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Sizing Generators for "2-Pole Controlled" Soft Starters

New soft starters change traditional sizing guidelines

Manufacturers of motor soft-starters have introduced a variation to their reduced voltage three-phase SCR controlled soft-starters. We are seeing soft-starters that only control current on two of the three phases in the market more often. The "uncontrolled phase" eliminates SCRs from one phase and thus does not limit current during motor starting. The result is starting current on one phase approaching 500% of full load current, significantly reducing the effectiveness of the soft starter when it is used specifically to limit voltage dip while connected to an emergency power source.

Fire pump controller manufacturers have started offering products with 2-phase controlled soft-starters. To size a generator and alternator properly, it is critical to know the type of soft-starter used; "2-pole controlled" or "3-phase controlled."

The traditional three-phase soft-starter implementation controls current on all three phases of the motor, as illustrated below.

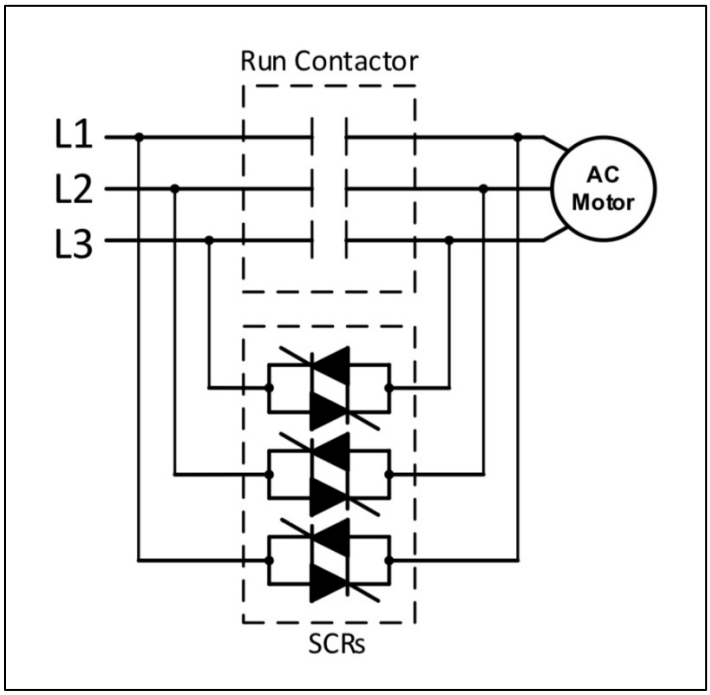


Figure 1: Three-phase controlled soft-starter. Image Credit, WEG Electric

The three-phase controlled soft-starter is able to limit current to all three phases of the motor, maintaining current and voltage balance. This is important when sizing generators and alternators to achieve a specified voltage dip limit; on fire pumps for example.

A three-phase controlled soft-starter is often modeled as a voltage ramped device that limits current to 350% to 400% of full-load running current. Generator sizing software, such as Generac's Power Design Pro, presumes the current is controlled and balanced on all three phases.

A 100 HP motor started across the line requires approximately 600 sKVA. The same motor with a three-phase controlled voltage-ramped soft-starter, limited to 350% full load current, requires 120 sKVA by comparison. The significant sKVA reduction with the three-phase controlled soft-starter allows use of a smaller generator and/or alternator to achieve a desired voltage dip target.

Field observations by Generac technical personnel, confirmed by manufacturers' literature, indicates that two-phase controlled soft-starters result in starting currents on the order of 500% full load running current. The same 100 HP motor started with a 2-phase controlled soft-starter requires 450 – 500 sKVA, close to the across the line starting condition of 600 sKVA.

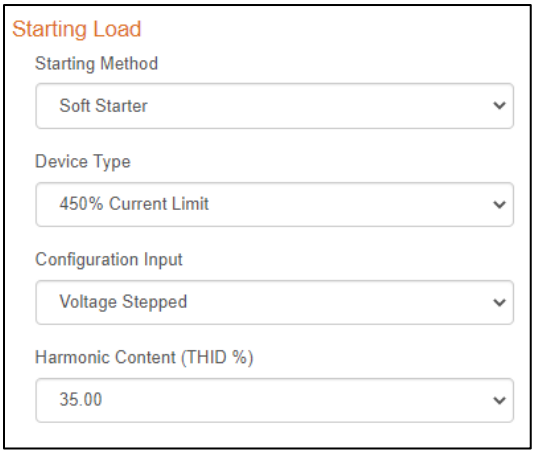
We will be making changes to PDP in the near future to address these devices. In the meantime, a 2-phase controlled soft-starter can be modeled with reasonable accuracy in Power Design Pro using the following motor starting characteristics:

Starting method: Soft Starter

Device Type: 450% Current Limit

Configuration Input: Voltage Stepped

Harmonic Content: 35% THID



Additional resources:

ABB Paper, Performance Comparison Between 2- and 3-phase Controlled Soft Starters. December, 2018.

Eaton Paper, Use of Two-Phase Control for Soft Starter Applications, September 2010

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