1.0 GENERAL

1.1 The automated distribution fault-interrupting system shall conform to the following specification.

1.2 The fault-interrupting system shall be an outdoor, three-pole device incorporating vacuum fault interrupters, individually operated by magnetic latching actuators capable of 2-millisecond Close-Open (pulse) operation, an integral power module(s), an integral protection and control module, an integral communication module, and integral sensors. All metallic housing components shall be stainless steel or corrosion-resistant non-painted materials, and all components shall be mounted on a unitized stainless steel base.

1.3 The unitized base shall be furnished with a single-point lifting means to facilitate installation.

1.4 The unitized base shall include provisions for mounting and grounding three surge arresters on each side. No additional grounding connections shall be required for the surge arresters.

1.5 Optionally, polymer-housed metal-oxide surge arrestors shall be factory-installed and wired on both sides of the fault-interrupting system.

1.6 Appropriate venting shall be provided to prevent gas and moisture buildup within the unitized base. Vents and seals shall prevent insects, dust, wind-driven rain, and fluid from pressure-washing from entering the base, protection and control module, and communication module.

1.7 The fault-interrupting system shall be furnished in the non-disconnect style, in the upright-crossarm mounting configuration, with two phases on one side of the pole and one phase on the other side of the pole.

or

The fault-interrupting system shall be furnished in the disconnect style, in the upright-crossarm mounting configuration, with two phases on one side of the pole and one phase on the other side of the pole. The integral three-pole group-operated disconnect shall provide a visible air gap and can be operated with a hot stick from below the unit. It shall be interlocked to permit operation only when the fault interrupters are open. The disconnect shall be capable of the full load-current capacity of 800 amps continuous and the fault-current capability of the unit. The disconnect shall include:

(1) Wiping contacts to prevent operational difficulties arising from corrosion or frost

(2) Bearings

(3) Low-resistance contacts indicating the open and closed positions of the disconnect

1.8 The control power shall be derived from an integral power module fed from one phase on one side of the fault-interrupting system.

or

The control power shall be derived from two integral power modules, each fed from a different phase on both sides of the fault-interrupting system.

1.9 The integral power module(s) shall provide all control power for the fault-interrupting system in standalone (non-communicating) applications. No batteries shall be required, but ac line voltage must be available to the integral power module(s).

1.10 The fault-interrupting system shall be capable of being opened without control power from any source.

1.11 Optionally, wildlife protection shall be furnished for the fault-interrupting system to reduce wild-life-related nuisance outages.

1.12 The fault-interrupting system shall be suitable for application in an ambient temperature range of -40°C (-40°F) to +40°C (+104°F).

1.13 The manufacturer shall have a minimum of 15 years' experience in the production of distribution automation and protection equipment.

1.14 The manufacturer shall supply all internal wiring for the fault-interrupting system.

1.15 The following design tests shall have been performed on the fault interrupter, and certified test reports shall be provided upon request:
Interrupting: ANSI C37.60-2003
Dielectric: ANSI C37.60-2003
Temperature Rise: ANSI C37.60-2003
Short Time: ANSI C37.60-2003
Fault Closing: ANSI C37.60-2003
Mechanical Endurance: ANSI C37.60-2003

1.16 The following design tests shall have been performed on the control, and certified test reports shall be provided upon request:
Electrostatic Discharge: IEC 801.2 (IEC 1000-4-2)
Fast Transient: IEC 801.4
Power Line Surge: ANSI C62.41
Surge Withstand: ANSI C37.90.1
Radio-Frequency Interference: ANSI C37.90.2
Electromagnetic Interference: FCC Part 15 Class B
Electromagnetic Compatibility: EN 61000-4-3
Dielectric: ANSI C37.90

2.0 FAULT INTERRUPTERS

2.1 Each fault interrupter shall be furnished with a magnetic latching actuator, described in Section 3.0, providing a Close-Open (pulse) of 2 milliseconds or less.

2.2 The fault-interrupter housing shall be molded from cycloaliphatic epoxy resin.

2.3 The fault interrupter and actuator shall have been tested and rated for at least 10,000 mechanical close-open operations.

2.4 A color-coded Open/Close indicator shall be provided for each fault interrupter, on the underside of the unitized base, that indicates green for open and red for closed. The indicator shall be readily visible from the ground.

or

A color-coded Open/Close indicator shall be provided for each fault interrupter, on the underside of the unitized base, that indicates red for open and green for closed. The indicator shall be readily visible from the ground.

2.5 Mechanical loading from jumpers to the fault-interrupter terminal pads shall not exceed 90 lbs. (40.8 kg) in-line, and 30 lbs. (13.6 kg) perpendicular to the terminal pads, per IEEE Standard ANSI C37.32-1996 Section 8.8.2.2.

