



# TURBINE TIPS

Turbine Tips provided by Pond and Lucier, LLC. ®

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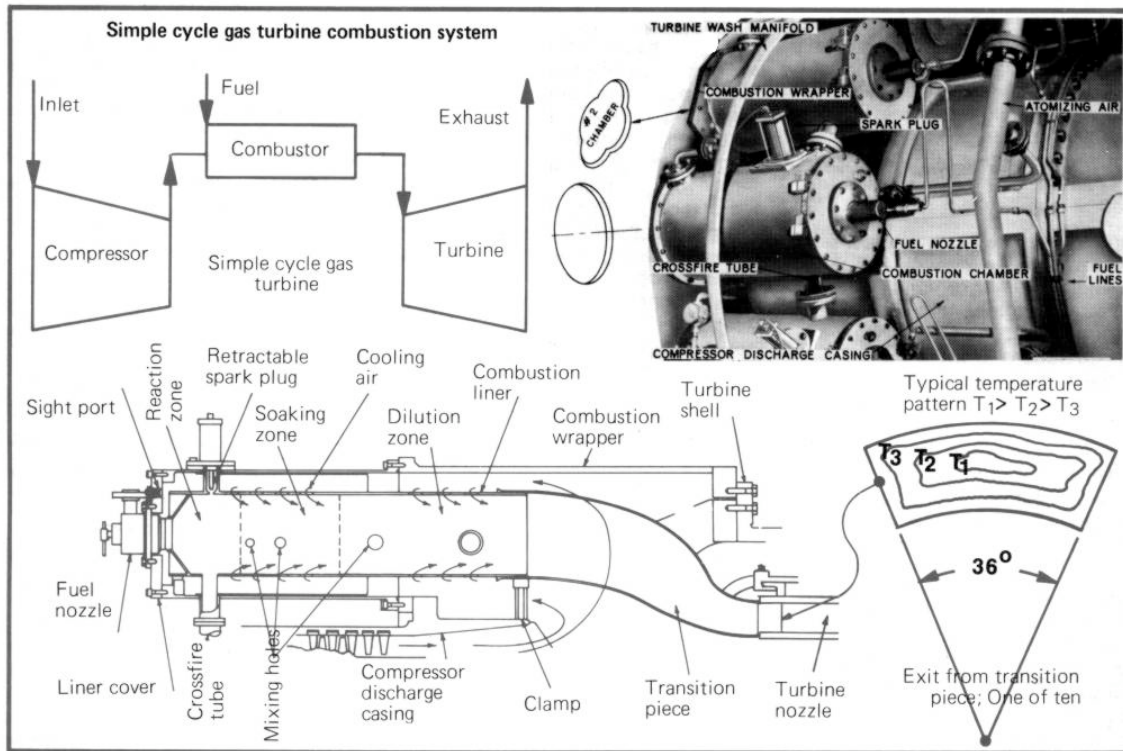


**February 2004**

**Subject: MAINTENANCE FACTOR FOR EMERGENCY FAST START OF GE HEAVY DUTY GAS TURBINE**

1. The General Electric Co.'s standard practice is to fire all Heavy Duty Gas Turbines at a nominal speed of 20% of full operating speed.
  - The only exception to this standard practice is if a client wishes to start up in an "Emergency Fast Start" mode, which is defined as occurring at  $<$  or  $\approx$  15% of full operating speed.
  - This is **NOT** intended to be a normal starting mode and is only intended for **emergency situations**.
  - The "Emergency Fast Start" mode can carry a Maintenance Starts Penalty of twenty, meaning that **each Emergency Fast Start has the same maintenance factor as twenty normal starts.**
    - By way of comparison, a trip from Full Load carries a Maintenance Starts penalty of eight, meaning that **each trip from Full Load has the same maintenance factor as eight normal starts.**
  - This information is documented by GE in their publication GER-3620J, last revised in January of 2003
2. Firing an MS7001 at  $<$ 15% speed can have a significant impact because the Air-to-Fuel Ratio is so far off from the "As Designed" point. The combustion system is designed with several key parameters involved:
  - The combustion system must be easy lighting. The GE system is intended to have a "Lean" combustion regime. Using a firing speed of  $<$ 15% pushes the combustor into a "Rich" regime due to too much fuel for the available air flow, which is contrary to the GE design intent. The "Delta-P" across the combustion liners is by design on the order of magnitude of 1.5 to 2.0 psig; if the Air-to-Fuel mixture is not at design point, then combustion hardware damage can occur prematurely.

- A stable flame pattern must be readily established in the spark plug chambers and then the flame must propagate quickly & reliably through the cross-fire tubes to the other chambers. Additionally, the mixing & dilution of the flame zone air along the length of the combustor must be such that a stable pattern factor is developed at the exit of the combustion transition pieces. If the isotherms of the pattern factor are not evenly distributed, then extreme overheating of the Stage 1 Nozzle Partitions occurs at the junction with the Side Wall of the nozzle. This is the most highly stressed portion of the nozzle & significant, premature cracking will occur. The Stage One Buckets will, of course, also be exposed to these off-design conditions.



- During the firing and acceleration mode of the start-up, temperature control is not implemented in the same manner as it is when the unit is at full speed and when it is loaded. Accordingly, temperature excursions can rapidly occur in the combustion and hot gas path sections as described above.
3. Another consideration when firing at <15% speed is that any off design conditions in the compressor, such as fouling, corrosion, erosion or Foreign Object Damage, could lead to compressor surge. Such an event at off design combustion conditions could well lead to an unstable flame pattern progressing upstream with potentially disastrous results.

4. If a GE Heavy Duty Gas Turbine is so equipped with the Emergency Fast Start feature, it should only be utilized to support a bona fide emergency situation. Customers should carefully consider the long-term maintenance impact of using the Emergency Fast Start feature.