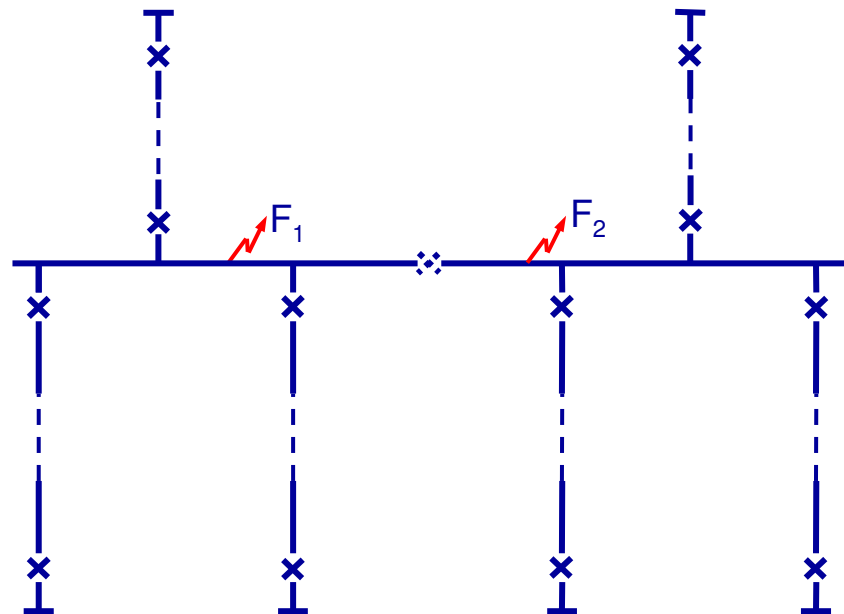




Busbar Protection

Protection & Contrôle / Application

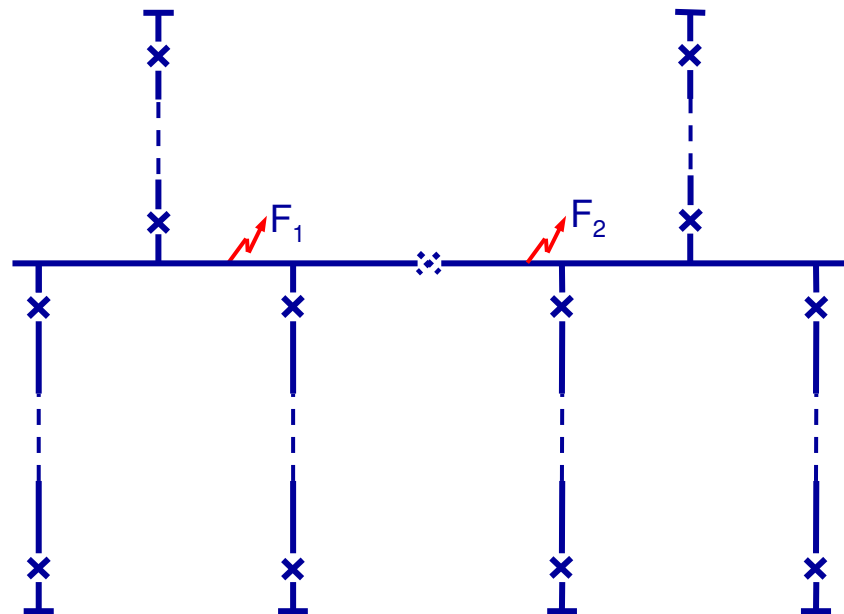
Without Busbar Protection



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.

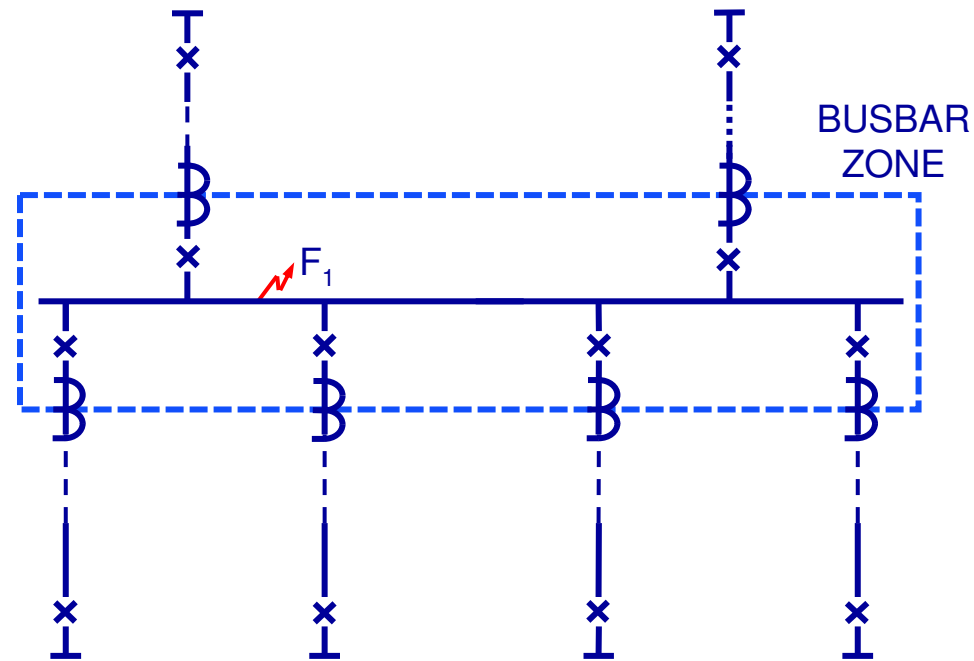
Without Busbar Protection



Drawbacks

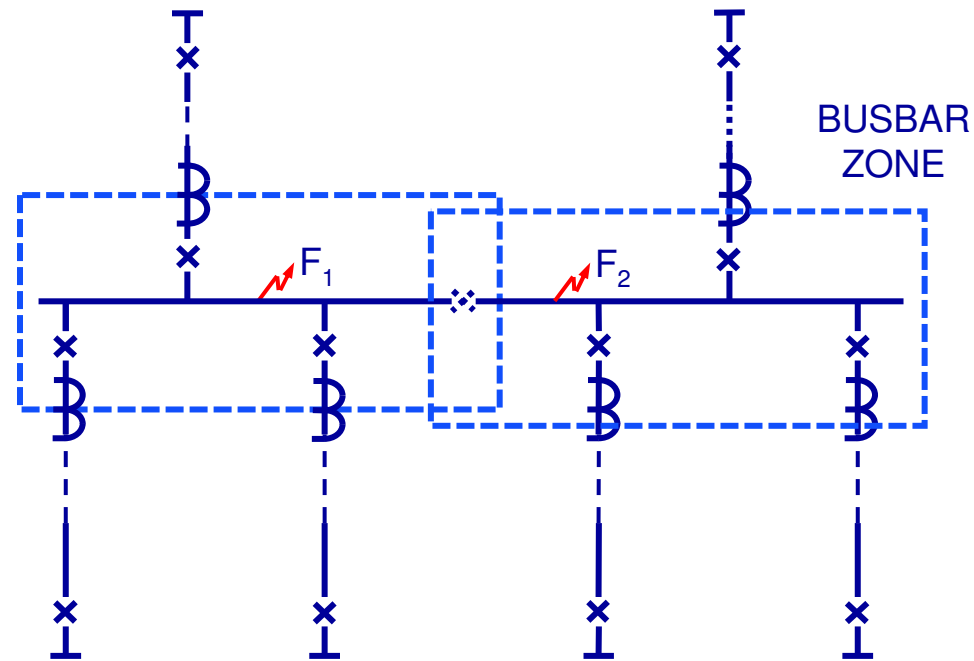
- Slow fault clearance.
Busbar faults at F₁ and F₂ are cleared by remote time delayed protection on circuits feeding the faults:
Time Delayed Overcurrent or
Time Delayed Distance Protection

With Busbar Protection



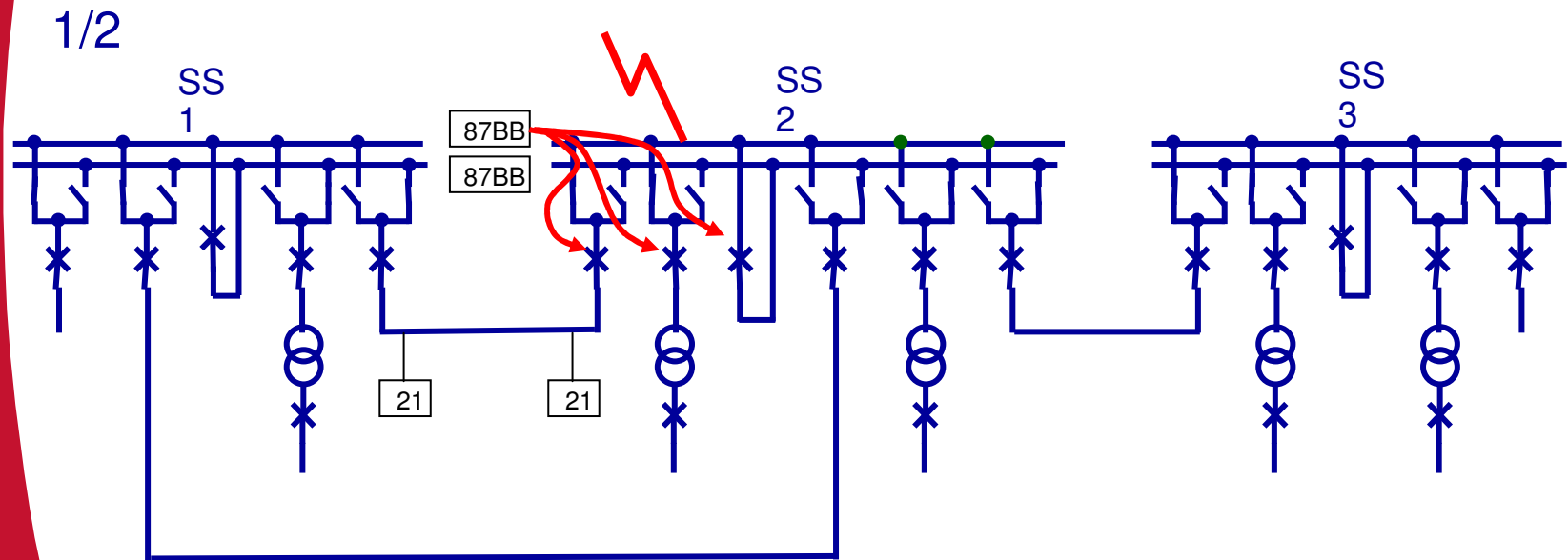
- Fast clearance by breakers at the busbars

With Busbar Protection



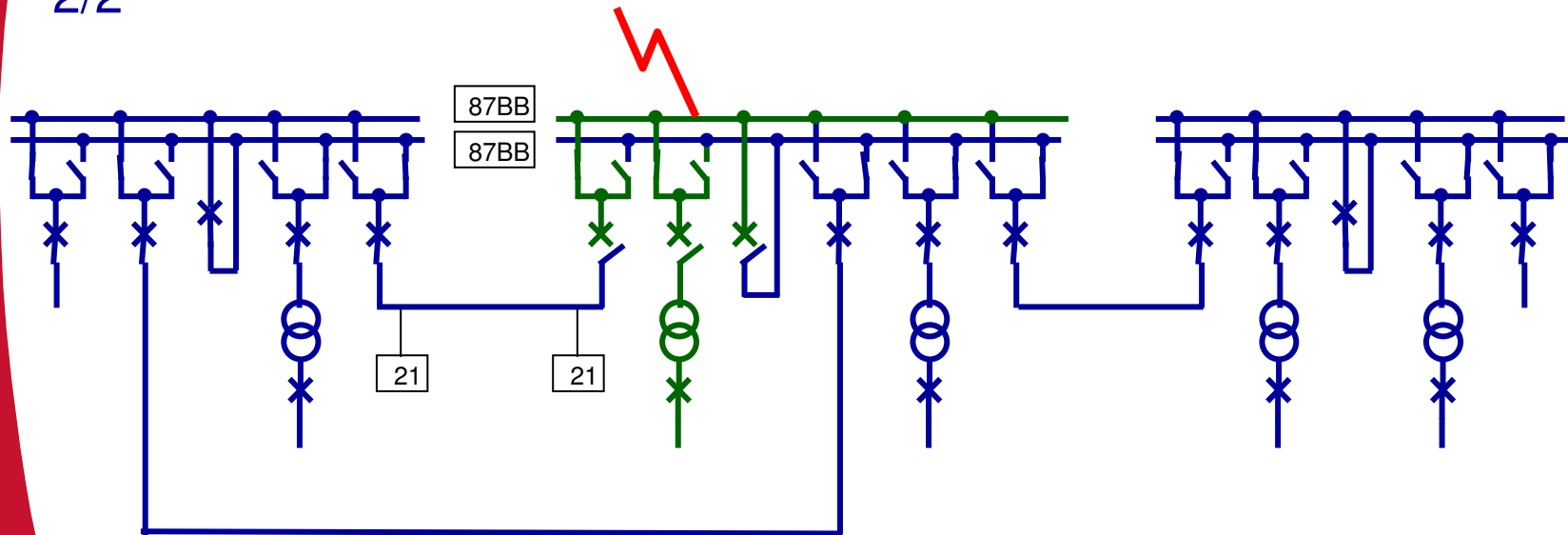
- Where busbars are sectionalised,
Protection can limit the amount of system
disruption for a busbar fault

