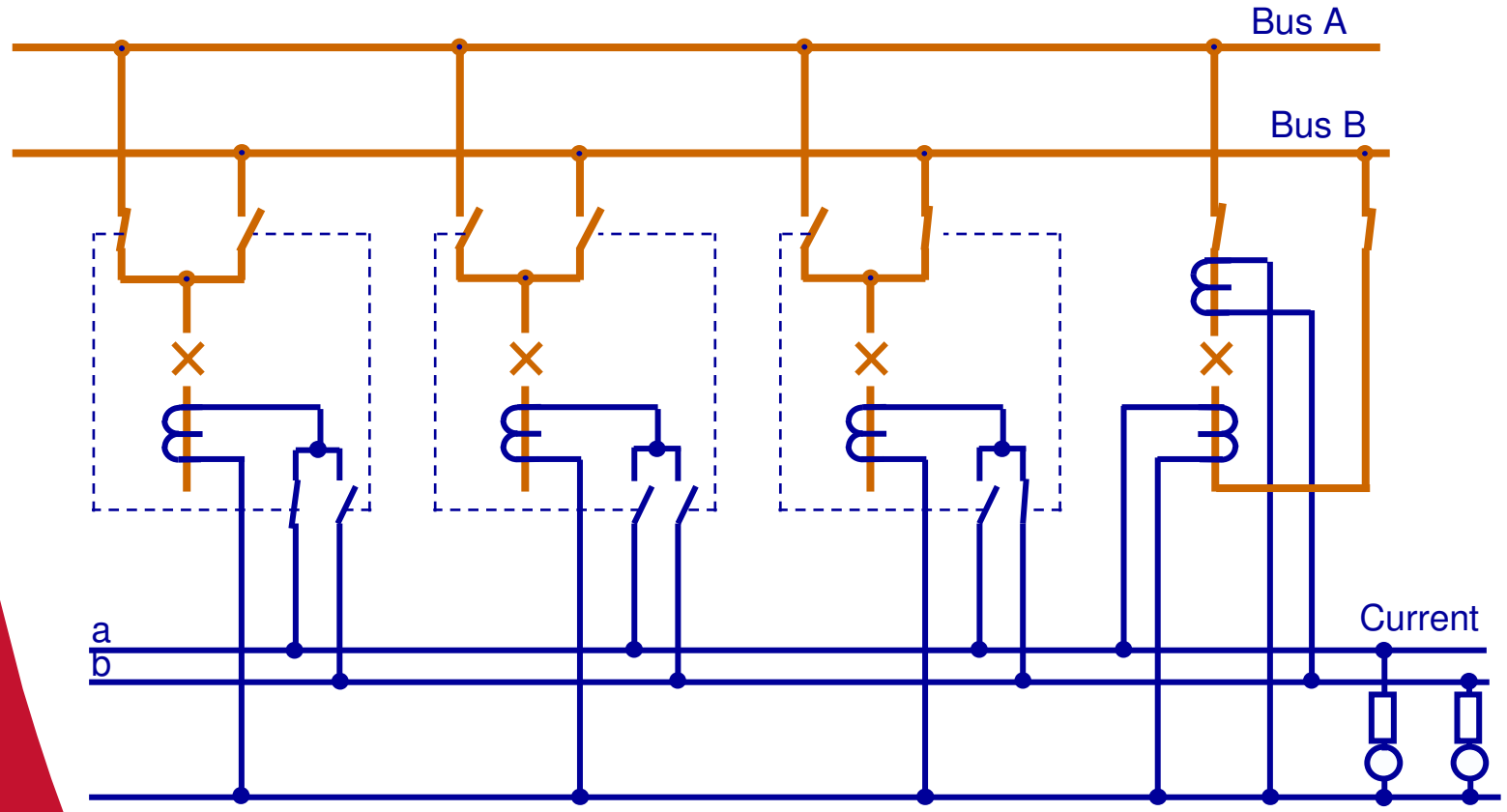
Isolator Auxiliary Switches
Current switching



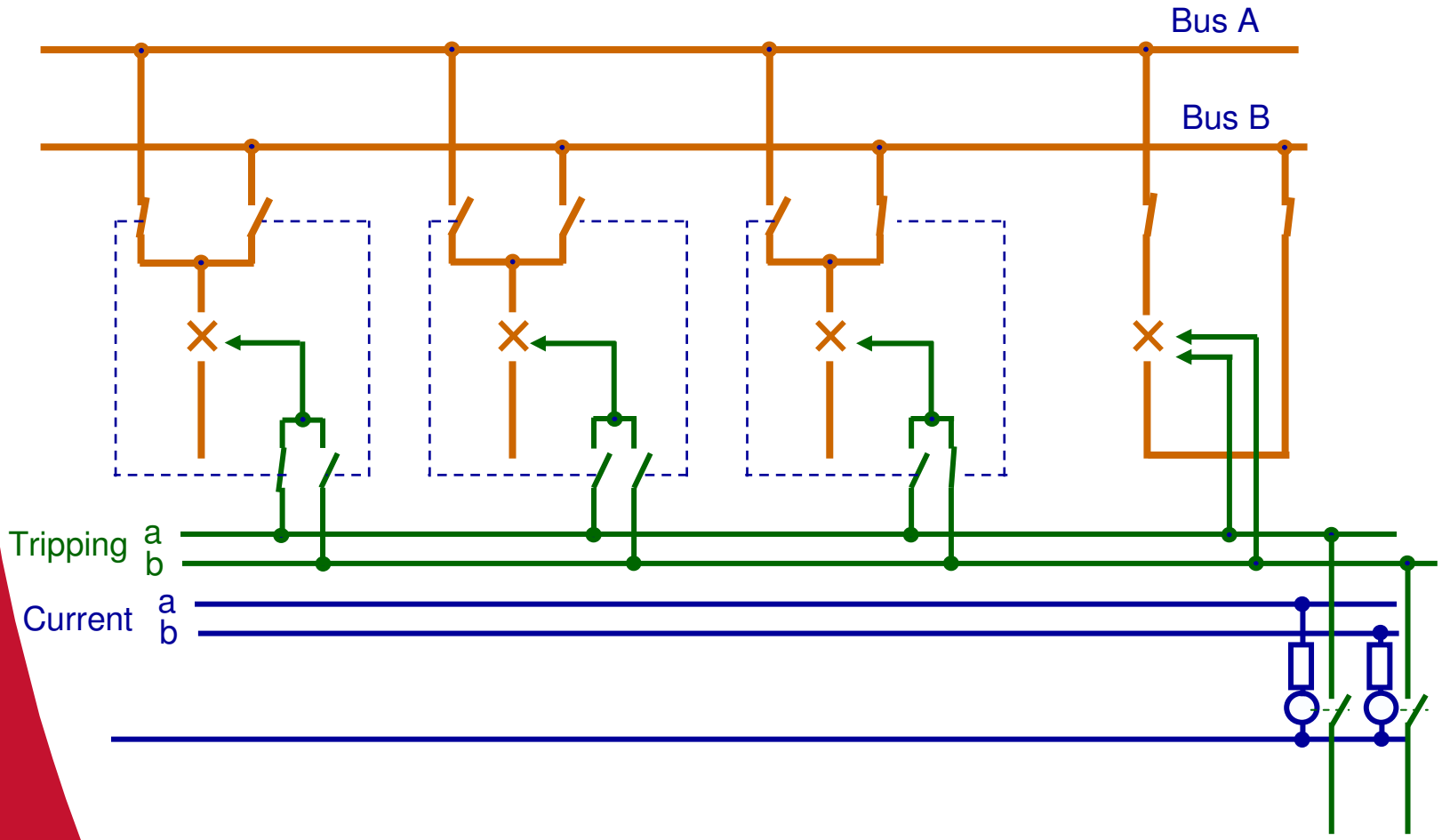
Isolator Auxiliary Switches
Current switching



Isolator Auxiliary Switches
Current switching



Isolator Auxiliary Switches
Tripping switching



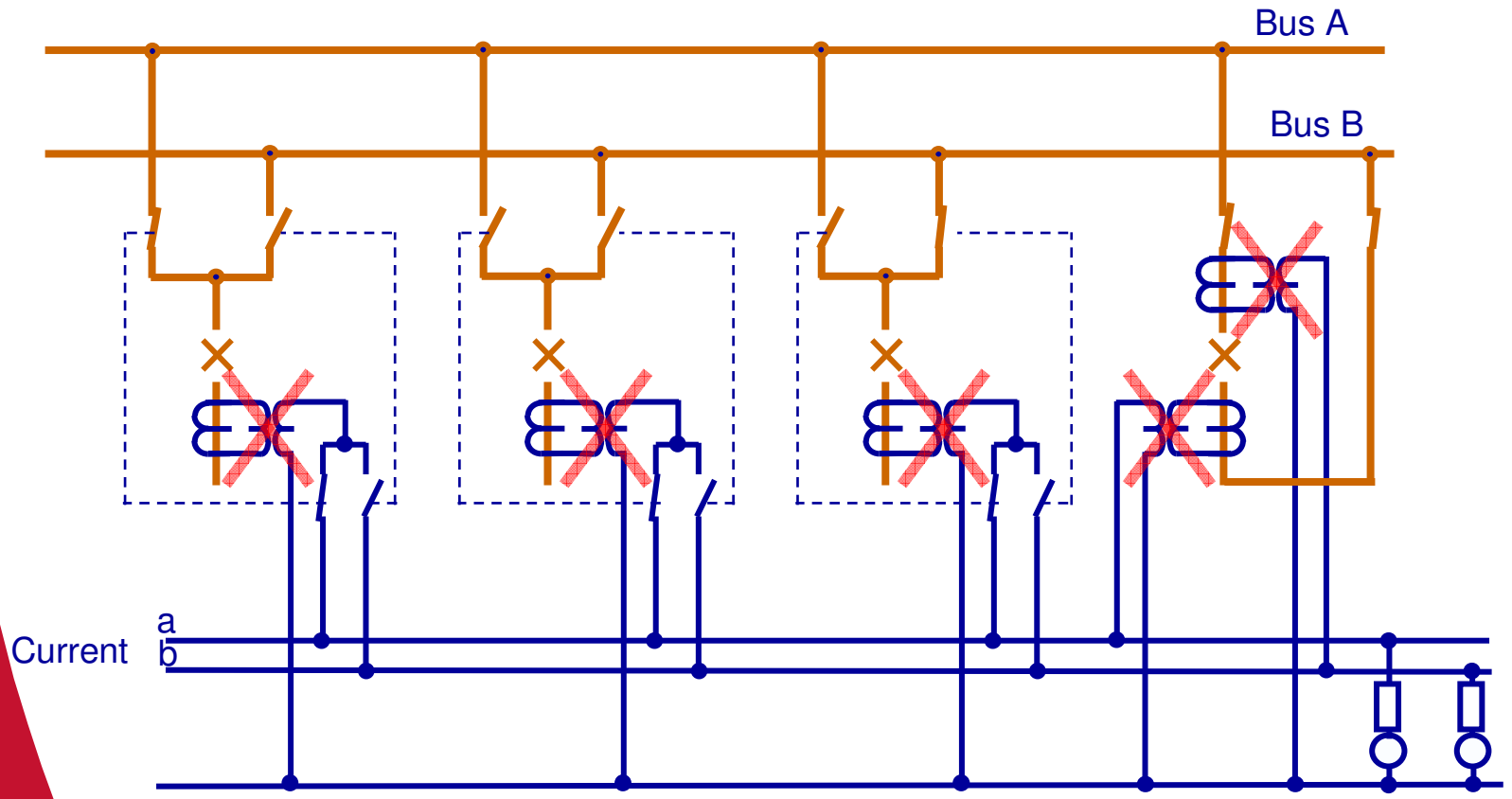
Interposing CT are not acceptable

- Main CT must be identical
- Current switching via auxilliary relay is not acceptable.

