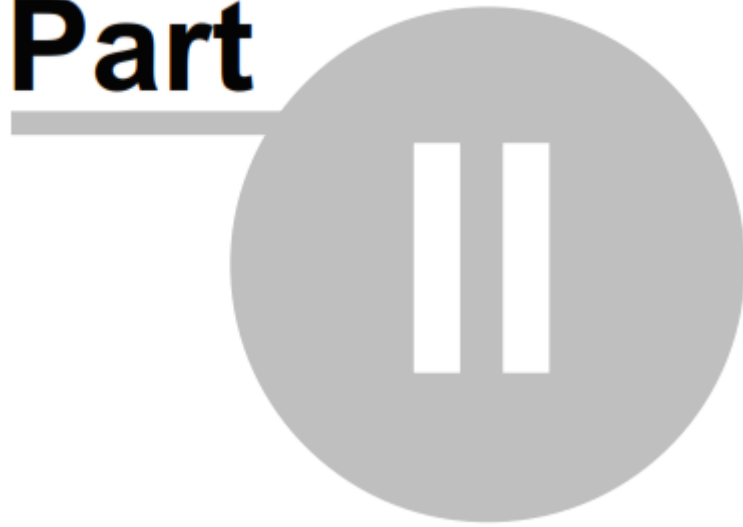


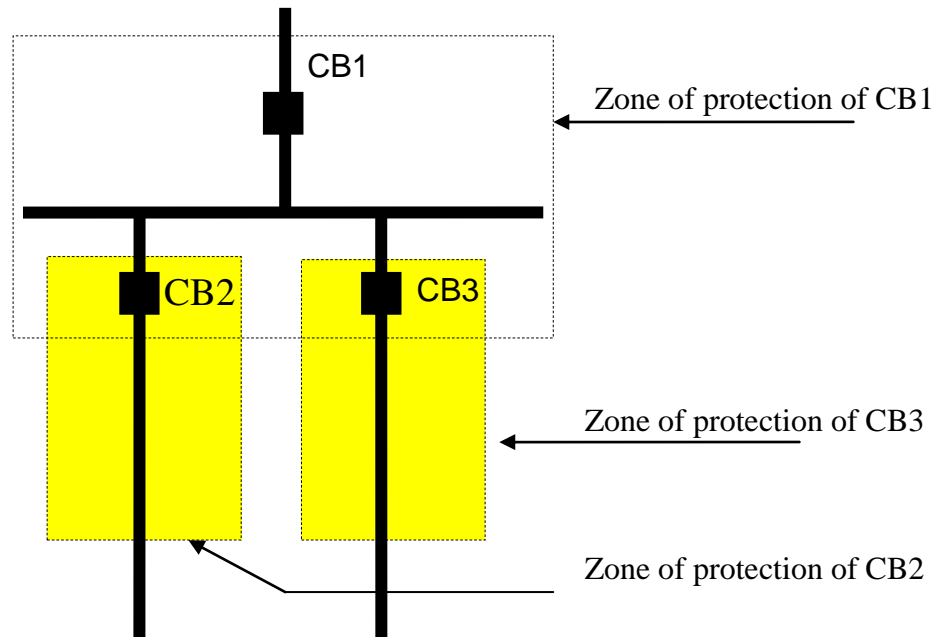
**Part**



# **Zones of Protection**

## Zones of protection

Zone of protection of a relay is the place or the distance that the relay can protect easily. Fig.1 shows an example of protection zones for three circuit breakers. It is to be noted that the protection zones are overlapped.

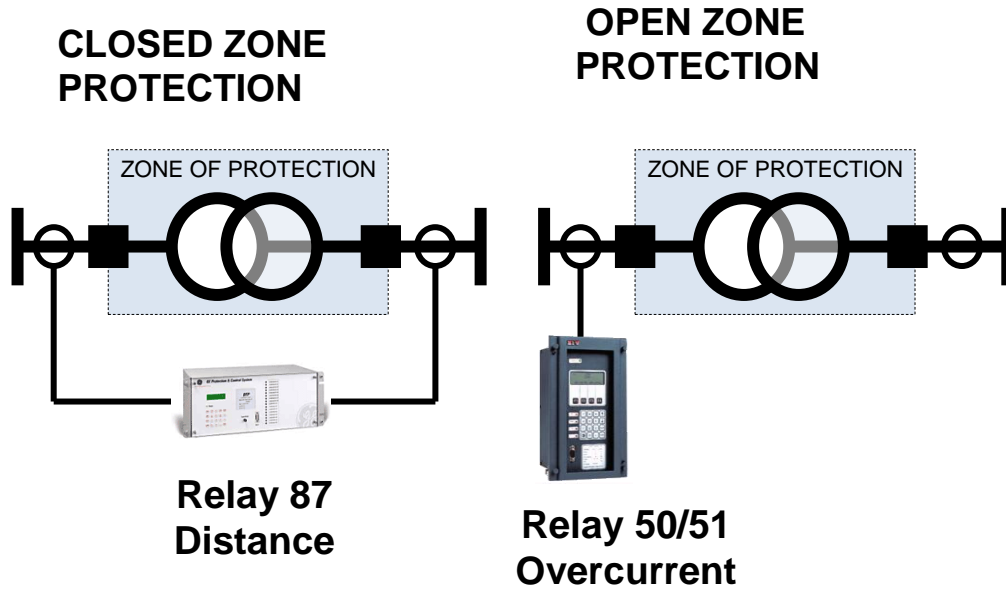


In power systems, all power system elements must be encompassed by at least one zone

