GAS TURBINE ASSOCIATION

May 7, 2014

RE: Environmental Protection Agency
Docket number EPA-HQ-OAR-2013-0495
Proposed Rules for GHG Emissions for Electric Utility Generating Units
79 Fed. Reg. 1,430 (Jan. 8, 2014)

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

The Gas Turbine Association (GTA) is a trade organization representing the major gas turbine manufacturers in the United States. GTA members produce turbines ranging from 1 to over 300 MW in size. Member companies produce gas turbines for the power industry, oil and gas operations, commercial operations such as hospitals and campuses, and industrial operations.

GTA serves as the unified voice for the gas turbine industry. Today gas turbines produce more than a quarter of our nation's electricity. They are a cornerstone energy conversion technology, providing electricity and heat for industries and communities. Gas turbines will play an increasingly important role in the achievement of national objectives related to energy and the environment. Recent technical advances make gas turbines the logical choice for new power generation and for replacing the aging fleet of thermal facilities operating on oil or coal due to their beneficial attributes, including:

- Flexibility, may be used to "shadow" renewables to keep the power grid stable
- Use of low-carbon, plentiful, cheap natural gas to reduce ambient air and hazardous pollutants and GHG emissions
- Lower capital costs
- Easier permitting
- Quicker to construct
- Smaller footprint
- Portable (in smaller sizes) for emergency power and temporary needs

Policymakers and other stakeholders need to know how gas turbines can meet the evolving power generation needs of our nation. Representing all major power gas turbine equipment manufacturers, the mission of the Gas Turbine Association is to provide the information needed to fully realize this potential.

GTA appreciates the opportunity to comment on EPA's proposed rule to regulate greenhouse gas (GHG) emissions from electric utility generating units (EGUs) under the Clean Air Act's new source performance standards (NSPS) program. 79Fed. Reg. 1,430 (Jan. 8, 2014). GTA's comments focus on emission regulations pertaining to natural gas fueled gas turbines (simple, combined cycle, and cogeneration). The complexity of the operating cycle, and the way in which the gas turbine is integrated into the power system requires a detailed explanation as a foundation for our recommendations. We provide in the background section a summary of how these cycles function, a description of the turbine technology entering the markets today, and how this may differ from the systems installed in the last decade.

GTA believes that the role of the gas turbine is critical to the US power grid and that the proposed regulatory standards are demonstrable only on combined cycle turbines, operating in a narrow performance range. Further, and importantly, GTA believes that compliance with the proposed new rule is only achievable through complex time averaging, not through any specific emissions reduction capability inherent in the design or operation of the gas turbine.

The industry has invested billions of dollars to improve gas turbine designs, enhance performance, and improve efficiency, largely in response to the nation's call for energy conservation and environmentally protective energy production. In establishing emission standards, it is important to recognize that the thermal efficiency of the gas turbine and the way it is deployed by the end user in any specific configuration will determine the performance based emission profile (mass of CO_2 per unit work generated). Current design gas turbines operate with thermal efficiencies between 30% and 40%, not too different from those in the installed fleet. Any proposed output standard is a simple function of the fuel carbon content (per MWh) divided by the unit efficiency. It will require a minimum efficiency of about 44% (LHV basis) to reach EPA's proposed level of 1,000 lb/MWh, which is challenging for almost any gas simple cycle gas turbine (ISO rated). Gas turbines can only achieve the proposed emission limits if they are used with energy recovery in a combined cycle mode. Given that a gas turbine is not the only power conversion system available, EPA's proposed regulatory burden may be a disincentive for end-users to select the cleanest and most efficient technology (the gas turbine) in many applications.

GTA relies on data to show that significant aspects of EPA's proposed rule lack technical support and rationality. GTA recommends alternative reasonable approaches to these provisions.