2.6 Ratings

Select the appropriate ratings from the following tables:

TABLE 1. 60-HZ APPLICATIONS, RATINGS DISCONNECT AND 38-KV MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
23.8	38	170	630	12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 800 amperes with a minimum wind velocity of 2 ft./sec.

TABLE 2. 50-HZ APPLICATIONS, RATINGS DISCONNECT AND 38-KV MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
23	38	170	630	12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 800 amperes with a minimum wind velocity of 2 ft./sec.

TABLE 3. 60-HZ APPLICATIONS, RATINGS 15-KV AND 27-KV NON-DISCONNECT MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
11.43 18.81	15.5 27	110 125	800	16 000 12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 900 amperes with a minimum wind velocity of 2 ft./sec.

TABLE 4. 50-HZ APPLICATIONS, RATINGS 15-KV AND 27-KV NON-DISCONNECT MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
10 20	17.5 24	110 125	800	16 000 12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 900 amperes with a minimum wind velocity of 2 ft./sec.

TABLE 5. 60-HZ APPLICATIONS, RATINGS 15-KV AND 27-KV DISCONNECT MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
11.43 18.81	15.5 27	110 125	900	16 000 12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 900 amperes with a minimum wind velocity of 2 ft./sec.

TABLE 6. 50-HZ APPLICATIONS, RATINGS 15-KV AND 27-KV DISCONNECT MODELS

kV①			Amperes, RMS	
Minimum	Maximum	BIL	Continuous②	Interrupting, Sym.
10 20	17.5 24	110 125	900	16 000 12 500

① Minimum and maximum ratings ensure adequate power from the integral power module(s).
② Allowable continuous-current capability: 900 amperes with a minimum wind velocity of 2 ft./sec.

3.0 MAGNETIC LATCHING ACTUATORS, OPERATING MECHANISM, AND EXTERNAL CONTROL LEVERS

3.1 The magnetic latching actuators shall be capable of electrically opening and reclosing the fault interrupters as well as performing circuit testing using PulseClosing® Technology.

3.2 The actuator shall use direct-drive magnetic actuation or solenoid actuation. No solenoid shall remain energized when either in the Open or Closed position.

3.3 Circuit testing using PulseClosing Technology shall rapidly close and open the interrupters to produce a current pulse of 2- to 8-millisecond duration. Detection algorithms shall analyze the current pulse to determine whether a fault is present. The fault-interrupting system shall not close if the fault is still present.

3.4 The operating mechanism shall provide three-phase tripping of the vacuum interrupters and three-phase lockout. The unit shall be configurable to allow single-phase or three-phase operation.

3.5 An external OPEN/CLOSE/READY lever shall be provided, allowing manual three-phase tripping of the vacuum interrupters using a standard or extendible hookstick. Control power shall not be required.

3.6 When the interrupters have been tripped by means of the OPEN/CLOSE/READY lever, electrical closing of the interrupters by the magnetic latching actuators shall be

mechanically blocked until the lever is returned to its Ready position. The OPEN/CLOSE/READY lever shall have provision for tagging or locking in the Open position.

3.7 The magnetic latching actuators shall be electrically interlocked with the integral disconnect discussed in Section 1.7, when furnished, such that the magnetic actuators can only be operated when the disconnect is in the fully open or fully closed position. The disconnect shall be mechanically interlocked such that it can only be operated when the fault interrupters are open.

3.8 An external lever shall be provided to allow manual application of a hot line tag to mechanically prevent reclosing functions and allow quick-trip operation while hot-line work is being performed. The lever shall have a provision for tagging or locking in the hot line tag active position. It shall only be possible to remove a manually applied hot line tag using this lever. If the lever is operated to give a second "remove" command, it shall also remove a hot line tag applied by a SCADA or secure Wi-Fi command.

3.9 The unit shall incorporate a ground-defeat mechanism, mechanically and electronically, to allow defeat of the ground relay during paralleling operations.

4.0 CONTROL AND COMMUNICATION

4.1 A control group, consisting of a protection and control module and a communication module, shall be located in the base of the fault-interrupting system. The modules shall be removable while the unit is energized with a module-handling fitting attached to a standard 8-foot (244-cm) hookstick.

4.2 The communication module shall communicate, via a secure Wi-Fi connection, to a user-furnished laptop computer within range. Required configuration software shall be provided with the fault-interrupting system. The unit shall not transmit a Wi-Fi signal until an encrypted wake-up message is sent by the securely recognized laptop. All wireless communications shall be adequately encrypted with user-definable encryption keys and be password protected for security purposes. The control program shall permit the selection of local or remote operation. It shall also indicate the Open/Closed position of each fault interrupter, phase voltages and currents, the reason for a phase trip, etc. When local operation has been selected, the control program shall command local electrical opening and closing of the fault interrupters.

