

TechTopics No. 41

Circuit breakers or switches - application considerations

Siemens is often asked to discuss the application considerations that favor the use of medium-voltage circuit breakers, and those that favor the use of medium-voltage, fused, load-interrupter switches. This is one of those age-old questions, so this issue of TechTopics is devoted to it.

To compare the application of medium-voltage circuit breakers and of load-interrupter switches, we must understand the basic characteristics of each switching technology.

The table on the next page shows the major characteristics of medium-voltage circuit breakers and load-interrupter switches that influence the application. Of course, the table entries are generalized, and the information varies by the voltage and current ratings of the equipment. This is particularly true for load-interrupter switches, where the endurance capabilities vary greatly according to the ratings. However, the table is valid for an overall understanding.

From the data in the table, Siemens makes these observations:

- Medium-voltage circuit breakers are favored when:
 - Continuous load current is high
 - Central monitoring/control is needed; remote control is necessary
 - Switching is frequent; high endurance (1,000s of operations) is needed
 - Process continuity is critical
 - Loads are concentrated.

- Medium-voltage, fused, load-interrupter switches are favored when:
 - Continuous load current is low
 - Central monitoring/control is not needed; manual control is acceptable or electrical operation is infrequent
 - Switching is infrequent; low endurance (150 to 500 operations, depending on rating) is acceptable
 - Process continuity is not critical
 - Loads are widely dispersed.

In industrial applications, a medium-voltage, fused, load-interrupter switch is most frequently used as the primary disconnect for a load center substation transformer. A load-interrupter switch is well suited to this application, as load currents are low, switching is infrequent and remote control is not ordinarily needed.

Medium-voltage, metal-clad switchgear with drawout circuit breakers is suitable for main power distribution in a large installation, with each feeder circuit breaker feeding several load center substations, each having a fused, load-interrupter switch on the primary of the transformer. The circuit breakers are suitable for switching high currents, and for control from a remote location. Since the circuit breakers can switch short-circuit currents and be ready for immediate closing, they are suitable where process continuity is critical.

When applied and maintained properly, both medium-voltage circuit breakers and load-interrupter switches should provide decades of reliable service. Applied incorrectly, either can lead to major headaches.

Characteristic	Circuit breaker	Load-interrupter switch
Continuous current	High (1,200 A, 2,000 A, 3,000 A or 4,000 A)	Moderate (usually 600 A, but 1,200 A also available). Current is limited to a lower value by available fuses.
Switching capability	Switch currents from very low (magnetizing) values to full system short-circuit current	<ul style="list-style-type: none"> ■ Switch currents from very low (magnetizing) values to continuous rating of switch (typically 600 A or 1,200 A load break. Switch (alone) cannot interrupt fault currents. ■ Fuses interrupt short-circuits.
Endurance – mechanical	High (typically 10,000 operations) (see ANSI/IEEE C37.06)	Low (250 to 500 operations for 15 kV, 150 to 350 for 38 kV) (refer to ANSI C37.22) (type SIMOSEC = 1,000 operations).
Endurance – electrical	High <ul style="list-style-type: none"> ■ Typically 10,000 operations at rated continuous current for vacuum ■ Typically 30 to 100 operations at full short-circuit rating for vacuum 	Low <ul style="list-style-type: none"> ■ For 600 A current switched, five operations at 38 kV, 30 at 15 kV, 50 at 4.76 kV (refer to ANSI C37.22) (type SIMOSEC = 100 operations at 600 A). ■ Short-circuit endurance is not given in standards.
Application limitations	<ul style="list-style-type: none"> ■ Not appropriate if very high endurance (100,000s of operations) is needed 	<ul style="list-style-type: none"> ■ Not suitable if high or very high endurance needed ■ Not suitable for motors, capacitors, filters, reactors or furnaces
Operation	<ul style="list-style-type: none"> ■ Electrically operated (manual operation for maintenance or emergency) ■ Suitable for complex control schemes 	<ul style="list-style-type: none"> ■ Manually operated (electrical operation) ■ Not appropriate for complex control schemes
Overcurrent/short-circuit protection	Requires protective relays	<ul style="list-style-type: none"> ■ Fuses required ■ Protective relay tripping not recommended due to limited interrupting capability of switch (must block tripping for currents above load break rating)
Remote operation	Well suited	If electrically operated, can be arranged for remote operation
Control power	Control power needed for protective relays, circuit breaker operation and space heaters (if present)	Control power not required unless electrically operated, or for space heaters
Construction	<ul style="list-style-type: none"> ■ Drawout, if metal-clad (ANSI/IEEE C37.20.2) ■ Stationary, if metal-enclosed (ANSI/IEEE C37.20.3) 	Stationary
Space requirements	<ul style="list-style-type: none"> ■ Larger enclosure ■ NEC® required workspace equal 	<ul style="list-style-type: none"> ■ Smaller enclosure ■ NEC® required workspace equal
Purchase cost	Relatively high	Relatively low
Maintenance	<ul style="list-style-type: none"> ■ Medium (long maintenance intervals, need to clean insulation) ■ Drawout feature allows maintenance of circuit breaker without main bus shutdown 	<ul style="list-style-type: none"> ■ Low (simple mechanism, need to clean insulation, replace fuses) ■ Main bus shutdown required for switch maintenance

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