GAS TURBINE ASSOCIATION

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RE: Environmental Protection Agency
Docket number EPA-HQ-OAR-2011-0660
Proposed Rules for GHG Emissions for Electric Utility Generating Units

Submitted By: Gas Turbine Association
Dr. William H. Day, Managing Director
billday3@comcast.net

The Gas Turbine Association (GTA) appreciates the opportunity to comment on EPA's proposed rulemaking to regulate greenhouse gas (GHG) emissions from electric utility generating units (EGUs) under the Clean Air Act's new source performance standards (NSPS) program. *See* 77 Fed. Reg. 22,392 (April 13, 2012). GTA's comments will be focused on emissions from gas turbines, which are highly efficient energy conversion devices with low CO_2 emissions normalized to energy production. The success of gas turbines can be measured by their market presence. The current installed capacity of combined and simple cycle gas turbines represents over 350,000 MW, producing over 20% of the total United States generation. Nearly all of the energy production is achieved using natural gas fuel.

Summary of GTA Recommendations

- Continue to exclude simple cycle gas turbines
- Include language that specifically prohibits the NSPS CO_2 limit from being adopted as the presumptive CO_2 BACT level for simple cycle turbines
- For units other than simple cycle, raise the CO_2 level to at least 1,100 lb/MWh to account for typical operating scenarios including part-load, rapid ramping and cycling, performance degradation and differences in site and atmospheric conditions
- Include exemption for startup/shutdown and part load operation
- Allow an alternate method to CEMs for compliance measurement, specifically fuel consumption
- Modify method for computing the 12-month rolling average
- Exempt combined heat and power units since their exhaust energy is very efficiently utilized
- Allow 500 hours of operation on backup fuel without inclusion in the emission average

Exemption for Simple Cycle Gas Turbines

The proposed rulemaking recommends that simple cycle gas turbines be excluded from the proposed CO_2 NSPS in the amended 40 C.F.R. Part 60. *See* 77 Fed. Reg. at 22,411, 22,431-32. The rationale laid out in the proposed rulemaking is that simple cycle gas turbines (which generally cannot meet the 1,000 lb/MWh rule on any fuel) are primarily used for peak shaving duty which is generally viewed to include less than 2,500 hours per year of operation. The proposed rulemaking excludes all gas turbines with the justification that most simple cycle gas turbines operate less than 2,900 hours per year (less than 1/3 of the total generation capacity).

The GTA agrees that simple cycle gas turbines should remain completely excluded from the rulemaking. GTA strongly supports the exclusion for the reasons EPA identifies, but even beyond the rationale EPA identifies, there are at least two additional reasons to exclude simple cycle gas turbines.

First, including simple cycle gas turbines in the NSPS will amount to an effective ban on simple cycle in other contexts (e.g. the NSPS level of 1,000 lb/MWh might be used as an upper limit for Best Available Control Technology (BACT) calculations if simple cycle gas turbines are included). The current Prevention of Significant Deterioration (PSD) GHG rule has a very low tons-per-year threshold, which means that PSD could be invoked for a large portion of newly installed simple cycle gas turbines in electric power generation that would not otherwise be subject to PSD. The Gas Turbine Association is already aware of one state environmental protection department that has given such guidance to a customer's permitting consultant for a simple cycle installation.

The GTA also wishes to emphasize that there is a strong likelihood that, even if simple cycle gas turbines are excluded from the proposed rulemaking, the 1,000 lb/MWh limit could be considered as a ceiling for BACT for <u>all</u> gas turbines regardless of cycle. If the 1,000 lb/MWh level is interpreted as a presumptive BACT for all turbines, such interpretation would effectively ban simple cycle gas turbines. Similarly, the proposed rule should not be allowed to be used in some way to establish lowest achievable emission rate (LAER). Thus, we request EPA include specific language in 40 CFR Part 60 amendment to explicitly prevent the unintended adverse impact on simple cycle gas turbines.

The GTA suggests that 40 CFR § 60.5520 (d) of the proposed rule be amended to add the following:

> *"Simple cycle combustion turbines are not subject to the requirements of this subpart. Further, this subpart and any emissions limits included herein is not intended to and shall not be used as a basis for establishing for simple cycle combustion turbines either best available control technology (BACT) or lowest achievable emission rate (LAER).*

Secondly, an effective ban on simple cycle gas turbines could risk the stability of the nation's power grid and hinder the Administration's goals to advance renewable energy. Increasingly, renewable generation resources are being added to the mix of generation assets and are forming a much greater percentage of the nation's electric power generation. The effect of increasing renewable generation share is a significant increase in power generation variability and thus significantly increased grid instability. The most effective means to mitigate the destabilizing effects of renewable additions is the installation of simple cycle gas turbines.