Table of Contents

I. Summary of GTA Recommendations

GTA recommends that EPA:

- Exclude simple cycle gas turbines as originally suggested in the 2012 proposal. The majority of all simple cycle gas turbines operate at efficiencies that cannot reach the standard for combined cycles. Without this exclusion, simple cycle gas turbines could be severely limited in their ability to operate at sufficient capacity to support the deployment of variable renewable generation, favoring a market for other, more polluting, technologies at the expense of clean-burning gas turbines.
- Modify the cut-point between large and small gas turbines to a level of 1,500 MMBtu/hr HHV. This level is more appropriate than the recommended value based on combined cycle performance of the fleet of available combined cycle gas turbines.
- Exempt startup/shutdown and load operation below 50% of Original Equipment Manufacturer (OEM) rated output. An exemption from startup and shutdown will be necessary to support a rapidly growing installed base of non-dispatchable renewable generation. Without exempting part load and alternative fuels, using the fuel flow method, a comparatively higher benchmark of 1,200 lb CO_2/MWh is more realistic.
- Exempt combined heat and power (CHP) units because their exhaust energy is very efficiently utilized. CHP facilities are fundamentally simple cycle gas units which also produce useful output (steam and / or hot water) which may or may not include the production of power. The proposed rule could also incentivize development of capacity that will remain outside the current grid system, where it would not be available to support the grid in unusual events.
- Ensure the regulation does not discourage adoption of combined cycle gas turbines. Based on a review of turbine data, GTA concludes that the combined cycle gas turbine is representative of a Best System of Emissions Reduction (BSER) for CO_2 for high capacity combustion turbines. The emission levels achievable with combined cycle turbines, however, do not reflect BSER for simple cycle units, which must be excluded, or for combined cycle units operating at loads below 50% or with multiple starts. EPA's standards should not impede the adoption of gas turbine technology in the marketplace.
- Exclude from compliance averaging the emissions that occur when alternative fuels are during emergencies, or when natural gas is curtailed (or unavailable).
- Determine compliance with a CO_2 lb/MWh standard at the maximum continuous rating point of the gas turbine and steam turbine during the initial performance testing on natural gas using a fuel measurement method noted in the text (reference ASME PTC 46).
- Simplify the method for computing the 12-month rolling average. EPA should make fuel consumption monitoring the preferred method of measurement for gas turbines, with Continuous Emissions Monitors (CEMs) being a widely-available alternative. Monthly data collection would be more than sufficient for reporting purposes.
- Specifically prohibit the NSPS CO_2 limit from being adopted as the presumptive CO_2 BACT level for simple cycle turbines.
- Utilize the option of a new NSPS subpart TTTT versus including language in subparts Da or KKKK.

II. Background and General Comments

The gas turbine, operating as a combined cycle, is very close to the most efficient use of energy available for power generation (one could argue that using a combined heat and power approach is even more efficient, although these are usually smaller power systems). The gas turbine is also known as a Brayton Cycle (with efficiencies ranging anywhere from 30% to 40%), and the steam turbine is also known as the Rankine or vapor power cycle (with efficiencies between 25 and 35%). The combination of these two cycles is referred to as a combined cycle. Adding the vapor power cycle to the high temperature exhaust of a gas turbine boosts the efficiency of the combination up to 50 to 60% (or slightly more). Under a market scenario where unit efficiency is the primary driver, most equipment owners will elect to use the most efficient steam cycle with the gas turbine. This would be approximately a steam turbine with about half of the output capacity of the gas turbine.

The EPA's NSPS, for combined cycle power plants EGUs, seeks to settle on a CO_2/MW-hr rate between 1,000–1,100 lb/MWh, which corresponds to a plant thermal efficiency, in round numbers, between 44% and 40% respectively (Figure 1). This annual average CO_2 rate allows most combined cycle machines operating at efficiencies greater than 50-60% or more, to spend a considerable portion of the year operating well below the proposed control limit as long as the average rate stays below the control threshold.

