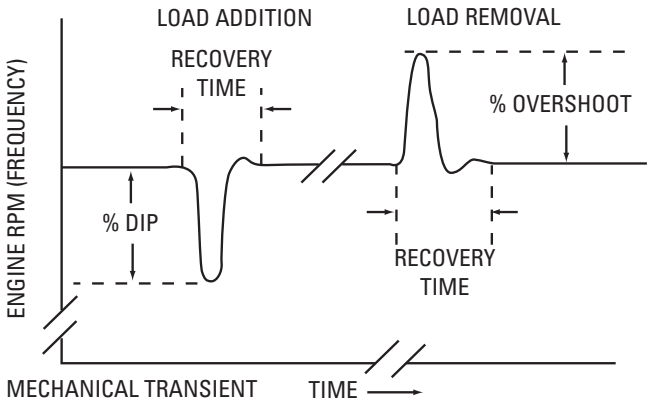
Transient Response

Understanding Transient Response

When a switch sends a few hundred kW out on a circuit, there's no need to worry about the local utility's ability to accept the load or any transient effects on power quality. However, these are valid concerns when power is being drawn from a genset. Both the amount of load that can be accepted in one step and the extent of temporary effects to power quality vary considerably from one genset model to another.

Whenever a large load is added to a generator set, engine speed temporarily slows down - or dips - before returning to its steady-state condition. When a load is removed, engine speed increases - or overshoots - temporarily. Since generator frequency is determined by engine rpm, the quality of electrical power is impacted. Measurements of these temporary speed changes are called transient response.

Transient response is measured by percentage frequency change and duration (see Figure 1). The amount of time it takes for the engine to return to steady-state operation is called recovery time. This can vary from as little as 1 second to 20 seconds. In general, the greater the load added to the bus, the greater the percentage of dip and the longer it will take the engine to recover.



Dips are generally more critical than overshoots because severe block loading can stall the engine and cause generator voltage to collapse. The genset's rotating mass helps maintain frequency, but inertia must be closely balanced between the generator and engine. This is an important factor when specifying an oversized generator, because the frequency dip decreases and allows more engine horsepower to be available for recovery.

Of all factors affecting transient response, the genset's voltage regulation system plays the most important role. Volts-per-hertz voltage regulation systems maintain voltage proportionally versus frequency. So as a large block load reduces engine rpm and generator frequency, voltage decreases also, which effectively unloads the engine and shortens recovery time. All CAT gensets use this system.

Constant-voltage regulation systems offer a lower percentage of voltage change, but recovery time is significantly longer. If full load is applied to the engine, there is more risk of an engine stall.

Some generators use increased volts-per-hertz regulation systems. While these systems significantly increase block-loading capability or shorten recovery time, they do it at the expense of much greater voltage dip.

Engine configuration also affects transient response. Most genset engines are turbocharged to give you more hp - and kW - without going to a larger engine. But turbocharging's down side is in transient response. In lugging situations, air becomes a limiting factor. The more highly turbocharged a genset engine is, the longer its transient response.