



TURBINE TIPS

Turbine Tips provided by Pond and Lucier, LLC. ®

634 Plank Road, Suite 103 Clifton Park, NY 12065

Phone: 518.371.1971 Fax: 518.371.1756 E-mail: pal@pondlucier.com



December 2001

Subject: **Synchronizing to the Power Grid**

Reference: **Speedtronic™** Control Systems for GE Gas Turbine/Generators

Applies to: All Marks of **Speedtronic™** Mark 1 through Mark IV

Did you ever ask yourself "Why is the speed setpoint set to **100.3 percent** during gas turbine start-up? Why is it not set at exactly 100.0 percent for generator synchronization to the power grid?"

Before I explain, I should clarify a couple of points regarding GE Speedtronic™ machines:

On **Speedtronic™ Mark I** and **Mark II**, speed/load setpoint is called the Digital Setpoint (DSP).

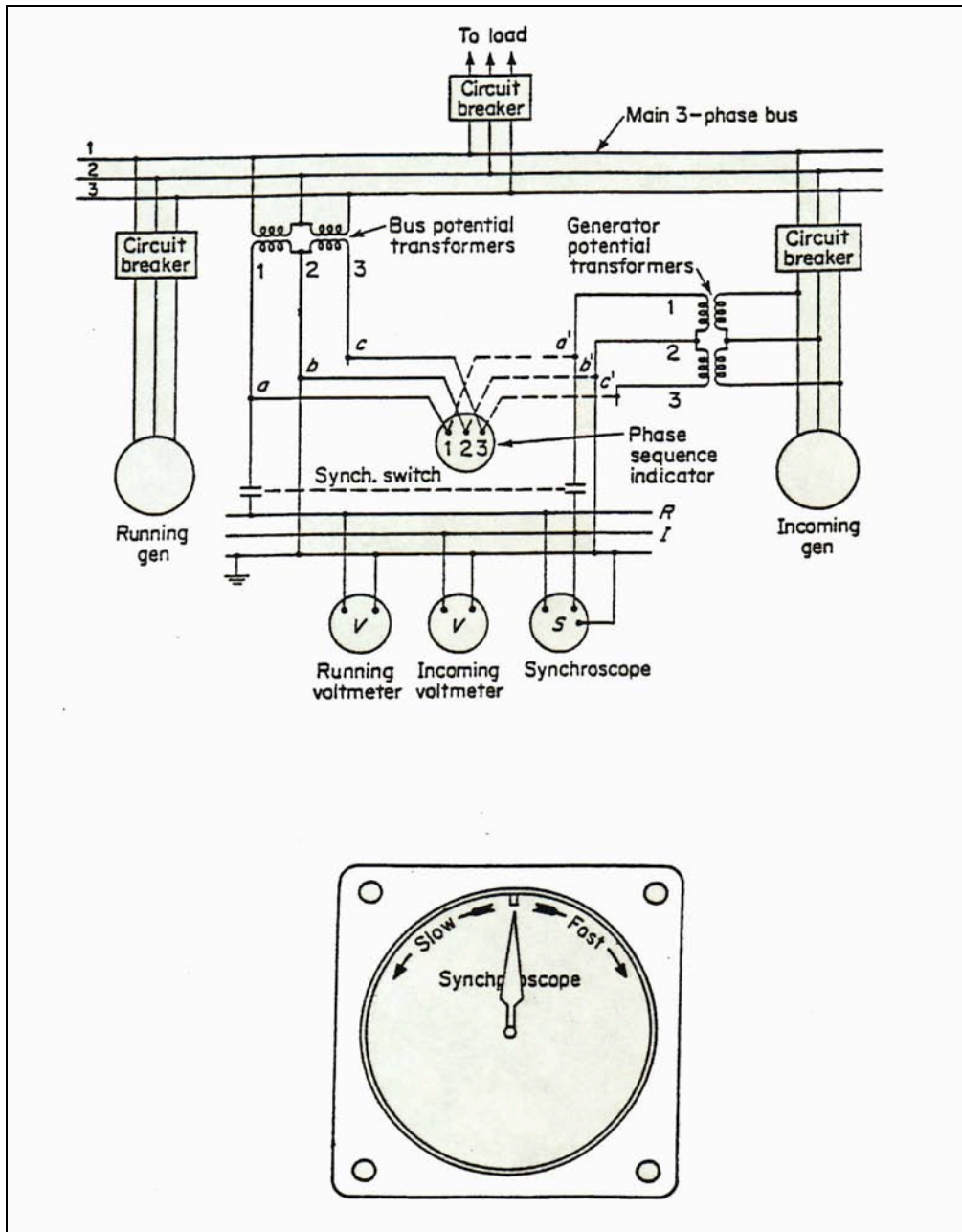
On **Speedtronic™ Mark IV**, **Mark V** and **Mark VI**, the turbine speed reference signal is called **TNR**. N is the engineering symbol for Speed.

Well, the reasons for a setpoint of 100.3 percent are two-fold:

1. With the "called for" speed of **.3 percent** greater than operating speed, the synchroscope will turn in a **clockwise (CW)** direction, as the auto-synchronizing circuitry searches to bring the "on coming" generator into phase with the power grid. The rate that the needle on the synchroscope turns with a setpoint that is .3 percent slightly faster than the power grid frequency (typically 60.00 cycles per second, cps). That is, 100.3 multiplied by 60.00 = 60.18 cps. This setpoint will drive the synchroscope in a **CW** direction at a needle sweep rate of approximately 5 seconds per revolution. It is also said that the on-coming generator is running "**Fast**," as is indicated on a typical synchroscope.
2. After the power circuit breaker (called **52G** by GE) closes to the grid, an instant later the grid "notices" an increase in frequency as the new generator attempts to "speed up" power grid. This is unacceptable to most power systems, so the other generators must



"shed" load to negate the effect of the "fast running" generator. Thus, the new generator will respond by accepting the load and delivering power to the grid.



How much power is represented by a setpoint of 100.3 percent? Glad you asked.

Suppose you have a GE gas turbine generator MS7001EA. Assume its rated power output is 80 megawatts. Assume that the grid frequency is exactly 60.00 cps when the breaker closes. Assume also that the speed governing circuit for the gas turbine has a 4 percent "droop" characteristic, which is typical.

The instantaneous jump in power output by the new generator when the **52G** breaker closes would be:

$$\text{Power Output} = [(.3) \div (4)] \text{ multiplied by } 80 = 6 \text{ megawatts}$$

If your GE Speedtronic™ machine has a setpoint of 100.3 percent but the system does not perform as explained above, look to recalibrate the analog circuitry (operational amplifiers) to make it comply.

Or call PAL Engineering to help!