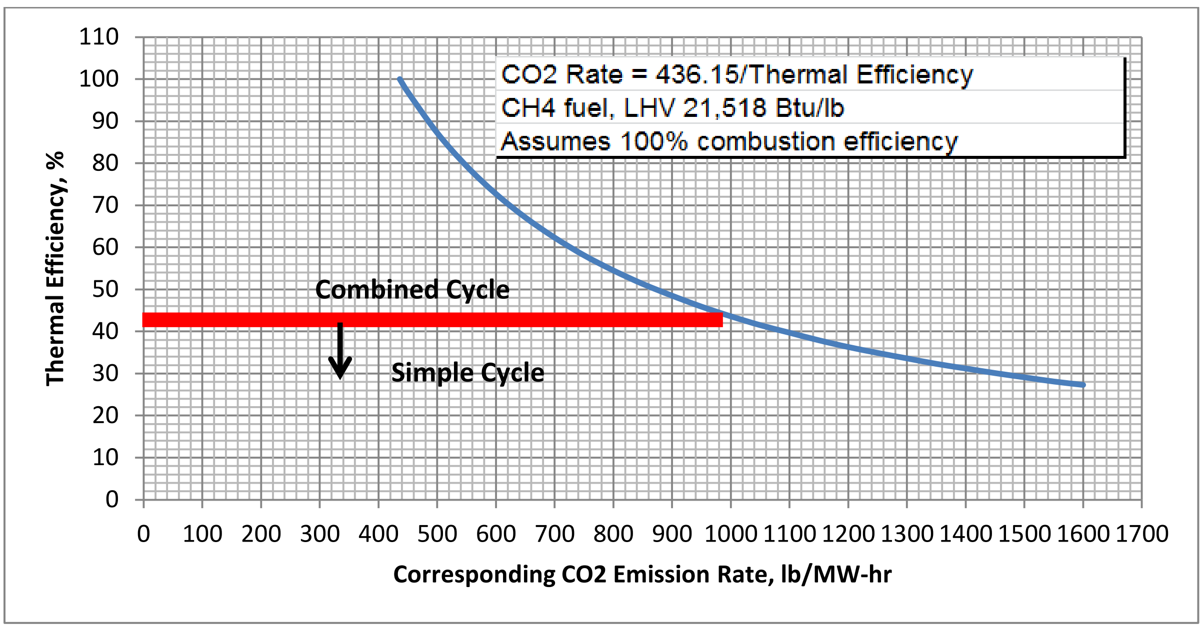

Figure 1. Thermal Efficiency and Corresponding CO_2 Emissions Rate

EPA has proposed that simple cycle machines, used primarily as peaking power to stabilize the power grid will only be allowed to operate a maximum of one-third of the year since historically this is how peaking units function. Paradoxically, industry OEM's have invested in development of high efficiency simple cycle gas turbines that operate in the aforementioned band of efficiency and CO_2 rates at maximum rated power. Having reached this milestone in innovation, GTA believes that the information provided will support our conclusion that limiting the operation of high efficiency peaking turbines to one-third of the year is impractical and inappropriate for utilities, OEMs, and electricity consumers.

Where flexibility and start time are critical, the optimal configuration of both the steam cycle and Brayton cycle may not result in the most efficient combined cycle. EPA's reliance on historical data from 2007 – 2011 reflects a fleet of primarily combined cycles designed to produce maximum efficiency of the two cycles working together. Future market designs are expected to require a high degree of component flexibility, which is expected to come at the expense of the annually averaged combined cycle efficiency, even if the gas turbine is a state-of-the-art machine.

GTA reviewed the data used to develop the proposed rule. For combined cycle turbines we concur with EPA that the majority of the operating units EPA reviewed do indeed achieve compliance with the proposed standard, particularly if they operate at high capacity factors. But GTA does not subscribe to EPA's assumption that a capacity factor limitation provides any measure of emission control. In fact EPA's proposed capacity factor limitation likely undermines efficient power production and lower emission rates. A high capacity factor implies increased utilization and most likely reduced time at part load. This translates to fewer emissions. Moreover, newly launched turbine packages may not operate at the peak efficiency, but rather under a condition that maximizes how quickly they can load follow.