With Busbar Protection



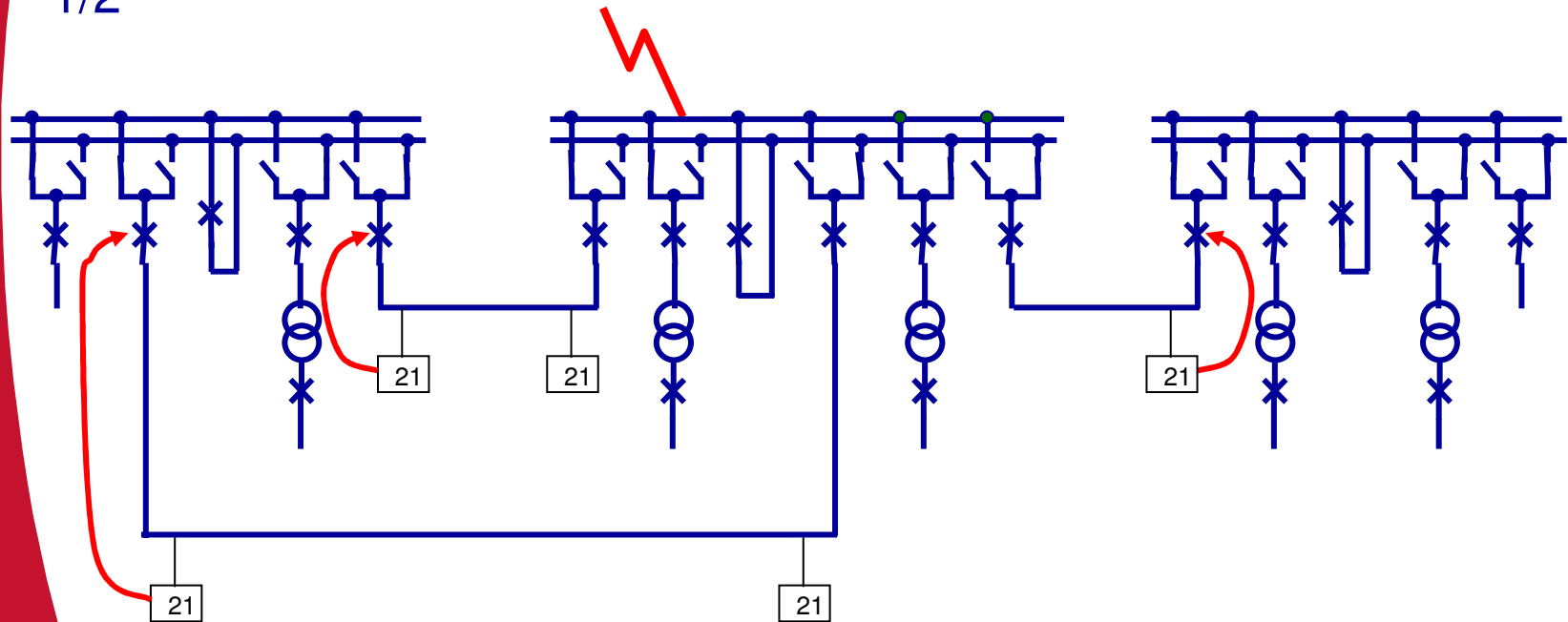
With Busbar Protection

2/2



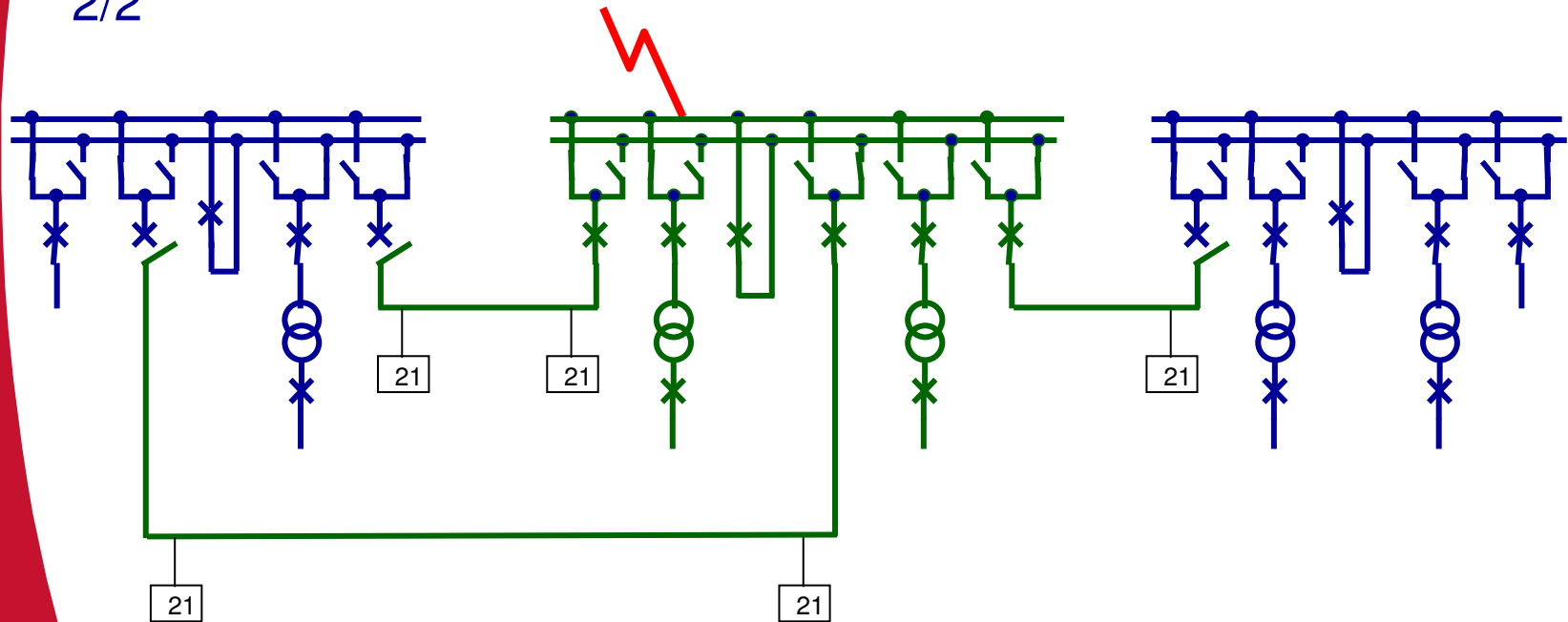
With **No** Busbar Protection

1/2

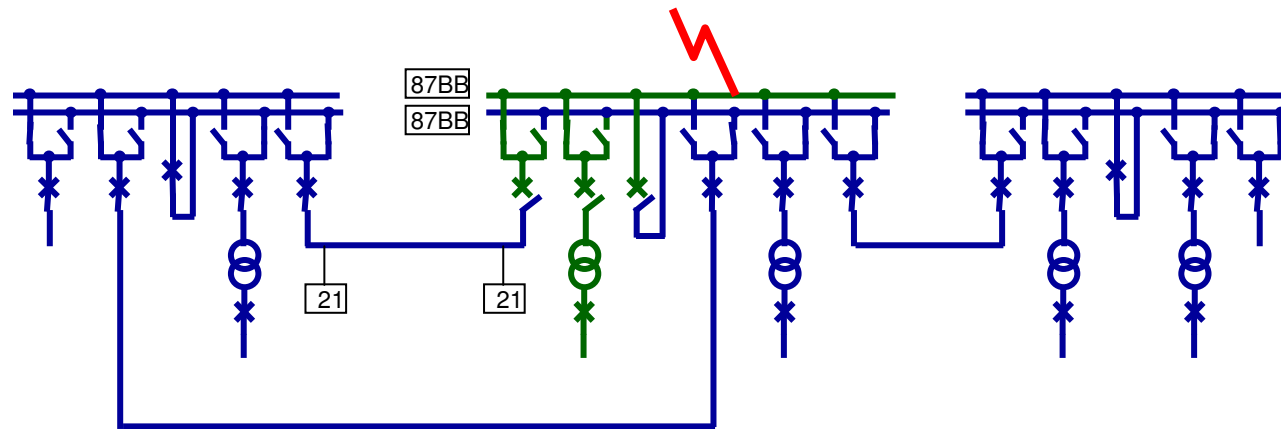


With **No** Busbar Protection

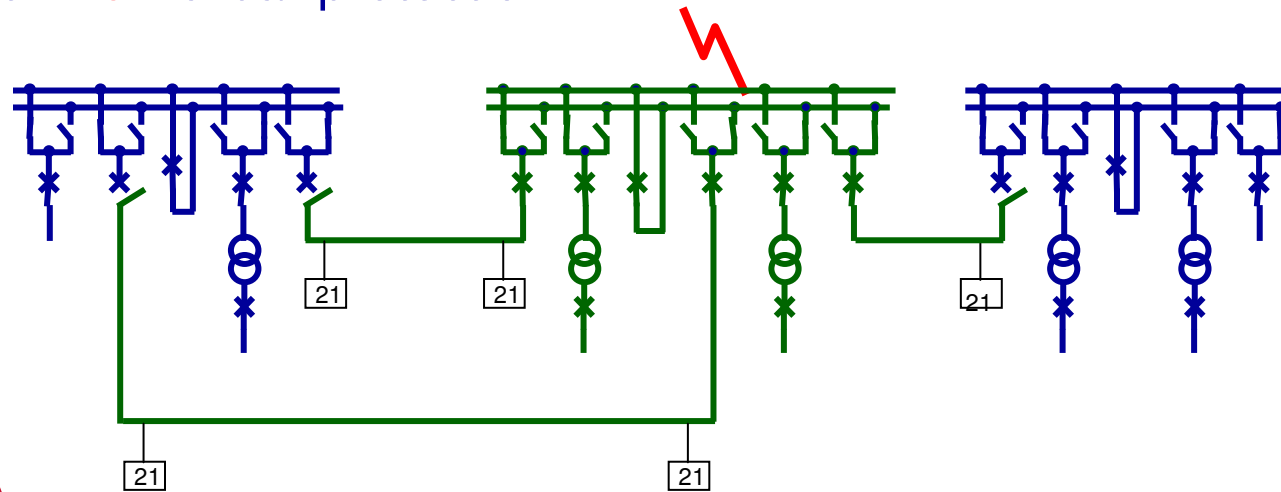
2/2



With Burbar protection



With **No** Burbar protection



Busbar Faults Are Usually Permanent

Causes of Busbar Faults :

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

Therefore :

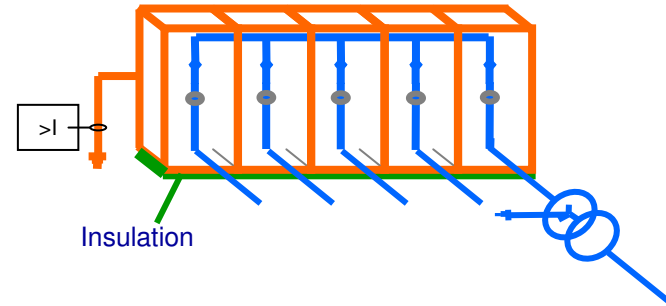
Circuit breakers should be tripped and locked out by busbar protection

Busbar Protection must be :

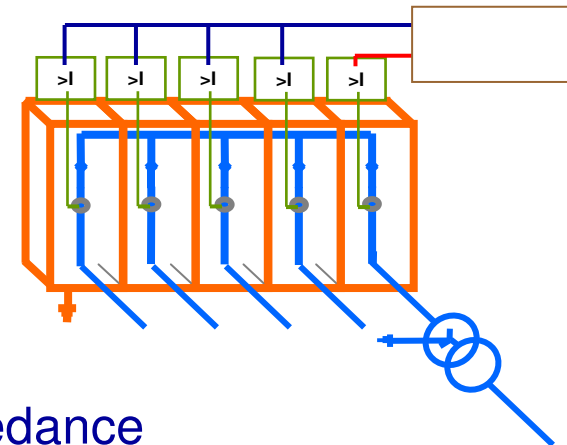
- **RELIABLE**
 - Failure to trip could cause widespread damage to the substation
- **STABLE**
 - False tripping can cause widespread interruption of supplies to customers / possible power system instability
- **DISCRIMINATING**
 - Should trip the minimum number of breakers to clear the fault
- **FAST**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

Methods of Providing Busbar Protection

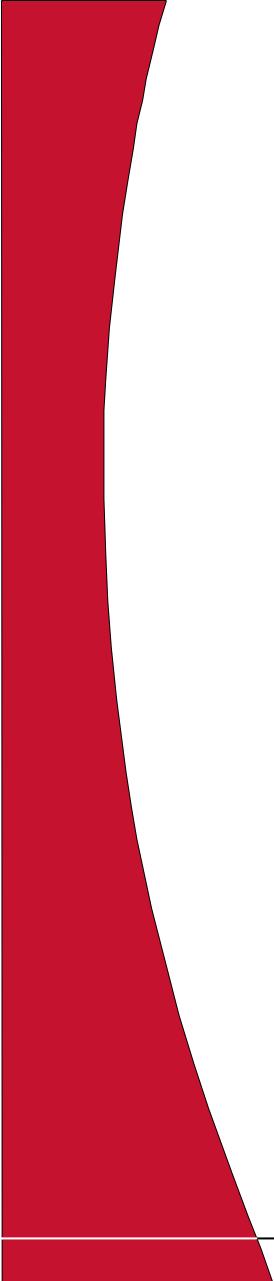
- Frame to Earth (Leakage) Protection



- Blocking Scheme Protection



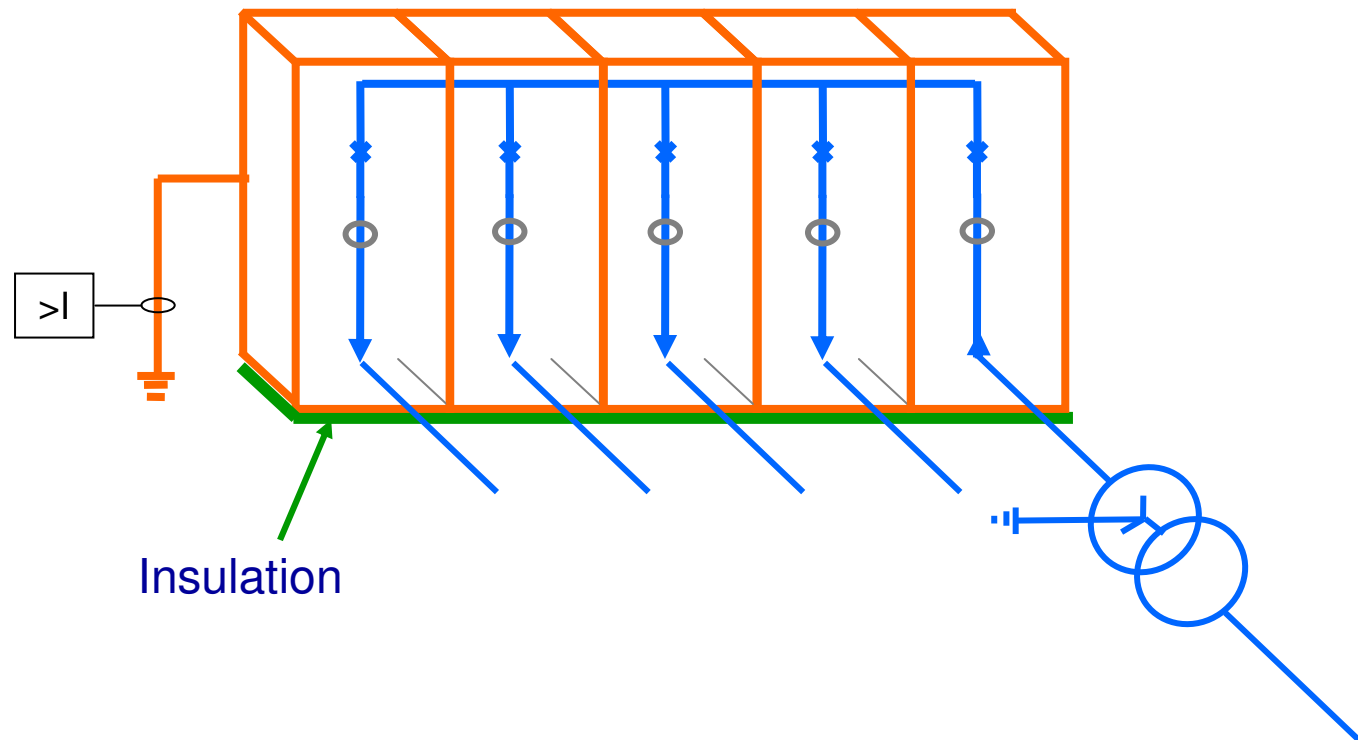
- Differential Protection : High Impedance
Low Impedance