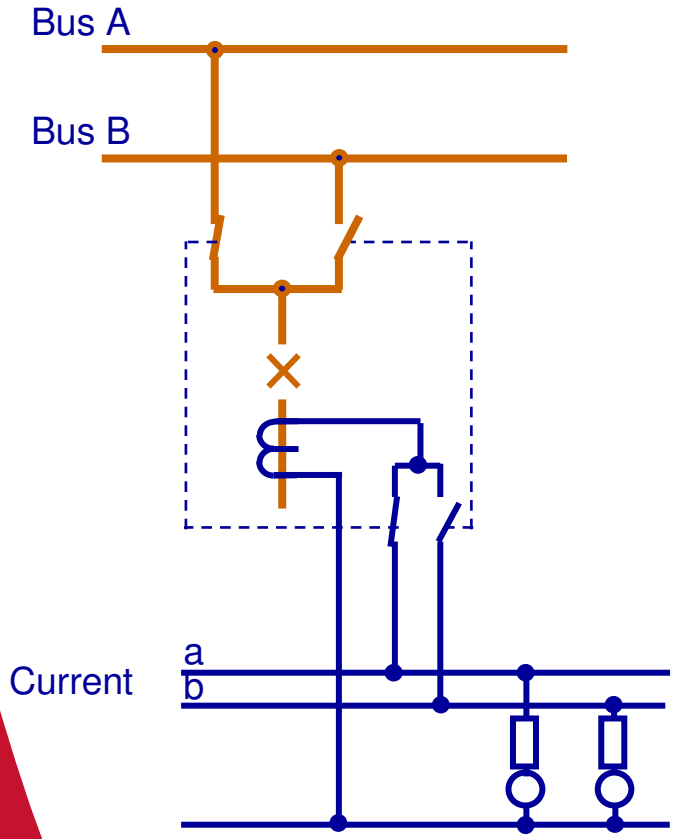
⇩

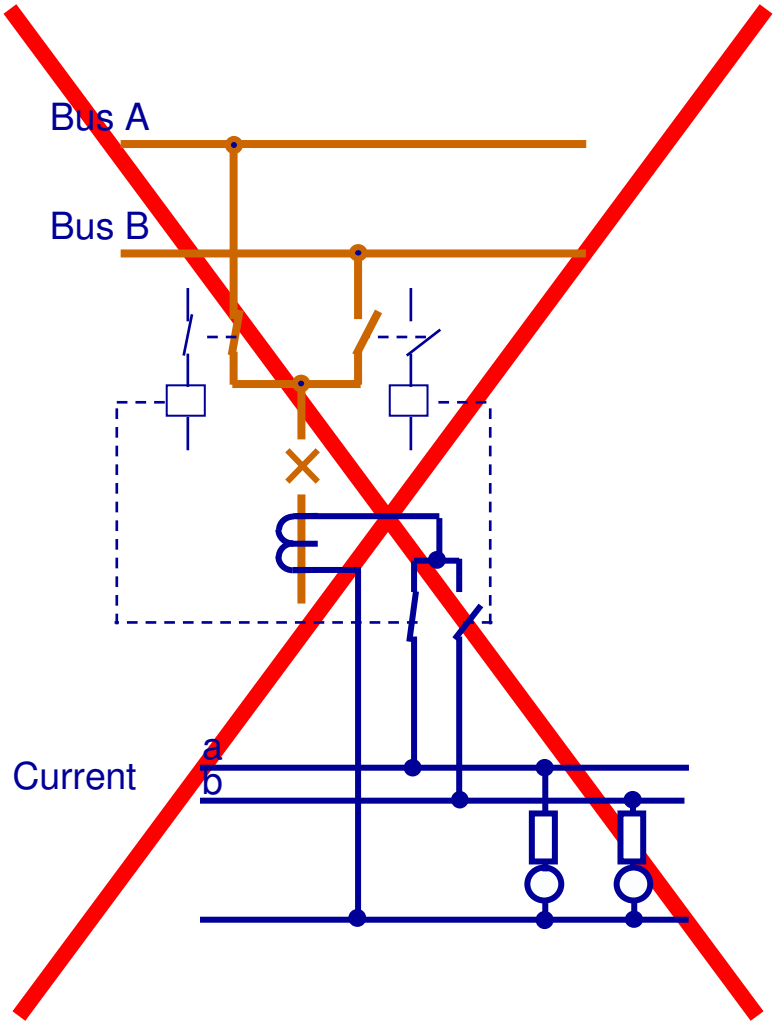
Requirement of number of position contact (Disconnector switch) is high