Based on historical CEM data used to structure the proposal, a substantial number of simple cycle turbines would not be able to comply with even the less stringent compliance level than in the proposal, if one considers all data that span eleven years (Figure 2). For simple cycles in the smaller gas turbine categories, 84% of the data points are above the proposed 1,100 lb/MWh hour benchmark. In fact, for most simple cycle gas turbines, emission levels exceed 1,200 lb/MWh (see Figure 3 for nominal CO_2 emission rates that would be expected from a range of simple cycle gas turbines. These data do not represent an OEM guarantee; such guarantees would reflect expected performance degradation, and component losses). Both the CEM and the published turbine performance data suggest that a higher emissions threshold would be required for simple cycle gas turbines, and as the later figures suggest, these values would be significantly above 1,100 lb/MWh.

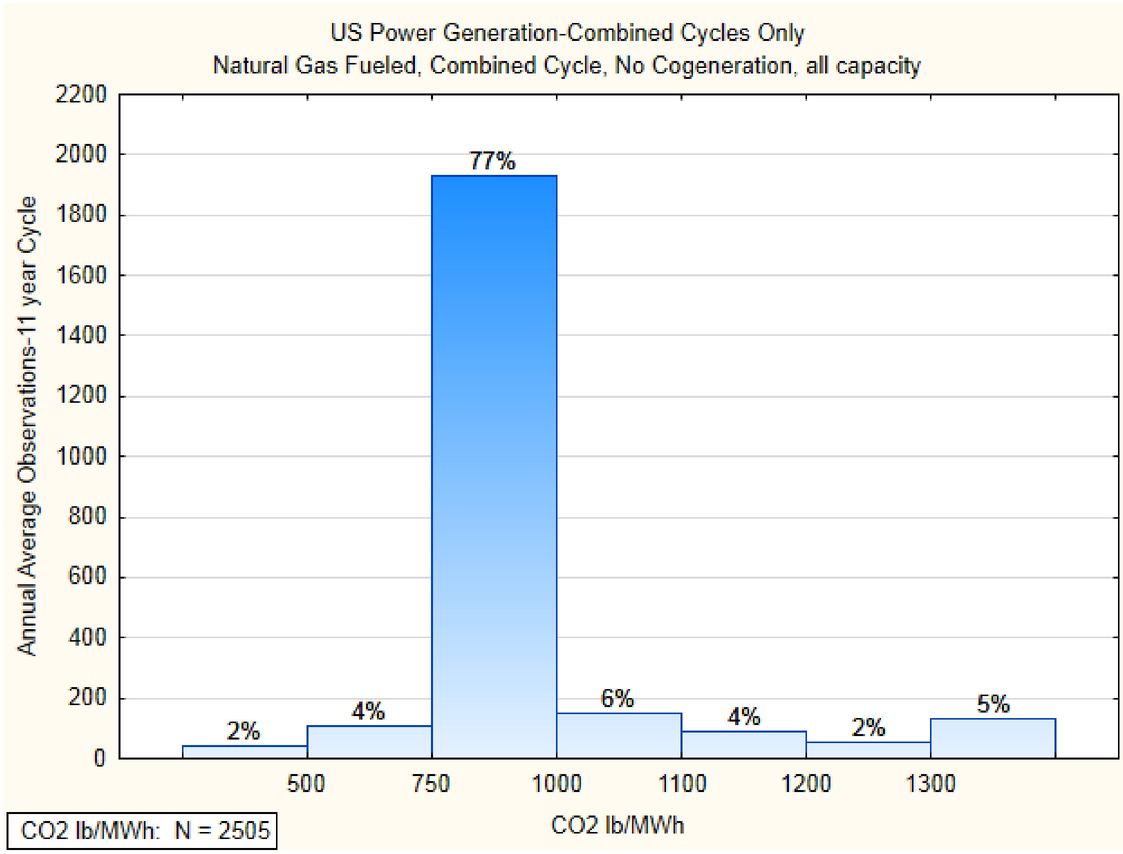

Figure 2. US Power Generation - Combined Cycles Only – CO_2 lb/MWh
All Data from SNL Energy (Annual Data Extracted from EPA Clean Air Markets)

Combined cycle data (based on natural gas operation, and only using a high capacity factor), yield an output based emission average of approximately 880 lb/MWh. Assuming the allowance for 95% compliance, using a 2 sigma statistical calculation based on the historical operation dataset, on natural gas operation the recommended benchmark would be 880+2 x 106 = 1,092, or approximately 1,100 lb/MWh for simplicity. The data are summarized in Table 1.

