

Electrical Distribution System

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Types of Systems

- Radial
- Primary-Selective Radial
- Loop-Primary Selective
- Secondary Selective
- Sparing Transformer
- Spot Network

Simple Radial System

- **Simple, least costly**
- **Easy to coordinate**
- **No idle parts**

Radial System

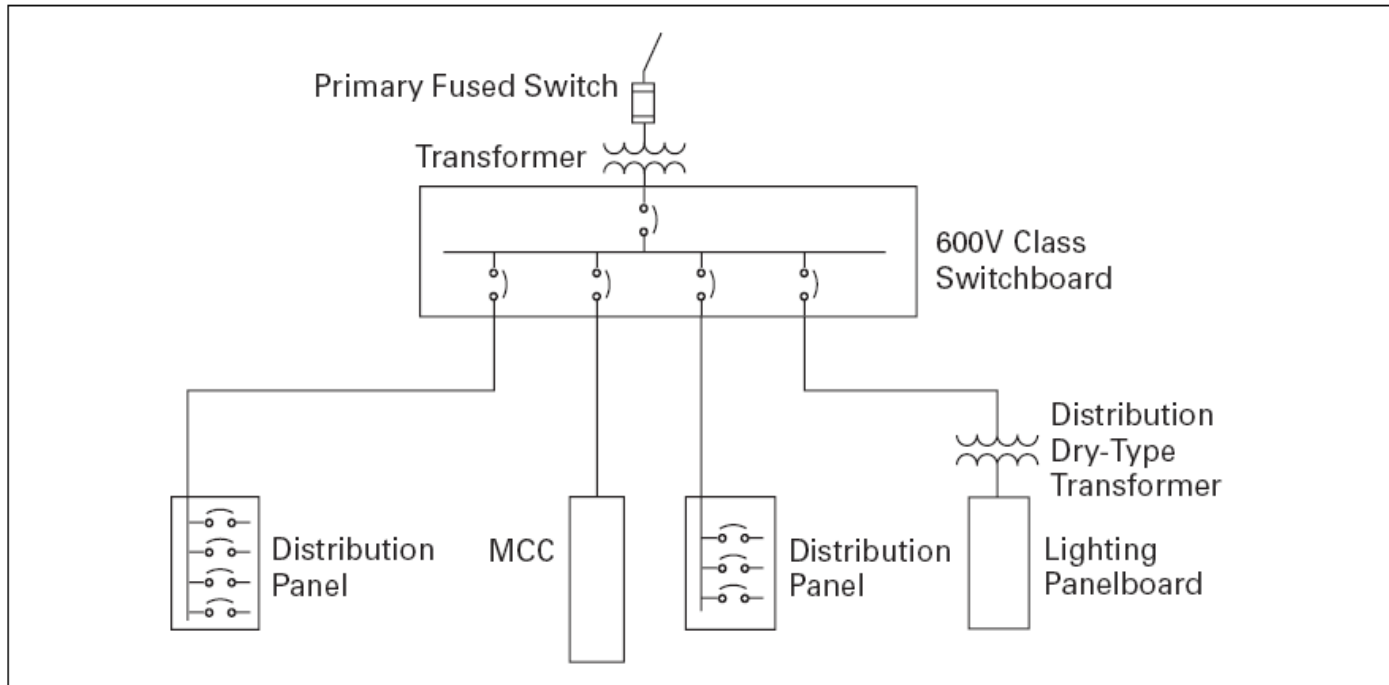


Figure 1.1-1. Simple Radial System

Primary and Secondary Radial

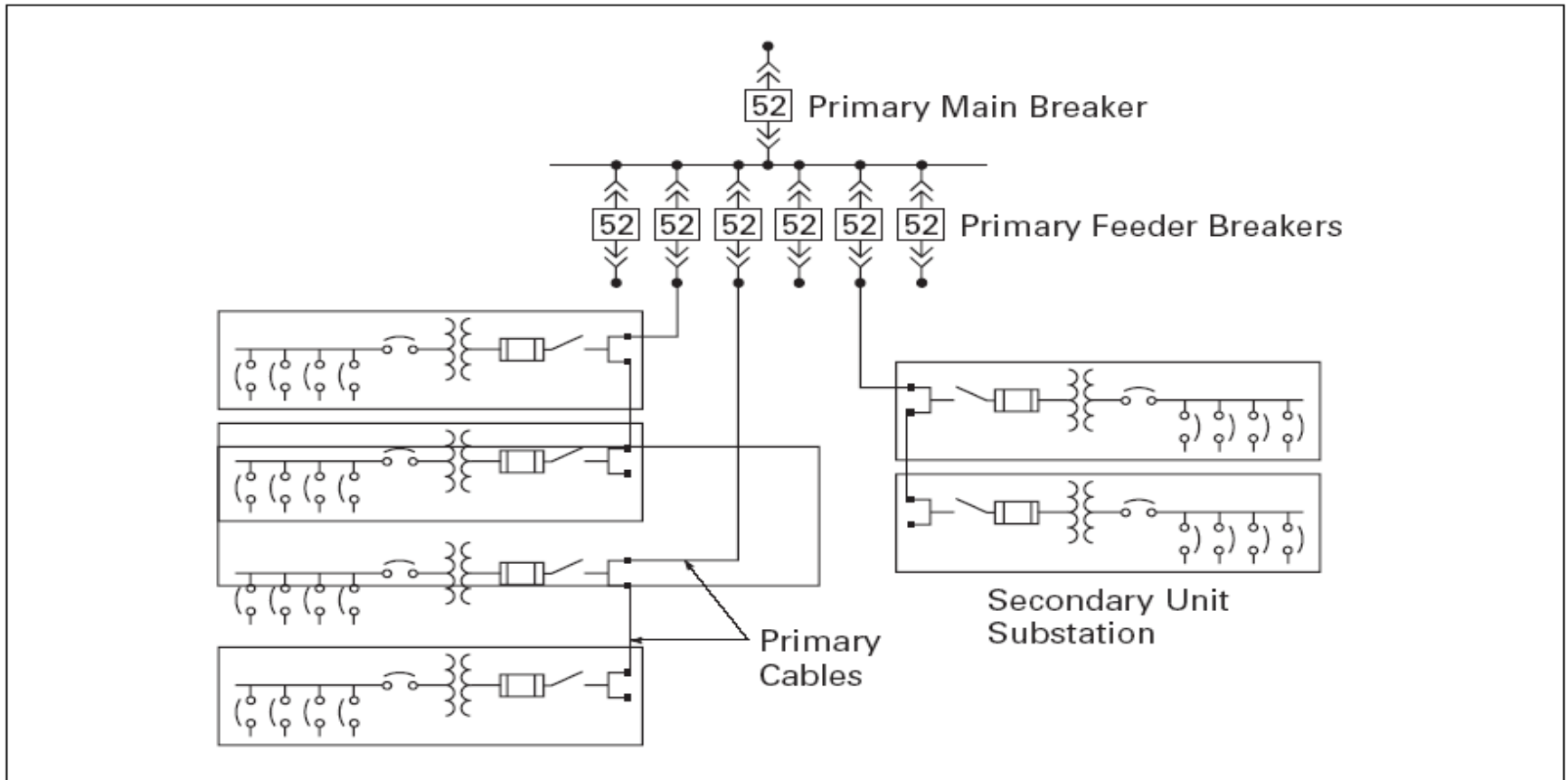