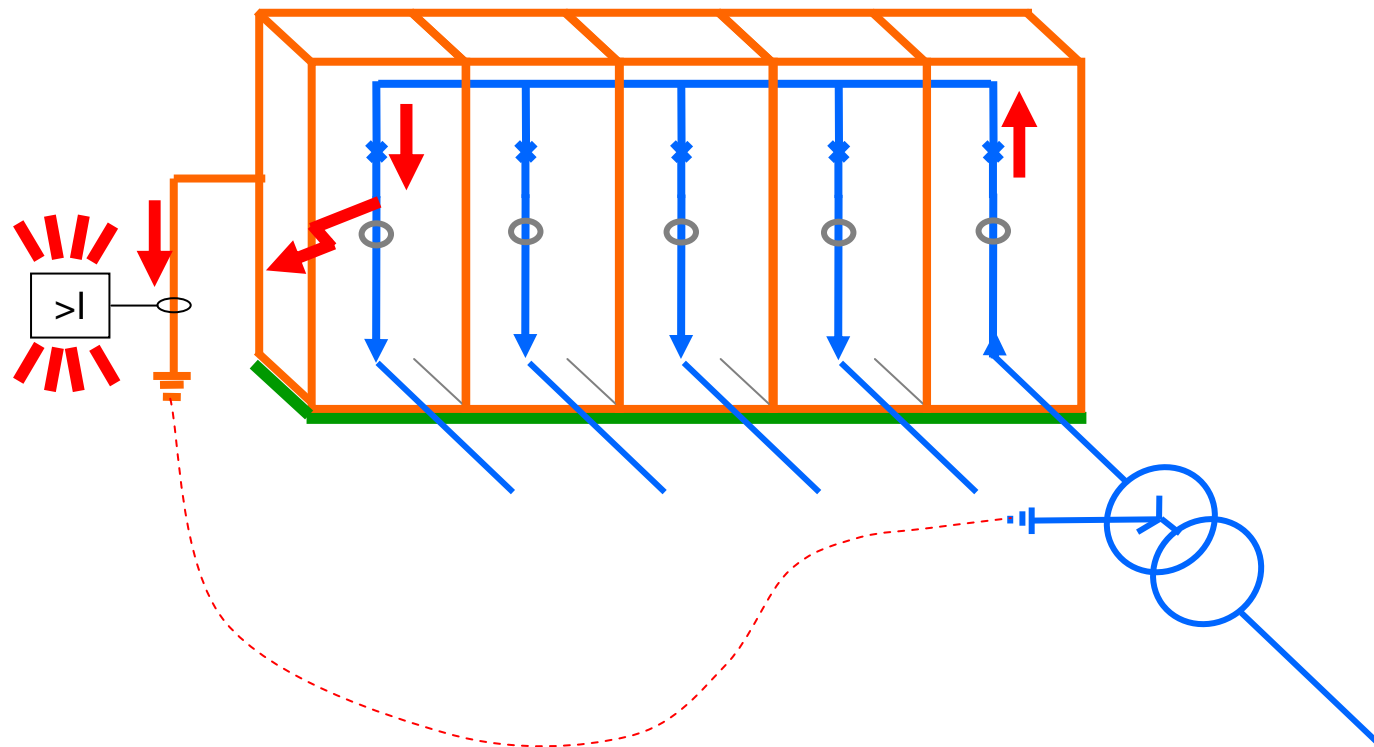
Frame Leakage Protection

Protection & Contrôle / Application

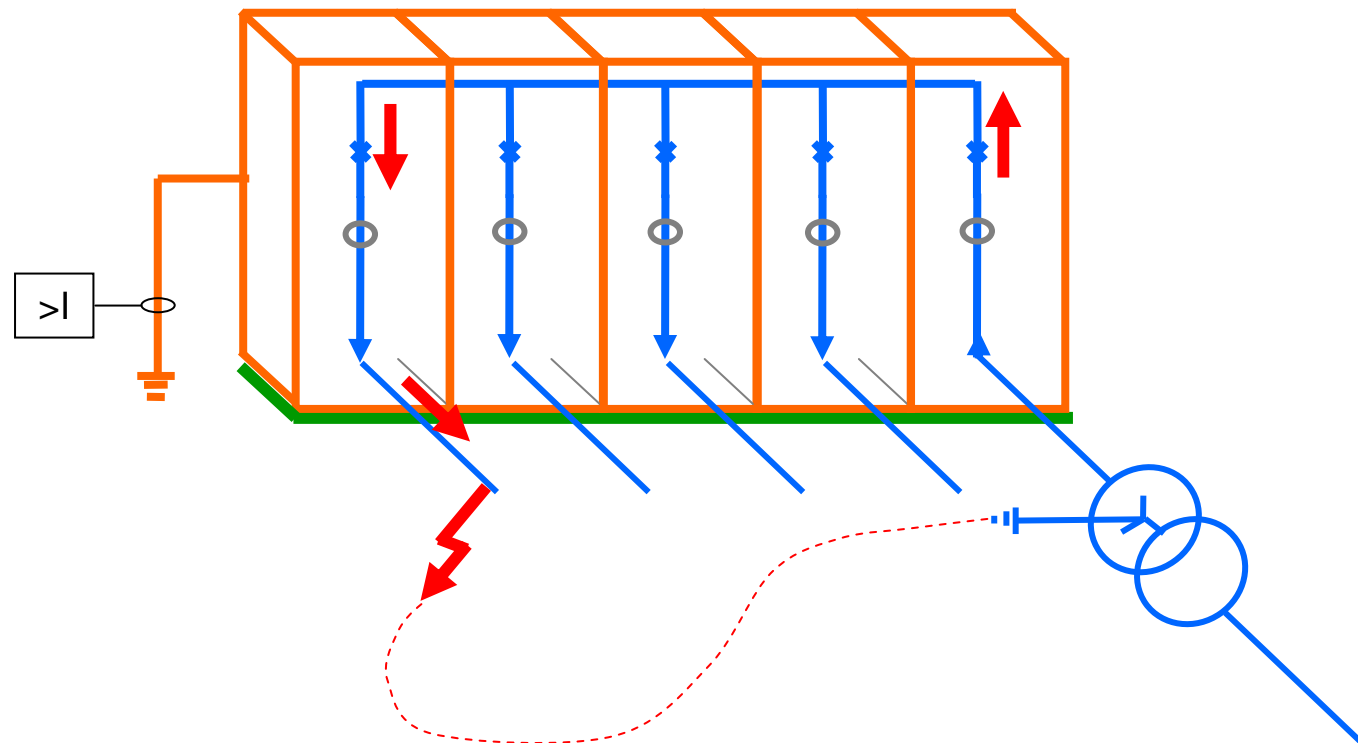
Frame Leakage Busbar Protection



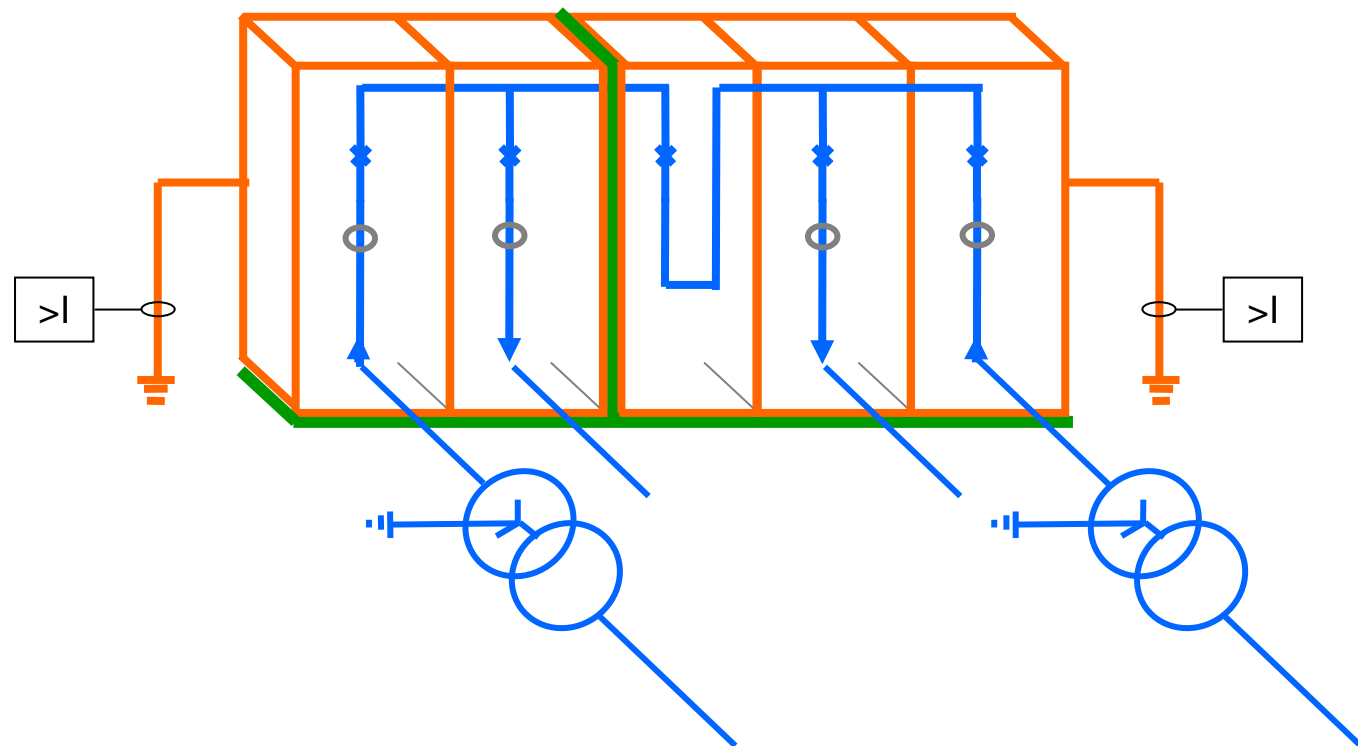
Frame Leakage Busbar Protection



Frame Leakage Busbar Protection



Frame Leakage Busbar Protection



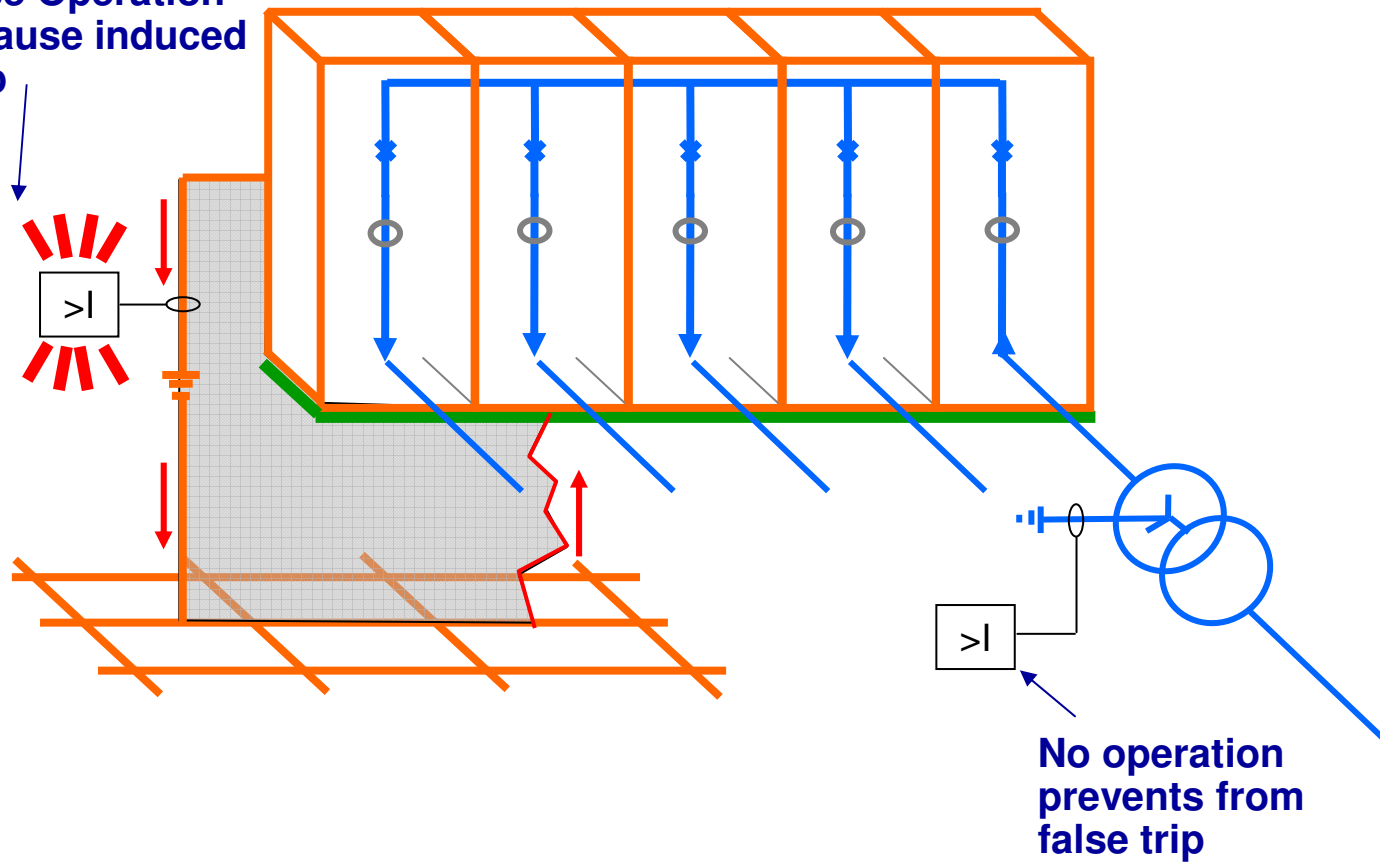
Frame Leakage Busbar Protection

- 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

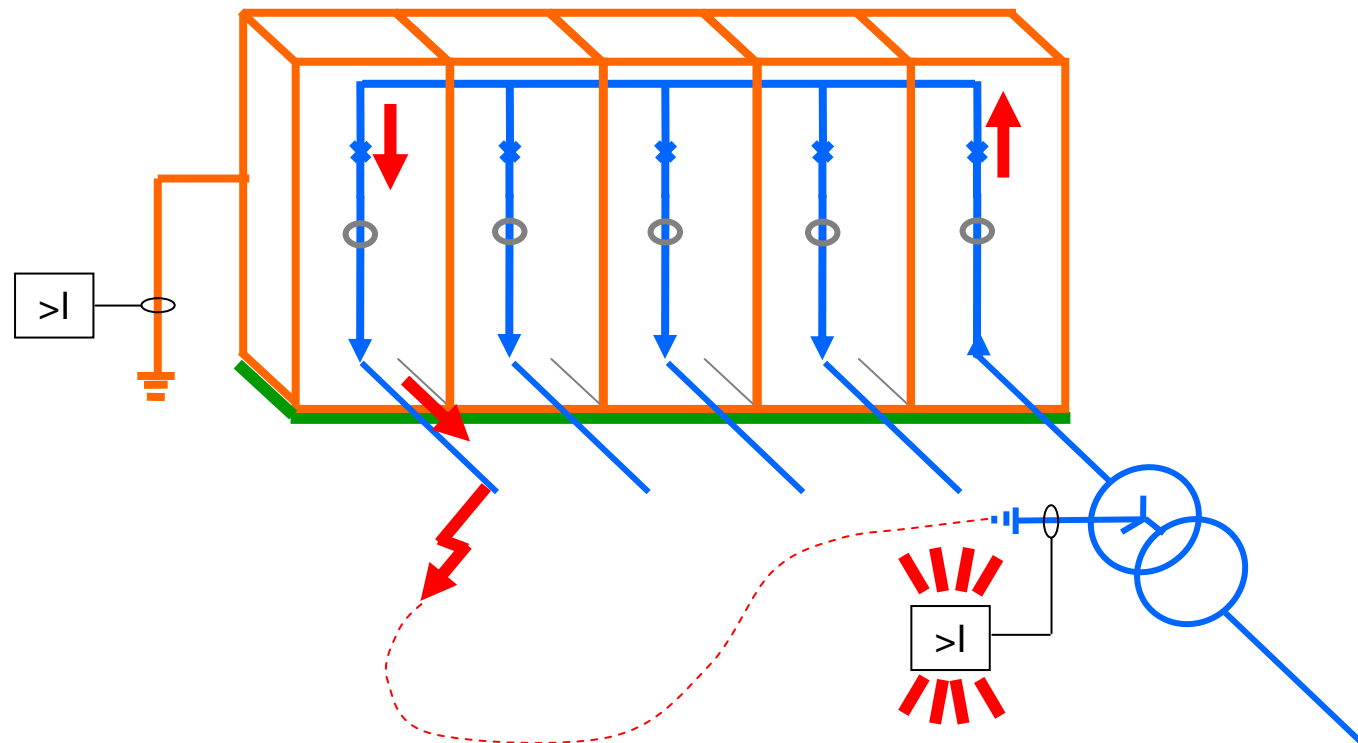
False Operation
because induced
loop



The diagram illustrates a multi-channel system, possibly a multi-robot system, with a feedback loop. A central rectangular structure is divided into five vertical channels. Each channel contains a blue vertical line with a downward arrow, representing a primary path. A red arrow points down in the first channel, and a red arrow points up in the fifth channel. A red dashed line with a jagged arrow points from the first channel towards a square block labeled $>I$ on the left. This block is connected to a battery symbol. A red dashed line also connects the battery to a square block labeled $>I$ on the right. This right block is connected to a circular component with two overlapping circles. A blue line connects the bottom of the fifth channel to this circular component. A blue line also connects the bottom of the first channel to the bottom of the structure. A red dashed line with a jagged arrow points from the first channel towards the $>I$ block on the left.