Isolator Auxiliary Switches
Current switching

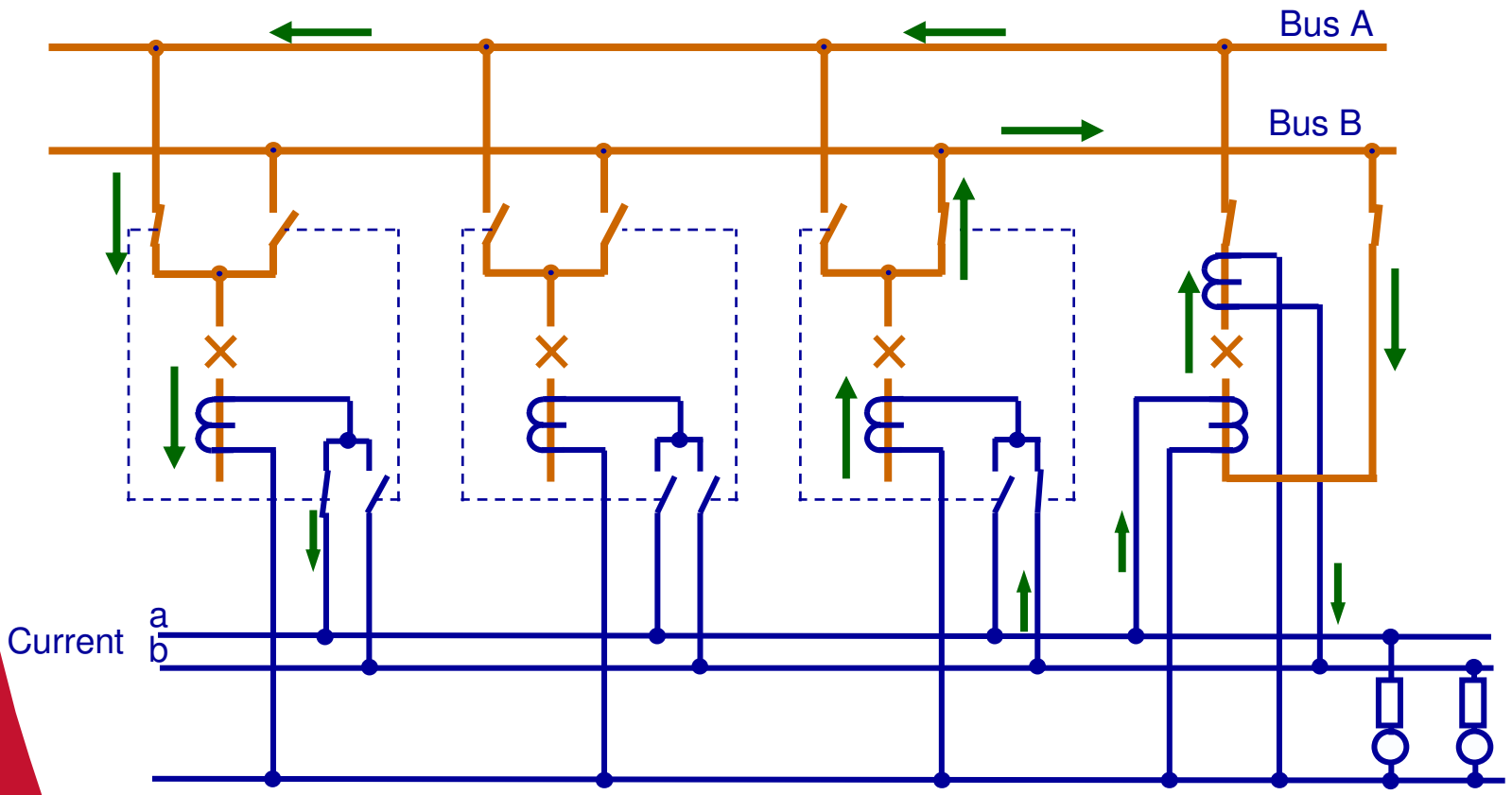


Isolator Auxiliary Switches
Current switching

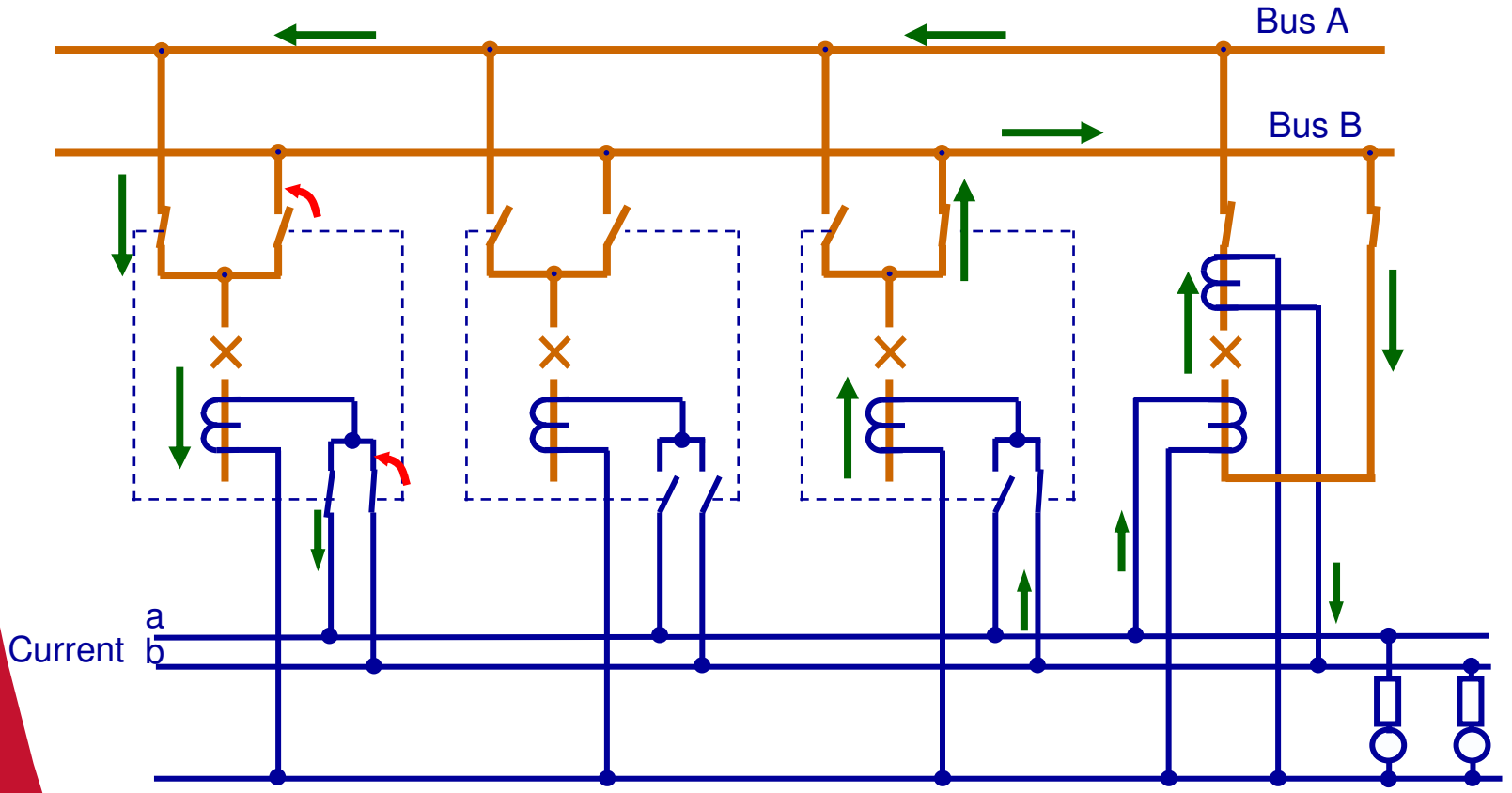




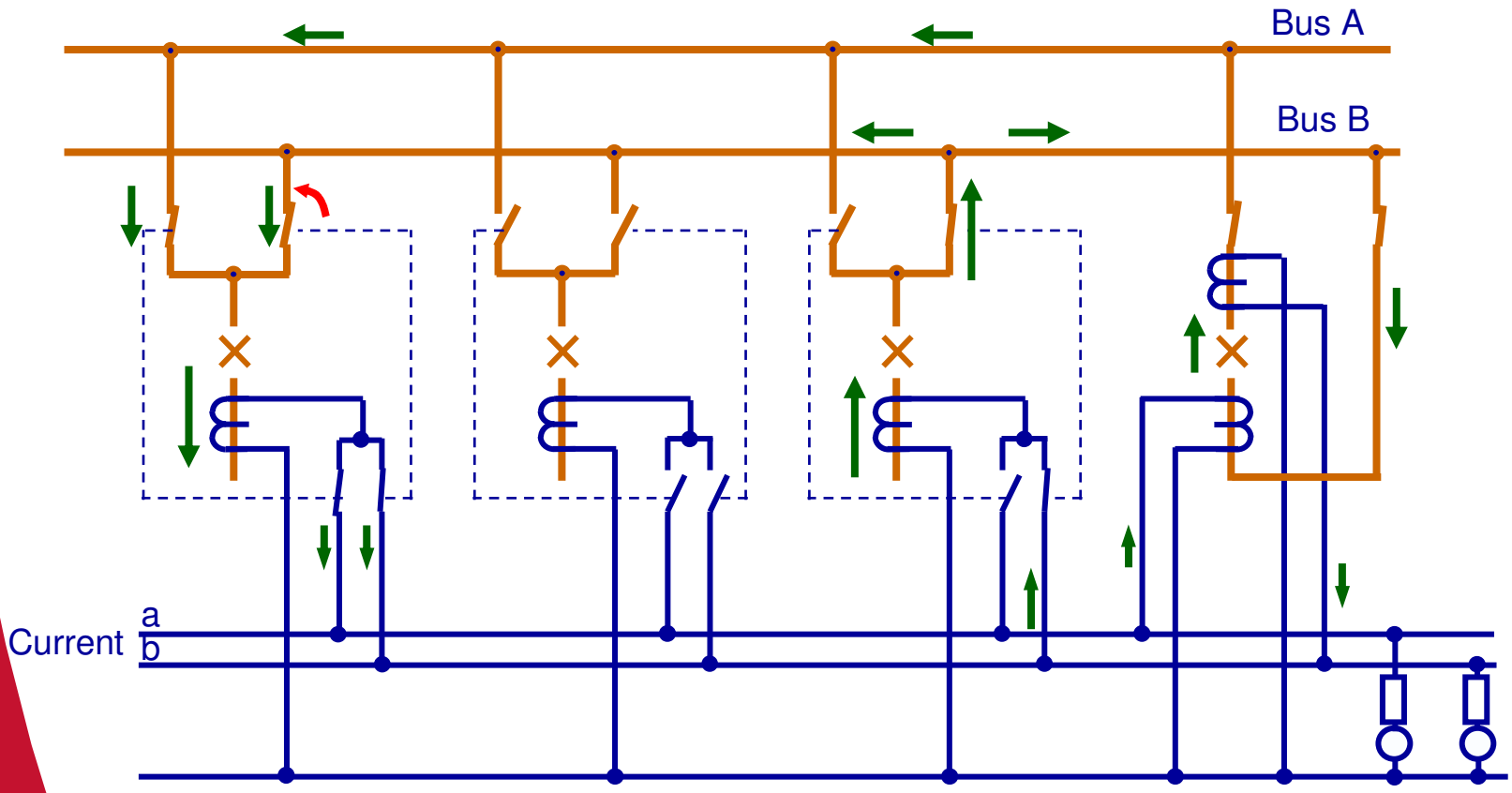
Isolator Auxiliary Switches
On Load Transfer



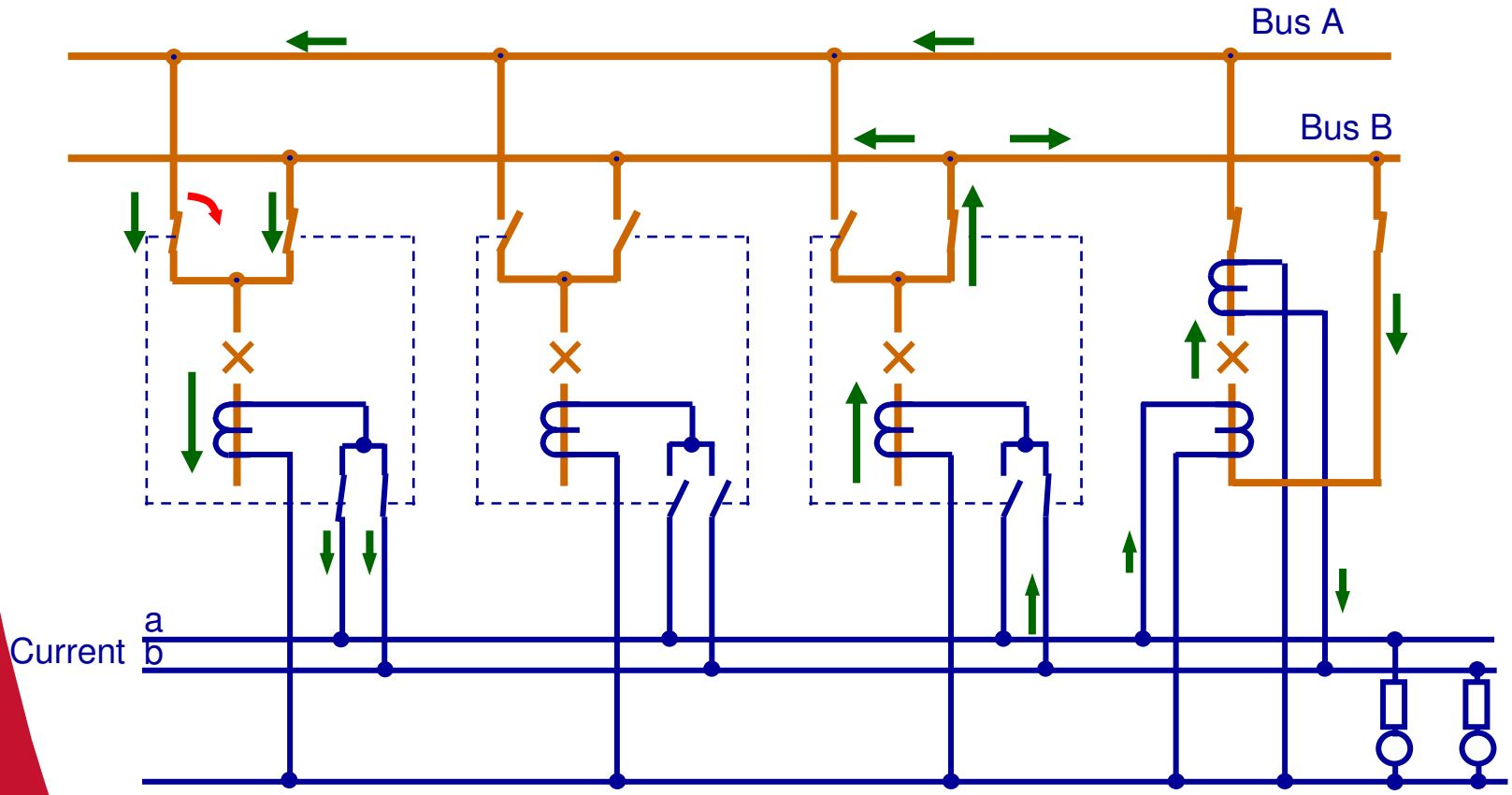
Isolator Auxiliary Switches
On Load Transfer