Figure 1.1-2. Primary and Secondary Simple Radial System

Loop Primary – Radial Secondary

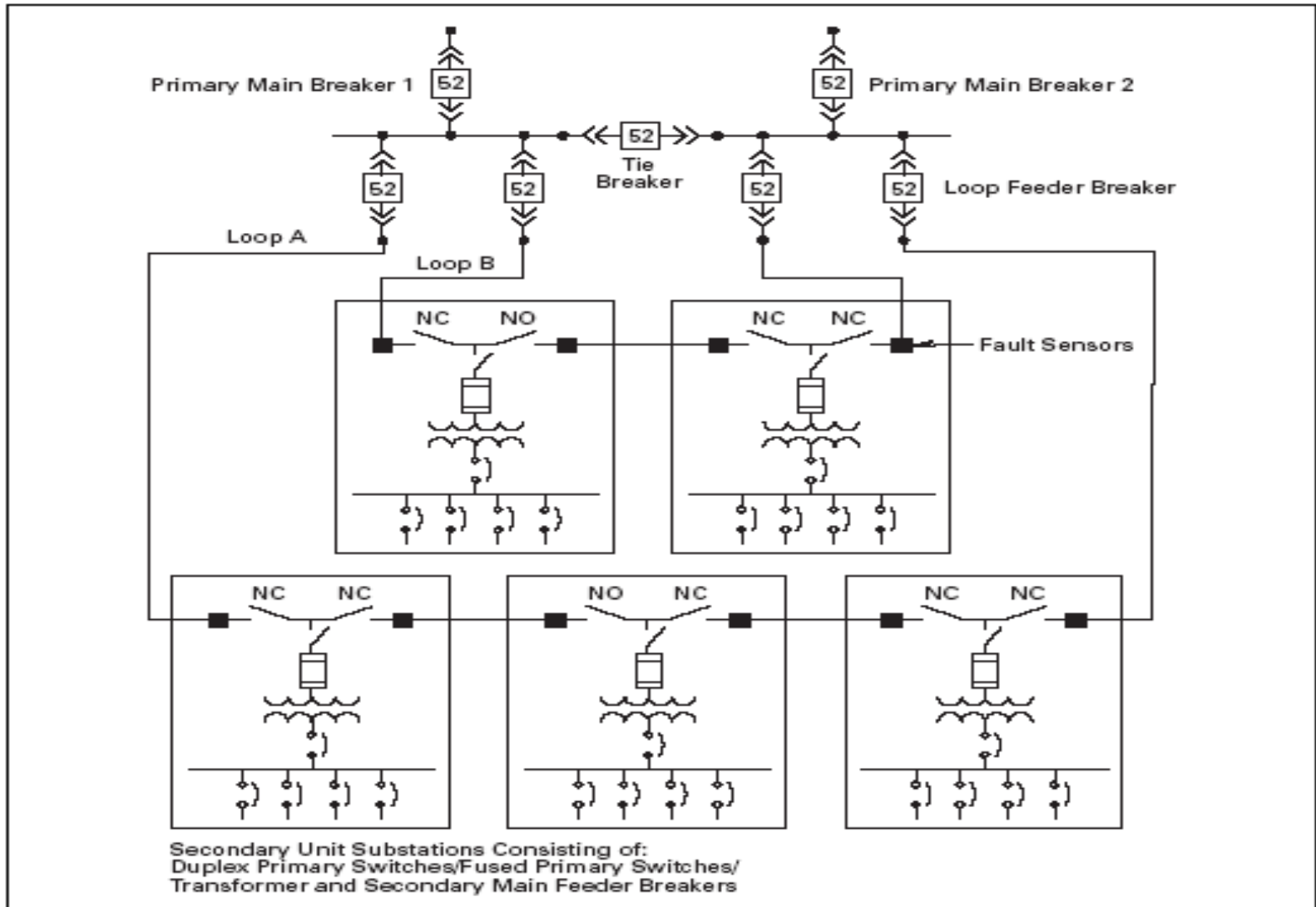


Figure 1.1-3. Loop Primary — Radial Secondary System

Loop Switching – Substation Transformer

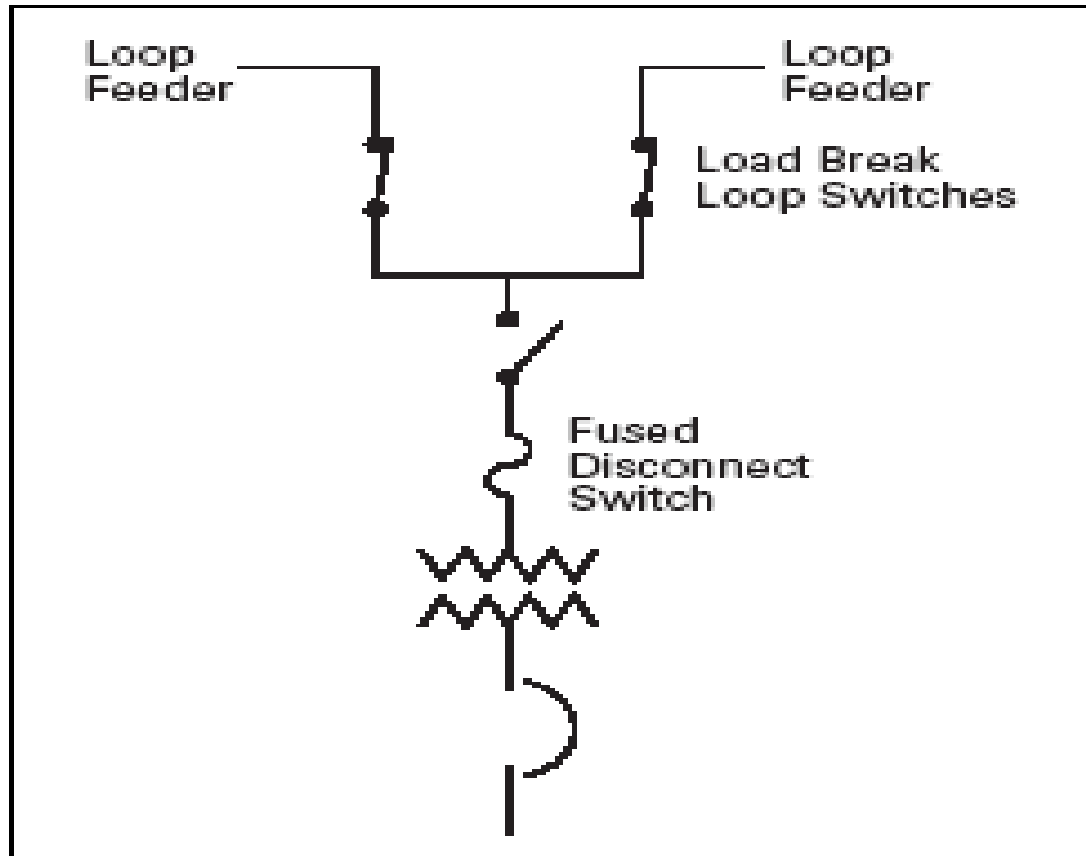


Figure 1.1-4. Secondary Unit Substation Loop Switching

Primary Selective Radial System

- Duplex or selector switch**
- Spare primary incoming circuit**
- Duration of outage from cable failure limited**