Frame Leakage Busbar Protection

Neutral Check



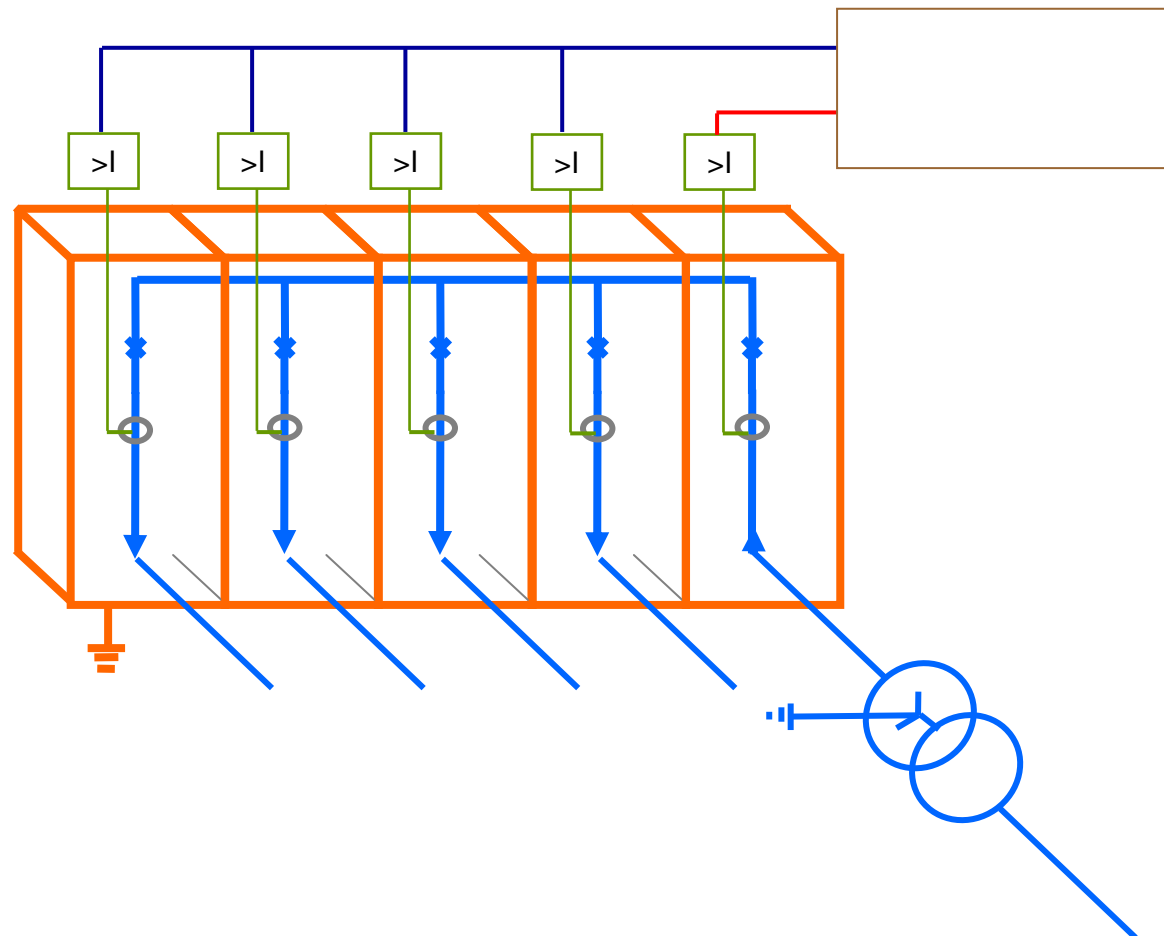


AREVA

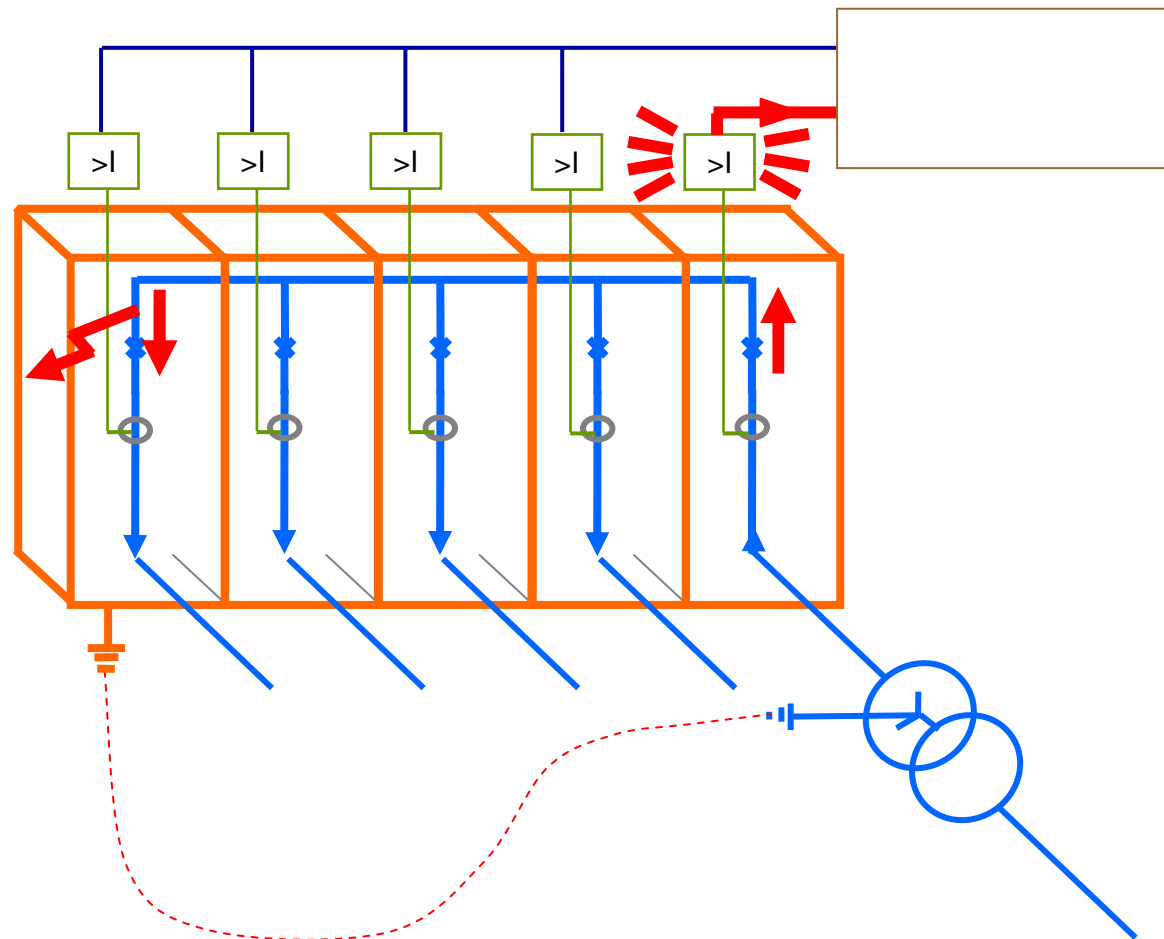
Blocking Scheme Protection

Protection & Contrôle / Application

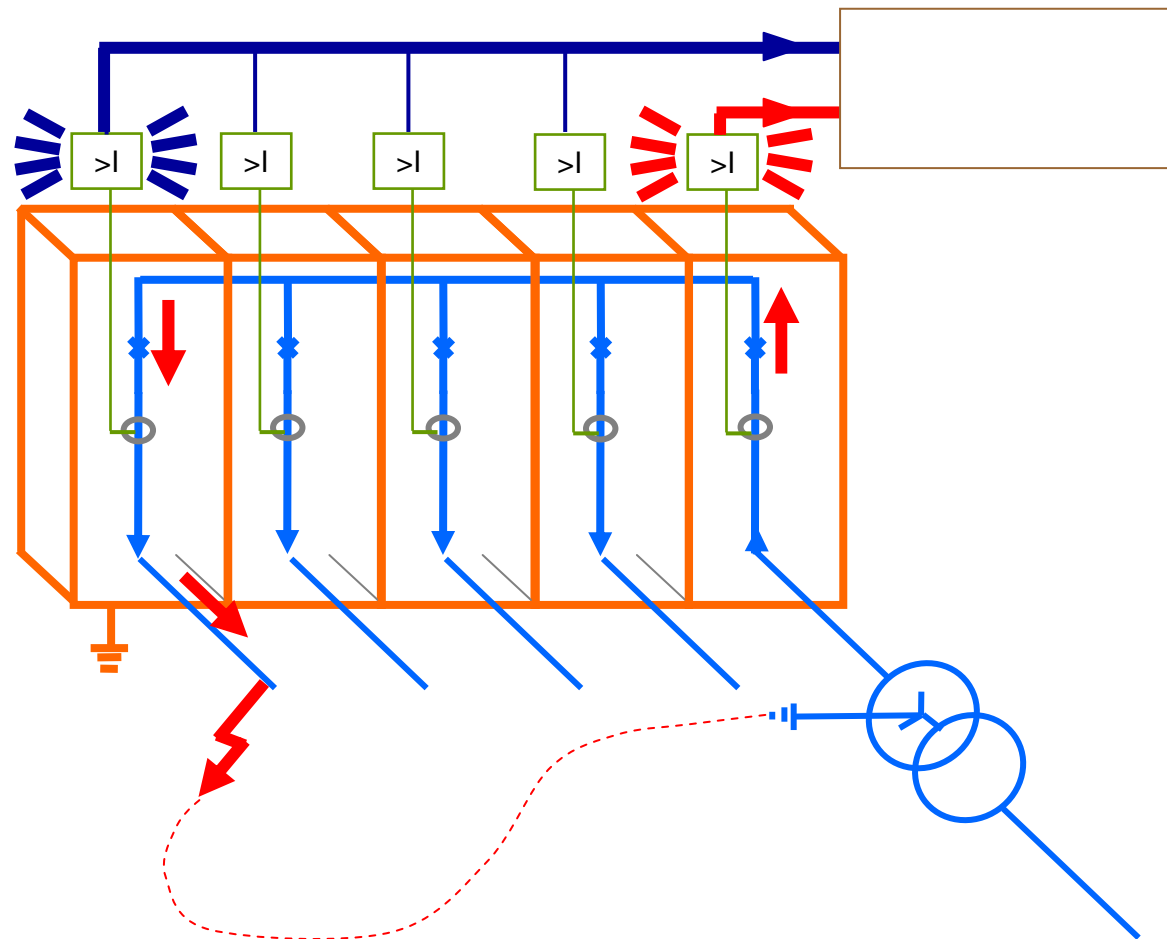
Blocking Scheme Busbar Protection

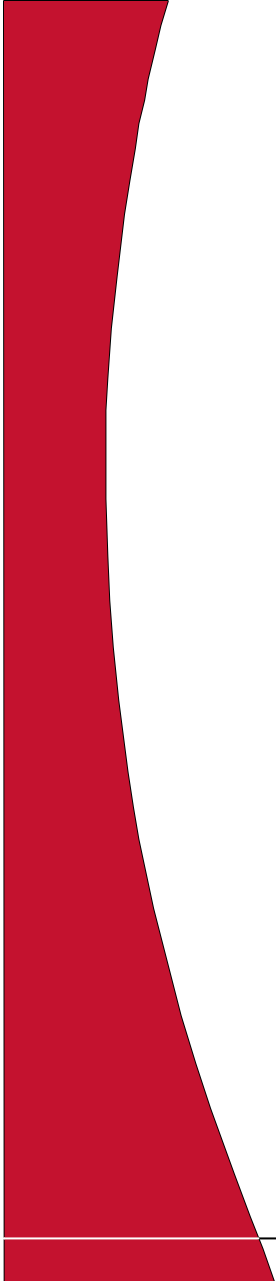


Blocking Scheme Busbar Protection



Blocking Scheme Busbar Protection



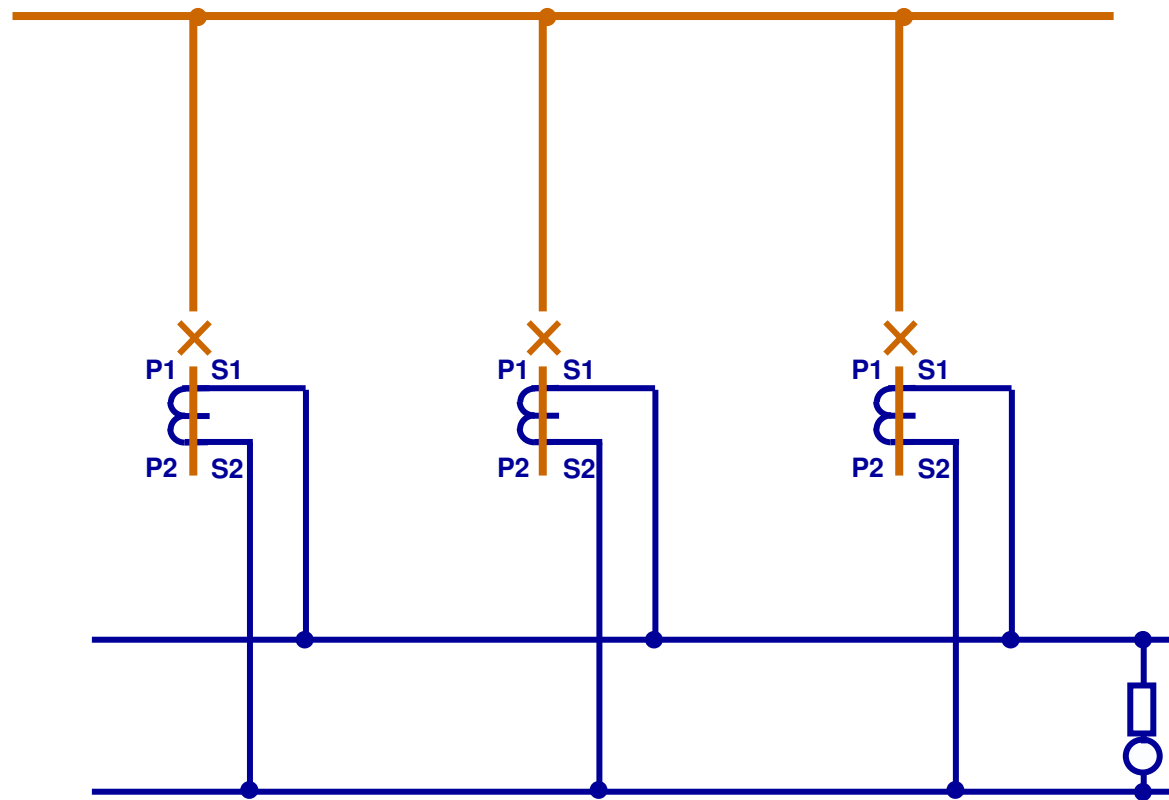
A large, red, curved graphic element on the left side of the slide, resembling a stylized 'A' or a protective shield.

