

# **TECHNICAL SPECIFICATIONS FOR SINGLE-PHASE STEP VOLTAGE REGULATORS**

## **1.0 GENERAL**

**1.1** This specification covers electrical, mechanical, and safety features and characteristics of outdoor, single-phase, oil-immersed, step voltage regulators. The voltage regulators must be completely self-contained and provide 10 percent regulation in thirty-two (32) 5/8 percent steps.

**1.2** Regulators furnished under this specification shall be designed and manufactured under the latest NEMA and ANSI standards covering the complete unit or any part thereof. These applicable standards shall be part of this specification.

**1.3** The voltage regulator specified shall be 19.92kV class wired and suitable for use on a 15.24/26.4kV grd Y system. Voltage regulator shall have the following ratings:

Current rating: 418 Amps  
Reg. KVA: 833  
BIL: 150kV

The regulator ratings shall be based on not exceeding a 55 degree C. rise.

## **2.0 CONSTRUCTION**

**2.1** The regulator shall be designed such that they can be partially or completely untanked for inspection and maintenance without disconnecting any internal electrical or mechanical connections. After the unit is untanked, it shall be possible to operate the regulator mechanism and to test the control panel from an external 120VAC source without any reconnections between the control and the regulator.

**2.2** The tap-changing mechanism shall be of the motor-driven, quick-break type, and shall be completely oil immersed.

**2.3** Tank design - The regulator shall be of a sealed-tank construction and must include a pressure relief device for venting combustible gases.

**2.4** Finish - All external parts and those applicable internal parts of the tank and the control enclosure shall be finished with a high-grade primer and paint designed to provide a long service life with little or no signs of degradation due to exposure to high humidity or ultraviolet radiation. The coating color shall be ANSI 70 light grey. All external hardware shall be stainless steel.

**2.5** A sufficient thickness of epoxy-coated insulation paper shall be used between windings and properly baked with sufficient mechanical pressure exerted on the winding to assure a complete bonding of the insulation to improve the short-circuit current withstand capabilities.

### **3.0    EXTERNAL FEATURES**

**3.1**    The BIL rating of the bushings shall be compatible with the BIL of the regulator. The bushing designations (S, L, or SL) shall be permanently marked on the regulator cover adjacent to the bushings. The S, L, or SL bushings must be interchangeable with each other.

**3.2**    Terminals - Clamp type terminals shall be provided that can accommodate either CU or AL conductors #2-800MCM.

**3.3** All regulators shall be provided with an external Metal Oxide Varistor (MOV) bypass arrester connected across the series winding.

**3.4** An external oil sight gauge shall be provided which indicates oil level and oil color.

**3.5** An external position indicator which is mounted above the oil level of the regulator shall be included to provide information as to the regulator tap position. The indicator shall be slanted at a 45 degree angle for ease of reading from below when the regulator is installed on a platform above ground level.

**3.6** Where applicable, single-phase regulators shall include an adjustment feature which will permit additional current carrying capabilities at reduced regulation per the following:

REGULATION (PERCENT)	CURRENT (PERCENT)
+10.0	100
+8.75	110
+7.50	120
+6.25	135
+5.00	160

The adjustment shall be located on or within the position indicator.

**3.7** Provisions shall be provided for the addition of lightning arresters near each bushing.

**3.8** All regulators shall be furnished with an oil sampling valve.

**3.9** Nameplate - A durable aluminum nameplate shall be affixed to the regulator and the regulator control which includes the following information:

1. Manufacturer's name and serial number.
2. Voltage ratings.
3. kVA rating and load current ratings.
4. Connection diagram and tap settings
5. Potential ratios and control power voltages
6. Untanked weight
7. Oil capacity (gal.)
8. Total weight (lbs.)

**3.10** All units shall be provided with a base suitable for securing them to an elevated structure.

## **4.0 REGULATOR CONTROL**

**4.1** The regulator control cabinet shall be weather-resistant and capable of being padlocked.

**4.2** A 30 foot remote mounting cable shall be included with the regulator to allow for remote mounting of the control if desired. The cable shall be pre-assembled at the factory.

**4.3** The control shall be micro-processor based and all printed circuit boards shall be conformal coated for fungi and moisture protection.

**4.4** All leads to the control shall be color coded or labeled for easy identification.

**4.5** The control panel shall be provided with an acceptable means for de-energizing the control and short circuiting the main current transformer to protect it prior to testing or removal.