Primary Selective – Secondary Radial

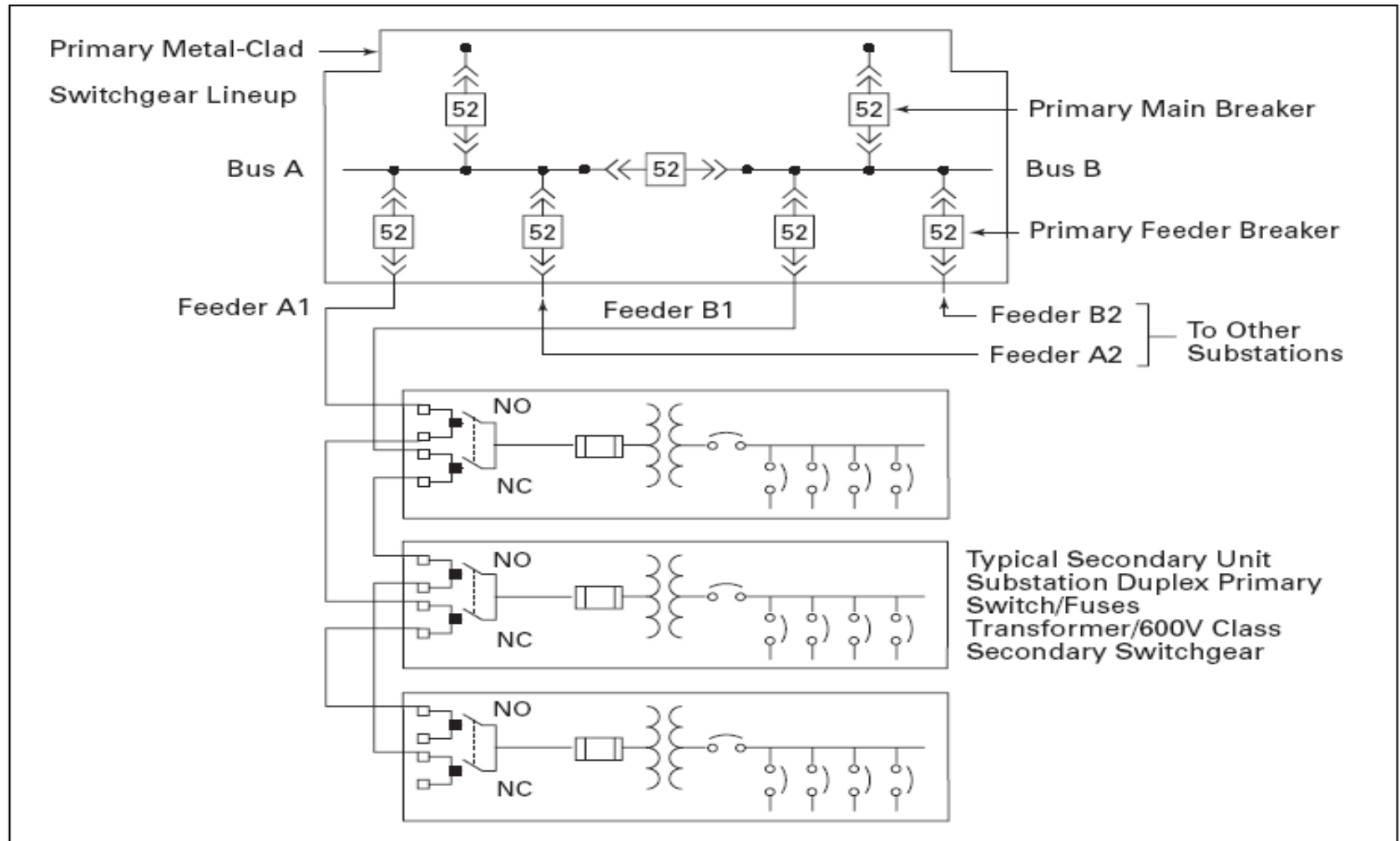


Figure 1.1-7. Basic Primary Selective — Radial Secondary System

Duplex Selector Switch

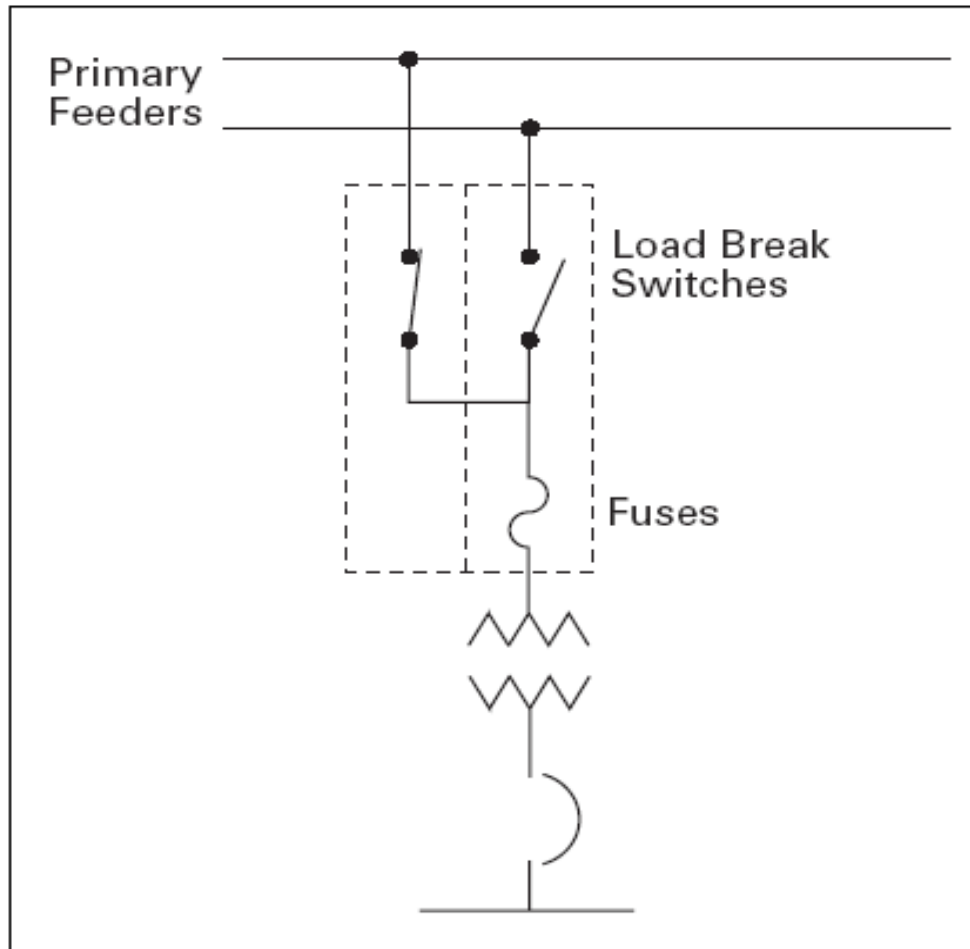


Figure 1.1-8. Duplex Fused Switch in Two Structures

Selector Switch – Single Structure

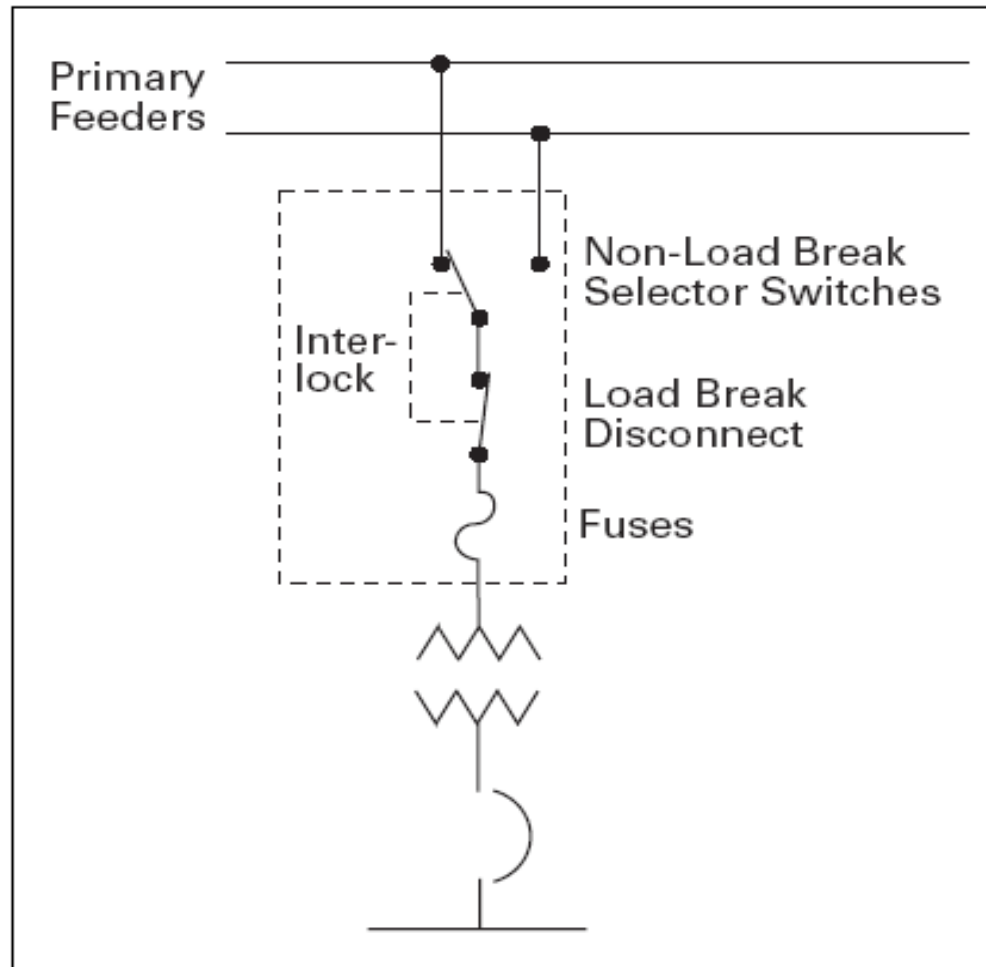


Figure 1.1-9. Fused Selector Switch in One Structure

Secondary Selective System