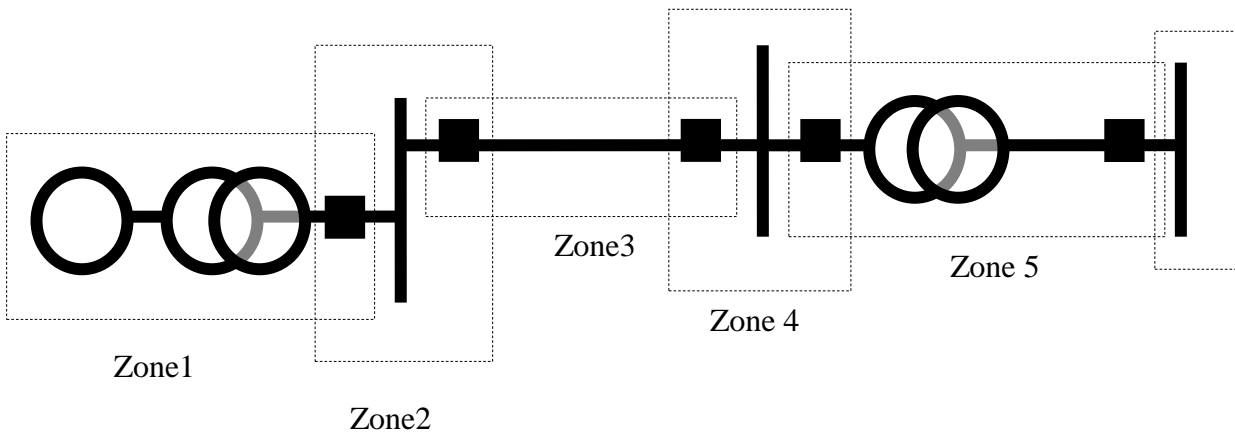
- The more important elements must be included in at least two zones
- Zones must overlap to prevent any element from being unprotected.
- The overlap must be finite but small to minimize the likelihood of a fault inside this region.
- A zone boundary is usually defined by a CT and a CB.
- *The CT provides the ability to detect a fault inside the zone*
- *The CBs provide the ability to isolate the fault.*

<b>Power System protection</b>	<b>Dr. Mohamad Tawfeeq</b>
<b>Zones of Protection</b>	

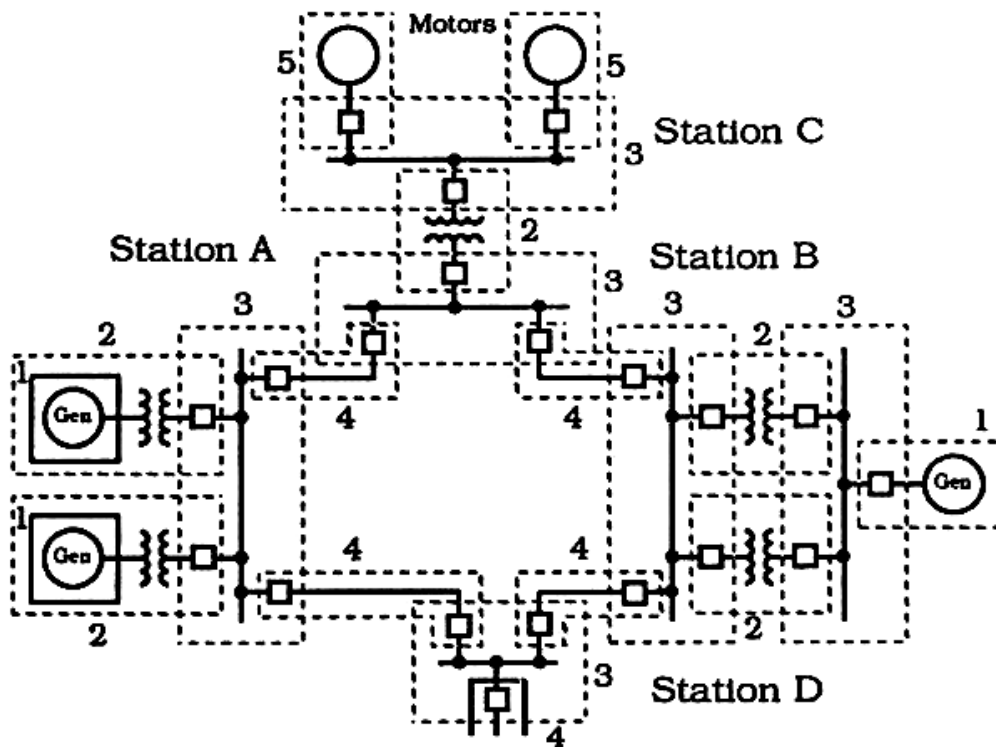
**CLOSED AND OPEN PROTECTION ZONES**



**Primary Zones of protection**



## Primary protection in power systems



**Primary protection zones for a typical power system**

<b>Power System protection</b>	<b>Dr. Mohamad Tawfeeq</b>
<b>Zones of Protection</b>	

