TURBINE TIPS
Turbine Tips provided by Pond and Lucier, LLC. ®
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Subject: Faulty Operation of the Digital Setpoint
Applies to: General Electric Gas Turbines (Speedtronic™ Mark I and II)
Related Subjects: Tip for March 2007

General Electric gas turbines from the 1970s and early 1980s with Speedtronic™ Mark I and II control systems utilized a binary counter to determine the "called for" speed. Fig. 1 below shows a typical Mark I panel with the lower door removed.

Fig. 1: Typical Speedtronic™ Control Panel with lower door removed

Fig. 2 shows a close up of the entire Speedtronic ™ "page," showing Row 0 at the top. The digital setpoint (DSP) is on the left of row 0. Notice the light in the upper left.

Fig. 2: Speedtronic “Page” for Mark I

An actual Digital Setpoint (DSP) system is shown below in Fig. 3. There are eight circuit boards, including the **LINA** lights on the left. This is a reversing counter system that includes raise/lower (RL) circuits, shift registers (SR), and a pulse generator (PG). A digital-to-analog card, **ADAD, i**s used to create an analog voltage that drives a panel meter shown in Fig. 5 below. The analog signal is also used as an input to the speed control circuit’s **SSZA**. The signal is positive when the setpoint is below 100% speed. At FSNL, the analog signal is zero volts DC. The signal “goes negative” as the signal increases above 100%. The setpoint goes from 95 to 107% for a voltage change of +2.5 volts to – 3.5 volts DC.

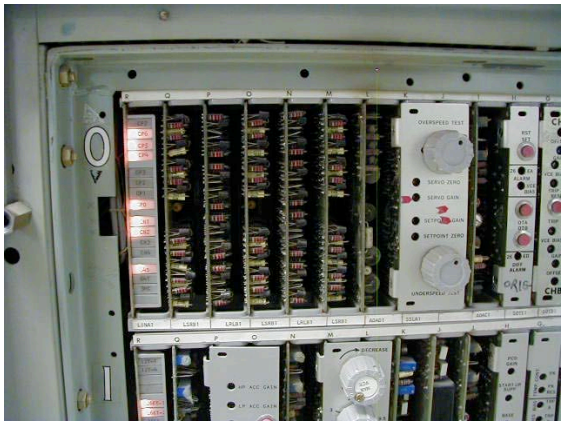

Fig. 3: Row 0 has binary lights for the LINA card of the DSP

Fig. 4 below shows the circuit boards (cards) in their respective slots that comprise the Digital Setpoint (DSP). Left to right, there are the following cards: (1) **LINA**, (3)**LSRB**. (2) **LRLB**, (1) **ADAD** and (1) **SSLA**. The **SSLA** card has adjust resistors for the servo amplifier and the setpoint gain and zero.

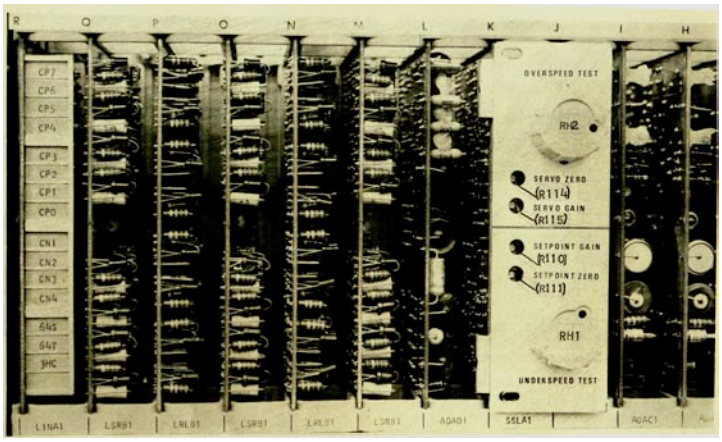

Fig. 4: Binary Counter for Digital Setpoint (12 lights on left from CN4 up to CP7)

Note: Only the upper 12 lamps are used on the **LINA** card for the **DSP**. The lights begin at the bottom CN4. If the CN4 light is on, it counts "1"; if it is off, it counts for "0" in the system. By counting in powers of 2, the next light above, CN3, would count "2" if on and 0 if off. The next one, CN2, counts "4" if on. See chart below.

NAME	VALUE IF "ON"
CP7	2048
CP6	1024
CP5	512
CP4	256
CP3	128
CP3	64
CP1	32
CO0	16
CN1	8
CN2	4
CN3	2
CN4	1

The **DSP** signal is also displayed on a panel analog meter. When the turbine is started, the **DSP** immediately goes to a count of 1809, which is displayed as 100.3%. This is done to set the "called-for speed" slightly higher than synchronous speed. When the generator synchronizes to the power grid, it will take on approximately .3 percent of rated load. If the generator does not load thereafter, the problem might be ***Incomplete Sequence.*** Check to see if all the Motor Control Center switches are in the AUTO mode. Also, check to see if relay **3-1** is energized. Verify that relay **14HS** has energized. Test it by pushing the button to see if it allows the **DSP** to function. If the DSP still will not "count up" to raise megawatt output, the problem may be with one of the circuit boards.

Fig. 5: Digital Setpoint Meter showing 98% "called for" speed.

Shut down the turbine. With the turbine at rest, put the operation selector switch in the "off" position. See if the **DSP** will raise or lower. If the counter does raise and lower, look to a problem with the "complete sequence" system.

Fig. 5: Digital Setpoint Meter showing 104.3% “called for” load

In Fig. 6 above, the setpoint is at approximately 104.3 %. This represents approximately Base Load.

For further information regarding this Speedtronic™ problem, contact Dave Lucier of ***Pond and Lucier, LLC*** by calling: 518-330-4801 or email to dave@pondlucier.com.