- **Normally operated as two electrically independent substations with tie breaker open**
- **Failure of either primary circuit affects only one bus**
- **Service restored by opening dead bus main and closing tie**
- **Operation can be made automatic**
- **Transformers not paralleled so fault currents similar to radial**

Two-Source Primary – Secondary Selective

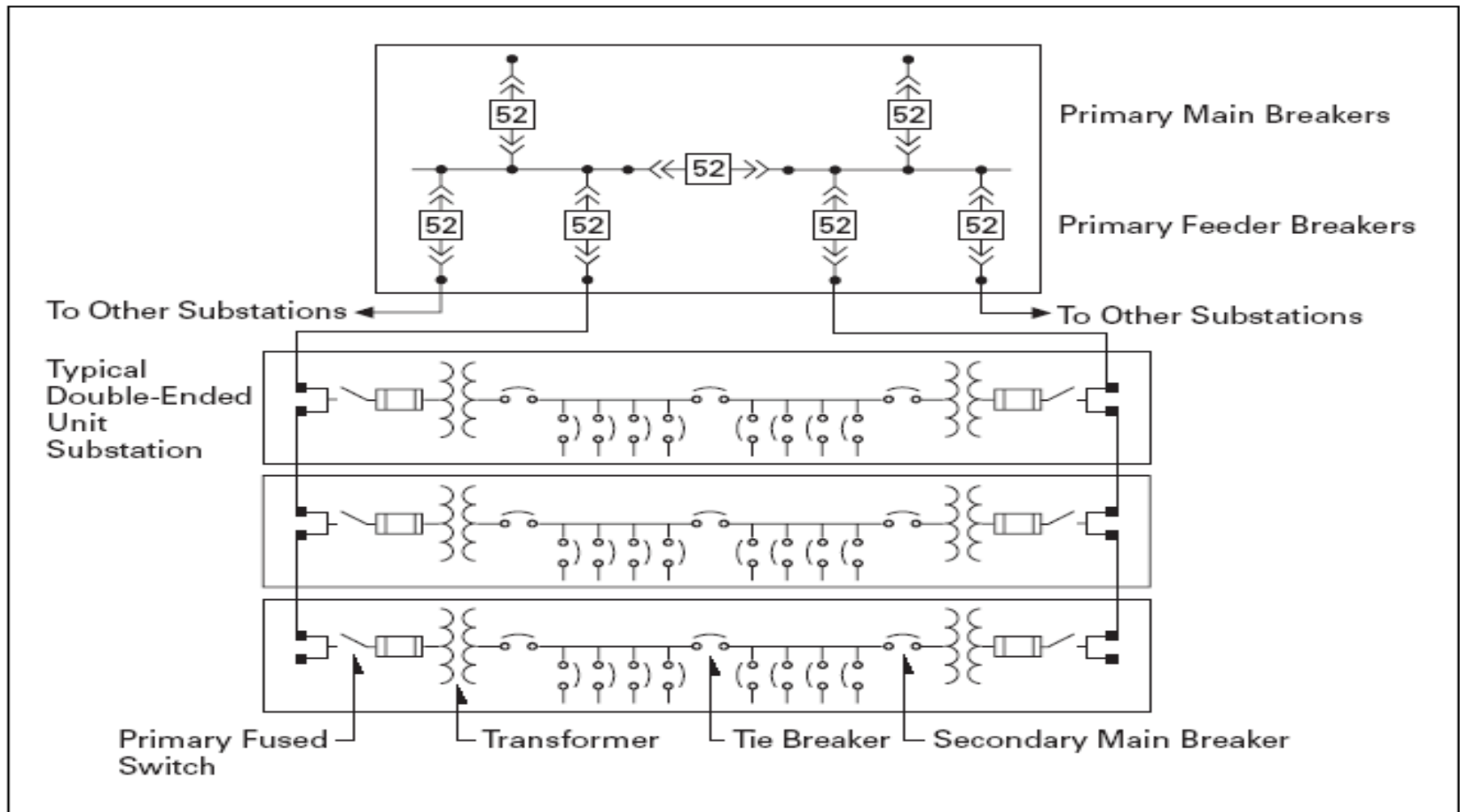


Figure 1.1-10. Two-Source Primary — Secondary Selective System

Sparing Transformer System

- **Alternative to Double-Ended Substations**
- **Single Common Backup Transformer**
- **Service restored by opening dead bus main and closing tie**
- **Operation can be made automatic**
- **Transformers not paralleled so fault currents similar to radial**
- **Location of substations limited (must be clustered)**