Table 1. Summary of Combined Cycle Fleet CEM Data
(> 33% capacity factor, no cogeneration)

	Combined Cycle Power Plants	Mean	1-Sigma
CO_2, (lb/MWh)	1280	880	106
Heat Rate (Btu/kWh)	1276	7524	694
Nameplate (MW)	1280	784	518

Later, we summarize why the fuel flow method is more accurate, and that using that method may not provide as much margin as noted here.

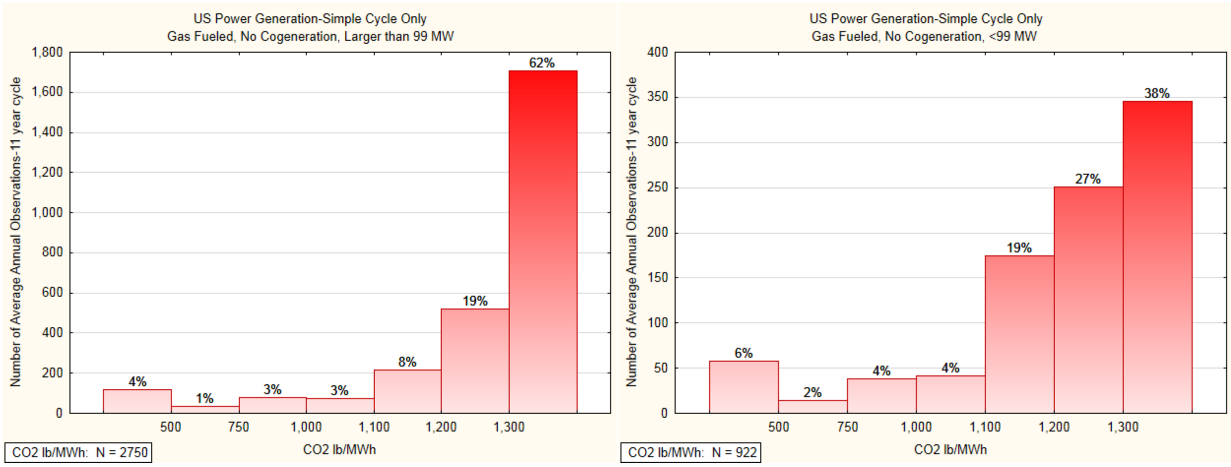

Figure 3. Simple Cycle Gas Turbine Performance
[Units larger (left) and smaller (right) than 99 MW (~850 MMBtu/hr)]

We also looked at the CO_2 emissions rate (using methane as the primary fuel[1]), for new-and-clean gas turbines. The output based emission standard is directly proportional to the heat rate, and the heat rates of OEM's equipment are published in Gas Turbine World. The data are presented in

Figure 4. The dotted line represents EPA's proposed small/large demarcation (850 MMBtu/hr of fuel addition). Based on the data, it is difficult to identify the reason for EPA's selection of this cut point between large and small turbines. In fact, the CO_2 emission profile is higher for many turbines above this heat addition rate than for some smaller gas turbines.

GTA also evaluated the CO_2 emission rates of only combined cycle plants. The improvement in performance (using CO_2 lb/MWh as the benchmark) is significant when the steam cycle is included in the power generation. This is evident in the published data shown in Figure 5. We also comment that these are not necessarily representative of guarantees provided by the OEM. In fact, for most OEM's the only guarantee will typically be associated with just the gas turbine component (represented by the simple cycle gas turbine emission performance depicted in Figure 4). For many turbine suppliers, the final end-use configuration (a single or multiple gas turbines with steam turbine heat recovery) evident in Figure 5 is beyond their scope of supply. Also, in this figure we note that the simple average of all the calculated performance is not too different from the CEM data that was used to summarize the historical fleet performance. This may be indicative that most of the historical data were obtained when the combined cycles were at are the maximum rated power point.

