

## Appendix F: Protection System Requirements for Facilities < 200kV

~~As a result of the competitive planning process established by FERC Order 1000, the PJM Planning Committee (PC) approved the formation of the Designated Entity Design Standards Task Force (DEDSTF). This task force established minimum engineering design standards to be used for Greenfield projects that are competitively solicited. These minimum design standards would only apply to projects that would require signing of a Designated Entity Agreement.~~

~~Greenfield projects will be limited to operating voltages of  $\geq 200\text{kV}$  and except for projects that have multiple flow gates or common contingencies for multiple projects. The operating voltages could be as low as 46kV which is the lowest PJM Market Monitored transmission facilities lowest voltage level. Therefore, Greenfield projects are subjected to M07 requirements at  $\geq 46\text{kV}$  and above. Appendix F was added to M07 to address the specific requirements for Greenfield facilities below 200kV.~~

This appendix outlines the Manual 07 requirements and/or exceptions, per section, for the protection of Greenfield project facilities at system voltages below 200kV but limited to 46kV. This appendix is applicable to new Greenfield projects approved after April 1, 2017.

### **Section 3: Generator Protection**

For generating units less than 100 MVA and connected below 200 kV and not previously addressed in this document, see Appendix D

### **Section 4: Unit Power Transformer and Lead Protection**

Manual 07 applies for unit power transformers and associated high-side leads where the transformers are (1) rated less than 100 MVA, or (2) are connected to utility systems at transmission system voltages below 200kV.

### **Section 5: Unit Auxiliary Transformer and Lead Protection**

Manual 07 applies for unit-connected auxiliary transformers and associated high-side leads where the transformers are (1) rated less than 100 MVA, or (2) are connected to utility systems at transmission system voltages below 200kV.

### **Section 6: Start-up Station Service Transformer and Lead Protection**

Manual 07 applies for start-up station service transformers and associated high and low-side leads connected to transmission systems at system voltages below 200kV.

### **Section 7: Line Protection**

Manual 07 applies for the protection of lines at system voltages below 200kV except for following requirements:

#### **7.2 Primary Protection**

- For transmission lines below 200kV, pilot protection may be required to meet coordination requirements of the interconnected Transmission Owner.

#### **7.4 Restricted Ground Fault Protection**

- Not required for transmission lines below 200kV

#### **7.5 Close-in Multi-Phase Fault Protection (Switch-Onto-Fault Protection)**

- Not required for transmission lines below **100kV**

### **Section 8: Substation Transformer Protection**

Manual 07 applies for the protection of substation transformers with high-side voltages of below 200kV except for following requirements:

#### **8.1.4 Current Differential Zone Considerations**

- Not required for substation transformers with high-side voltages below 200kV

#### **8.2 Isolation of a Faulted Transformer Tapped to a Line**

- As stated in Section 8, Manual 07 applies since bulk power lines operated below 300 kV may be tapped with the concurrence of the transmission line owner(s).

##### **8.2.2 Protection Scheme Requirements**

- A device failure scheme for the fault interrupting device is not required for substation transformers with high-side voltages below 200kV.

#### **8.3 Transformer Leads Protection**

- High and low side leads of transformers with high-side voltages below **100kV** must be protected by two independent schemes, only one of which must be high-speed. If the leads are included in a line protection zone, transformer lead protection is not required.

### **Section 9: Bus Protection**

- For the protection of substation buses at system voltages below **100kV**, one high speed protection scheme is required for protecting the bus. Remote or local protection is required as a backup. The schemes must utilize independent current and/or voltage sources and independently protected DC control circuits.

### **Section 10: Shunt Reactor Protection**

Manual 07 applies for the protection of shunt reactors at system voltages below 200kV.

### **Section 11: Shunt Capacitor Protection**

Manual 07 applies for the protection of shunt capacitors at system voltages below 200kV with the following exception:

#### **11.2 Unbalance Detection Scheme**

- For facilities below 200kV, one capacitor bank unbalance detection scheme must be installed.

### **Section 12: Breaker Failure Protection**

Manual 07 applies for breaker failure protection at system voltages below 200kV with the following exception:

### **12.1 Local breaker failure protection requirements**

- For facilities below 100kV, a dedicated breaker failure scheme shall be used for each fault-interrupting device and shall initiate tripping of all local sources of fault current only if the remote backup protection is inadequate.

### **Section 13: Phase Angle Regulator Protection**

Manual 07 applies for the protection of phase angle regulating transformers connected at system voltages below 200kV.

### **Section 14: Transmission Line Reclosing**

Manual 07 applies for automatic reclosing schemes for fault interrupting devices at system voltages below 200kV.

### **Section 15: Supervision and Alarming of Relaying and Control Circuits**

Manual 07 applies for supervision and alarming of relaying and control circuits applied to protect equipment at system voltages below 200kV.

### **Section 16: Underfrequency Load Shedding**

Manual 07 applies for underfrequency load shedding schemes at system voltages below 200kV.

### **Section 17: Special Protection Schemes**

Manual 07 applies for Special Protection Schemes (SPSs) at system voltages below 200kV.

### **Appendix A: Use of Dual Trip Coils**

- The use of dual trip coils in circuit breakers are not required at system voltages below 100kV

### **Appendix B: Direct Transfer Trip Requirements**

Manual 07 applies for facilities below 200kV.

### **Appendix C: Dual Pilot Channels for Protective Relaying**

Manual 07 applies for facilities below 200kV.

### **Appendix D: Small Generator Protection Requirements**

Appendix D applies for generating units less than 100 MVA and connected below 200kV.

### **Appendix E: Acceptable Three Terminal Line Applications**

Manual 07 applies for facilities below 200kV with the following exception:

#### **2.1 Protection Requirements**

- For facilities below 200kV, directional comparison blocking (DCB) or unblocking scheme (DCUB) operating over power line carrier to a third terminal is acceptable for primary or backup line protection.