Sparing Transformer

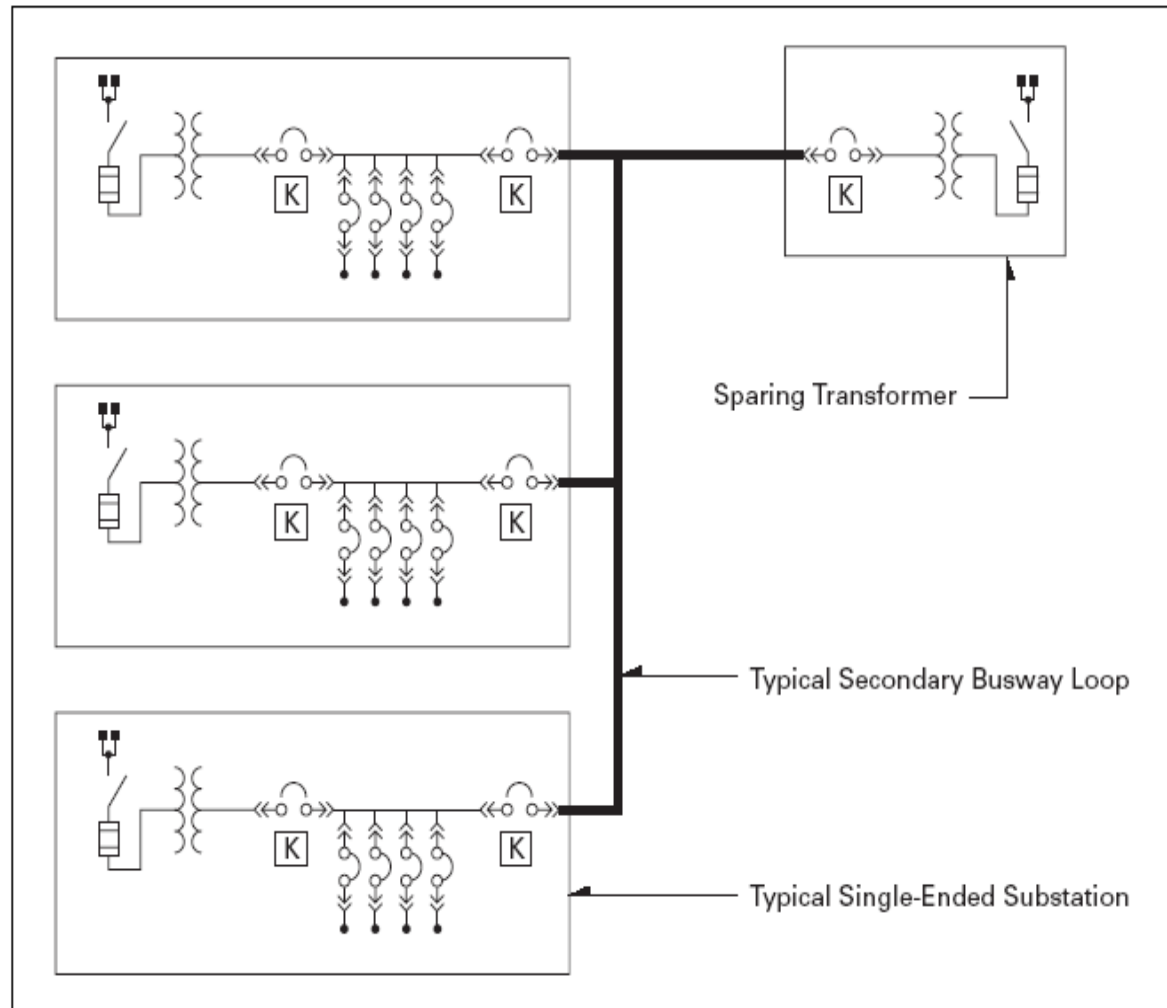


Figure 1.1-11. Sparing Transformer System

Spot Network

- Transformers paralleled on the secondary side
- Uses network protectors
- If primary voltage fails, associated protector automatically opens
- Other protector remains closed
- No “dead time” on bus, even momentarily
- Upon voltage restoration automatically synchronizes and re-closes
- Improved voltage regulation
- Secondary fault current increased