Simple cycle gas turbines can accommodate the very quick start times and rapid ramp rate load-following required to stabilize the grid in the presence of significant renewable generation. Grid instability may require a significant share of simple cycle gas turbines to run more than 2,900 hours per year. An effective ban on simple cycle gas turbines would eliminate a crucial tool for maintaining grid stability.

Further, the final rule should clearly state the simple cycle exemption does not impose a restriction on simple cycle turbine annual hours of operation. While a majority of current, and anticipated future simple cycle turbine installations, operate less than 2900 hours, many installations are operate in excess of these number of hours to support grid requirements. The facility will be required to operate the number of hours required by electric demand. Limiting hours of operation again would restrict the operational flexibility of this fleet of turbines necessary ensure reliable and stable electricity supply.

Finally, the exclusion of simple cycle gas turbines from the NSPS rulemaking would not inappropriately favor them over combined cycle gas turbines in the marketplace, nor have the unintended effect of delaying the upgrade of simple cycle installations to combined cycle. *Cf.* 77 Fed. Reg. at 22,432. The economics of the application always govern the choice between simple and combined cycle with capital costs and efficiencies being significantly different between the two. Thus anticipated run times (peaking, daily start-stop, or base load), the price of fuel, and capital cost of the power plant are the controlling drivers in decision making. Because most combined cycle units will have less trouble meeting the proposed regulation, at least at high loads, we believe that the proposed regulation will have little effect on the timing of upgrade decisions.

Proposed CO_2 Limit

EPA has proposed a standard of 1,000 lb/MWh for CO_2 emissions, but has requested comments on a range of 950 to 1,100 lb/MWh. *See* 77 Fed. Reg. at 22,406. In addition to excluding simple cycle turbines entirely, GTA believes the limit should be raised to 1,100 lb/MWh for other units.

While the GTA recognizes the 1,000 lb/MWh level may be achievable under certain limited conditions – particularly when units are newly installed, clean, with no degradation due to thousands of hours of operation, at sea level, under standard day conditions, and running at base load – the standard is unlikely sustainable under real world conditions. During real life operating scenarios, combined cycle gas turbines (CCGTs) operate in a wide variety of ambient conditions (high altitudes, hot weather) with frequent starts and stops and operate across a wide load range. Also, gas turbine equipment will experience varying amounts of performance degradation due to service.

An critical attribute of CCGT facilities is the generation flexibility that is essential to ensuring a stable, secure, reliably energy supply while enabling the deployment of variable renewable energy generation. The proposed limit is attainable by most new CCGT facilities, when operating at base load, however during variable operation, including frequent starts/stop cycles and significant part load operation, many facilities are not able to maintain these emission levels. As a result, a more restrictive limit would not result in a lower emitting facility, but would result in a constraint in the necessary flexible operation of the CCGT. To ensure and enable flexible plant operation, which is essential to the mission of CCGT operation, the GTA recommends an emission limit no lower than 1,100 lbs CO2/MW-hr.

Also, various design features and site requirements must also be considered. As example, air cooled condenser equipment is often required in arid climates. Air cooled condensers have the advantage of reduced water consumption. This benefit comes at a performance penalty. This penalty can range from a 1 to 4% percent loss in plant efficiency dependent on site climates and design basis. The variable operating conditions and range of design requirements result in actual performance below the reference case.

A recent report by the University of California Center for Energy and Environmental Economics reported similar findings regarding only base loaded CCGTs: "*The EPA reports that 95 percent of these units first operating between 2006 and 2010 would meet the target, and we find a similar percentage when looking at predicted emissions based on power plant heat rates. Yet we find a lower number at 84 percent based on actual emissions and self-reported generation."*[1] The study captures only a small amount of real world variability. Analysis for daily start and stop, intermediate duty, and power plants operating for a significant period of time at part load are not included. Inclusion of such plants would have further reduced the percentage of complying power plants. It is, in fact, critical to the management and stability of the electric grids in the United States that dispatching authorities have the flexibility to dispatch CCGTs at loads from 50% to 100%. Dispatch flexibility is operational flexibility. A limit of 1,000 lb/MWh will greatly impede real world operational flexibility and the stability of grids in the United States will suffer.