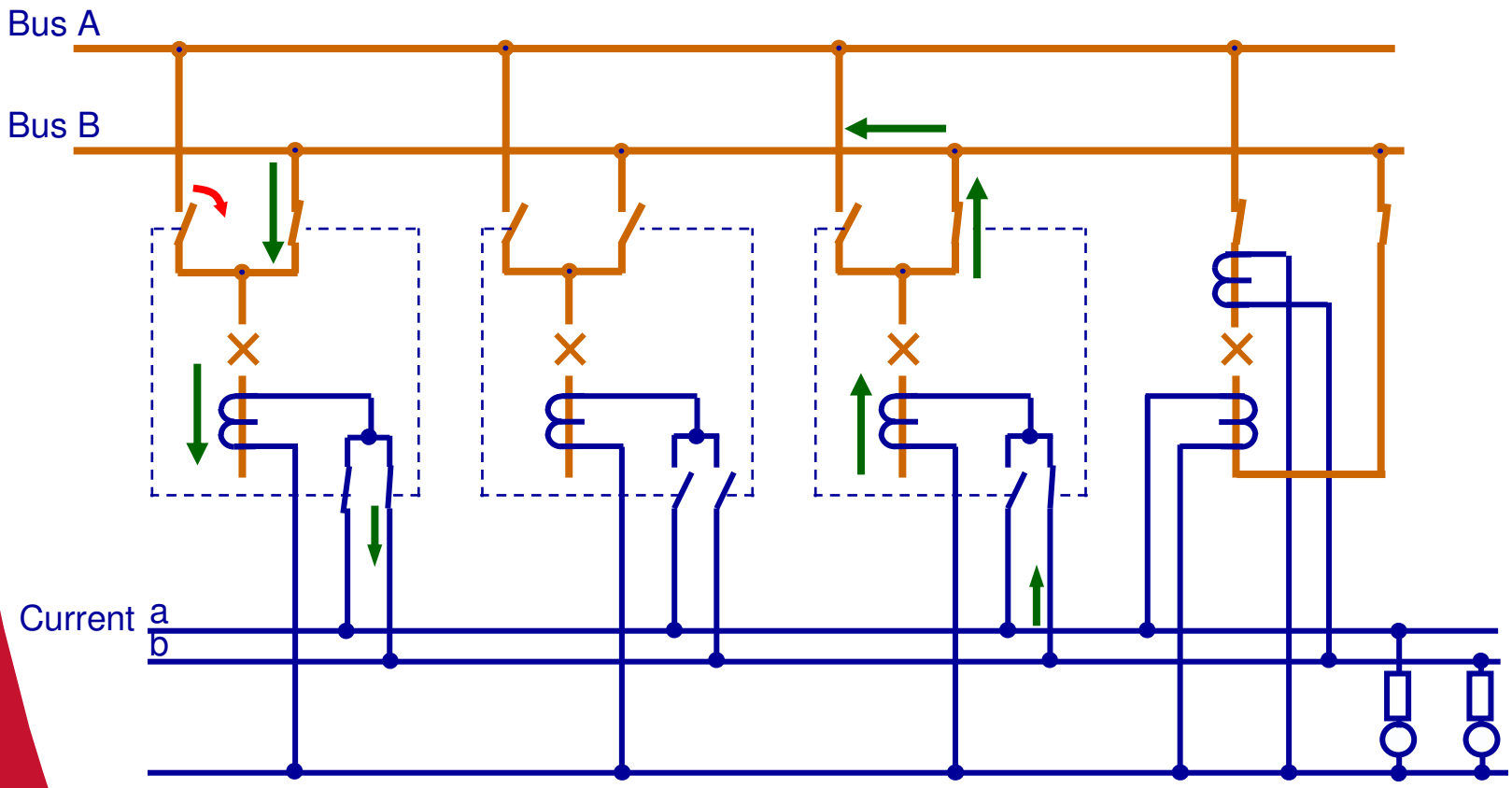
Isolator Auxiliary Switches
On Load Transfer



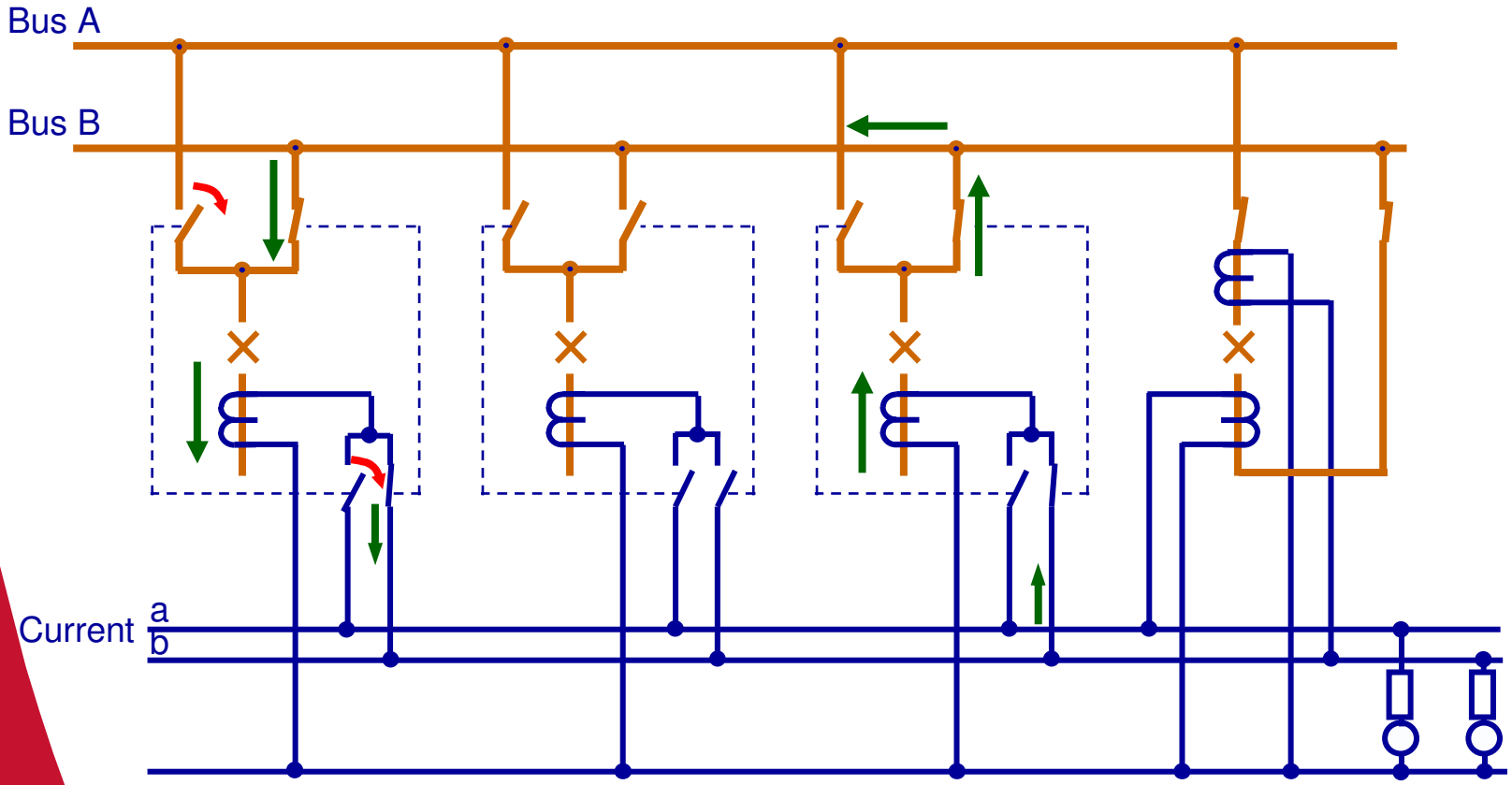
Isolator Auxiliary Switches
On Load Transfer



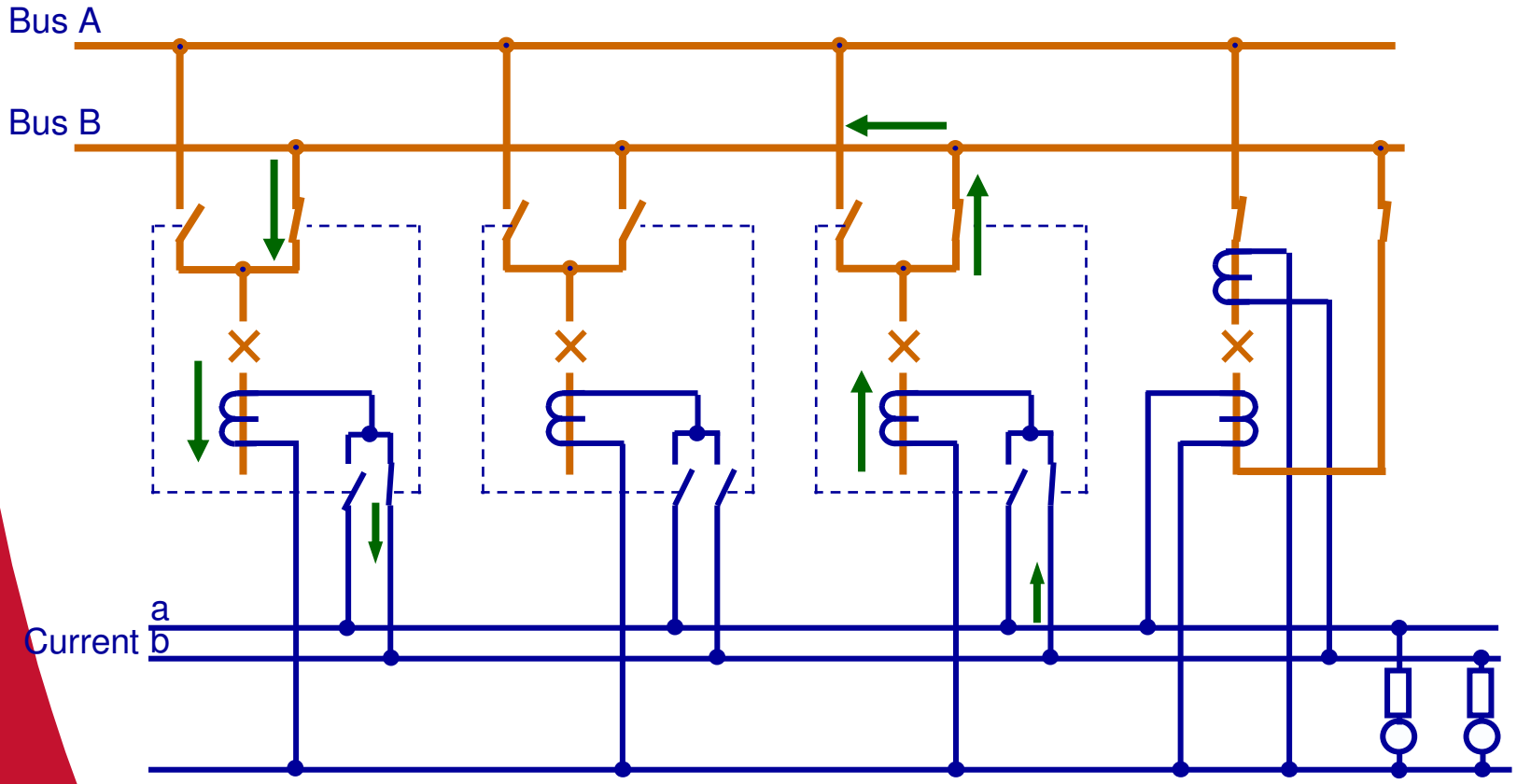
Isolator Auxiliary Switches
On Load Transfer