Spot Network

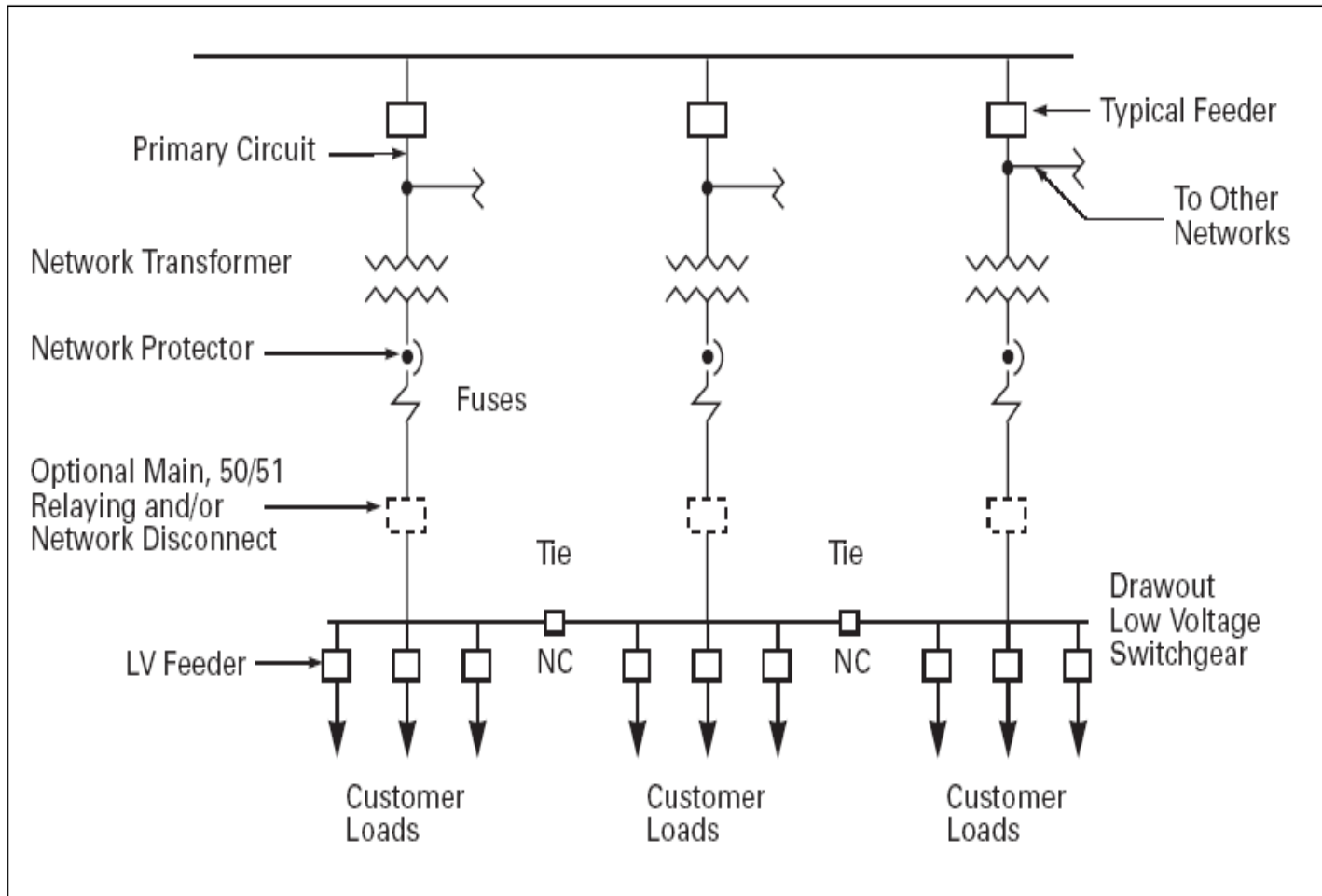


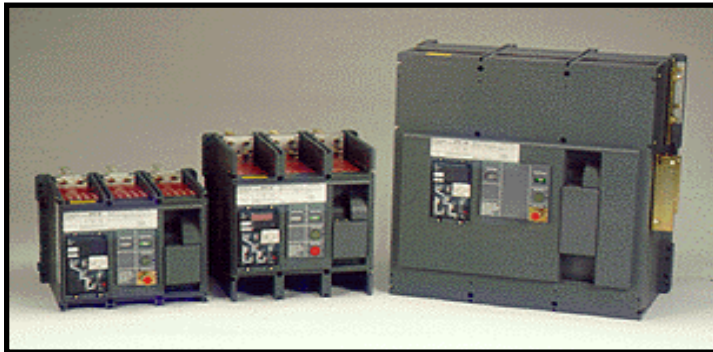
Figure 1.1-12. Three-Source Spot Network

Low-Voltage Circuit Breaker Types



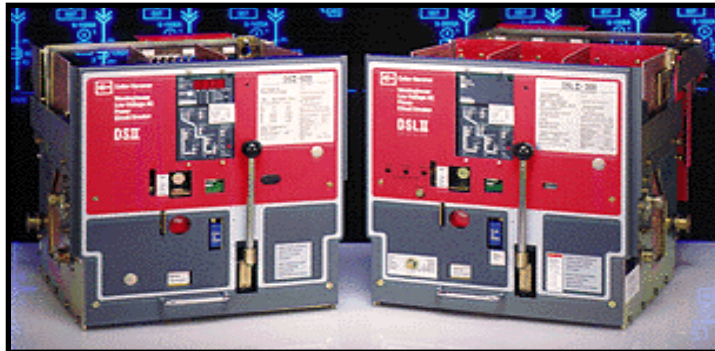
Molded Case Circuit Breakers

- *Tested in accordance with UL489 & Nema AB-1*
- *Open Air Test - Rated @ 80% (Optional 100%)*
- *Over Toggle Mechanism*
- *Sealed Case - Not Maintainable*
- *Applied in Switchboards/Panelboards*



Insulated Case Circuit Breakers

- *Tested in accordance with UL489 & Nema AB-1*
- *Open Air Test - Rated @ 80% or 100%*
- *2-Step Stored Energy Mechanism*
- *Sealed Case - Not Fully Maintainable*
- *Applied in Switchboards*



Power Circuit Breakers

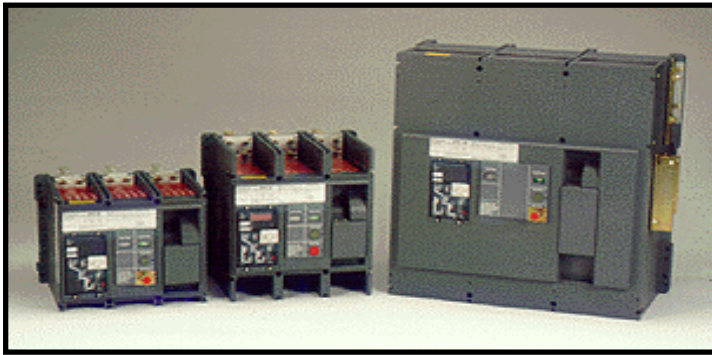
- *Tested in accordance with UL1066 & ANSI C37*
- *Tested in the Enclosure - Rated @ 100%*
- *2-Step Stored Energy Mechanism*
- *Open Access - Fully Maintainable*
- *Applied in Metal-Enclosed Draw-out Swgr*