The GTA recommends the emission limit be set at 1,100 lbs CO2/MW-hr. The 1,100 lbs CO2/MW-hr level is consistent with levels set in California, Oregon, and Washington.

Exemption for Startup/Shutdown and Part Load Operation

GTA's analysis of the operating fleet reveals that part load operation is a very likely operating scenario going forward due in significant part to the need for rapid response in support of non-dispatchable generation (*i.e.*, wind and solar). Reduced load operations (as well as starts and shutdown) can result in a level of CO_2 emissions above the proposed level because gas turbine efficiency declines significantly at off-design operating loads. CO_2 emissions above the proposed 1,000 lb/MWh level is expected to also occur with new advanced gas turbines entering operation due to the basic physics of turbomachinery.

Because of the severe penalty encountered with part load operation, GTA recommends that CO_2 emissions during operations below 50% of maximum continuous rating (of the gas turbine) be excluded from the averaging and reporting.

Continuous Monitoring

EPA proposes to require compliance monitoring with the NSPS via a CO_2 mass rate continuous emissions monitoring system (CEMS). 77 Fed. Reg. at 22,409. The GTA believes that fuel consumption monitoring should be available as an acceptable alternative to CEMS.

CO_2 mass rate CEMS and associated automatic data acquisition and handling are but one technical approach to determine compliance. A CEMs system measures CO_2 species concentration in the stack as well as stack total and static pressures in the stack. From the data

[1] Kotchen and Mansur, *How Stringent is the EPA's Proposed Carbon Pollution Standard for New Power Plants?,* University of California Center for Energy and Environmental Economics, April 2012.

the total stack mass flow rate and mass flow rate of CO_2 are calculated and then integrated over time and normalized, by the electric output in MWh, to determine CO_2 lb/MWh over a timeframe.

While the CEMS method is necessary for criteria pollutants, such as NO_x and CO which vary widely in emissions characteristics from one engine model and operating condition to another, a much simpler and more accurate method is available for CO_2. By accurately measuring fuel flow over time and assuming that all the carbon in the fuel is oxidized to CO_2 (a very accurate assumption) the total emission of CO_2 may be determined very easily and accurately. EPA has relied heavily on fuel consumption monitoring as an alternative to CEMS for its Mandatory Reporting of Greenhouse Gases Rule, with three of the four methodological tiers for calculating CO2 emissions under that rule relying on fuel consumption data, rather than on CEMS. *See e.g.*, 74 Fed. Reg. 56290. EPA should allow fuel consumption monitoring here as well. Using fuel consumption monitoring instead of CEMS is far more accurate and avoids the challenging problem of measuring emissions during transient periods when stack flow rate measurements are inaccurate. During transient operation stack flow conditions may be changing rapidly, the kind of conditions that would be difficult for a CEMS to produce accurate results. Many combined cycle units that were expected to operate at base load in the United States are now found to be operating over a much wider range of loads, with many more starts and stops, thus relegating a fuel consumption monitoring method appropriate

EPA may already have envisioned a fuel consumption monitoring alternative, but an apparent drafting error makes that ambiguous. Proposed regulations 40 C.F.R. §§ 60.5535(c) and 60.5560(c) refer to fuel combustion monitoring. *See* 77 Fed. Reg. at 22,437, 22,438. Criteria for using fuel combustion monitoring method, however, are cross-referenced to a proposed provision, § 60.5525(c)(2), which does not exist. GTA urges EPA to correct the oversight and make fuel consumption monitoring a widely-available alternative to CEMS.

Method for Computing the 12-Month Rolling Average

GTA believes the specified method of averaging will lead to an inaccurate measure of CO_2 emissions. Monthly operation of gas turbines can vary widely from a very small capacity factor to 100% capacity factor depending on a wide variation in parameters affecting unit dispatch such as load demand, periods of overhaul and refurbishment, fuel availability, and amount of time spent starting and stopping. Therefore, all months should not be weighted equally, a feature of the current methodology specified in § 60.5540. We note further that there is no public health reason to compel compliance on a monthly basis. It would be far more accurate, at the end of each month, to compute a new rolling average by summing all CO_2 emitted in the past 12 months and dividing by the total MWh's generated in the past 12 months.