AREVA **High Impedance Protection**

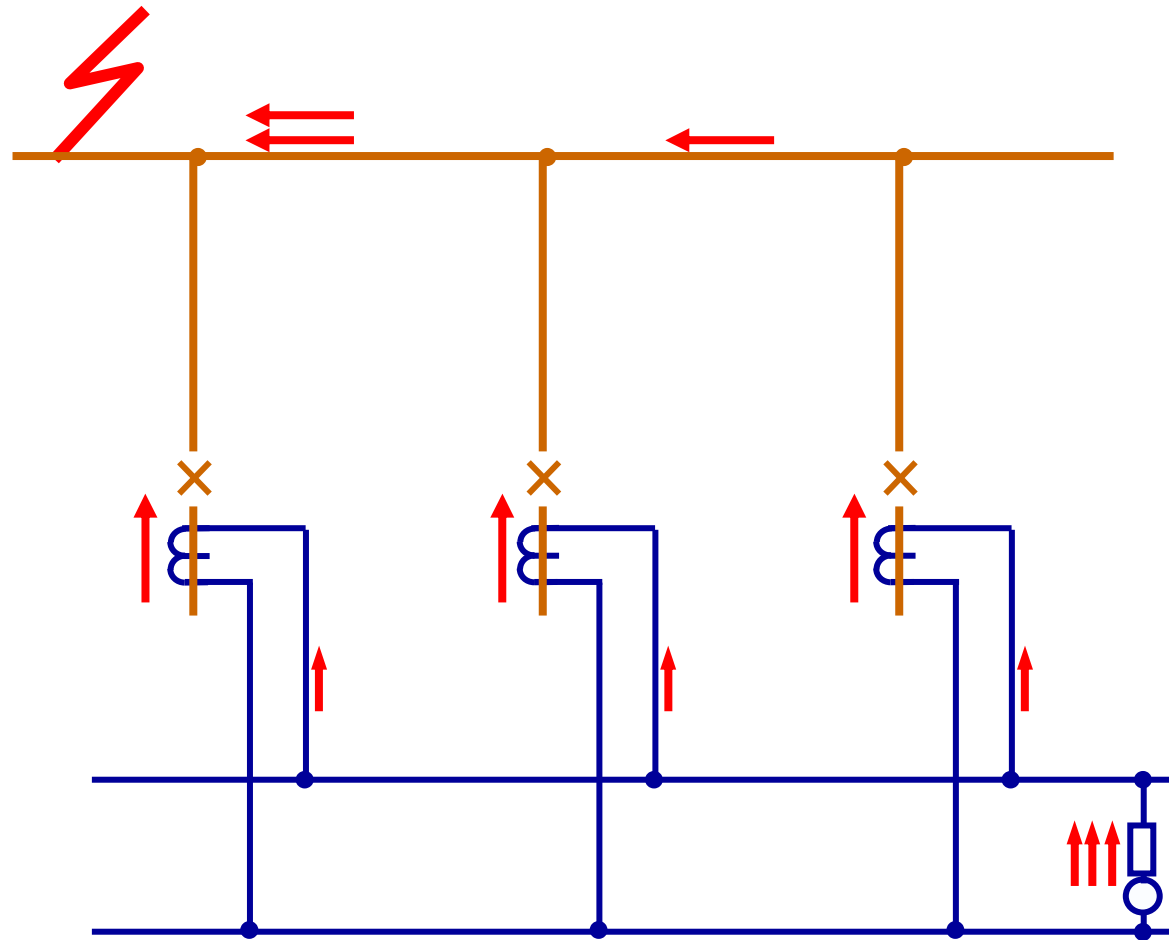
Protection & Contrôle / Application

Single Bus Substation

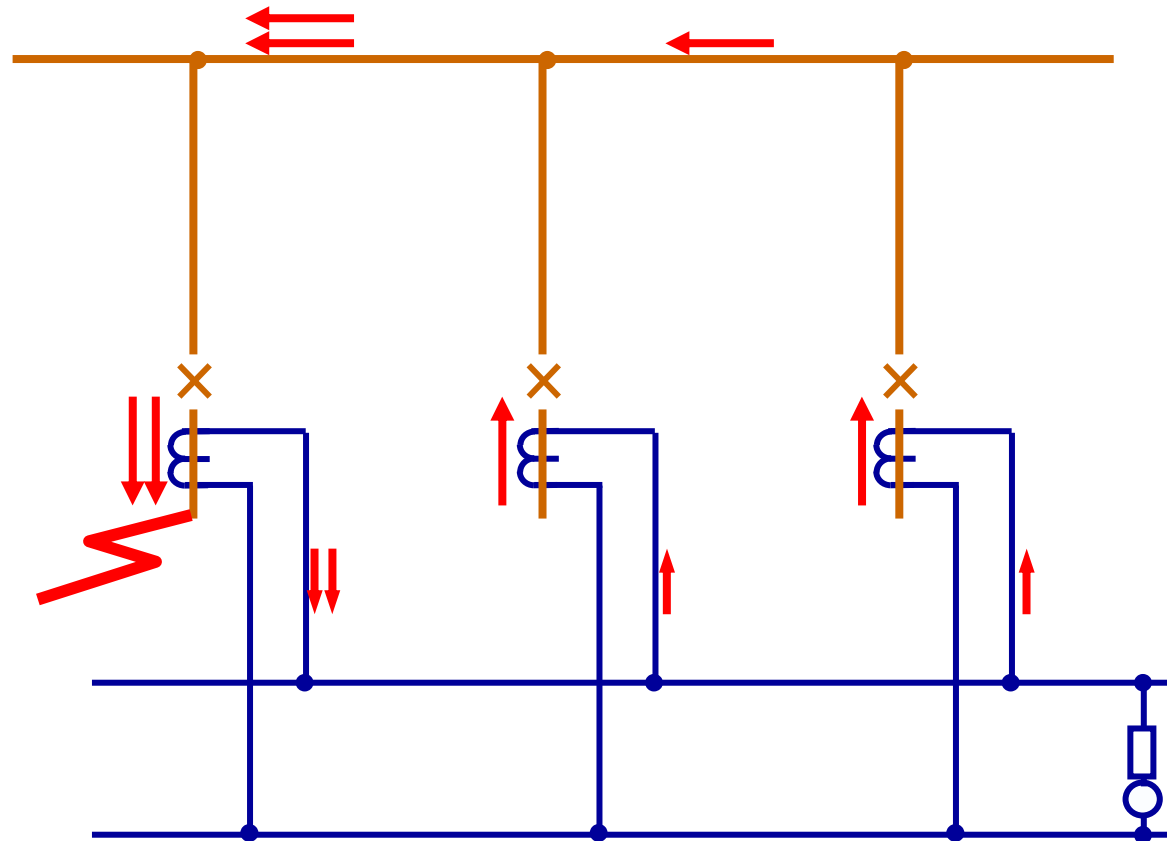
Single Bus Substation



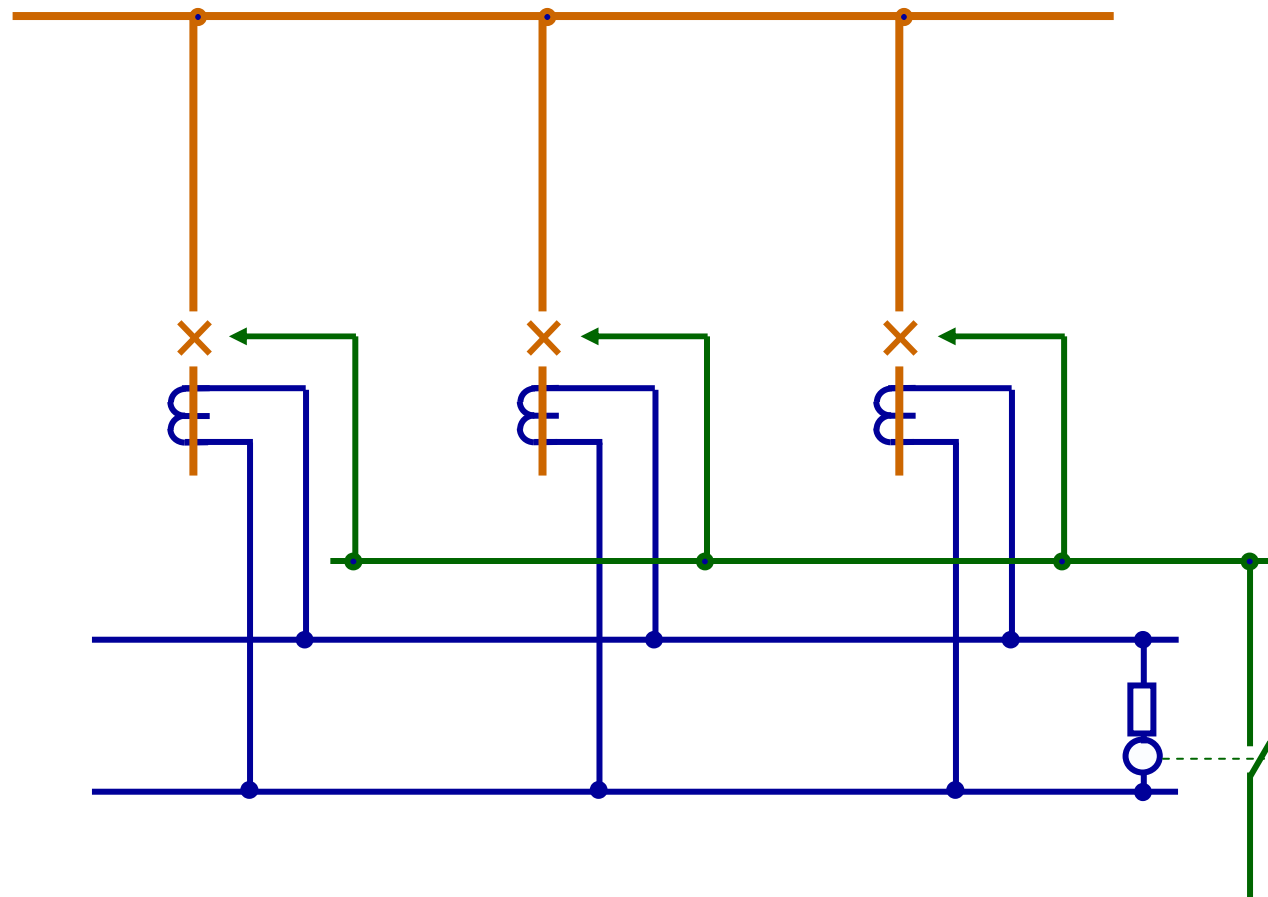
Single Bus Substation



Single Bus Substation



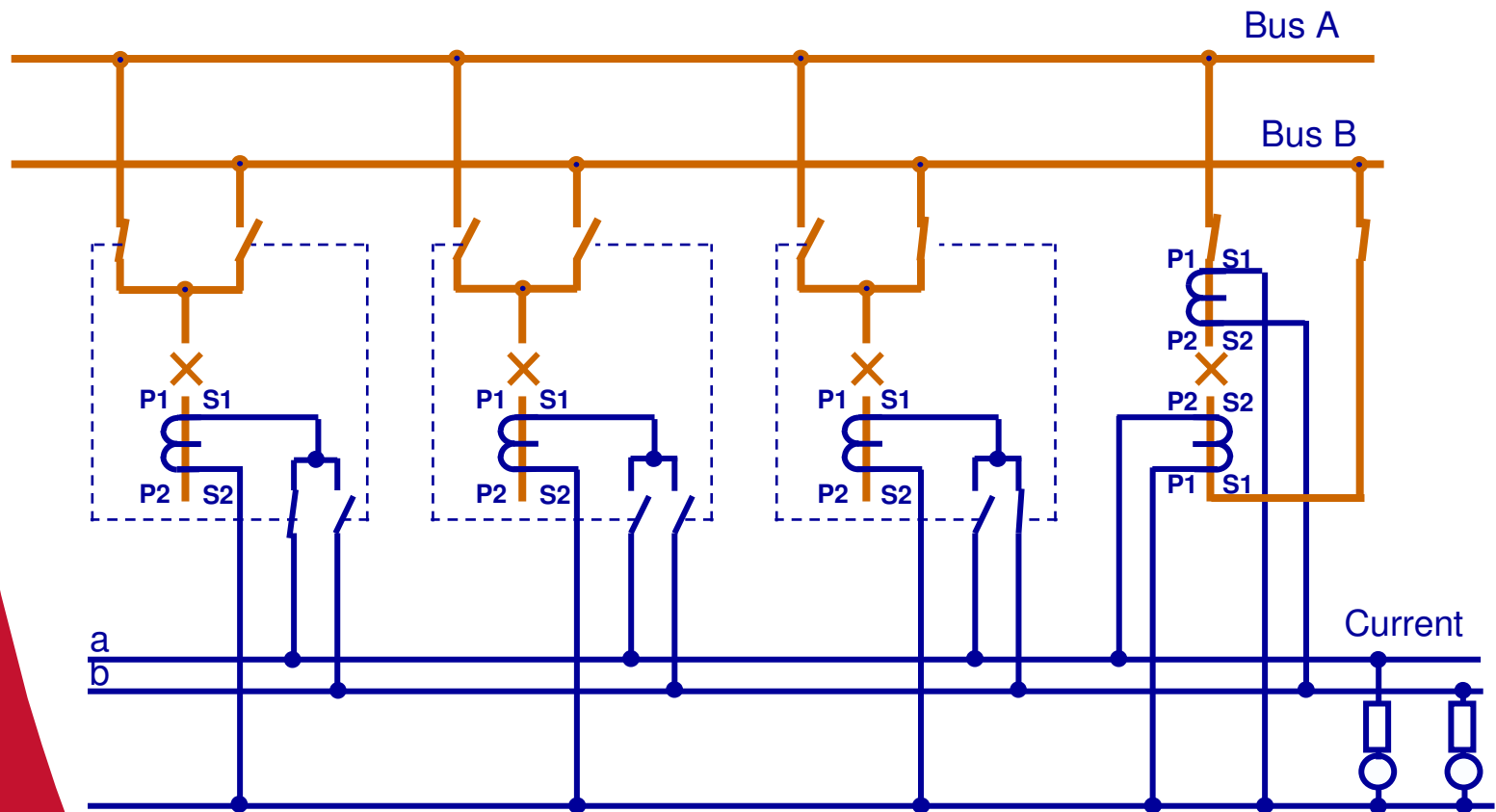
Single Bus Substation



Double Bus Substation

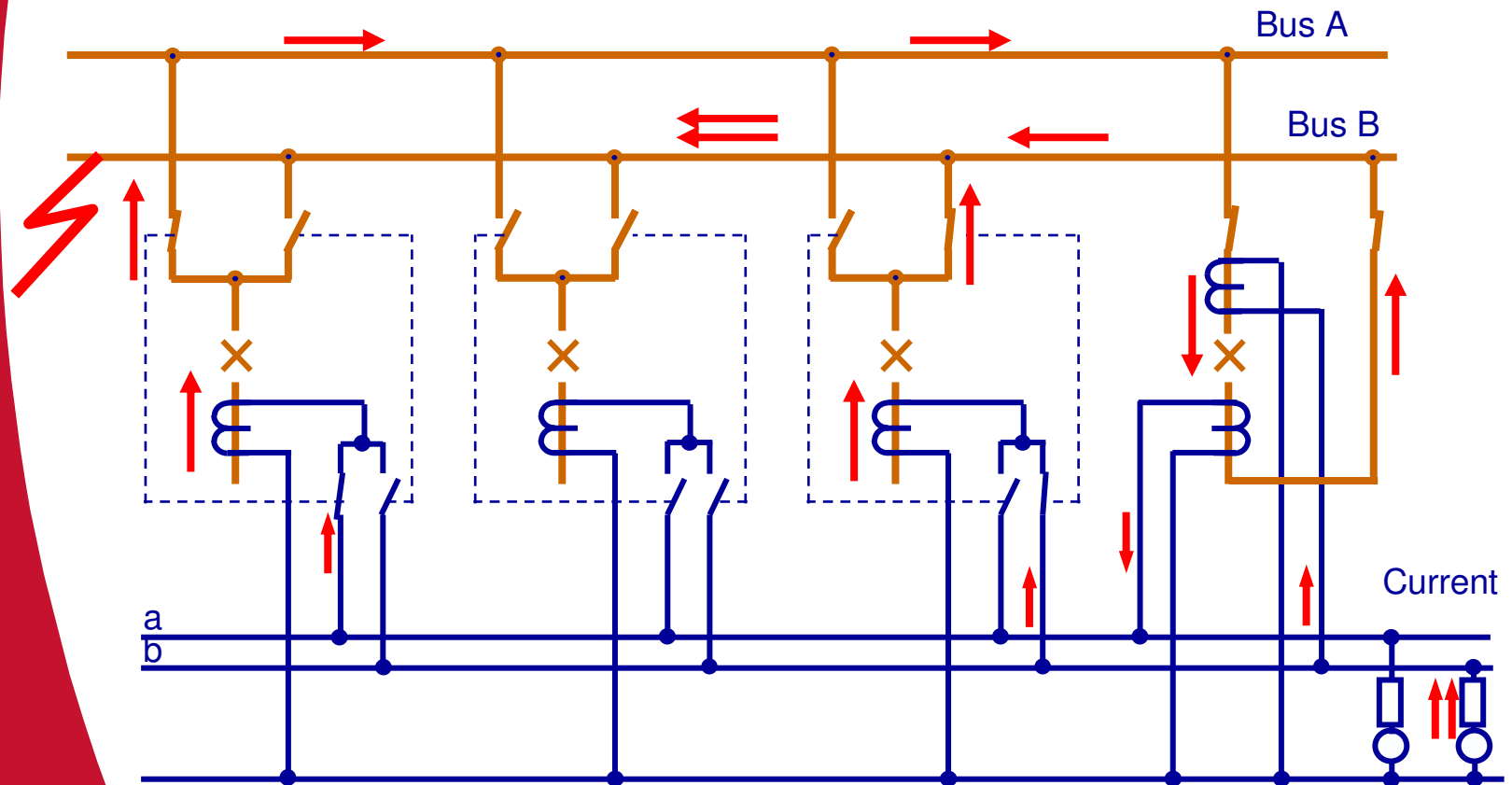
Isolator Auxiliary Switches

Current switching



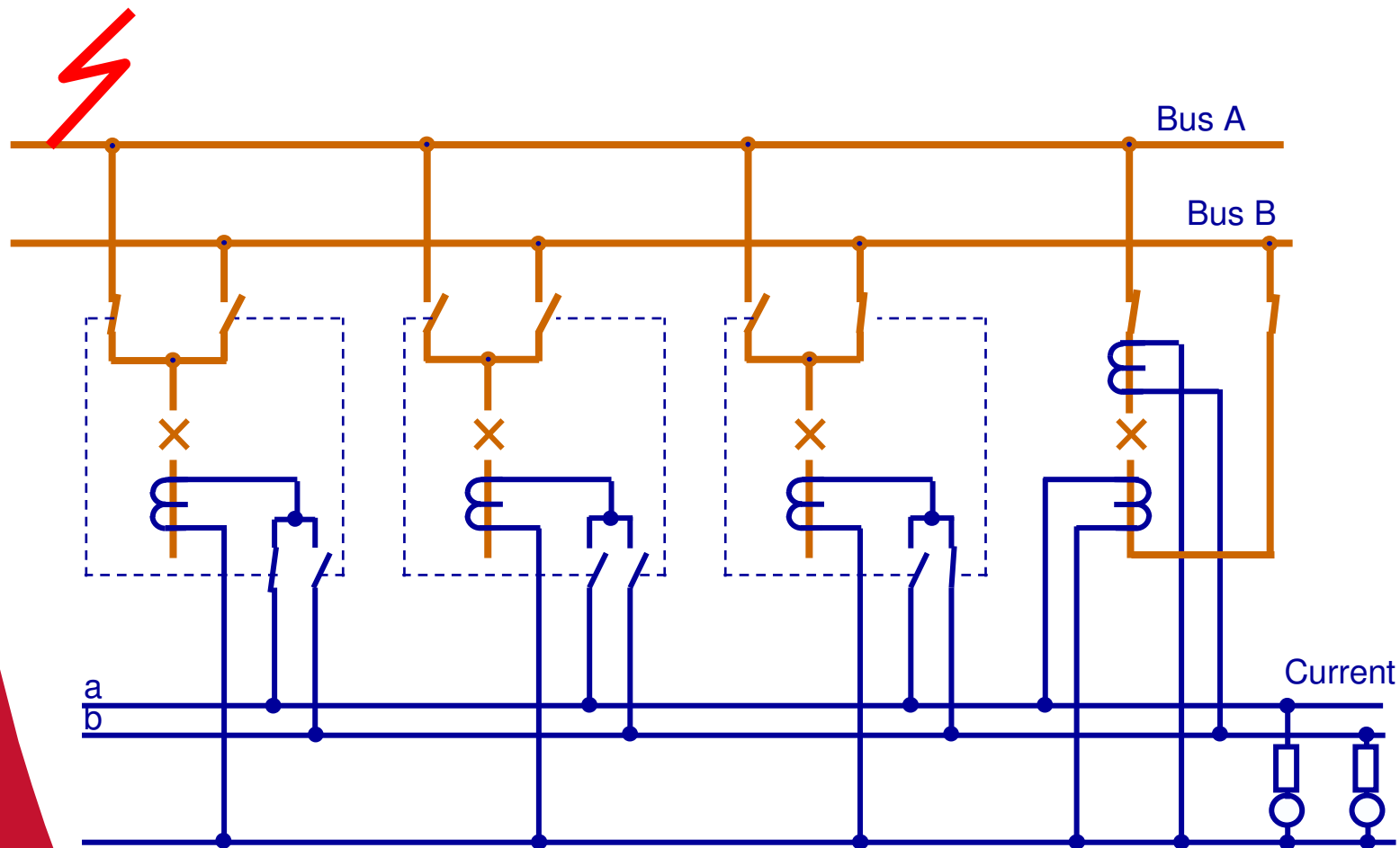
Isolator Auxiliary Switches

Current switching



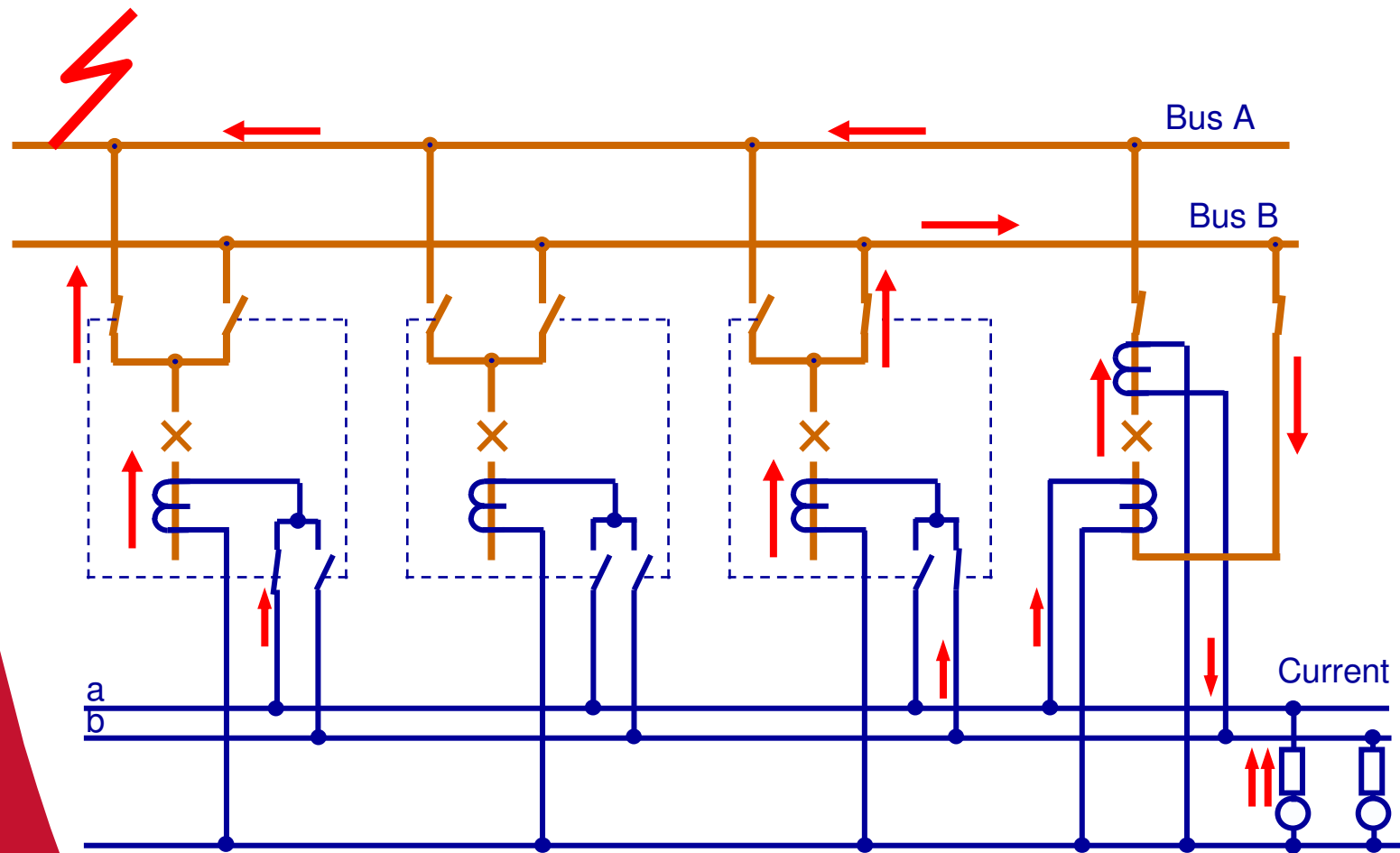
Isolator Auxiliary Switches

Current switching



