

# TECHNICAL SPECIFICATION FOR 600V FILTERED AUTOMATIC POWER FACTOR CORRECTION BANKS

## 1. Equipment Size / Ratings

System operating voltage (line-to-line): 600V, 3 phase, 60Hz. Capacitors shall be rated minimum 690V to protect against current and voltage overload due to harmonic distortion.

Total kVAr required at system voltage at present: 300

Total kVAr required at system voltage for future: 450

Total bank to be switched in 4\*75 (plus room for 2 Expansion steps of 75 kVAr) kVAr steps.

## 2. Capacitors

Individual capacitors shall be CSA and UL approved, 3 phase, gas or oil filled under vacuum, and of a self-healing design utilizing a low loss metallized polypropylene film dielectric system with a pressure sensitive circuit interrupter. Metallized paper is not acceptable. Capacitor casing shall be of a seamless aluminum design. Electrical losses shall be less than 0.25w/kVAr. Dielectric fluid shall be high flash point, biodegradable, non-toxic and contain no PCB's. Capacitors shall include internal fusing for short circuit protection to 10kA, and include a grounding / mounting stud at the bottom of the capacitor cell for easy replacement.

Capacitors shall be rated for a minimum of 130% continuous current overload and 110% continuous voltage overload based on the 690 Volt rating of the capacitors. Individual capacitor cells shall not exceed 25 kVAr at the system voltage to keep replacement costs at a minimum.

Capacitors shall be suitable for -40°C to +60°C ambient temperature.

Dry type capacitors and / or capacitors without a pressure sensitive circuit interrupter are not acceptable.

## 3. Discharge Resistors

Adequate discharge resistors shall be provided for each capacitor cell to reduce the voltage to 50 Volts or less in one minute after disconnection of supply voltage.

## 4. Harmonic Filtering Reactors

Filter tuning frequency shall be  $4.5 \times 60 \text{ Hz}$  (270 Hz).

Harmonic filtering reactors shall be three phase iron core complete with one "+" tap and one "-" tap per phase for field adjustment of inductance. Reactor insulation shall be rated at 220°C. The maximum temperature of the reactor at maximum continuous rms amperage shall be no higher than 145°C with a 45°C ambient. Reactor maximum continuous rms amperage shall be sized to match the maximum continuous rms amperage of the capacitors. The minimum reactor Q factor shall be 90.

Reactors shall be equipped with snap action thermostats which trip at 145°C and are wired to a monitoring system which switches off and locks out the associated contactor for the overheated reactor. An LED shall indicate which step has the overheated reactor. A pushbutton reset located on the door shall reset the alarm.

In no case shall the harmonic filtering reactor size exceed 75 kVAr at the system voltage to allow for ease of replacement.

## 5. Contactors

Contactors shall be 3 phase, IEC rated, and rated for capacitor switching duty. Contactors must be capable of switching 135% of the nominal amperage of the capacitors being switched. The contactors

shall be capable of switching the maximum continuous rms amperage rating of the capacitors. Contactor coils shall be 120 Volt, 60 Hz.

## **6. HRC Fusing**

3 HRC fuses shall be included for each contactor. HRC fuses shall have a minimum interrupting rating of 200 kA. Fast acting fuses shall be sized for at least 180% of the nominal amperage of the capacitors to prevent clearing on inrush. Time delay / dual element fuses shall be sized for a minimum 140% of the nominal amperage of the capacitors.

## **7. Digital Microprocessor Controller**

The digital microprocessor controller shall be a minimum 12 step controller, which includes the following features:

- a) adjustable target power factor from 0.85 lagging to -0.95 leading
- b) circular or linear switching modes
- c) automatic or manual switching of steps
- d) switching ratios of 1:1:1:1:1, 1:1:2:2:2, 1:1:2:2:4, 1:1:2:3:3, 1:1:2:4:4, 1:1:2:4:8, 1:2:2:2:2, 1:2:3:3:3, 1:2:3:4:4, 1:2:3:6:6, 1:2:4:4:4, 1:2:4:8:8
- e) switches up to 12 steps for each switching ratio
- f) option of selecting switched steps as fixed steps
- g) adjustable capacitor current to current transformer ratio (c/k value or sensitivity) from 0.025A to 1.5A.
- h) selectable switching on and off delays of 10, 30, 60, 120, 180, 300, and 500 seconds and an option to have the controller automatically adjust the switching on and off delay between 2-500 seconds as a function of reactive load.
- i) selectable reswitching blocking delay of 20, 60, 180, and 300 seconds
- j) choice of automatic, semi automatic, or manual determination of CT ratio and position, c/k ratio, step switching ratio, and step quantity.
- k) memorization of CT position after the first startup in automatic startup mode.
- l) measuring voltage range of 58 - 690 Volt without potential transformer
- m) displays capacitor step current based on CT ratio without having to use multipliers
- n) displays fundamental and rms current on the main bus bar without having to use multipliers
- o) displays individual harmonic current distortion on the main bus bar for the 3rd, 5th, 7th, 11th, 13th, and 17th harmonics
- p) temperature sensor adjustable from 25 to 50°C.
- q) alarm relay for temperature above set point, individual harmonic current distortion above set point, total harmonic current distortion above set point, power factor below target set point, measuring voltage missing, excessive CT secondary current, CT secondary current too low.
- r) selectable step switching feature in alarm conditions which provides anti-resonance features
- s) selection of activation or deactivation of individual alarms.
- t) display shows symbols for alarms when in alarm status and dry alarm contact closes in alarm condition
- u) no voltage release switches out all capacitors in case of interruption of supply voltage
- v) monitors and displays quantity of individual step operations for determining contactor wear.
- w) displays a fault when any step current is reduced to zero indicating faulty step components.
- x) communications via RS232 as a standard with price adder for RS485 MODBUS RTU using DOS or Windows software
- y) key board locking feature to prevent unauthorized tampering
- z) watchdog continuously monitors processor and indicates a fault if the processor malfunctions.

## **8. Split Core Current Transformer**

A split core current transformer of adequate size, ratio, and burden shall be supplied.

## **9. Termination**

A suitably sized three phase terminal block shall be provided for feeder termination. Ground terminals shall be provided for ground wire termination.

Feeder Cable Entry Location: Top Feeder Cable Size: 2\*350MCM per phase

## 10. Enclosure

Enclosures shall be of at least the minimum gauge steel as required by code. Enclosures shall suitable for the installation location. NEMA 1 enclosures shall be easily field changeable to NEMA 2, NEMA 3R, and NEMA 12. Thermostatically controlled ventilation shall be sized to maintain a maximum temperature of 45°C inside the enclosure at the extreme high ambient temperature.

NEMA 3R enclosures shall include thermostatically controlled anti-condensation heaters to maintain at least -20°C inside the enclosure based on the extreme low ambient temperature. Dripshields, air filters for dust, moisture, and vermin shall also be included for NEMA 3R enclosures. Dripshields and air filters for dust shall be included for NEMA 12 enclosures. Dripshields shall be included for NEMA 2 enclosures. The controller shall be semi-flush mounted on the door for NEMA 1 applications. The controller shall be mounted behind safety glass and the display visible for NEMA 2, NEMA 3R and NEMA 12 applications.

Adequately sized control transformer and control fuses shall be provided for all controls including heating and cooling.

All components must be suitably mounted to provide ease of replacement with front access only. All enclosure mounting hardware and framework shall be either galvanized steel or zinc plated steel for grounding continuity. Painted mounting hardware and framework with paint removed for grounding is not acceptable. All enclosure parts other than mounting hardware and framework shall be powder coated ASA 61 Grey.

The enclosure door shall have a lockable handle.

Enclosure rating required: NEMA 1  
Minimum ambient temperature: 10°C Maximum ambient temperature: 35°C

## 11. Labelling

A "Wait one minute after disconnection from supply" label shall be located on the enclosure door. A "Wait five minutes after disconnection from supply" label shall be provided loose for the disconnecting device. Both labels shall be worded as per code requirements.

## 12. Testing

Testing shall be performed as per CSA and UL standards. All assemblies must be bear a certification label for both Canadian and USA standards. For filtered units a confirmation of the filter tuning frequencies must be performed prior to shipment.

## 13. Approved Manufacturers