1.0 General

1.1 The transformer protector shall conform to the following specification.

1.2 The transformer protector shall be designed exclusively for fault protection of distribution substation transformers.

1.3 The transformer protector shall be an outdoor, three-pole, resettable device incorporating single-gap SF_6-gas-filled puffer-type interrupters. A user-furnished, source-side, three-pole, group-operated disconnect is required in series with the transformer protector to provide visible air-gap isolation when interrupters have been tripped, and to pick up transformer magnetizing inrush current after interrupters have been closed.

1.4 Pole-units shall be electrically linked to provide maximum mounting flexibility as well as three- phase tripping simultaneity of less than ¼ cycle.

1.5 The transformer protector shall be tripped by a user-furnished external signal.

1.6 The transformer protector shall consist of three vertical pole-units that may be mounted on either manufacturer-supplied mounting pedestals or a wide range of user-furnished structures. Pole-units shall be compatible with virtually any transmission line and transformer arrangement.

1.7 The transformer protector shall be designed and tested in accordance with all applicable sections of IEC Standard 56 and IEC Standard 694.

1.8 The ratings for the transformer protector shall be as designated below.

kV, Nominal . . . . . [ ]●
kV, Maximum . . . . . [ ]●
kV, BIL . . . . . [ ]●
Hz . . . . . 50 or 60
Amperes, Continuous 420
Amperes, Continuous, 4-Hr. 630
Amperes, RMS, Peak Withstand. 81 900
Amperes, RMS, Interrupting 31 500
Amperes, RMS, 1-Second. 31 500
Amperes, RMS, Secondary Faults . . . . . [ ]●
Amperes, RMS, Fault Interrupting, Duty-Cycle, Three-Time . . . 31 500
Amperes, RMS, Fault Interrupting, Duty-Cycle, Five-Time 18 900
Amperes, RMS, Fault Interrupting, Duty-Cycle, 10-Time 9 450
Amperes, RMS, Fault Interrupting, Duty-Cycle, 30-Time 3 150
Interrupting Time, Cycles, Maximum 3

1.9 The transformer protector shall be installed in accordance with the following specification:

Specify applicable description:

(a) The transformer protector shall be vertically mounted on manufacturer-supplied mounting pedestals of 8-inch-square steel-tube construction, of galvanized steel and of [ ]● height. Phase spacing of [ ]● shall be provided.

(b) The transformer protector shall be vertically mounted on a user-furnished structure, meeting the requirements specified in the manufacturer's applicable information bulletin. Mounting provisions shall be provided on each pole-unit.

TABLE 1. SELECTION OF VOLTAGE RATINGS, AND HEIGHT AND PHASE SPACINGS FOR MOUNTING PEDESTALS

Rating, kV			Amperes, RMS Secondary Faults	Dimensions, Inches (mm)	
Nom.	Max	BIL		Pedestal Height	Phase Spacing
69	72.5	350	4200	96 (2438) 120 (3048) 144 (3658)	48 or 84 (1219 or 2134)
115	123	550	2600	96 (2438) 120 (3048) 144 (3658)	84 or 102 (2134 or 2591)
138	145	650	2600	96 (2438) 120 (3048) 144 (3658)	84 or 102 (2134 or 2591)

● Specify values from one of the lines in Table 1.

1.10 The transformer protector, when mounted on a user-furnished structure per the manufacturer's applicable information bulletin, or when on manufacturer-provided mounting pedestals with recommended anchor bolts, and with flexible connections at all six terminal pads, shall be capable of withstanding wind loadings of up to 100 miles (160 kilometers) per hour, as well as performing as intended both during and after seismic loading of 0.25 g ground acceleration in any direction.

1.11 The transformer protector shall be rated for a temperature range of -35°C (-31°F) to +40°C (104°F).

1.12 The transformer protector shall be rated for use at altitudes up to 3300 ft. (1000 meters) above sea level.

1.13 The transformer protector shall not require periodic maintenance.

1.14 The transformer protector shall be fully compatible with comprehensive protection schemes using differential, sudden-pressure, or overcurrent relays.

1.15 Each pole-unit shall be completely assembled at the factory before shipment.

2.0 Construction

2.1 Pole-Units

(a) Pole-units shall be constructed with a lightweight, composite-polymer silicone insulation, in accordance with IEC Standard 815 for medium insulation. Each pole-unit shall weigh approximately 187 lbs. (85 kg) at 69 kV, 231 lbs.(105 kg) at 115 kV, and 234 lbs. (107 kg) at 138 kV. The leakage distance is 100 inches (2540 mm) across the interrupter and 80 inches (2032 mm) line to ground for 69-kV models; 131 inches (3327 mm) across the interrupter and 156 inches (3962 mm) line to ground for 115-kV models; and 131 inches (3327 mm) across the interrupter and 177 inches (4495 mm) line to ground for 138-kV models.