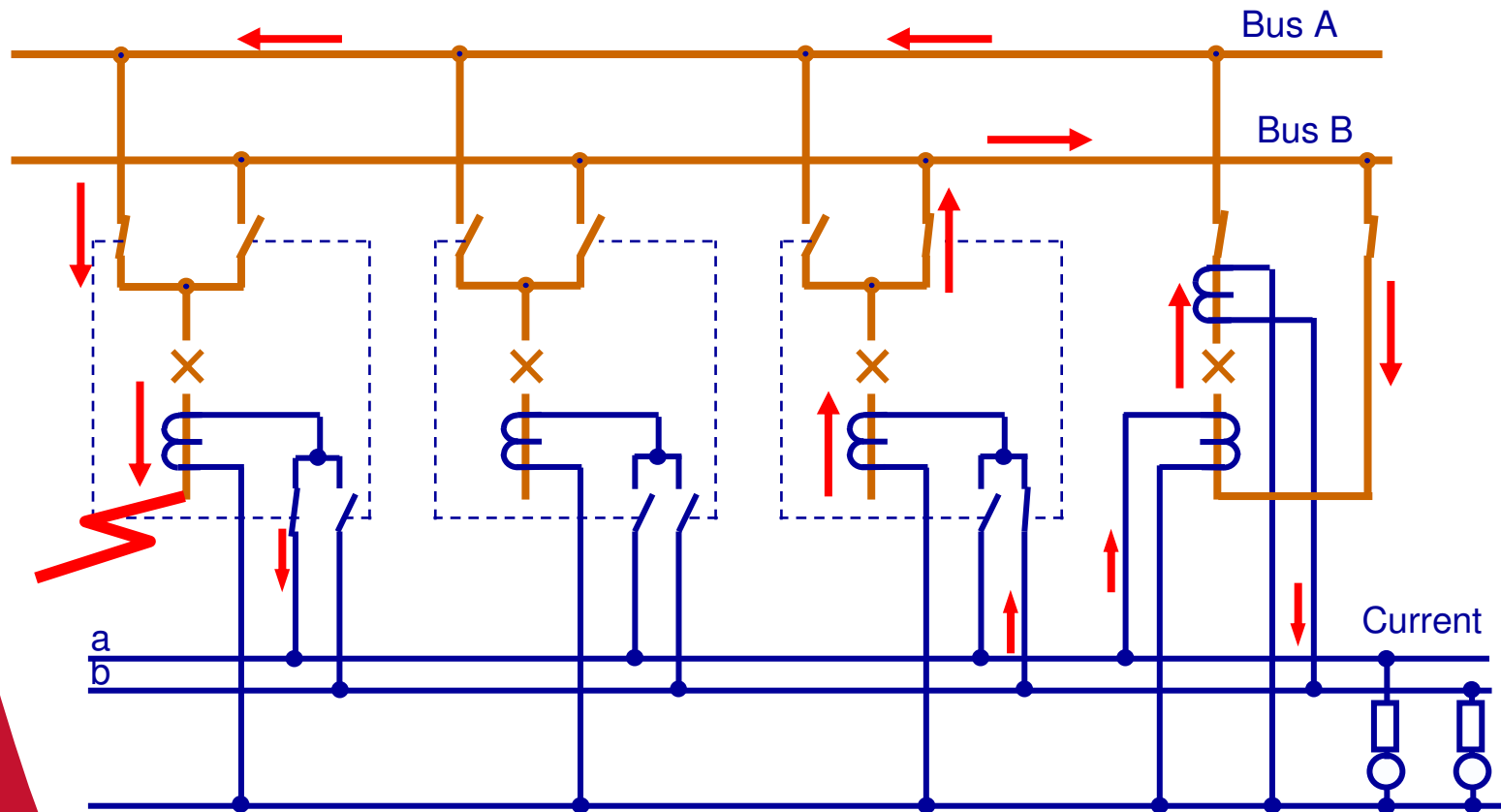
Isolator Auxiliary Switches

Current switching



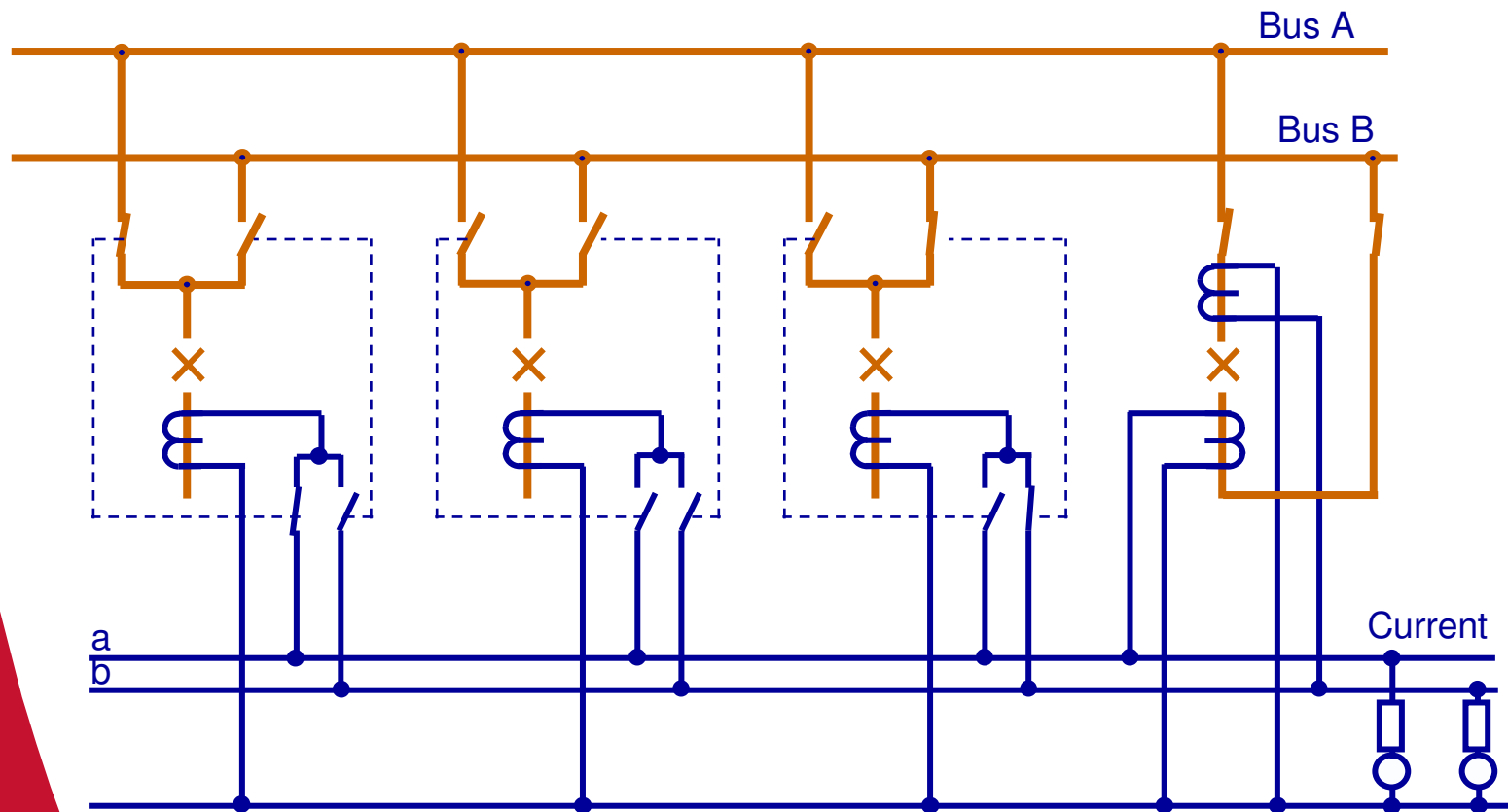
Isolator Auxiliary Switches

Current switching



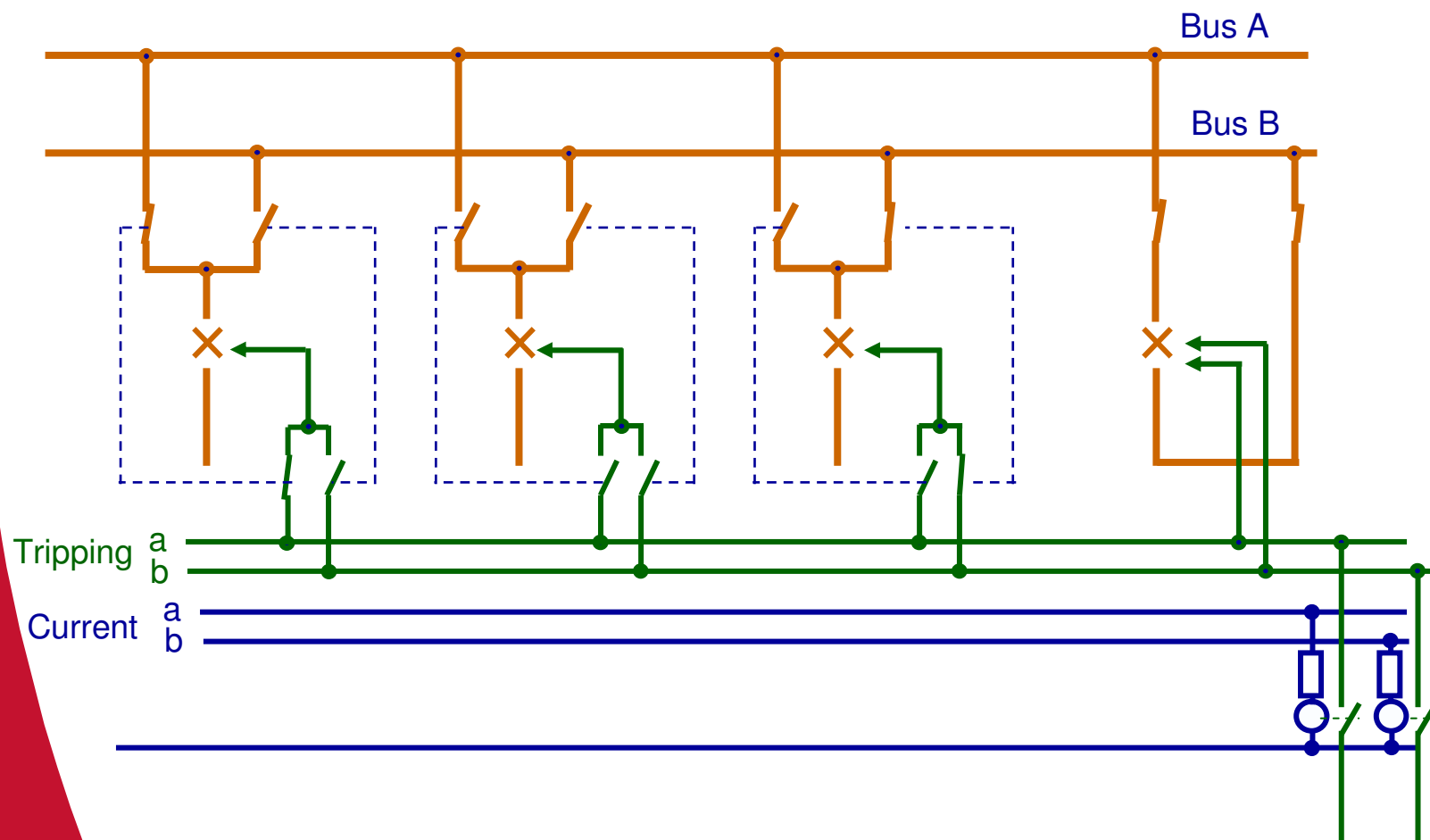
Isolator Auxiliary Switches

Current switching



Isolator Auxiliary Switches

Tripping switching



Interposing CT are not acceptable

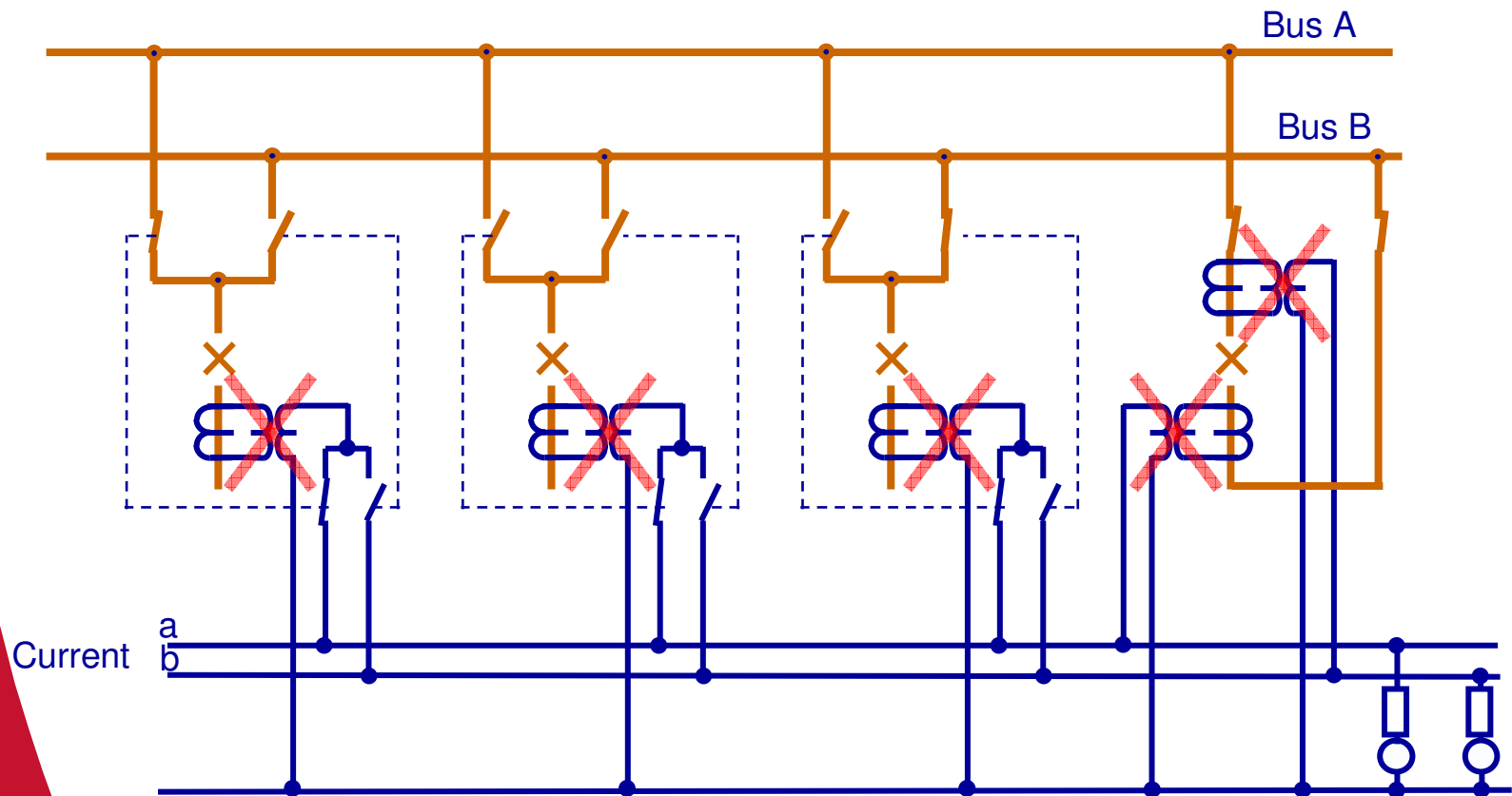
- Main CT must be identical
- Current switching via auxiliary relay is not acceptable.



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

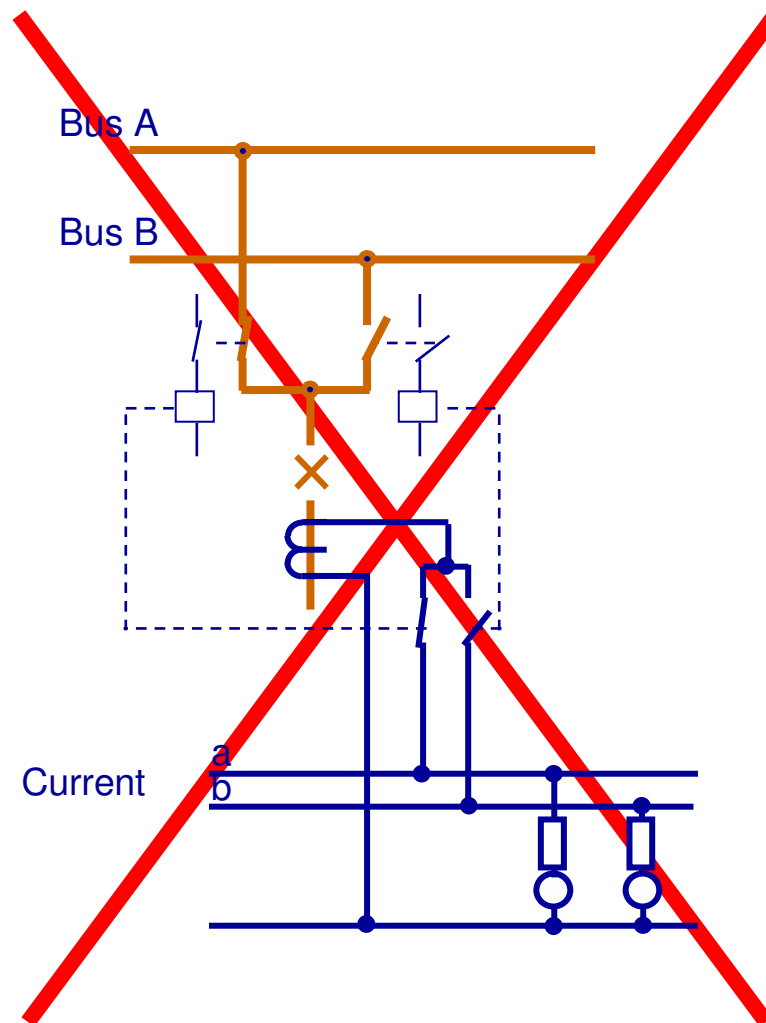
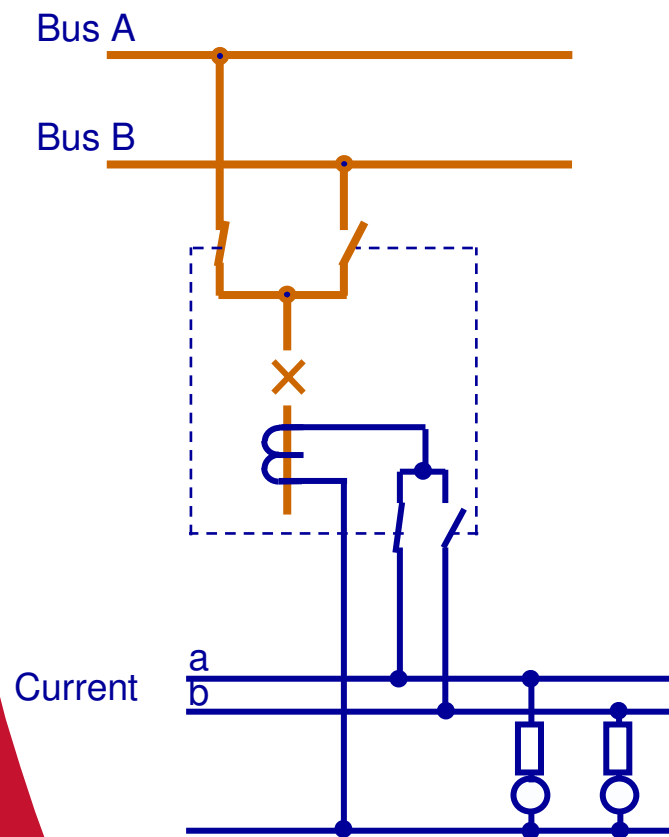
Isolator Auxiliary Switches