Combined Heat and Power (Cogeneration)

GTA recommends that EPA develop a specific exclusion for Combined Heat and Power (CHP) applications. CHP plants operate in a similar manner to the CCGTs that are covered by the proposed rule. The thermal energy from CHP plants can be diverted to either energy production (kWh) or to thermal loads (heating and cooling). The regulatory challenge of quantifying the equivalence of the thermal energy used in terms of kWh to determine compliance with the proposed NSPS would be immense and impractical. Because of that complexity, we propose that CHP and cogeneration facilities be specifically exempted from the rulemaking.

Backup/Multi-Fuel Operation

Because of the stringency of the proposed compliance level, GTA requests EPA clarify that the NSPS rule only apply during periods of natural gas operation with an exemption for 500 hours of operation on backup fuel. During periods of extreme weather events (typically cold winter days), plants operating with interruptible gas supplies may be forced to use an alternative or backup fuel. Most commonly the backup fuel is number 2 distillate (or similar fuels); which have a significantly higher CO_2 emission profile.[2] As Figure 1 shows, there is a large difference between emission levels based on natural gas and other fuels. An exemption to operate on a backup fuel for a period of up to 500 hours per year would accommodate the potential need to use a back up fuel.

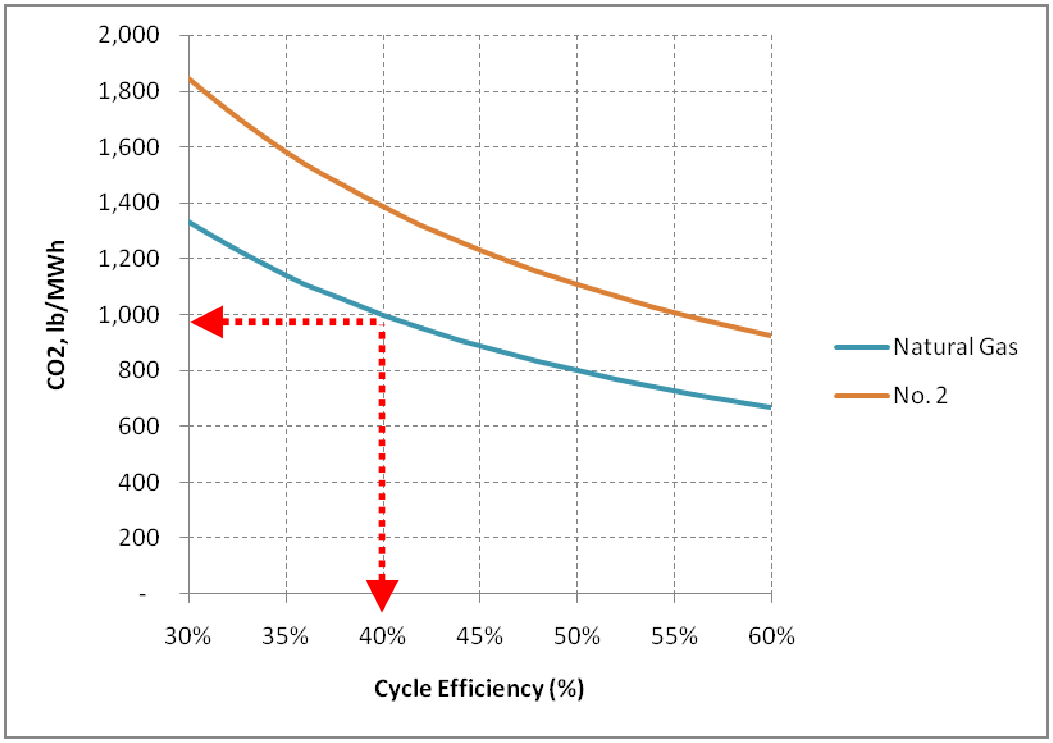

Figure 1. CO_2 emissions as a function of fuel choice and cycle efficiency (based on Higher Heating Value)

GTA Member Companies

Alstom Power
GE Energy
Florida Turbine Technologies
Pratt & Whitney Power Systems
Rolls-Royce
Siemens Energy
Solar Turbines Incorporated
Meggitt Sensing Systems

[2] Other liquid backup fuels include diesel, ultra-low sulfur diesel, Jet A, K-1, GT No. 1, No. 2 distillate, and some bio-based fuels such as bio-diesel.