## Backup protection

- It is essential that provision be made to clear the fault by some alternative protection system in case of the primary protection fails to operate. These are referred to as backup protection systems
- Ideally primary and backup are independent (relay,breaker,CT,PT)
- Slower than primary
- Sometimes backup protection opens more circuit breakers than absolutely necessary to clear the fault
- Provide primary protection when usual primary equipment out of service

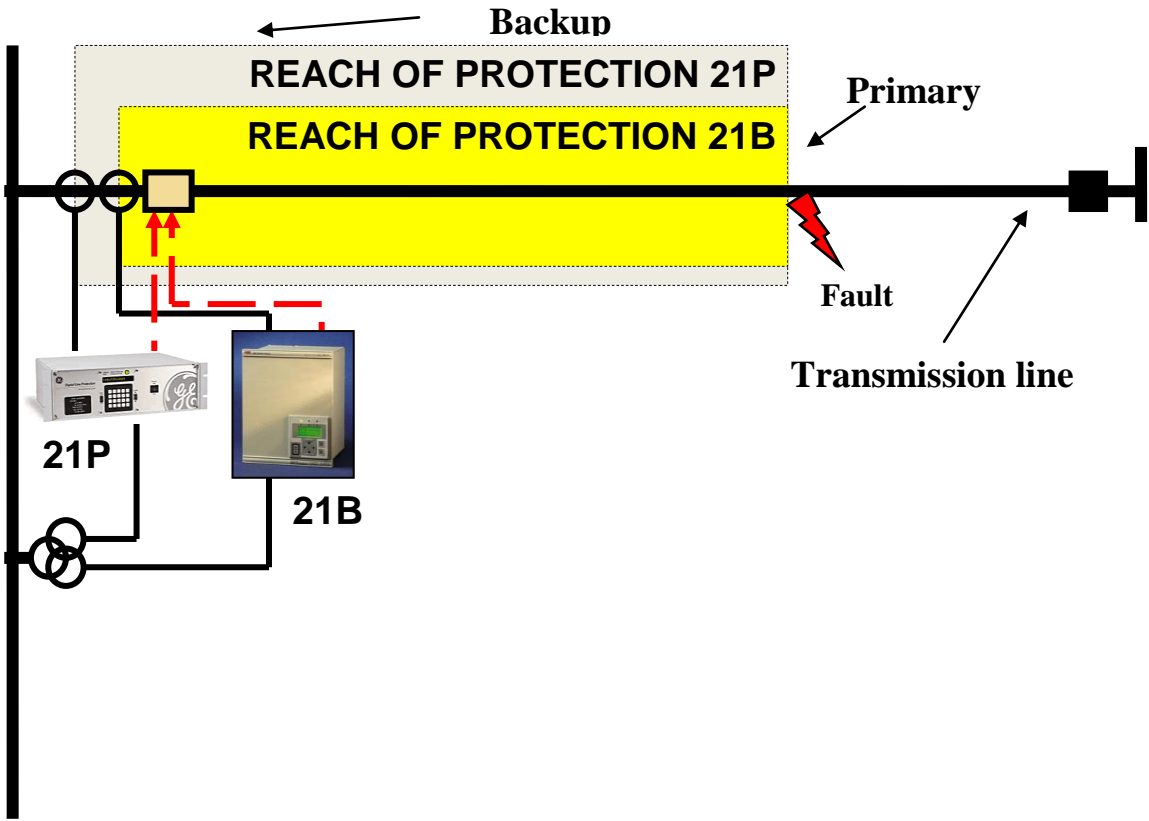
# Two Types of Backup Protection

Back up relaying may be installed locally, in the same substation, or remote in other substations or places:

- Local backup : Clears fault in the same station where the failure has occurred
- Remote backup : Clears fault on station away from where the failure has occurred