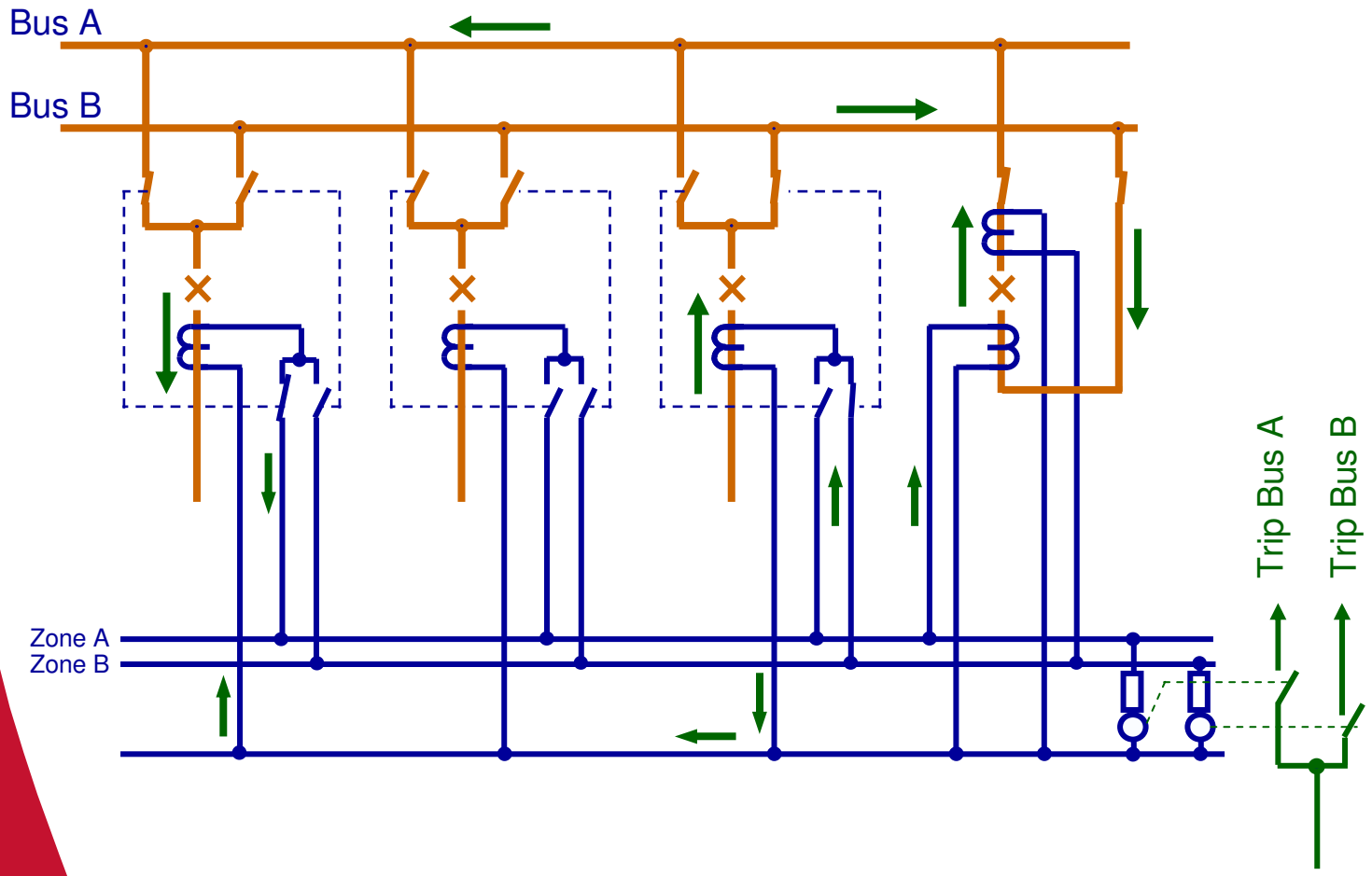
Isolator Auxiliary Switches
On Load Transfer



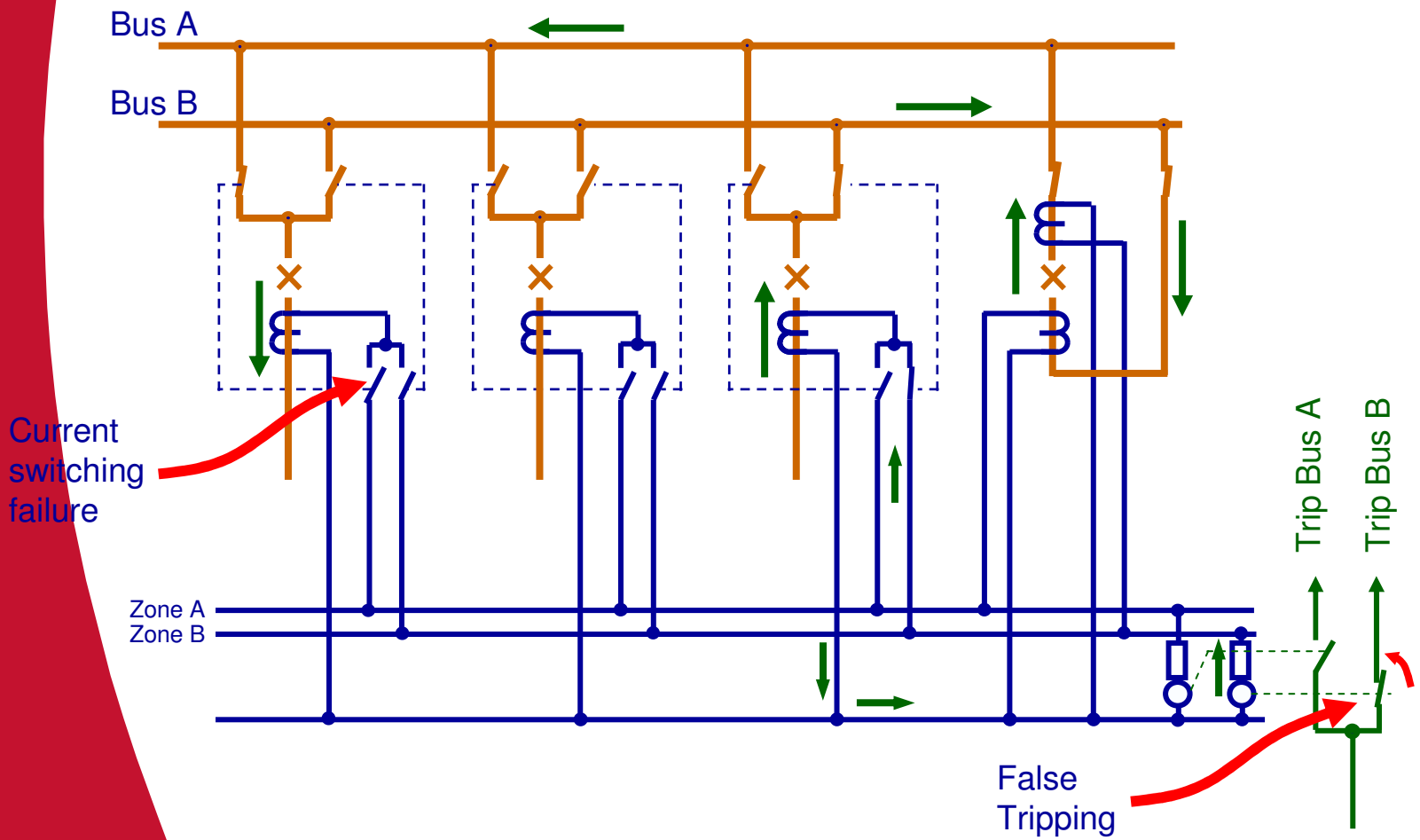
Isolator Auxiliary Switches
On Load Transfer



