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

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Subject: What does "complete sequence" mean?
Applies to: General Electric Gas Turbines
Examples used herein: Speedtronic™ Mark I and II)

General Electric gas turbines installed in the 1960s - 1980s had a panel light to indicate ***Complete Sequence.*** This term means that the turbine has reached operating speed and that all of the motor-driven auxiliaries that ***should shut down, have indeed shut down***. It should be remembered that the gas turbines start with motor-driven auxiliary devices. For example: **88QE**, the DC motor-driven lube oil pump is used for black-start turbines. Another example would be for a turbine starting on liquid fuel, **88CA**, the AC motor-driven atomizing air compressor is required. Once the turbine reaches operating speed, these motors should stop and ***Complete Sequence*** should illuminate. See Fig. 1 in the lower right of the picture.

Fig. 1: Complete Sequence lights on Mark I Speedtronic Panel

Fig. 2 below shows the turbine up at operating speed (4 green lights are **ON** for speed relays) but the ***Complete Sequence*** light is **OFF**. It is very likely that one of the Motor Control Center (**MCC**) switches is in the manual position, preventing relay 3-1 from energizing to turn on the **RED** light indicating that the starting sequence is complete.

Fig. 2: Complete Sequence lights on Mark II Speedtronic Panel

The way that an incomplete sequence condition manifests itself is that the Digital Setpoint (**DSP**) will not allow the generator to be loaded. It will sit at about 3-4 megawatts and not increase in load. The **DSP** counter (flashing sequence of lights on a **LINA** card) will not work. Fig 3 below shows a typical **MCC**. Sometimes a particular motor is tagged out of operation (as shown); other times, the small switch on the lower right of a particular motor is turned to the **MANUAL** position for testing. Before start-up, the switch should be returned to the **AUTO** mode.


Fig. 3: Motor Control Center (MCC) showing switch in the upright **AUTO** mode (lower right side)

Refer to Fig. 4 below. There are twelve **DSP** lights on the far left for the **LINA** card. The lowest one is **CN4** and the upper one is **CP7**. If the lights do not "count" up or down properly, it could be that a switch in the **MCC** (above in Fig. 3) is not in the **AUTO** mode.

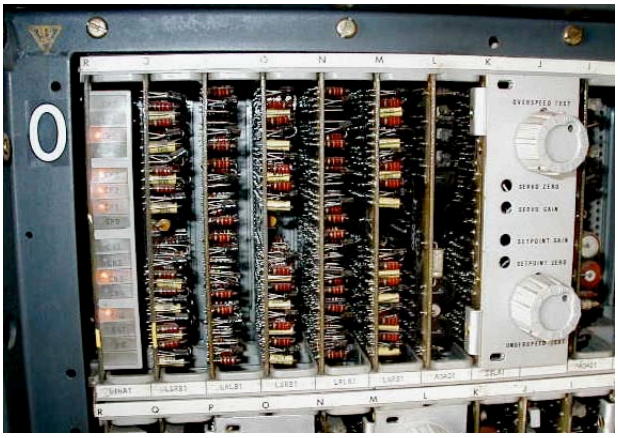

Fig. 4: Binary Counter for Digital Setpoint (12 lights on left from CN4 up to CP7)

The **DSP** signal is also displayed on a panel analog meter. In Fig. 5 below, the setpoint is at approximately 104.5 %. When the turbine is started, the **DSP** immediately goes to a count of 1809, which is displayed as 100.3%. This is done so as to set the "called-for speed" slightly higher than synchronous speed. When the generator synchronizes to the grid, it will take on approximately 3 percent of rated load. If the generator does not increase load thereafter, the problem might be ***Incomplete Sequence.*** Check to see if all the **MCC** switches are in the **AUTO** mode. Also, check to see if relay **3-1** is energized. Test it by pushing the button to see if it allows the **DSP** to function. More on the possible failure of the binary counting system in a future PAL Turbine Tip.

Fig. 5: Digital Setpoint Signal remains at 100.3 %

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.