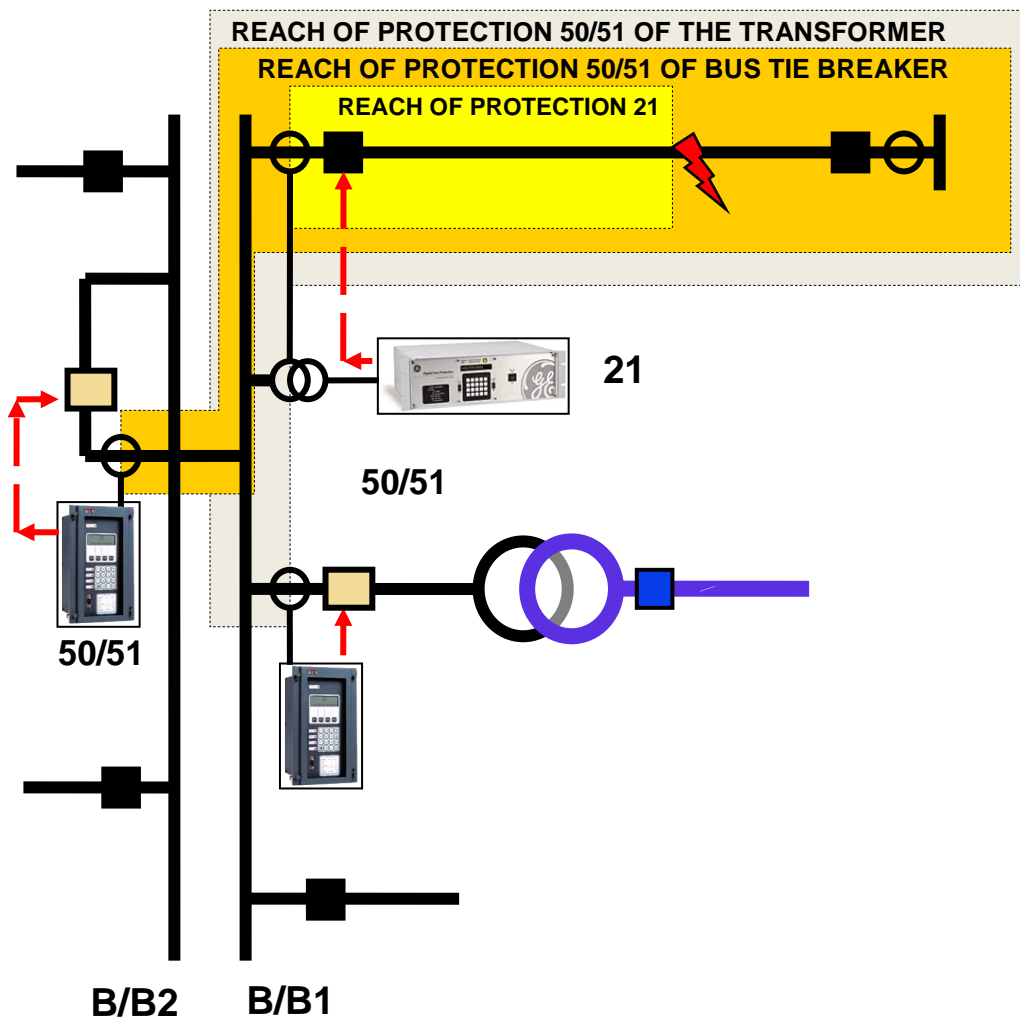
<b>Power System protection</b>	<b>Dr. Mohamad Tawfeeq</b>
<b>Zones of Protection</b>	

# Primary and Back up protection at the same location ( Local Backup)



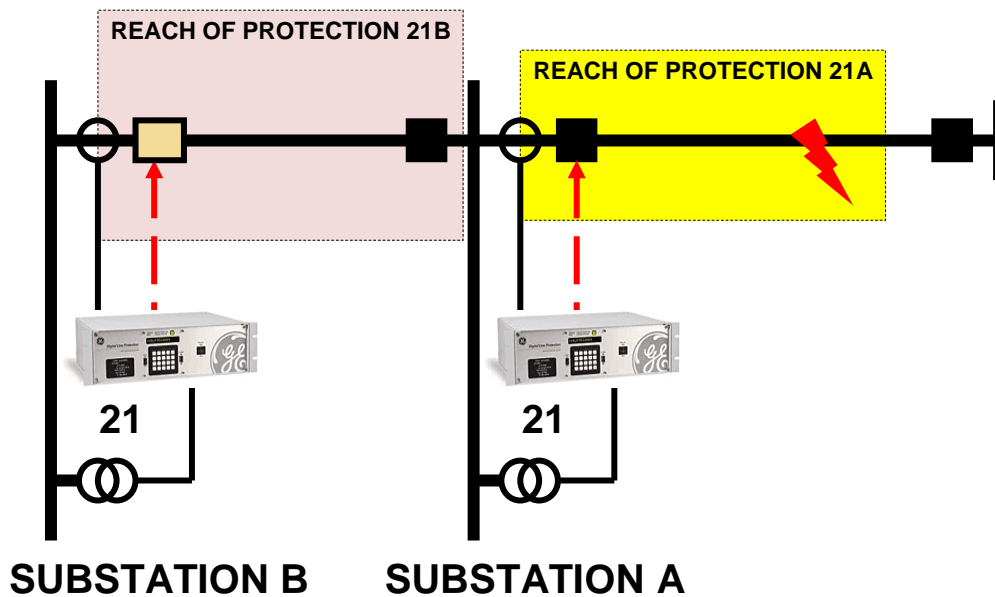
<b>Power System protection</b>	<b>Dr. Mohamad Tawfeeq</b>
<b>Zones of Protection</b>	