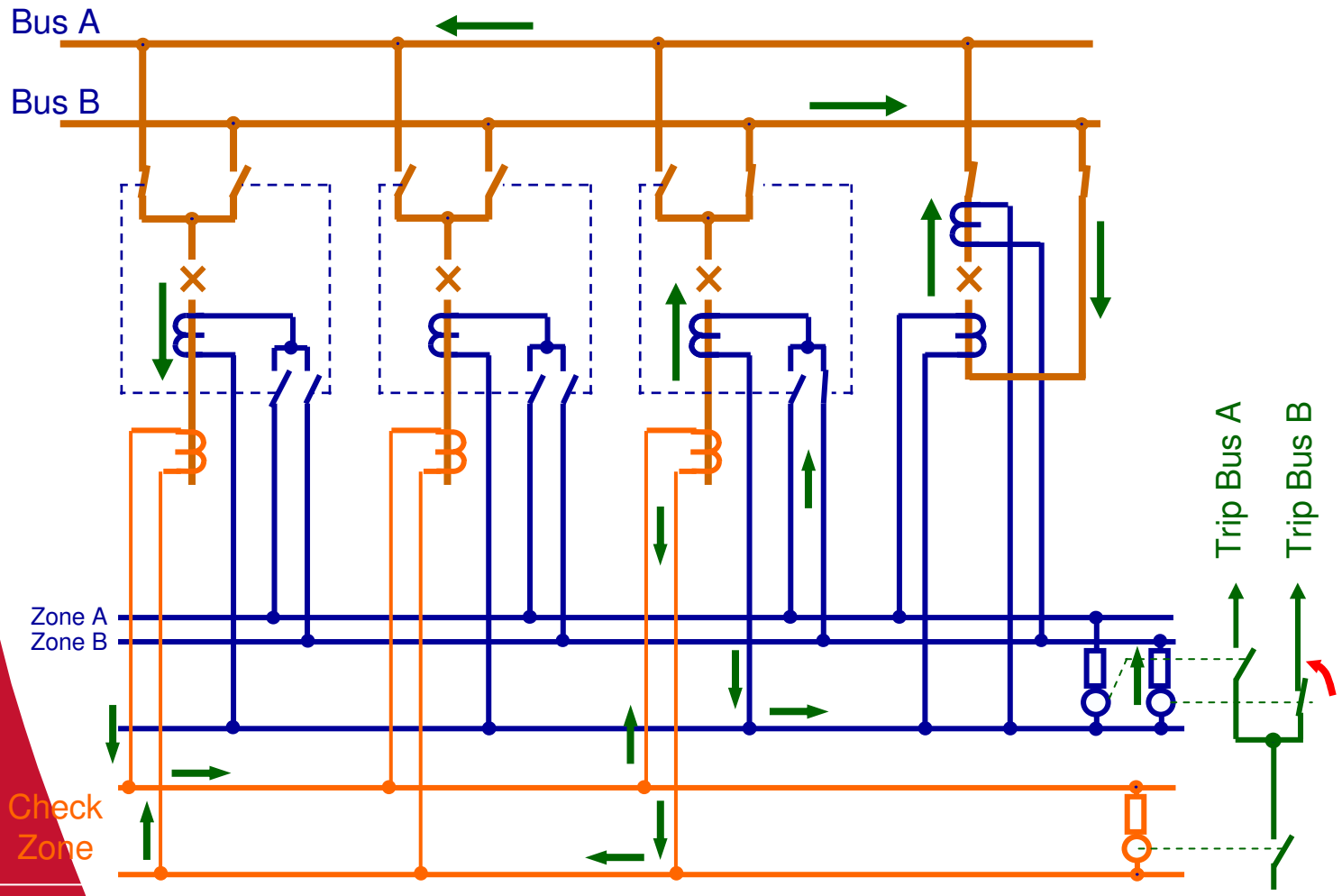
Isolator Auxiliary Switches
Check Zone



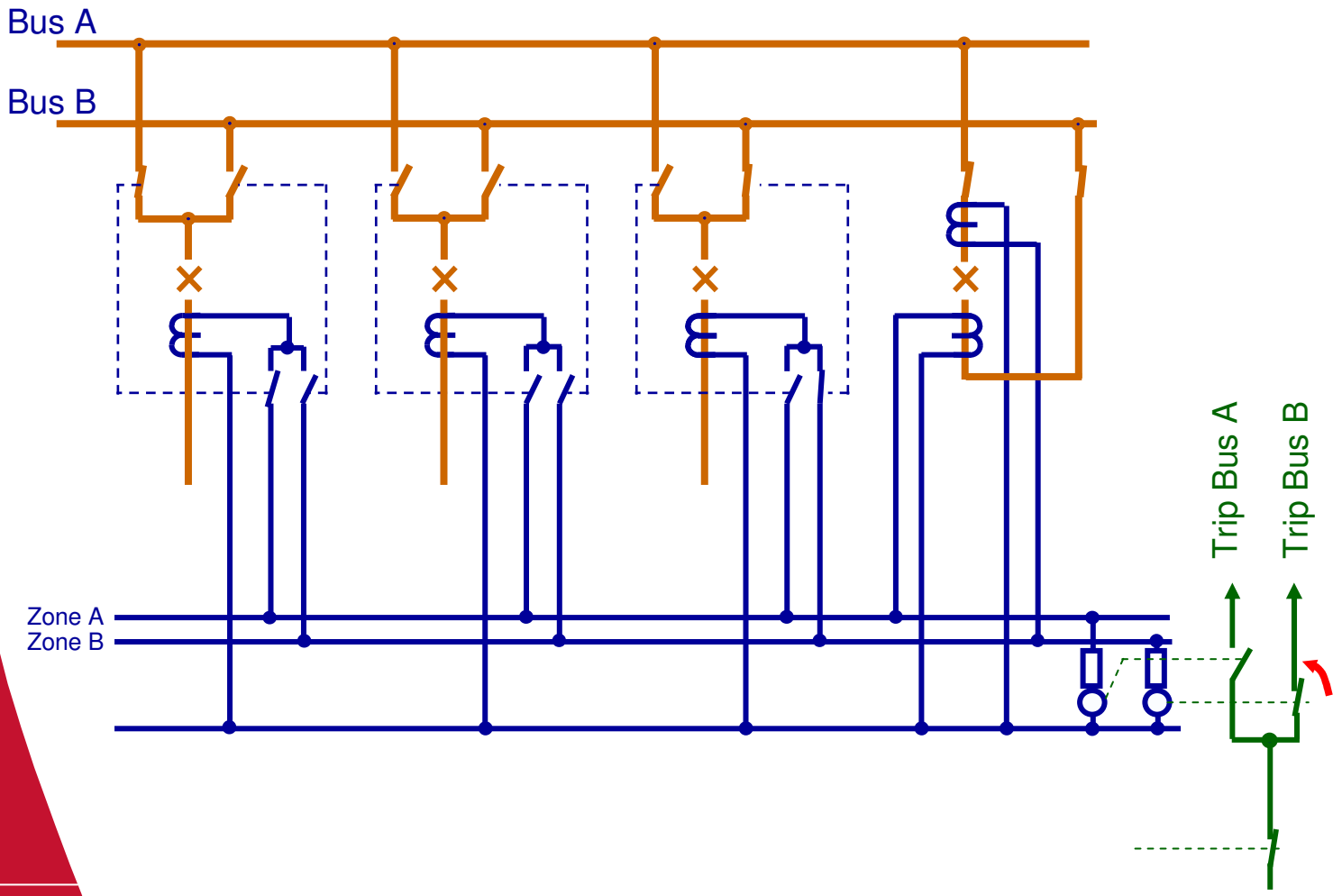
Isolator Auxiliary Switches
Check Zone



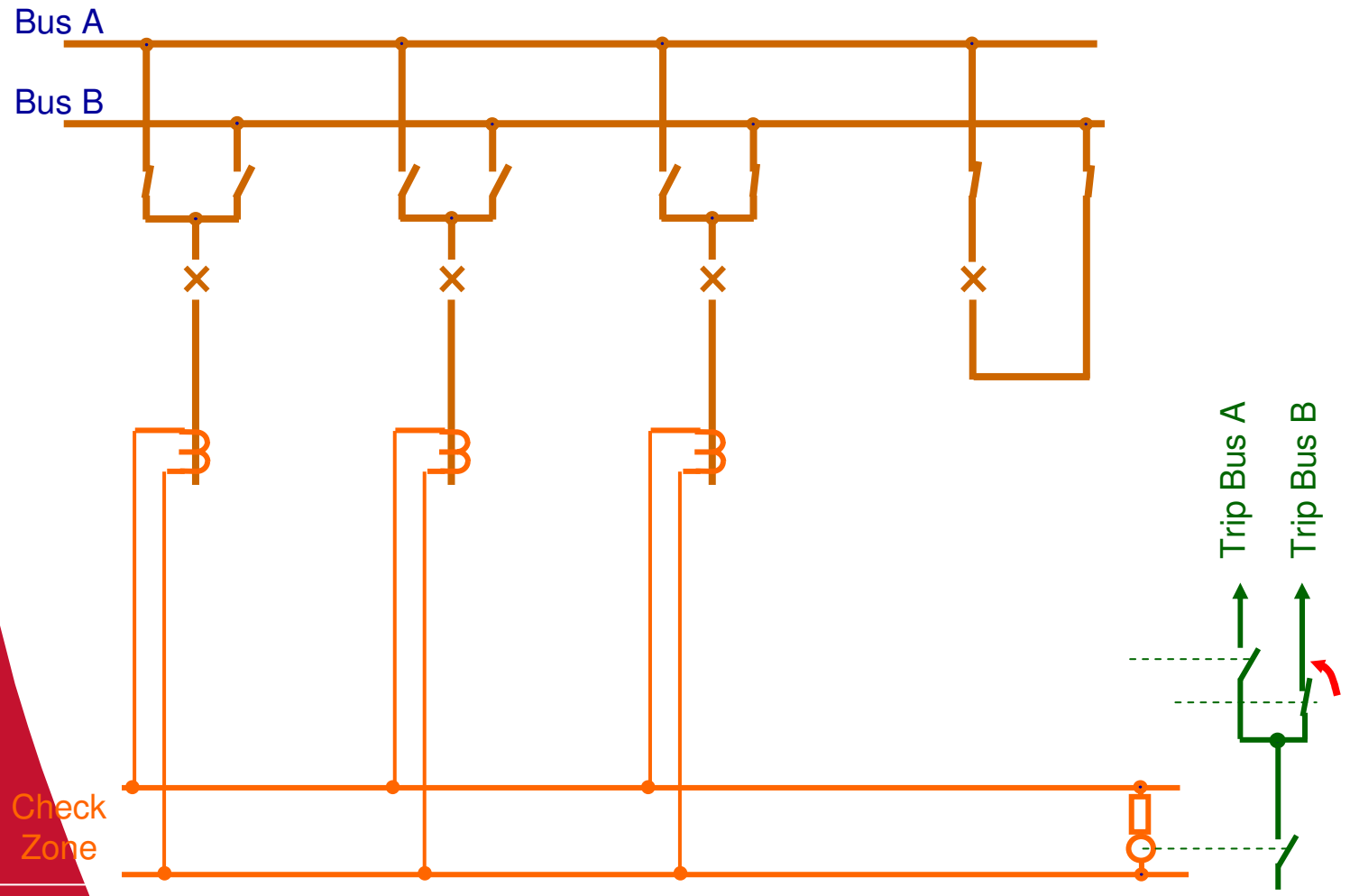
Isolator Auxiliary Switches
Check Zone



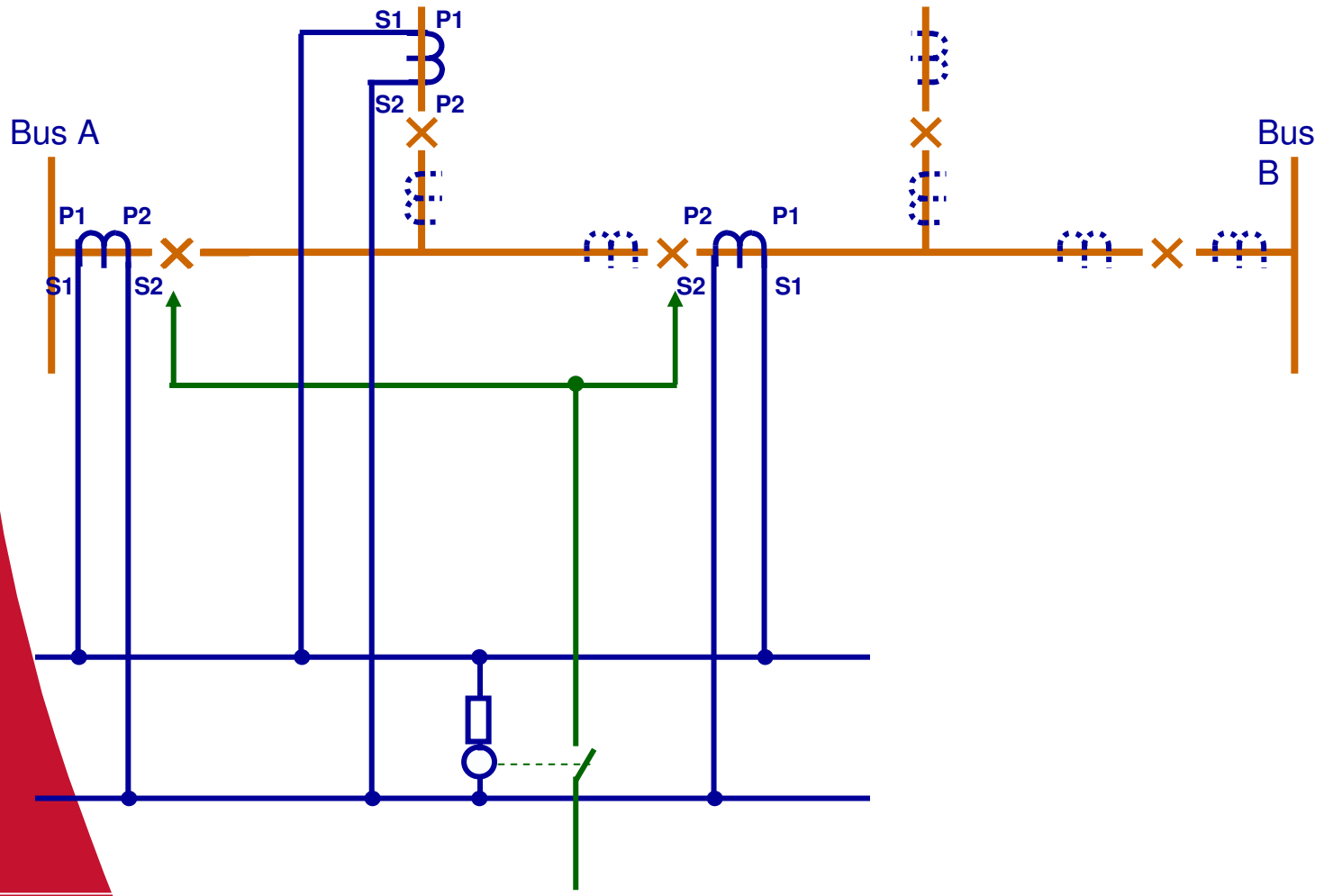