4.3 Trip curves shall be permanently resident in control memory, even upon loss of all ac or dc power. Trip curves shall be selectable from a library of industry-standard recloser time-current characteristic curves.

4.4 The control program shall provide a minimum of four protection profiles, a hot line tag protection profile, and two closing profiles. The closing profiles shall close without testing and shall persist for a user-determined time. The transition from the active protection profile to a new protection profile shall be displayed. The transition between protection profiles shall not be limited.

4.5 The control program shall feature selectable programming for a minimum of four cycles for recloser control (i.e. three openings) with separate and different programmable timing for each cycle.

4.6 The control program shall indicate the position of the integral disconnect discussed in Section 1.7, when furnished.

4.7 The communication module shall include an integrated Global Positioning System clock for 1 millisecond accurate event time-stamping of events.

4.8 A status light on the protection and control module shall provide local indication of normal operation, Wi-Fi connection and disconnection, and loss of control voltage. The status light shall also provide local indication that the OPEN/CLOSE/READY lever has been moved from the Ready position to the Open position, from the Open position to the Ready position, and from the Ready position to the Closed position.

4.9 A hot line tag light on the protection and control module shall provide local indication of hot line tag application or removal.

4.10 An integrated communication antenna mounting system consisting of a female N-Type antenna connector with integral surge suppressor shall be mounted to the unitized base for use with a radio in SCADA applications. The connector shall permit installation of a remotely located antenna.

4.11 A non-volatile memory module installed in the unitized base shall back up configuration data and site-specific information such as the device identifier, sensor-calibration data, and operation counter reading. If the protection and control module is replaced, site-specific information shall be loaded in the new module, and as an option the module shall be fully configured automatically upon insertion in the base. Sensor-calibration data and the operation counter reading shall not change when new set points are loaded in the memory module.

The standard control group shall require no batteries in standalone (non-communication) applications; however, ac line voltage must be available on the side of the fault-interrupting system that supplies the integral power module. The standard control group shall provide wide-area network capability for SCADA applications when furnished with a suitable radio.

or

The standard control group with battery backup shall provide wide-area network capability for SCADA applications when furnished with a suitable radio. User-replaceable batteries in the communication module shall support operation for a minimum of three hours after loss of ac line voltage on both sides of the fault-interrupting system, permitting extended dead-line switching and SCADA communication.

or

The IntelliTeam® SG Automatic Restoration System SpeedNet control group shall be furnished with a SpeedNet™ Cell Edge Gateway, providing communication via DNP 3.0

Protocol, and IntelliTeam SG Automatic Restoration System software. User-replaceable batteries in the communication module shall support operation for a minimum of four hours after loss of ac line voltage on both sides of the fault-interrupting system, permitting extended dead-line switching and SCADA communication.

4.12 The control shall include the following protection and control elements:

(a) Simultaneous independent directional phase, ground, and negative-sequence time-overcurrent elements

(b) Simultaneous independent directional phase, ground, and negative-sequence instantaneous-overcurrent elements

(c) Simultaneous independent directional phase, ground, and negative-sequence definite-time elements

(d) Directional blocking overcurrent elements

(e) Intelligent fuse-saving overcurrent elements

(f) Overvoltage/undervoltage elements

The protection and control elements shall enable sequence coordination, phase-unbalance detection, and synchronization check functions, and include a cold-load pickup modifier.

5.0 SENSORS

5.1 Voltage and current sensors shall be integrally molded into the fault-interrupter housings.

5.2 The sensors shall provide three-phase monitoring of line current and three-phase monitoring of system line voltage on both sides of the fault-interrupting system.

5.3 Total system voltage sensing accuracy shall be within ±0.5% across the tested temperature range of -40°C (-40°F) to +50°C (+122°F).

5.4 Total system current-sensing accuracy shall be within ±0.5% for metering up to 900 amps and ±2% across the full fault-detection range up to 24.8-kA asymmetrical interrupting and across the tested temperature range of -40°C (-40°F) to +50°C (+122°F).

6.0 APPLICATIONS

6.1 The fault interrupter's control system shall be capable of running communication-enhanced coordination to allow more devices than is practical with conventional time-current coordination.

6.2 The fault interrupter's control system shall have a non-communicating PulseFinding™ Fault Location Technique application to allow more devices than is practical with conventional time-current coordination.

6.3 The coordination curves shall have a fixed tolerance of ±2.0 percent and a fixed time delay of ≤16 ms.