## Local backup protection at different locations





## Remote back up protection

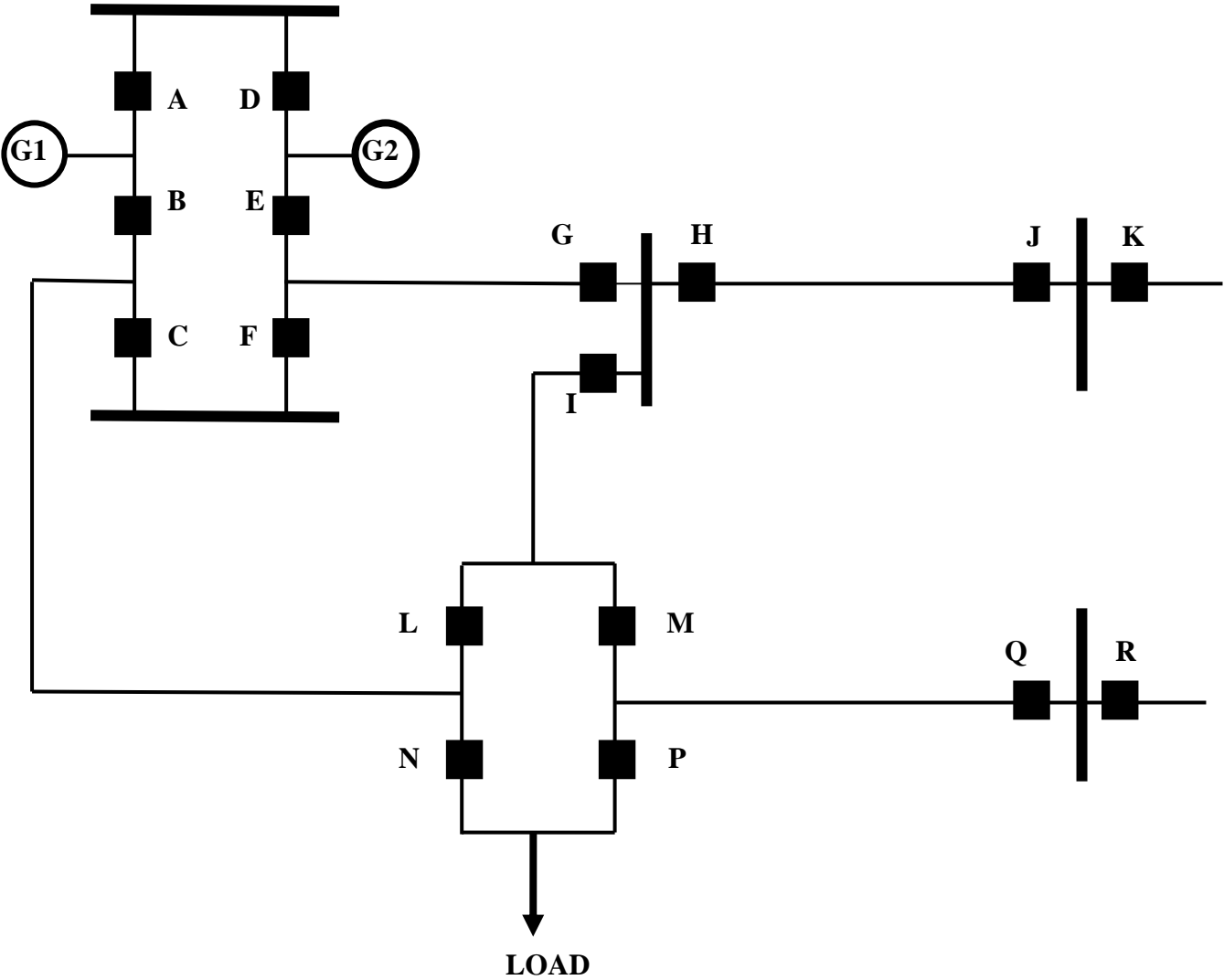


### ■ Selectivity and zones of protection

Selectivity is defined in terms of regions of a power system (zones of protection) for which a given relay is responsible.