Low-Voltage Circuit Breaker Typical Ratings



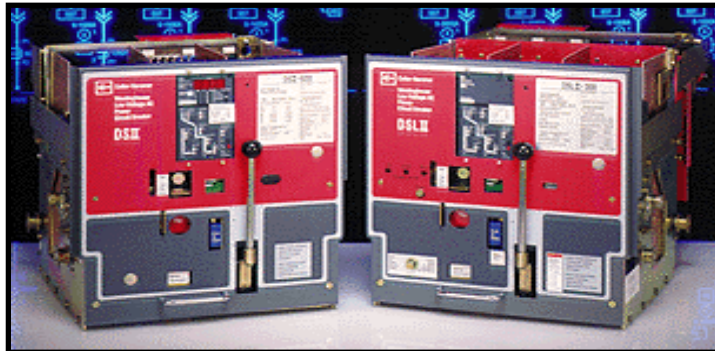
Molded Case Circuit Breakers

- *Frame Size: 100 through 3000 ampere*
- *Interrupting: 10/35/65/100 kA @ 480 Volts*
- *Limiters Available: 200 kAIC*
- *Instantaneous: 10-13X Frame Rating @ various X/R*



Insulated Case Circuit Breakers

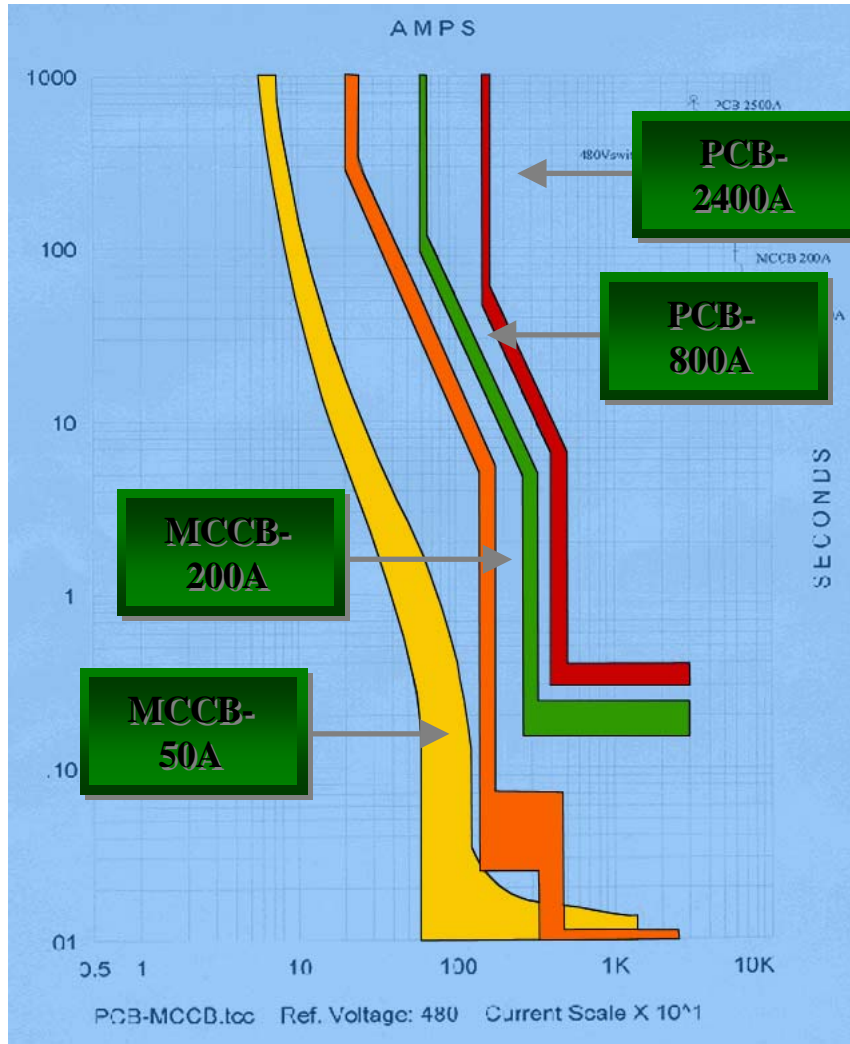
- *Frame Size: 400 (800) through 5000 ampere*
- *Interrupting: 65/85/100 kA @ 480 Volts*
- *Limiters Not Normally Available*
- *Inst./Short Time: 25/35/65 kA @ various X/R*



Power Circuit Breakers

- *Frame Size: 800 through 5000 ampere*
- *Interrupting: 65/85/100 kA @ 600 Volts*
- *Limiters Available: 200 kAIC*
- *Short Time: 35/65/85/100 kA @ X/R of 6.6*

TCC with Power Circuit Breakers



PCB 2400 amp

480V, Microprocessor Trip, LS

Frame size: 3200 A

Sensor: 2400

LTPU: 1.0 f(S) = 2400 amp

STPU: 5.0 f(s) = 12000 amp

LTD: 7.00 sec.

STD: .3 sec.

No Instantaneous Trip

PCB 800 amp

480V, Microprocessor Trip, LS

Frame size: 800 A

Sensor: 800

LTPU: 1.00 f(S) = 800 amp

STPU: 5.0 f(s) = 4000 amp

LTD: 7.00 sec.

STD: .1 sec.

No Instantaneous Trip

MCCB 200 amp

480V, Microprocessor Trip, LSI

Frame size: 250 A

Trip: 200 A

Inst. PU: 10.0*T = 2000 A

MCCB 50 amp

480V, Thermal-Magnetic Trip

Frame size: 100 A

Trip: 50 A

Inst. PU: Non adjustable

Maintenance - MCCBs and ICCBs

- Enclosed design requires little maintenance
- Terminal connections and trip units tightened to the proper torque values
- Inspect conductors
- Visually inspect and operate periodically
- Replacement parts are not available
- Repair, refurbishment, or remanufacture not recommended
- replace damaged breakers

Maintenance - PCBs

- Designed to be serviced
- Replacement parts are available (contacts, pole assemblies, arc chutes)
- Inspection and maintenance program is recommended
- Keep it dry, keep it clean, keep it tight