Isolator Auxiliary Switches
Check Zone

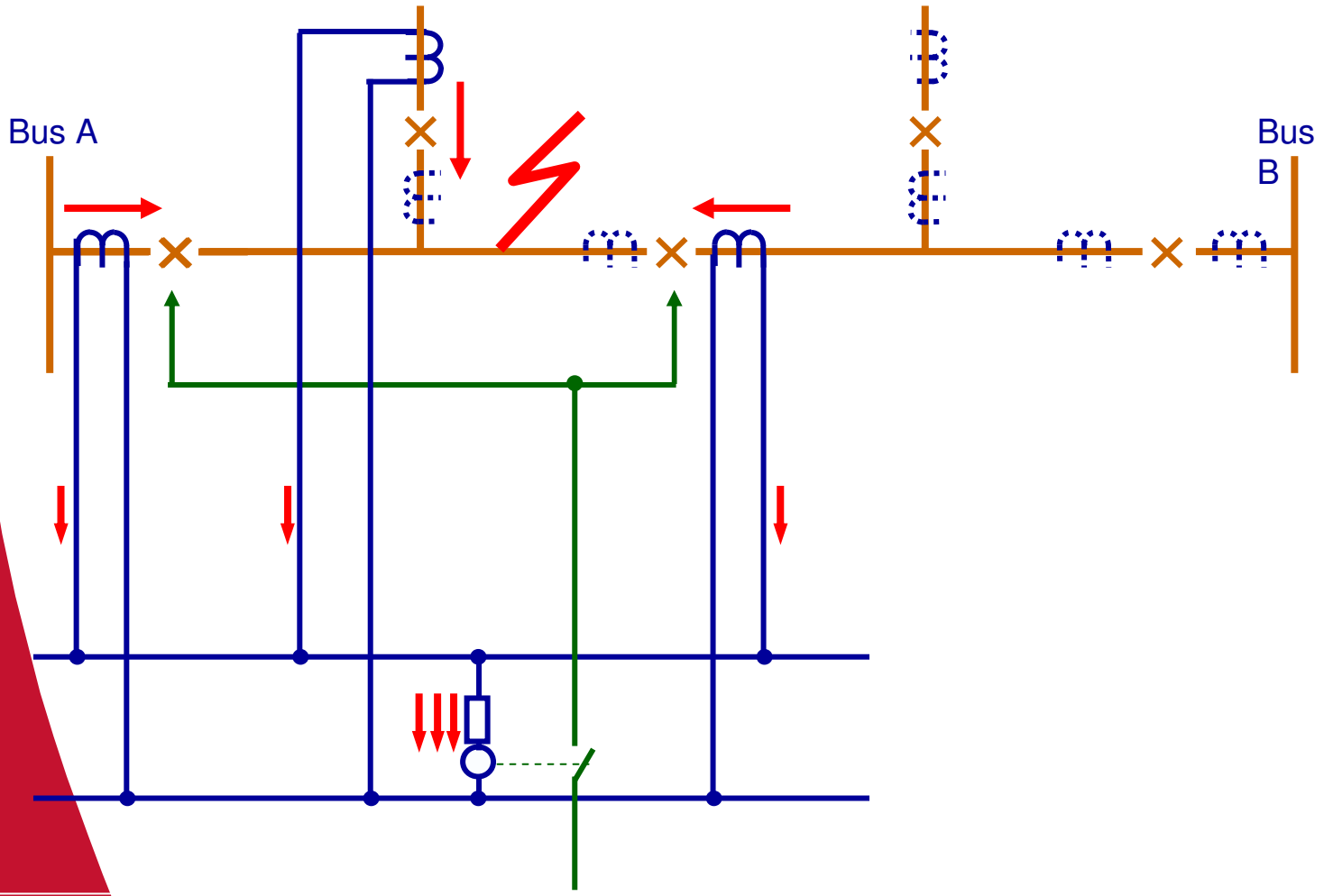


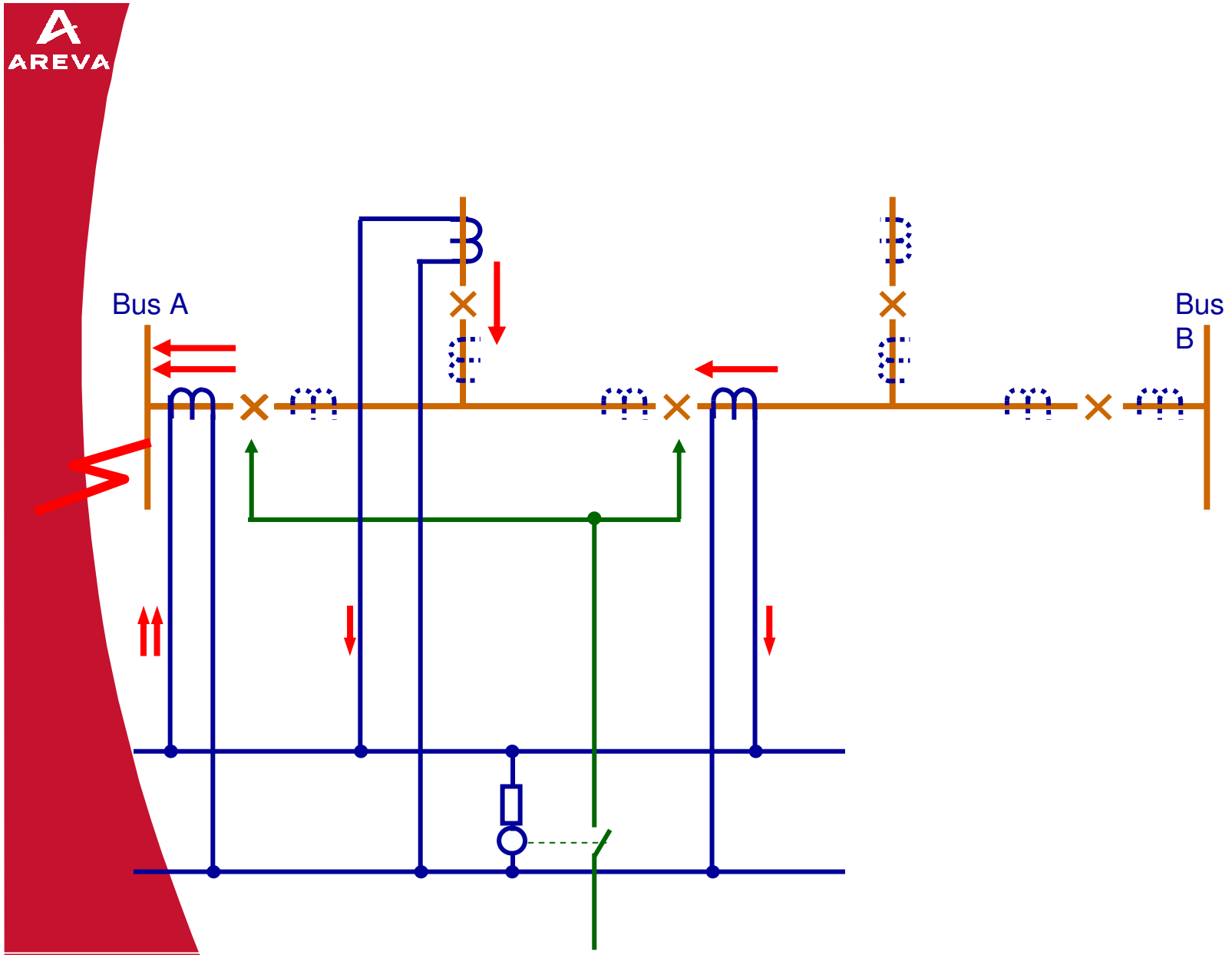
Isolator Auxiliary Switches
Check Zone

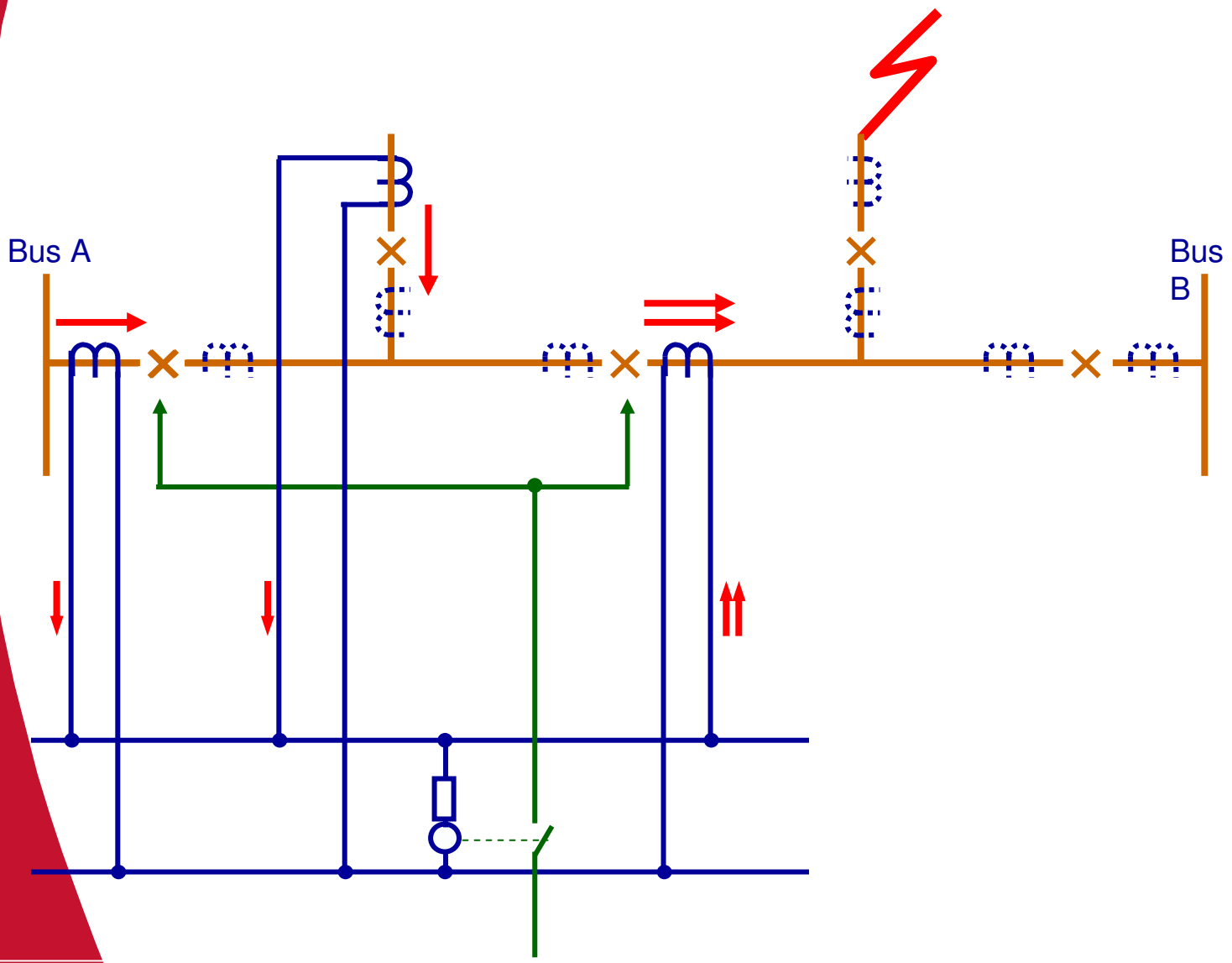


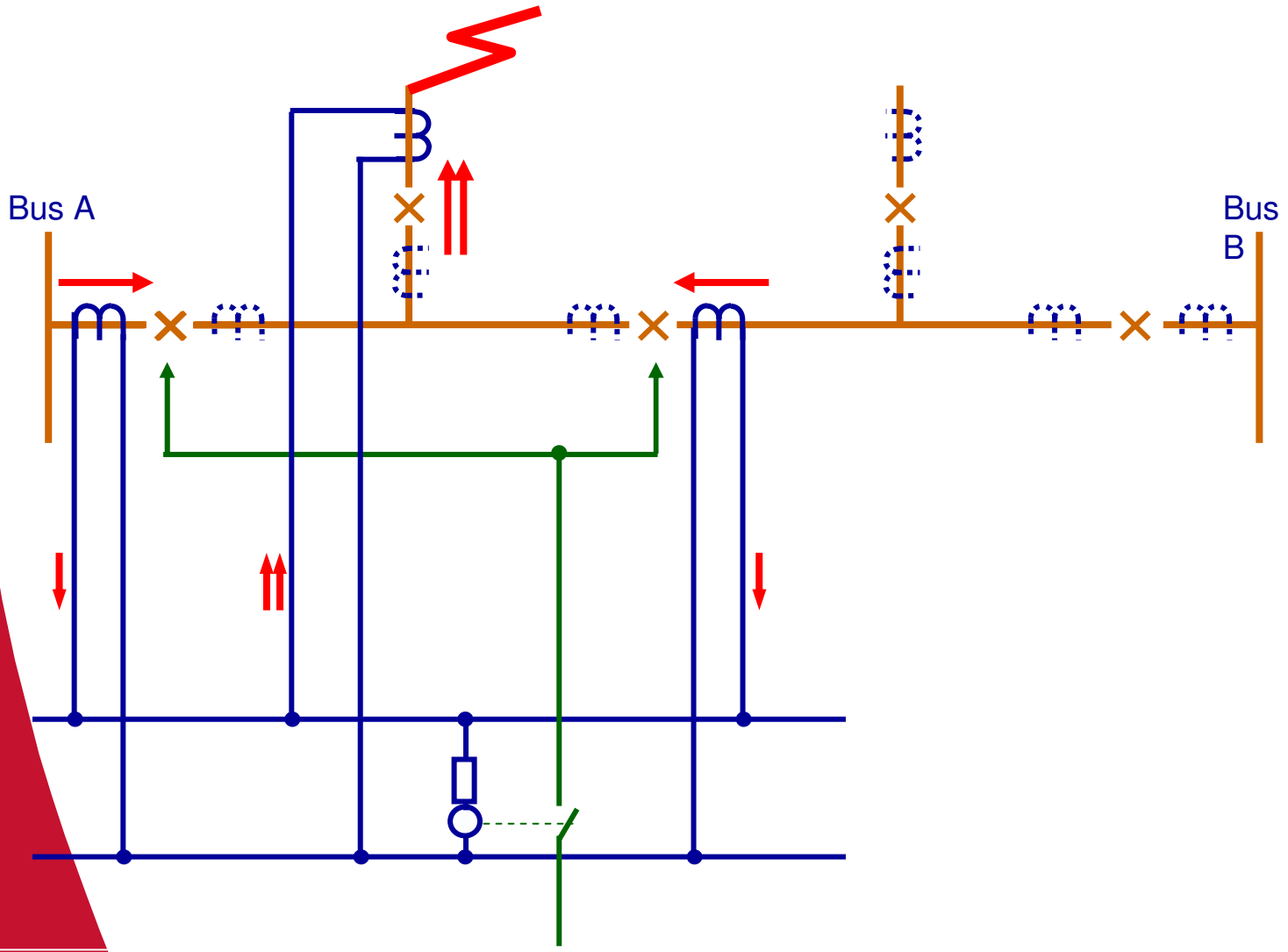
One Breaker and a Half Substation


S1
P1