[1] Methane is the dominant chemical in pipeline natural gas, and using this as a basis simplifies the analysis.

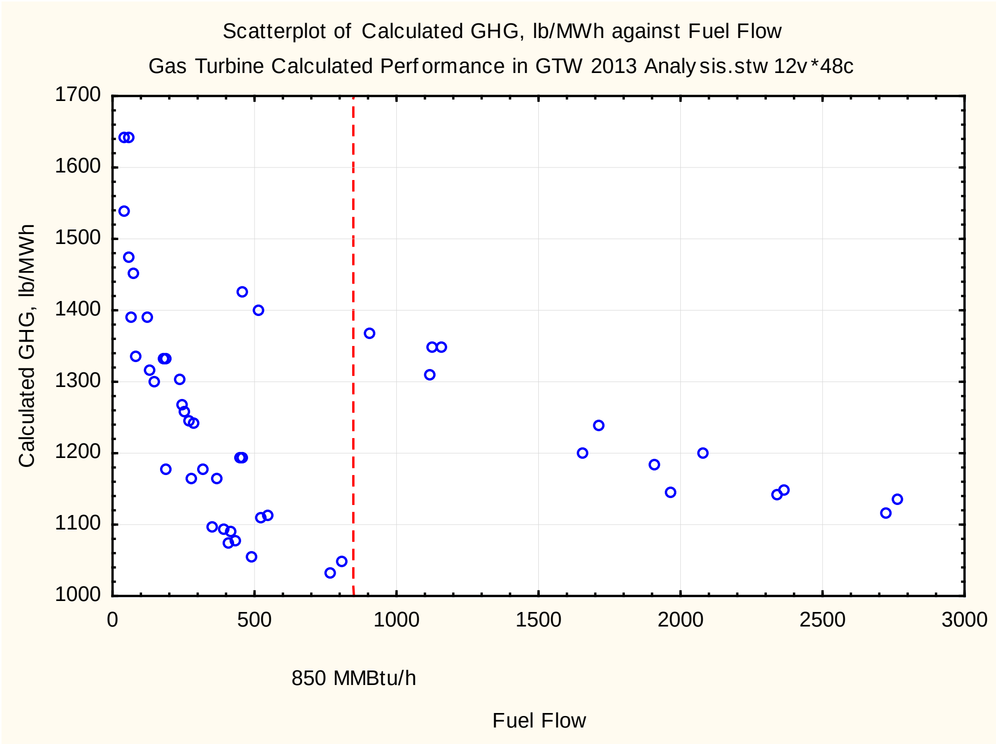

Figure 4. Calculated CO_2 Emission Rate for Turbines Based on Fuel Flow (Gas Turbine World, 2013).

