

## Cyclic Peaking and Starting Factors: Educational Document

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### Cyclic Peaking and Starting Factors - Where we are today

Gas turbine manufacturers typically use Equivalent Service Hours (ESH) or Equivalent Operating Hours (EOH) to specify inspection and maintenance intervals. One Equivalent Service Hour is equal to one hour of base load operation without water or steam injection. In order to account for the extra wear and tear of non-base load operation, gas turbine manufacturers use multipliers of base load operation hours for startup, peak load, steam/water injection, and transients such as when a unit trips. PJM uses the terms of “cyclic peaking factor” for operation above base load and “cyclic starting factor” for startups.

Currently, cyclic peaking and starting factors are values specified in Manual 15 and are used to modify incremental maintenance dollars on combustion turbine units based on non-base load operation and incremental starts. Currently, cyclic peaking factors are 3.0 for all combustion turbines (CTs). Cyclic starting factors are 5.0 for aircraft-type CTs, and 10.0 for industrial-type CTs and were based on a survey of manufacturers. These factors are used by generators as multipliers to include the incremental maintenance costs attributable to start costs and to peaking MWh in their cost offers.

Some OEMs claim that newly built combustion turbines do not require additional maintenance per start, and therefore these factors would appear to be unnecessary. Additionally, there is no clear source or history for these values, and they may be out of date, inaccurate, or no longer relevant for certain combustion turbine models.

The Independent Market Monitor brought this issue forward for consideration by the Cost Development Subcommittee (CDS). After reviewing Manual 15, it became clear that cyclic peaking and starting factors were possibly out of date for new combustion turbine units, and possibly inaccurate for current units in PJM.

Since the Independent Market Monitor brought this item forward, Manual 15 has been revised to remove the ability for combustion turbines and combined cycles to include major inspection and overhaul costs in their cost offers. Cyclic peaking factors and starting factors are typically used to include major inspections and overhaul costs in a unit’s VOM. The current values contained in Manual 15 may no longer be relevant.

### References to PJM Documents



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[Manual 15: Cost Development Guidelines](#) details the standards for determining cost components for markets where products or services are provided to PJM at cost-based rates, as referenced in Schedule 1, Section 6 of the PJM Operating Agreement. Generation Owners use Manual 15 to develop their cost based offers. Manual 15 Section 5 “Combined Cycle (CC) Cost Development” and Section 6 “Combustion Turbine (CT) and Diesel Engine Costs” mention Cyclic Peaking Factors and Cyclic Starting Factors. Currently, Cyclic Peaking Factors are 3.0 for all CTs. Cyclic Starting Factors are 5.0 for aircraft-type CTs, and 10.0 for industrial-type CTs.<sup>1</sup>

### Other RTOs

ERCOT’s Verifiable Cost Manual Appendix 1B specifies that Cyclic Peaking Factors are 3.0 and Cyclic Starting Factors are 5.0 for aircraft-type CTs & 10.0 for industrial-type CTs when determining maintenance costs for combustion turbines and combined cycle power plants<sup>2</sup>:

A review was performed of the manuals for ISO New England, Midwest ISO, California ISO, New York ISO, and IESO but no reference to Cyclic Peaking Factors or Cyclic Starting Factors was found.

### Gas Turbine Manufacturer References

GER-3620J “Heavy-Duty Gas Turbine Operating and Maintenance Considerations” specifies that GE bases gas turbine maintenance requirements on independent counts of starts and hours. Whichever criteria limit is first reached determines the maintenance interval. GE does not agree with the approach used by some other manufacturers which converts each start cycle to an equivalent number of operating hours (EOH). GE uses Hours Factors for fuel, peak load, and water/steam injection. Hours Factors for peak load vary by technology and the firing temperature difference over base load.<sup>3</sup>

### Summary

In general, updates for Cyclic Peaking Factors and Cyclic Starting Factors for new gas turbine technologies may be available and are not reflected in Manual M15.

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<sup>1</sup> Manual 15



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<sup>2</sup> [www http://www.ercot.com/content/meetings/cops/keydocs/2007/1106/08.\\_Verifiable\\_Cost\\_Manual.doc](http://www.ercot.com/content/meetings/cops/keydocs/2007/1106/08._Verifiable_Cost_Manual.doc)

<sup>3</sup> [GER-3620J “Heavy-Duty Gas Turbine Operating and Maintenance Considerations”](#)