S2
P2
Bus A
Bus
B
P1
P2
S1
S2
P2
P1
S2
S1


Bus A
Bus
B


Bus A
Bus
B


Bus A
Bus
B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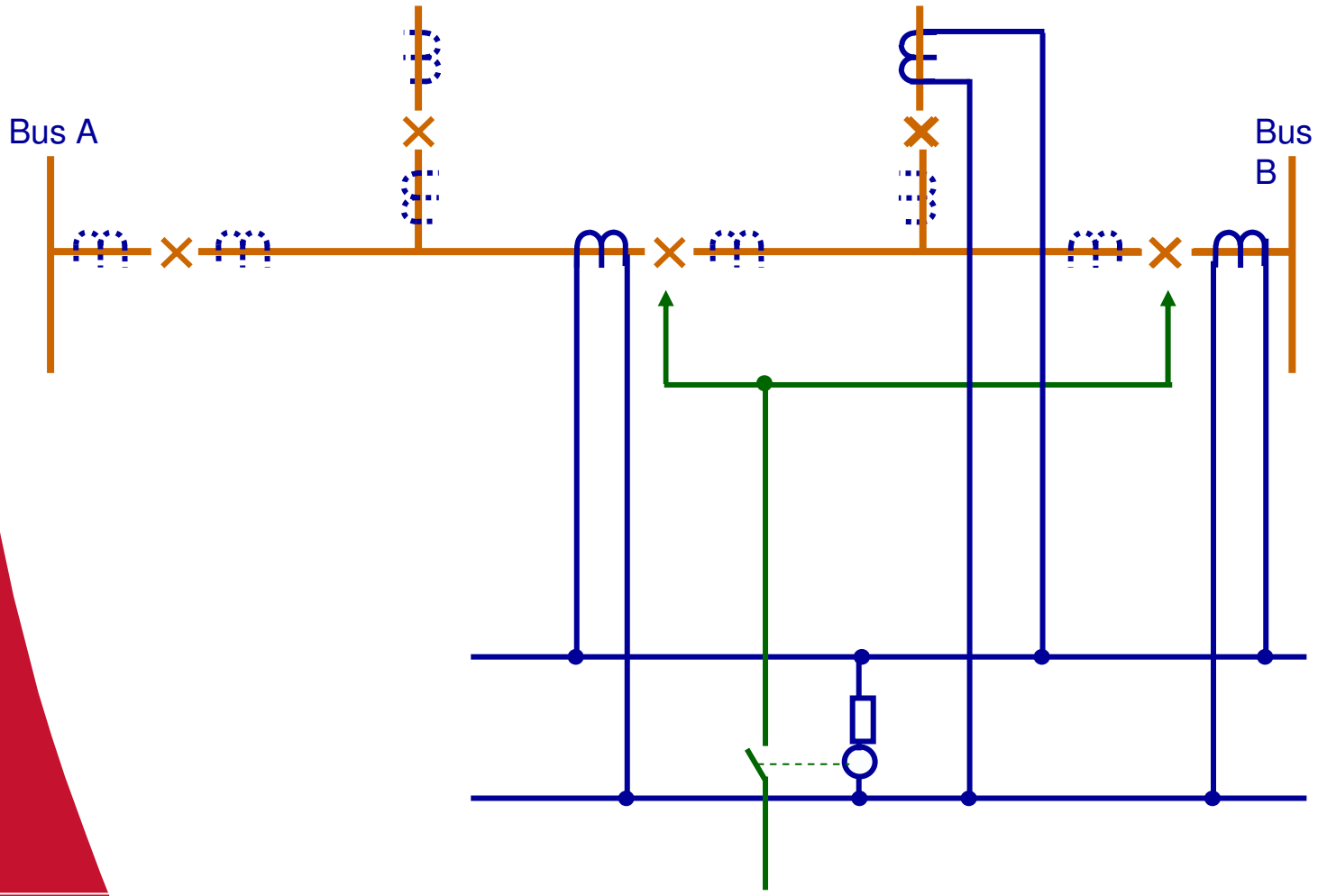
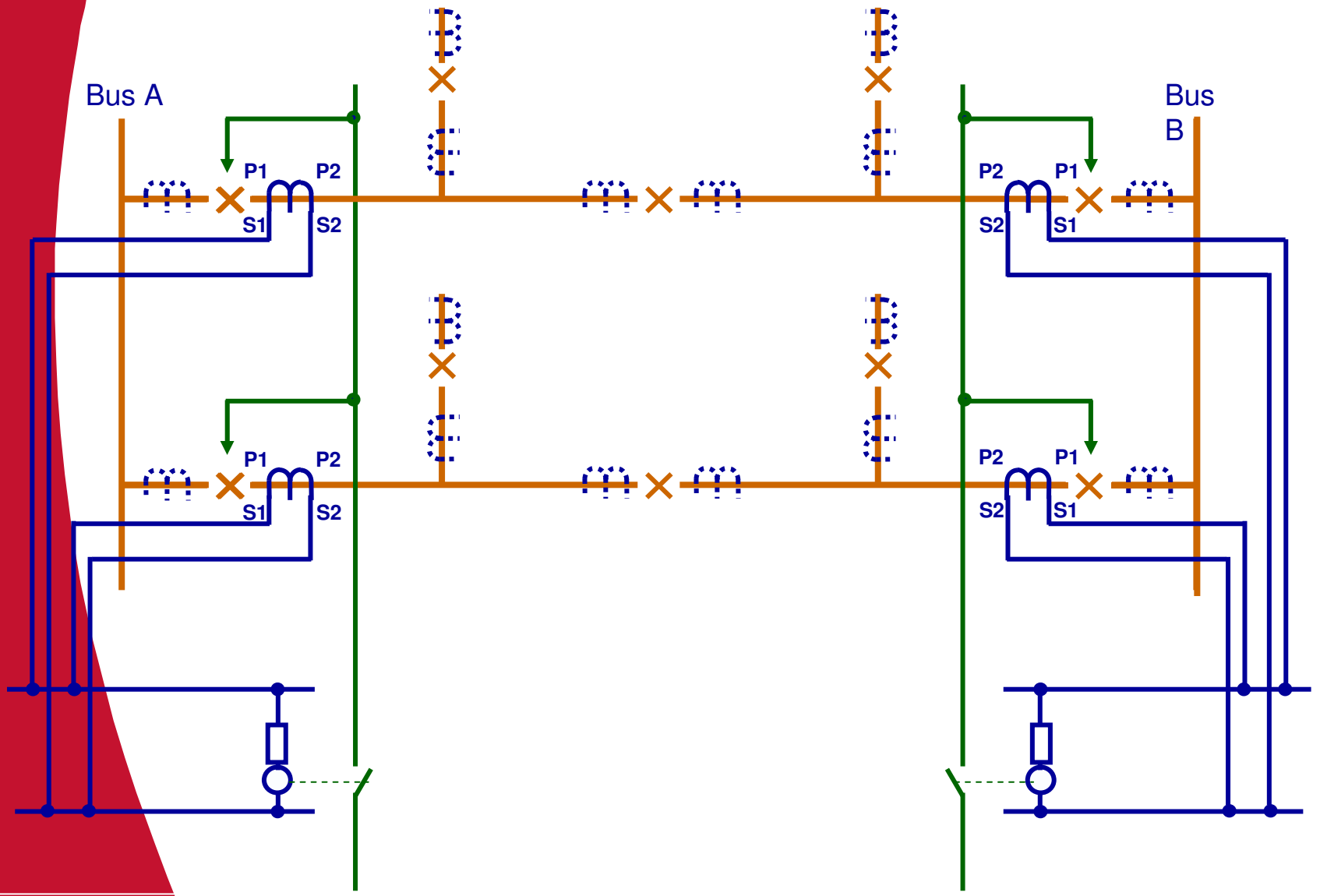

Bus A
Bus
B


Bus A
Bus
B
P1
P2
S1
S2
P2
P1
S2
S1
P1
P2
S1
S2
P2
P1
S2
S1