(b) Each pole-unit shall be factory-filled to full pressure with SF_6 of carefully controlled purity, under controlled conditions, and then permanently sealed. Field filling shall never be necessary, thus eliminating the risk of contaminating the interrupting medium.

(c) A common gas manifold shall not be required, eliminating the need to refill or replace other pole-units, should one pole-unit require replacement.

(d) A temperature-compensated gas-pressure gauge shall be provided for each pole-unit. Sensors shall be mounted inside the pole-unit to ensure reliable measurement of gas density. Each gas-pressure gauge shall provide local indication of normal gas density and two alarm levels.

2.2 Interrupters

(a) Fully pressurized interrupters shall maintain rated dielectric withstand values when open.

(b) A built-in pressure-relief device shall be furnished.

2.3 Operating Mechanism

(a) Each pole-unit shall be equipped with its own spring-charged, stored-energy operating mechanism. The mechanism shall be housed in the base of the pole-unit.

(b) The mechanism shall be designed for use with a user-furnished control-power source rated either 48 Vdc or 125 Vdc. The transformer protector shall ship wired for use with a 125-Vdc control power source, and can be field-adjusted for a 48-Vdc source.

(c) The mechanism shall be sealed in SF_6, protecting the mechanism from the external environment and providing excellent corrosion resistance. Heaters shall not be necessary to maintain a dry internal environment.

(d) Local indication of pole-unit state, i.e., "closed and charged" or "open and discharged," shall be provided.

(e) Each pole-unit shall include contacts suitable for remote indication of pole-unit state.

(f) The transformer protector shall include a manual tool for closing and charging pole-units. The tool shall be captured during the charging process, and shall not be removable until the pole-unit is fully closed and charged. Thus, the transformer protector shall always be in one of two states: "closed and charged" or "open and discharged." The manual charging tool shall include a torque limiter to prevent the pole-unit from being over-stressed during charging.

(g) Each pole-unit shall be manually resettable.

With motor-operator option

(h) Each pole-unit shall be reset by a mechanical motor operator. Each pole-unit shall have the ability to be manually reset in case of power loss to the pole-unit operator.

2.4 Low-Voltage Connection Enclosure

(a) Pole-units shall be field-wired by the user to a central low-voltage connection enclosure, which shall be constructed of painted mild steel.

(b) The enclosure shall include provisions for mounting to a user-furnished structure or manufacturer-supplied mounting pedestals, and for padlocking.

(c) Prior to painting, the enclosure shall undergo a thorough, automated pretreatment process. Then protective coatings shall be applied for corrosion resistance and to protect the enclosure. Finally, a stable, acrylic topcoat shall be applied for a durable finish.

3.0 Design Tests

3.1 The following design tests shall have been performed on the transformer protector by the manufacturer, and certified test reports shall be provided upon request:

(a) Dielectric withstand: 60-Hertz; impulse

(b) RIV

(c) Temperature rise

(d) Short-time current withstand: momentary

(e) Current-interrupting performance: primary and secondary faults

(f) Internal arc withstand

(g) Mechanical endurance

(h) Operation at temperature extremes

(i) Gas sealing

(j) Seismic testing to .25 g ground acceleration in any direction

4.0 Production Testing

4.1 The following production tests shall be performed on each transformer protector before shipment:

(a) Trip timing

(b) SF_6 leak test

(c) Electrical resistance

5.0 Optional Equipment

5.1 The transformer protector shall be furnished with the following optional equipment *(specified as required)*:

(a) Key interlocks, to coordinate transformer protector operation with that of the user-furnished series disconnect (not available if the motor operators option is specified.)

(b) Remote gas-density indicator, to provide remote indication of two-level low-gas-density alarms

(c) Local-trip push button, to facilitate local trip operations

(d) External motor operators, to reset the pole-units remotely. Includes local trip and close push buttons, to facilitate local operations

(e) Bypass accessory for transformer protectors rated 69–115 kV: a three-pole, stick-operated device rated 630 amperes continuous, 31,500 amperes momentary

(f) Quick-connect control cable that uses plug-style connectors to replace the butt-splice electrical connections at the pole-units and at the conduit entrance to the low-voltage enclosure

Only available if motor operators are specified:

(g) Local-remote selector switch, to prevent remote operation of operator when selector switch is placed in “local” mode, as for example, during inspection

(h) Complete quick-connect control cable. Includes plug-style connectors replacing the terminal block connections at the motor operator as well as the connections in (f) above.