Current switching

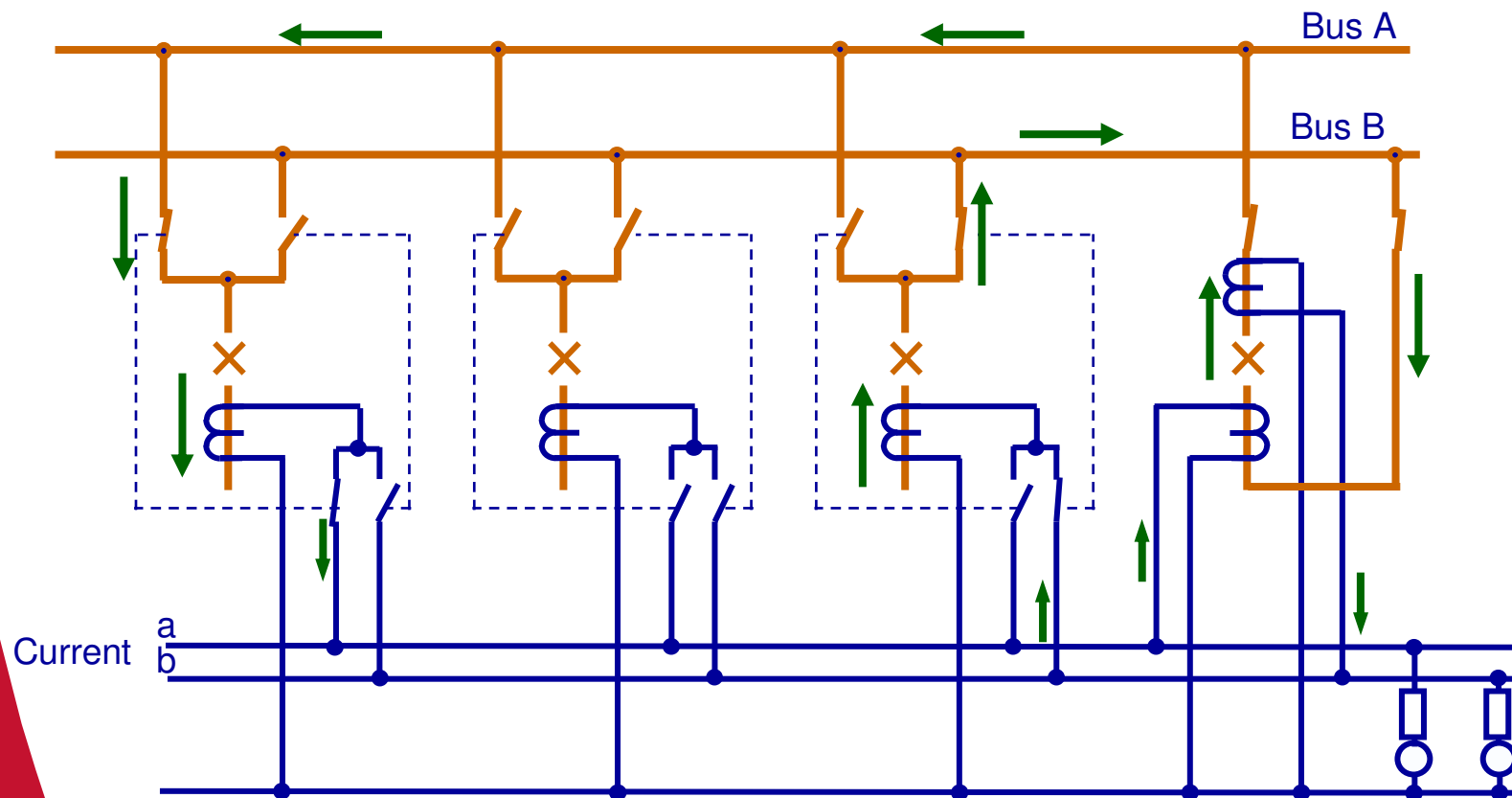


Isolator Auxiliary Switches

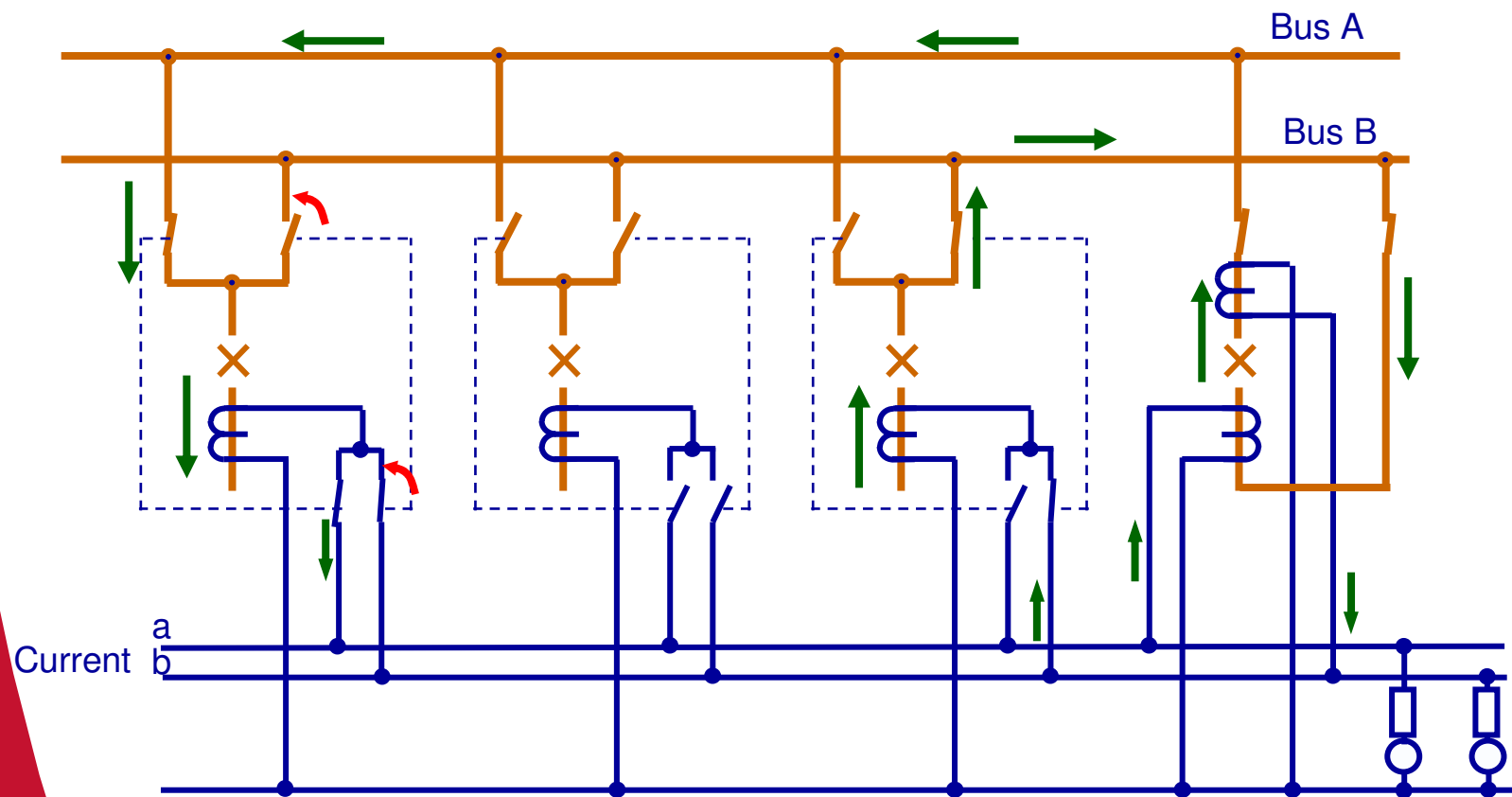
Current switching



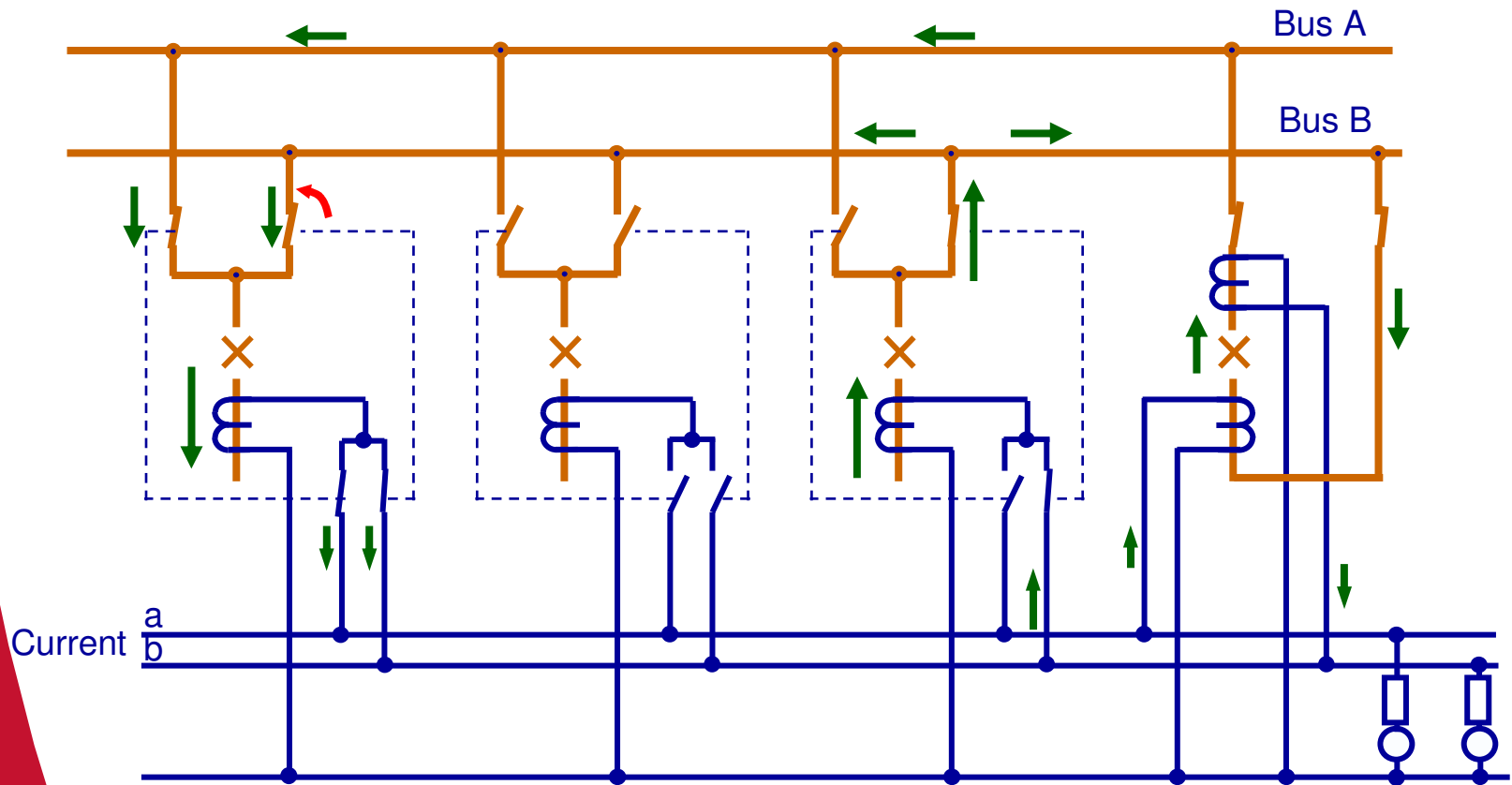
Isolator Auxiliary Switches On Load Transfer



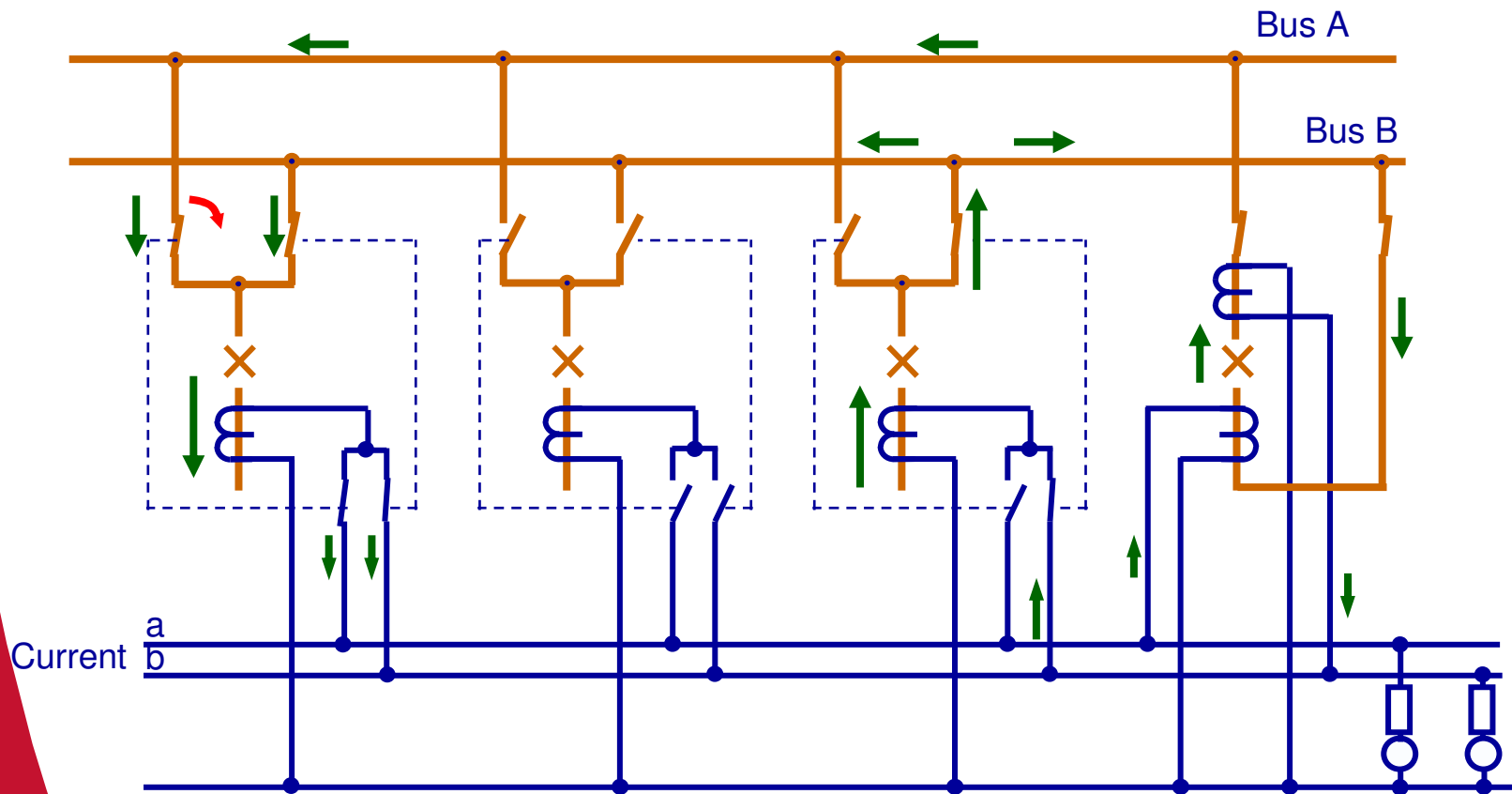
Isolator Auxiliary Switches On Load Transfer



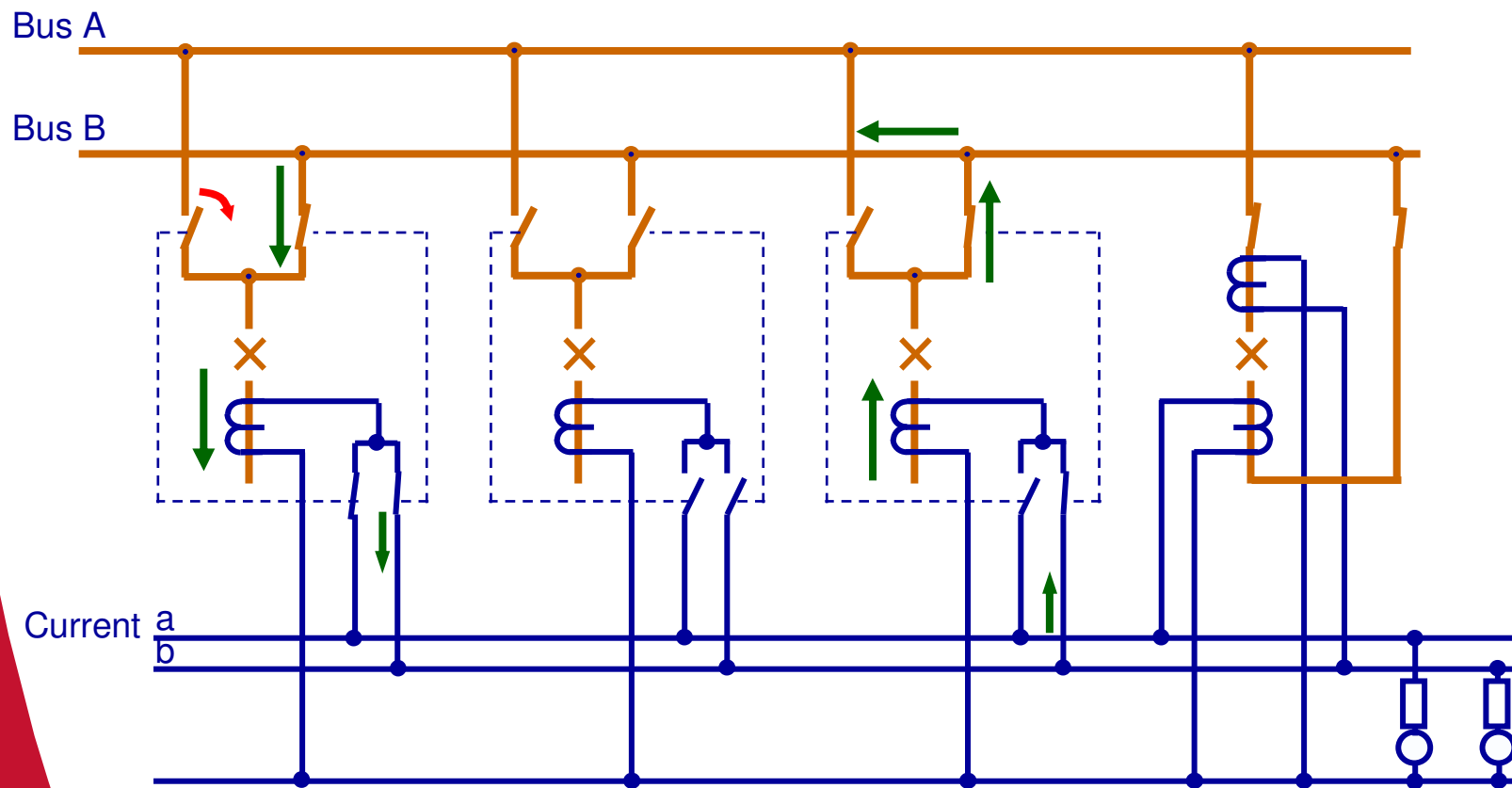
Isolator Auxiliary Switches On Load Transfer



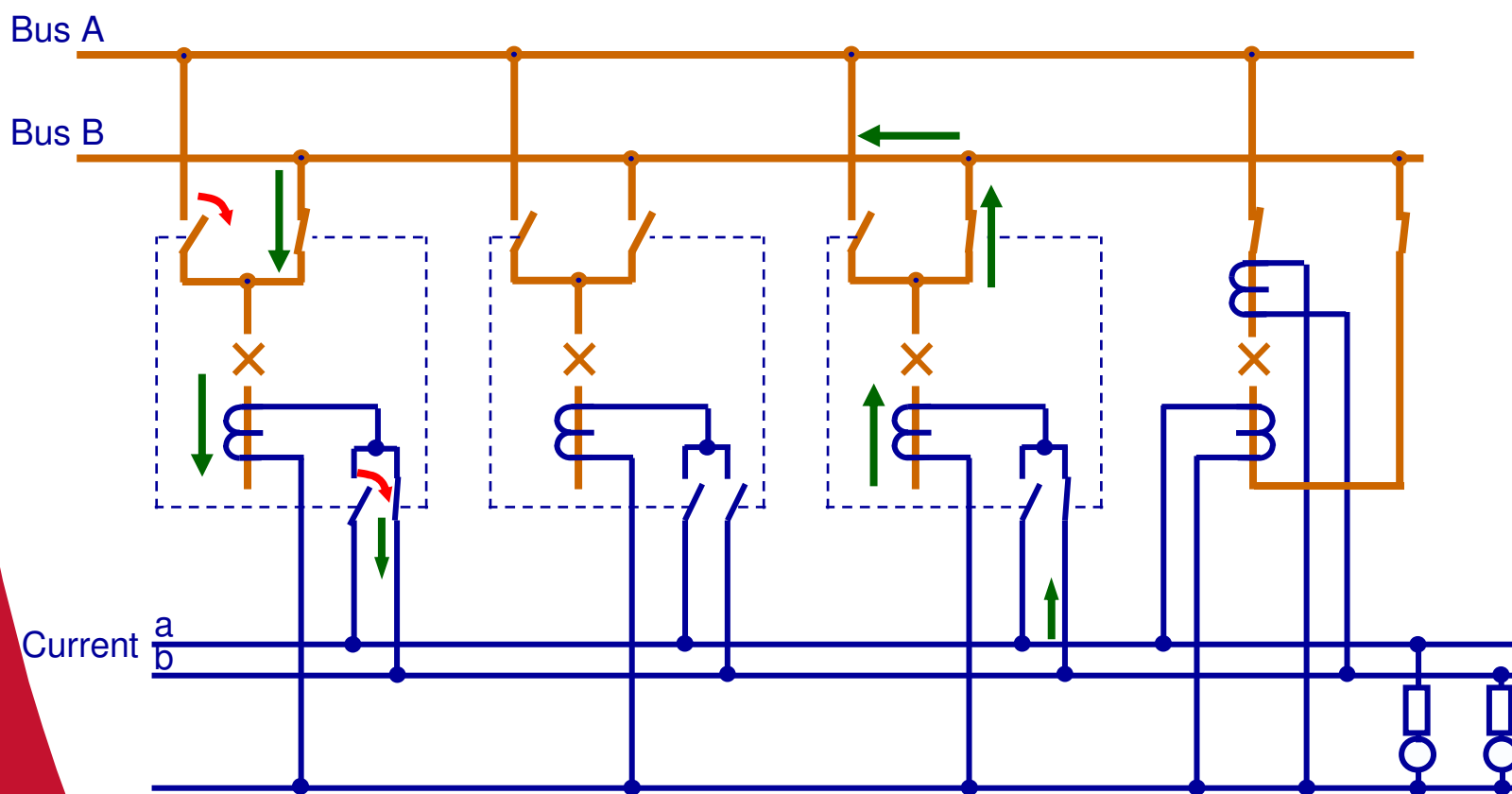
Isolator Auxiliary Switches On Load Transfer



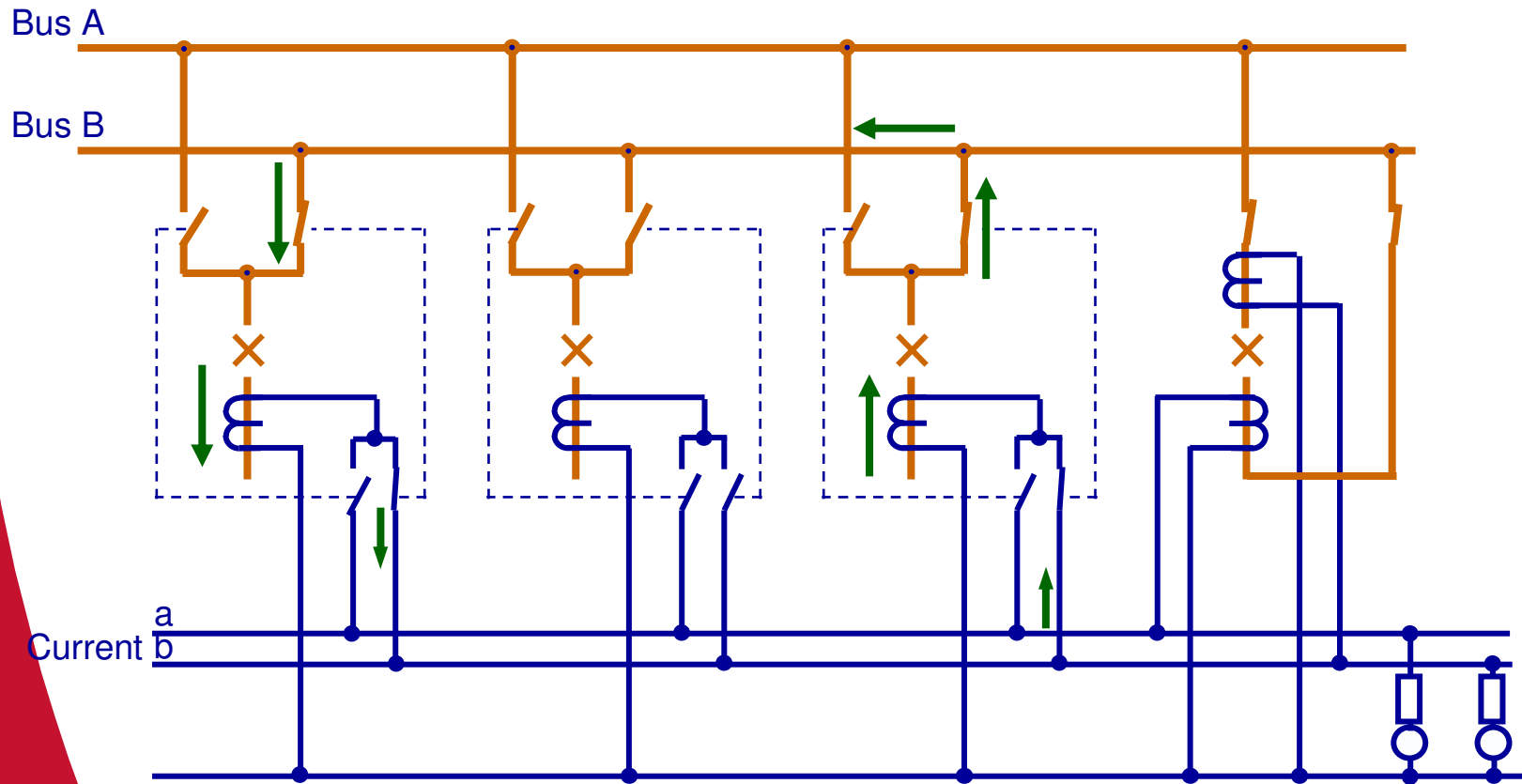
Isolator Auxiliary Switches On Load Transfer



