

# V. Design, Application, Maintenance & Operation

## Technical Requirements

### V.D PJM Design & Application of Circuit Breakers

#### 1.0 General Requirements

- 1.1 The nominal and maximum operating voltages of the effectively grounded transmission systems are as follows:

Nominal System Voltage (kV)	Maximum Operating Voltage (kV)
69	72.5
115	121
138	145
230	242
345	362
500	550
765	803

Refer to PJM Manual 03, Section 3.3.1 for detailed operational voltage limits.

- 1.2 PJM circuit breakers which are intended to operate on the transmission system shall be designed to satisfactorily operate at the specified voltages listed above in the table.

#### 2.0 Specification

- 2.1 All circuit breakers shall meet or exceed the latest applicable ANSI, IEEE, NEMA, ASME, ASTM, NESC, and OSHA Standards and Loading Guides. In case of conflict, consult with the affected Transmission Owner(s); contact PJM for assistance with coordination.
- 2.2 Circuit breakers shall be designed with adequate electrical and mechanical characteristics for the specific electrical system on which it is installed and for the application for which it is intended. These include but shall not be limited to: continuous current rating, short-circuit capability, interrupting capabilities, operating voltage, BIL, transient recovery voltage and environmental conditions.
- 2.3 Studies for each breaker application shall be performed and special consideration shall be given to all switching applications, specifically cable, capacitor, reactor, and out of phase switching. The speed of the breaker and careful analysis of the intended switching application, are requisite to proper breaker application.
- 2.4 Circuit breakers shall be designed for an in service operating life, considering normal routine maintenance, comparable to other electrical apparatus in the system to which it is applied.
- 2.5 The following ratings apply to outdoor circuit breakers installed on the various transmission systems:

Nominal System Voltage (kV)	Maximum Operating Voltage (kV)	Minimum BIL (kV)
69	72.5	350
115	121	550
138	145	650
230	242	900
345	362	1300
500	550	1800
765	803	2050

Circuit breaker BIL shall be carefully selected based on system studies, insulation coordination, and surge protection provided. Consideration shall be given to insulation capabilities to ground and insulation capability across an open breaker. BIL must be carefully selected to avoid open breaker flashover.

2.6 All newly installed outdoor transmission system circuit breakers shall have independent trip coils.

### **3.0 Application and Special Considerations**

3.1 Local environmental conditions should be considered when selecting creep requirements for circuit breaker bushings.

3.2 Circuit breakers, at a minimum, shall be designed to operate at ANSI required ambient of -22° F to +104° F (-30° C to +40° C). All circuit breakers shall be designed to operate satisfactorily in the ambient dictated at their installed location. Some locations in PJM have required -40° C capability. Also refer to Chapter II, environmental design criteria table for details.

### **4.0 Maintenance**

4.1 Circuit breakers shall be maintained in order to preserve their function during their operating life. For typical maintenance requirements, refer to Section V.L.2.D

### **5.0 Ratings**

5.1 Ratings of electrical system apparatus, including circuit breakers, are critical to the reliable operation of the PJM system. Ratings of circuit breakers applied to the PJM system should be determined using the PJM TSS rating guide VI.C "Circuit Breakers", latest version.