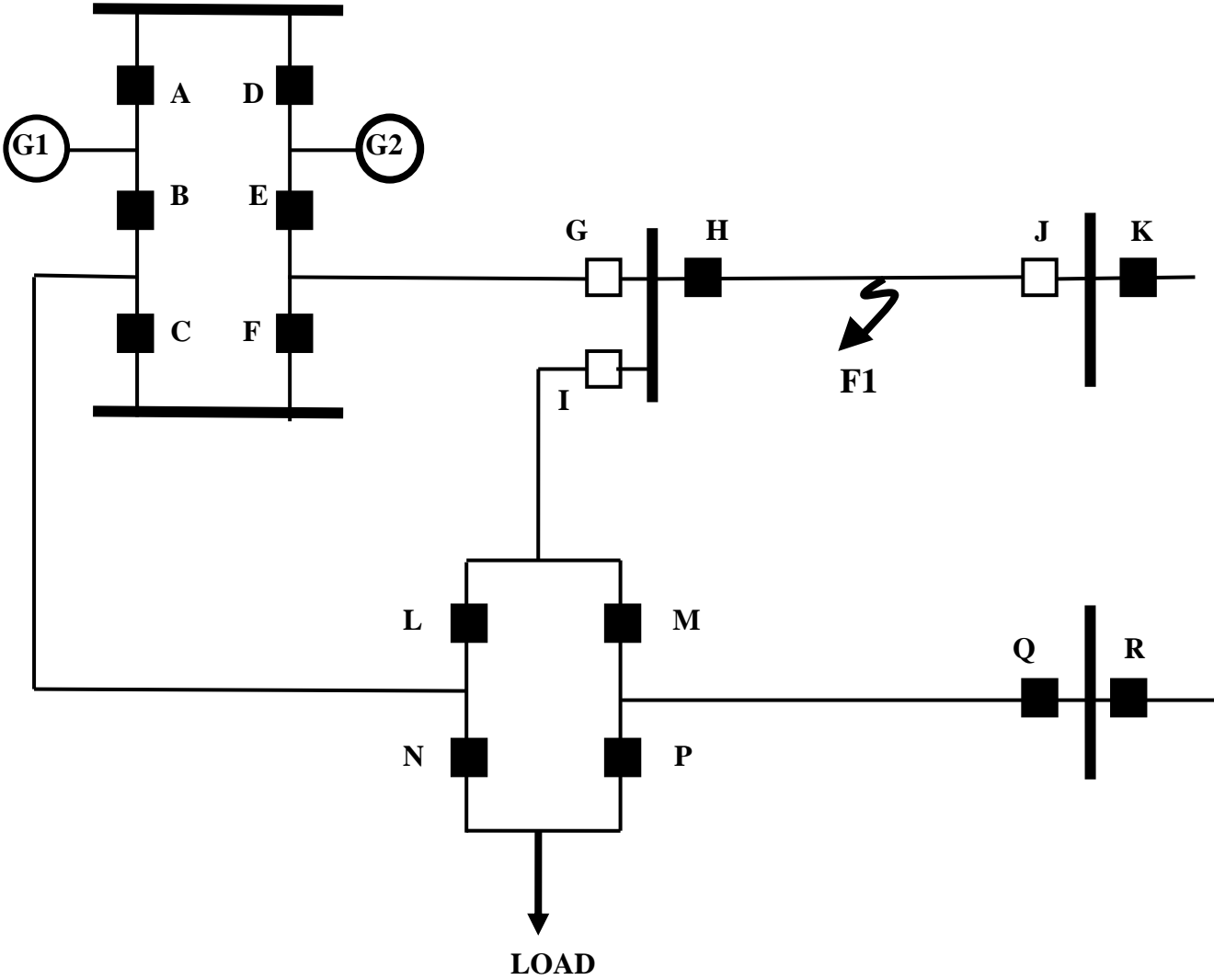
- The relay will be considered **secure** if it responds only to faults within its zone of protection

**Example : Consider the following simple power system:**



Discuss the local and remote backup protection for two fault locations as follows:

# Case 1: Local Backup



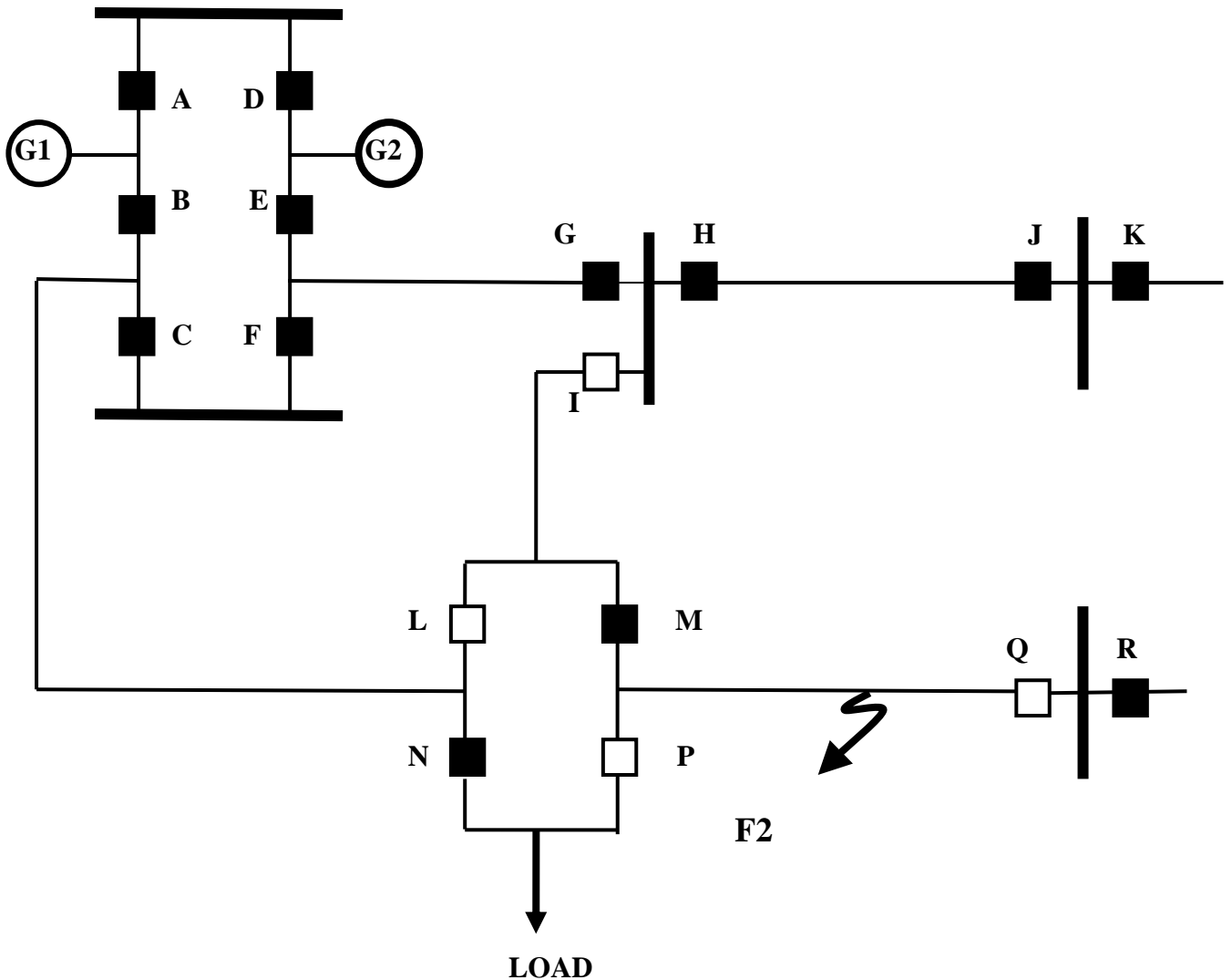
Breaker closed       Breaker opened

For fault at F1: Suppose that breaker J operate and breaker H failed to operate.

Therefore:

G and I must operate as **local backup** protection

## Case 2: Local Backup



■ Breaker closed



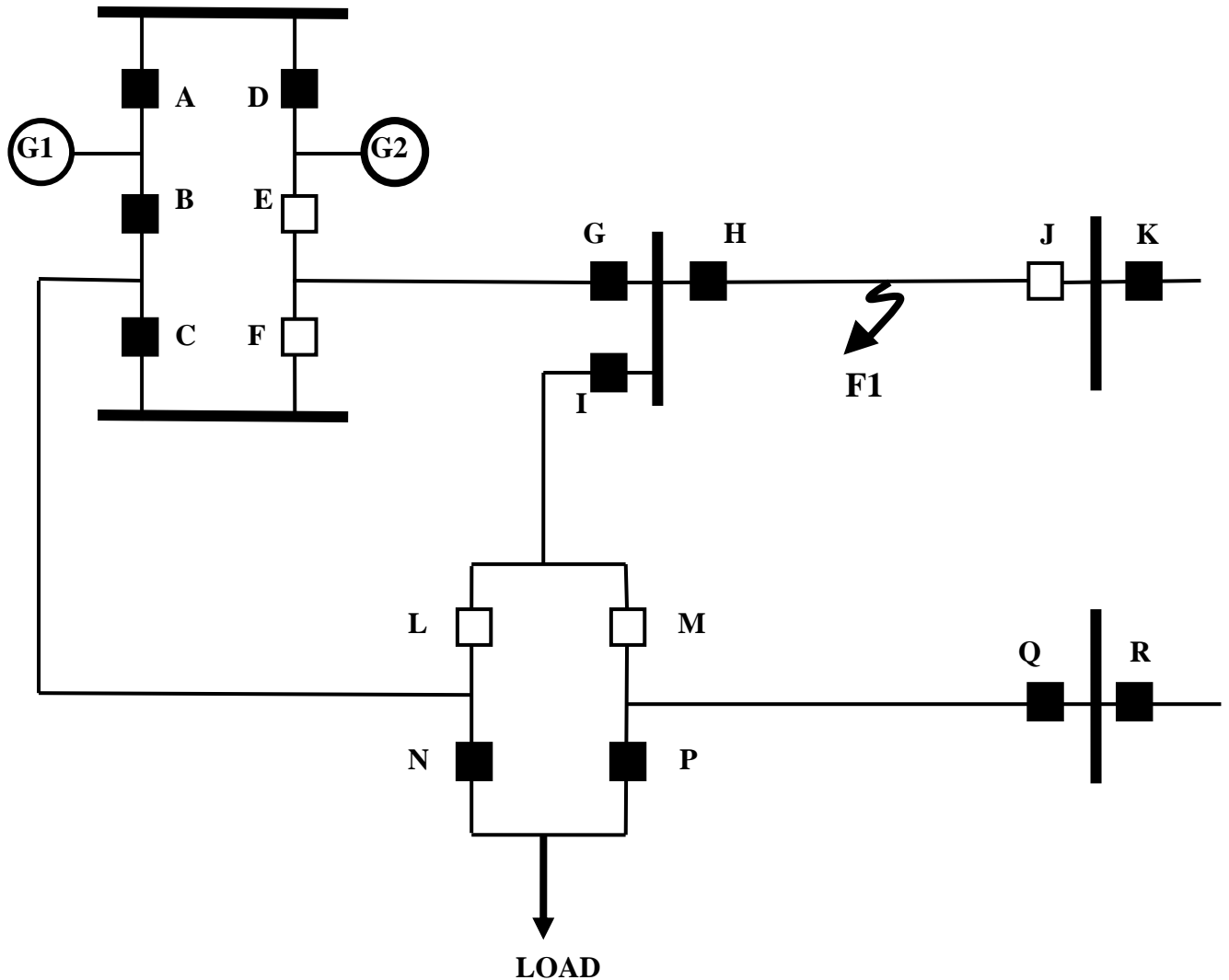
Breaker opened

For fault at F2: Suppose that breakers P and Q operate and breaker M failed to operate.

