Motor Start Concerns

Address Your Motor Starting Concerns

Motor starting is an important issue which must be considered when applying a generator set. The high current that motors draw when starting causes voltage dips in the system. This may require oversizing the generator or applying motor starting techniques which maintain this voltage dip at acceptable levels for your system and its attached components.

Motors, either loaded or unloaded, draw several times rated full load current when starting. This is termed locked rotor current, or starting kVA (SkVA). SkVA is calculated from locked rotor current like this: SkVA = V x A x 1.732 / 1000

In-rush current to the motor causes a rapid drop of generator output voltage. In most cases, a 30% voltage dip is acceptable, depending on the equipment you already have on line. The degree of dip must be identified by an oscilloscope, since mechanical recorders and digital multimeters are too slow.

Motor Starting Options

If you have an application where motor starting is a concern, consider the following:

- Change the starting sequence, with largest motors first. More SkVA is available, although it does not provide better voltage recovery time.
- Use reduced voltage starters. This reduces kVA required to start a given motor. If you're starting under load, remember this starting method also reduces starting torque.
- Specify oversized generators.
- Use wound rotor motors, since they require lower starting current. Wound motors typical cost more, however.
- Provide clutches so motors start before loads are applied. While SkVA demand is not reduced, the time interval of high kVA demand is shortened.
- Improve the system power factor. This reduces the generator set requirement to produce reactive kVA, making more kVA available for starting.
- Use reduced voltage starters. High quality 24-pulse or higher solid-state reduced voltage starters do not create sine wave issues, have become much more affordable, and extend motor life. Plus many utilities now require soft starters or VFDs on all motors larger than 50hp.
- Consider the use of Cat UPS for critical motor loads.

Watch Voltage Dip

Motor starting is affected by motor and generator design, and load on the motor. Initial voltage dip depends mostly on motor and generator windings. Use of a permanent magnet exciter will not significantly decrease this dip – only the recovery time. The magnitude of voltage dip tolerable depends on the type of equipment on line. Motor starting contactors may open if voltage drops below 65% of rated.

Motors draw starting currents to eight times normal running current. Preloads on motors do not vary maximum starting currents but do determine time required for motors to achieve rated speed and current to drop back to normal running value. If motors are excessively loaded, they may not start or may run at reduced speed.

Motors connected directly to high inertia centrifugal devices or loaded reciprocating compressors cause severe frequency excursions and lengthy motor run up. Comparing starting current between loaded and unloaded motors shows the extended time loaded motors demand high current.

When specifying motor loads, SkVAs, and acceptable system voltage dips to a genset specifier, it is important to ensure that you are evaluating the instantaneous voltage dip of the generator's voltage on the system. Instantaneous voltage dip is the actual maximum voltage dip experienced when a motor load is applied.

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Some genset manufacturers state voltage dip in terms of "sustained" voltage dip. Sustained voltage dip is calculated by ignoring the actual voltage dip for the first few cycles of motor starting, where the voltage dip is highest, and then averaging the voltage dip during part of the recovery period. This significantly underestimates the actual voltage dip any equipment attached to the system experiences and may cause system and equipment problems due to higher instantaneous voltage dips. A 90% sustained voltage number does NOT equal a 10% instantaneous voltage dip. If you have motor starting questions, please contact Cashman. We can help you avoid serious equipment problems.

Properly Size a Genset to Your Application

You may click here and download Cat's SpecSizer program which allows you to enter your site conditions, loads, and load sequence and predict voltage and frequency dips. It also allows you to modify sequencing to see if adding sequence controls can help reduce the size of your generator set and the associated cost.