**4.6** The regulator control panel shall include the following features:

**a.** A three -position voltage source switch labeled "INTERNAL-OFF-EXTERNAL" or "NORMAL-OFF-EXTERNAL SOURCE". This switch shall select regulator control operation from an internal voltage transformer, external source, or de-energize the regulator control.

**b.** A three -position motor transfer switch labeled "MANUAL-OFF-AUTO" or "AUTO\REMOTE-OFF-MANUAL". This switch allows automatic or manual operation of the regulator, or allows the control to be turned off. Supervisory control shall be permitted only when the switch is in the "AUTO" position.

**c.** A three-position manual "RAISE-OFF-LOWER" switch shall be provided to allow manual raising or lowering of the regulator tap changer. This switch shall only be active when the control switch is in the "MANUAL" position.

**d.** A position indicator drag hand reset switch.

**e.** A neutral indicating lamp that is activated via the tap changer to provide neutral indication. A means shall also be provided to verify that the neutral lamp is operating.

**f.** A six digit operations counter which counts every tap change.

**g.** A means shall be provided to indicate whether the output voltage of the regulator is inside or outside the set voltage band.

**h.** Independent motor and panel fuses shall be provided which are replaceable from the front panel. Fuse label and size shall be clearly marked above or below each fuse.

**i.** Voltage test terminals which connect to the 120V base output (Load Side) of the regulator.

**j.** External voltage source terminals shall be supplied to allow tap changer operation from an external 120V source. An interlocking means shall be provided to prevent energizing the high-voltage bushings from the external source.

**k.** Voltage level setting adjustable between 106 to 134 volts in increments no larger than 1 volt.

**l.** Voltage Bandwidth settings shall be adjustable from 1.0 to 6.0 volts, in increments of 0.5 volts.

**m.** Line-drop compensation resistance and reactance settings with polarity selection.

**n.** Time-delay shall be adjustable from 10 to 180 seconds.

**o.** Reverse power flow detector which automatically senses a power reversal and changes the necessary regulator circuitry for proper operation in a reverse power flow condition. A source-side voltage transformer shall be installed within the regulator for this feature and metering purposes which meets ANSI Class 1 accuracy.

**p.** A voltage reduction control which will reduce the output of the regulator up to 10.0 percent in 1 percent increments. This voltage reduction control shall be capable of being activated either locally or by use of remote supervisory control. Additionally, two automatic voltage reduction settings shall provide a range for 0.1 to 10.0 percent voltage reduction for values of load current.

**4.7** Regulator control shall also have the following safety, information retrieval, and communication features:

**a.** A voltage limit control which prevents the regulator from further raising or lowering its output above or below the preset values of the limit control.

**b.** A digital metering package of class 1 metering accuracy which provides the following instantaneous information: load voltage, compensated voltage, current, power factor, kVA load, kW load, kVAR load, voltage harmonics, and current harmonics. The present value, the maximum value since the last

reset and minimum value since the last reset shall be provided for the following demand functions: load voltage, compensated voltage, current, kVA load, kW load, and kVAR load. Also, the power factor shall be provided at the Max. kVA demand and at the Min. kVA demand.

c. Standard RS-232 or suitable front panel port that allows for local attachment of a handheld/laptop computer for downloading information from the control panel or changing control settings.

d. Communication modules or boards shall be provided to access the regulator for complete, two-way digital communications by means of fiber optic cable.

## **5.0 TESTING**

**5.1** All regulators shall be tested in accordance with the latest ANSI standards. In addition, every voltage regulator shall receive the following tests:

a. Impulse test at 100 percent rated BIL on S and SL bushings to assure full integrity of the insulation system.

b. Operated for a minimum of 1,000 operations, stepping through multiple steps in both the raise and lower directions to verify correct control and tap changer operation and to assure that all infant failures are detected at the factory.

## **6.0 DEVIATION FROM SPECIFICATION**

**6.1** It is expected that any regulators supplied by the manufacturer will be in strict accordance with this specification unless appropriately noted on the bid. The JEA reserves the right to evaluate any exceptions that are taken by the manufacturer. Any deviation from this specification without prior approval will be sufficient cause for rejection of the manufacturers bid.

## **7.0 APPROVED MANUFACTURERS**

Siemens  
Cooper Power Systems