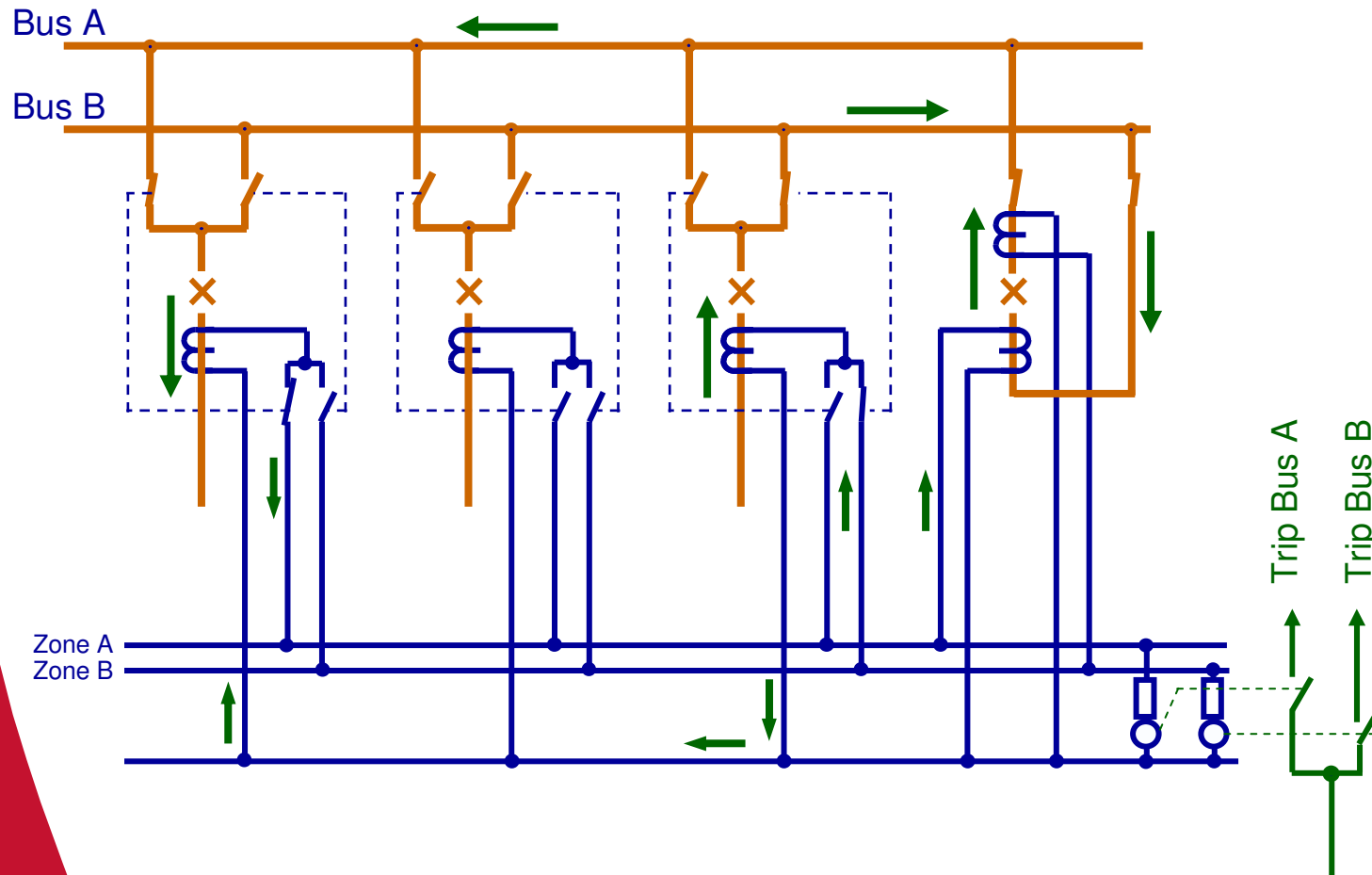
Isolator Auxiliary Switches On Load Transfer



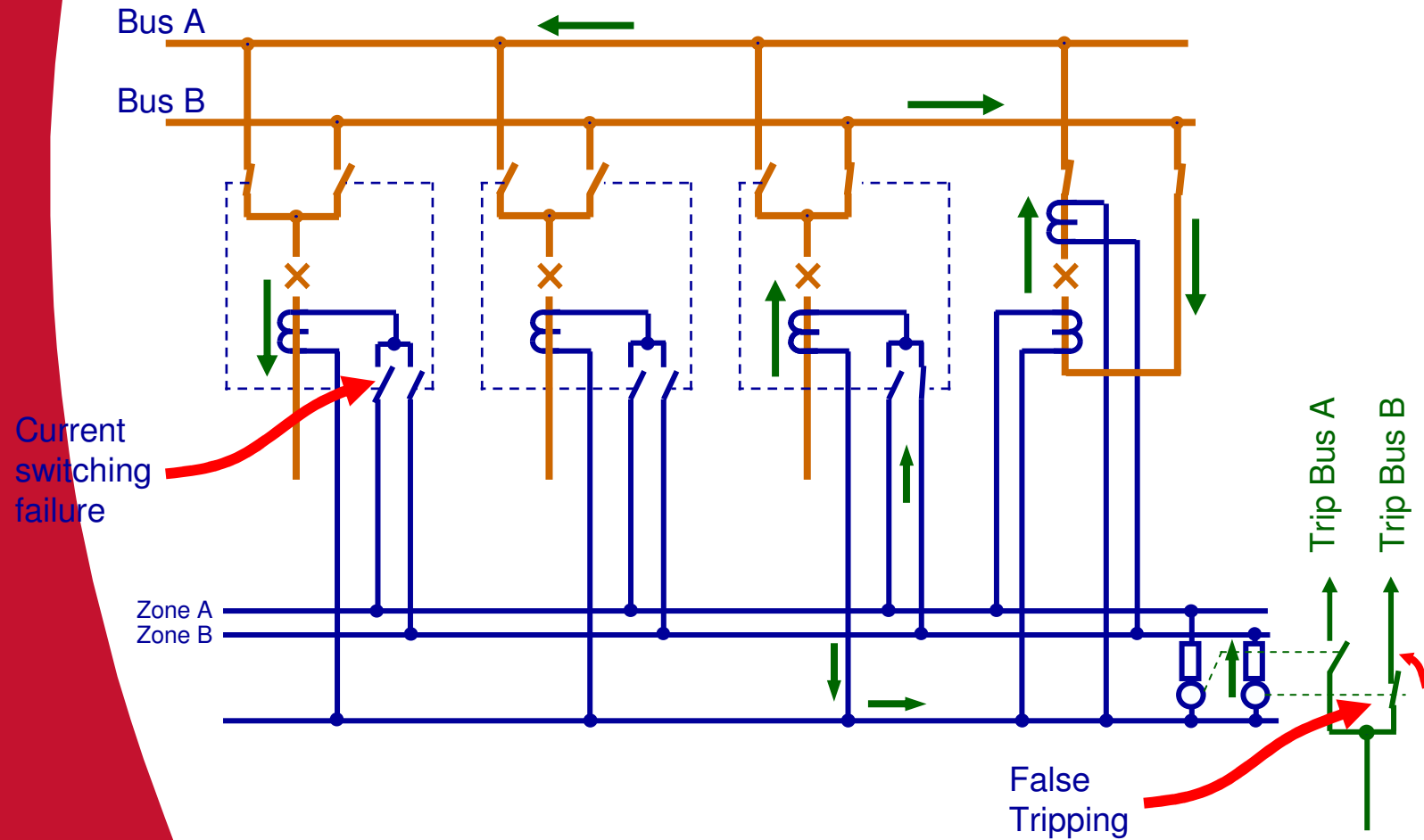
Isolator Auxiliary Switches On Load Transfer



Isolator Auxiliary Switches Check Zone

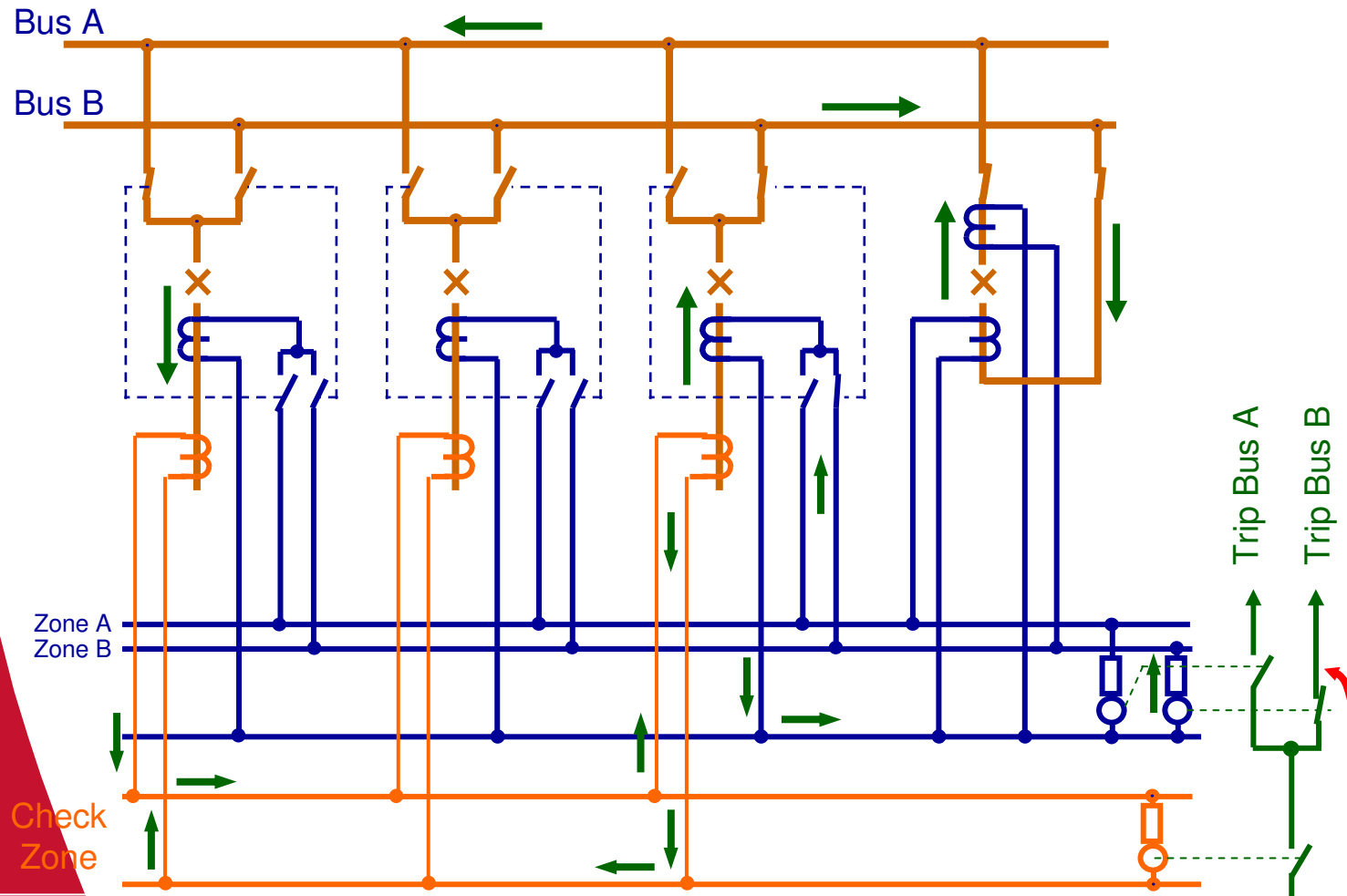


Isolator Auxiliary Switches Check Zone

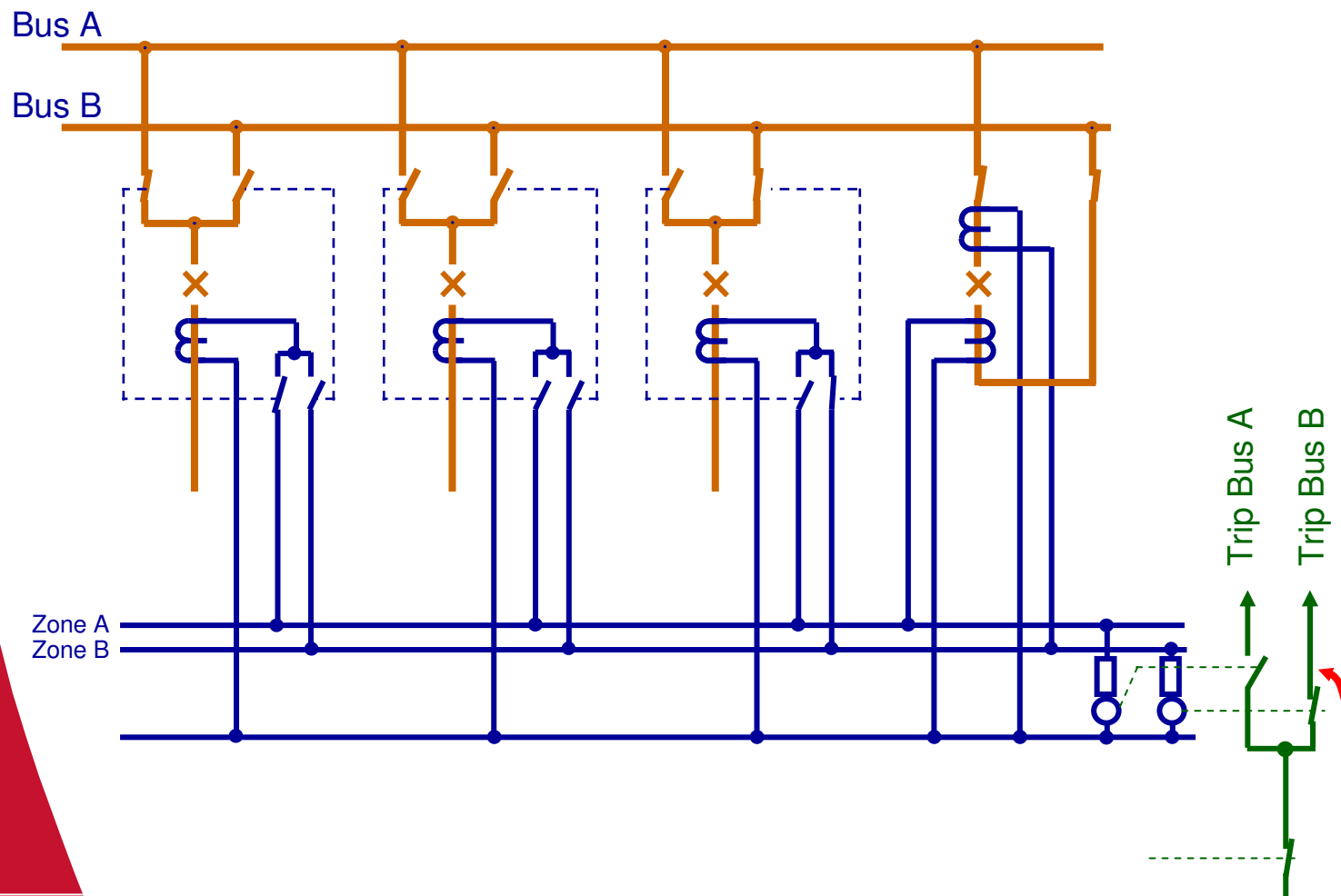


Isolator Auxiliary Switches

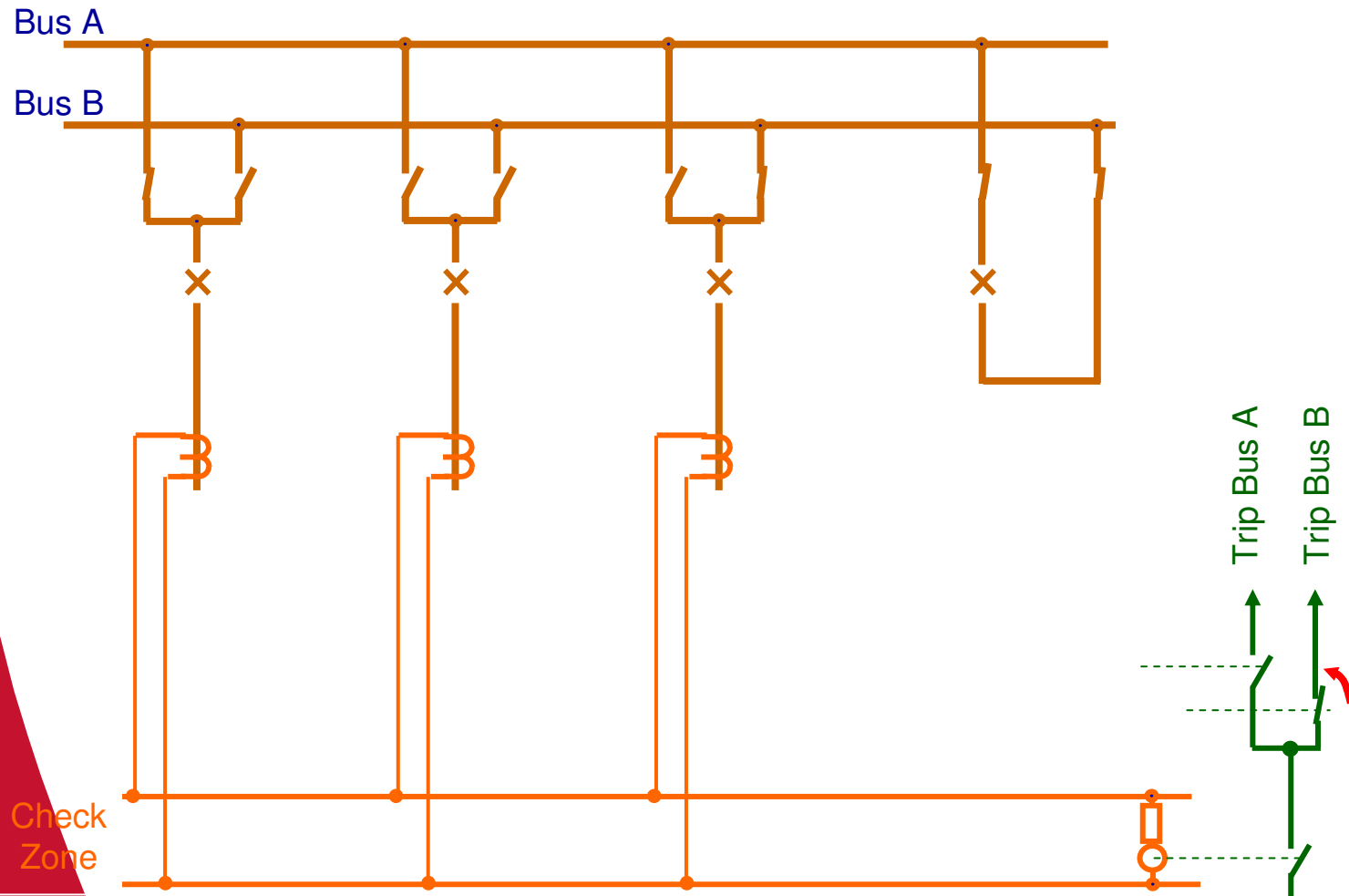
Check Zone



Isolator Auxiliary Switches Check Zone



Isolator Auxiliary Switches Check Zone



One Breaker and a Half Substation