Therefore:

L must operate as **local backup** protection and I should tripped by communication signal (Transfer Trip)

## Case 3: Remote Backup



■ Breaker closed

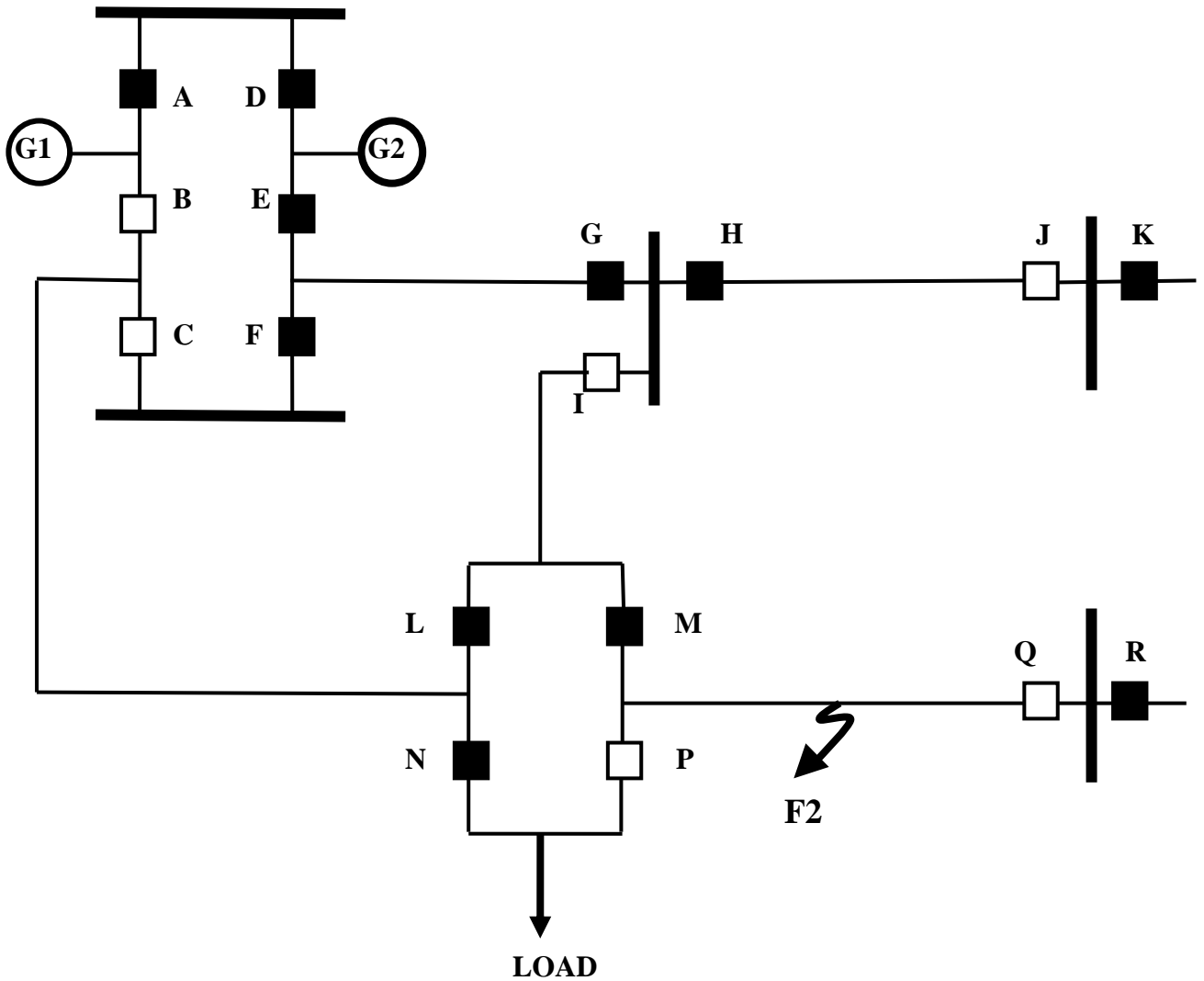
□ Breaker opened

For fault at F1: Suppose that breaker J operate and breaker H failed to operate.

Therefore:

E, F, L and M must operate as Remot backup protection

## Case 4: Remote Backup



■ Breaker closed      □ Breaker opened

For fault at F1: Suppose that breakers **P & Q** operate and breaker **M** failed to operate.

Therefore:

**I, B, and C** must operate as Remot backup protection