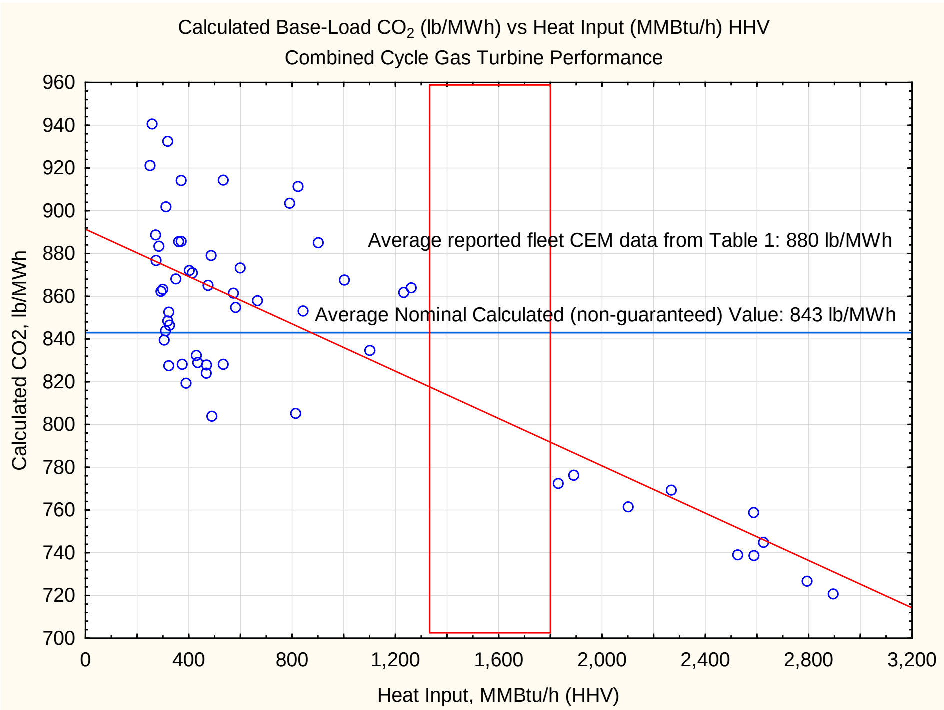

Figure 5. Calculated CO_2 Emission Rate for Combined Cycles (Gas Turbine World, 2013)

We also collected data from SNL Energy[2] summarizing annual emissions for the gas turbine fleet (shown in Figure 2 and Figure 3) which were filtered to remove excessively high CO_2 emissions data (>5,000 lb/MWh, or equivalent to implied efficiency of only 9%), which we believe to be incorrectly reported and to remove CO_2 emissions that were lower than what might be theoretically possible (i.e. those less than 440 lb/MWh, or the equivalent of an implied efficiency above 100%). For simple cycle turbines, emissions data less than 1,000 lb/MWh should probably be excluded because there is no commercially available equipment in the world capable of performing at this level. Similarly, emissions below 440 pounds per megawatt hour imply efficiency at the facility of something close to an impossible 100%. Data from cogeneration units were also excluded (In a cogeneration application, the useful output is considerably more than the gas turbine output so emissions data per unit of gas turbine output is misleading).

The data collected span 11 years from 2001 to 2012 and represent annualized emissions data. As is evident in Figure 2, combined cycle CEM data set reveal emission levels below 1,000 pound per megawatt hour (or better) emission output (shown in Table 1 the average was 880 lb/MWh).

However the information extracted from the CEM shown in Figure 3 reveal that few simple cycle units can match that emissions performance. Later we will show that using a recommended fuel flow technique would suggest actual values are higher than the CEM data shown in Figure 3.

Any implied compliance mechanism is based upon the design features within the gas turbine and the possible utilization of exhaust energy by a steam cycle added to the gas turbine. Significant technical innovations over the last 50 years have indeed reduced the carbon footprint of the gas turbine. Essentially, it has become more efficient, a feature usually reported as the heat rate of the turbine or the facility. However, none of the innovations has included technology to efficiently and cost-effectively extract carbon dioxide from the exhaust of either a simple cycle or a combined cycle gas turbine.

The proposed rule does not suggest that carbon capture is a viable adaptation for a combined cycle. However, it does not explicitly state – but should so state – that carbon capture is not viable for a simple cycle gas turbine. The operating environment at the exhaust for a simple cycle is much more severe than for the combined cycle, making the application of that technology a near impossibility.

Lacking any viable post combustion innovations, the only tool for compliance with this proposed standard is the operational characteristics of the facility. As already noted, operating at base load, nearly any commercially available combined cycle turbine might be expected to achieve an emissions performance of less than 1,000 pounds per megawatt hour. However we now confront a new era. Operating at peak performance is still important, but flexible operating capability, namely the ability to continue operation at reduced load, rapidly ramp both increasing and decreasing in load, and rapid and frequent start and stop cycles are increasingly critical to maintain grid stability and balance the performance of intermittent supplies added to the system.

[2] SNL Energy is a data provider; data are obtained and reported as annual averages from EPA's Clean Air Markets database

These are necessary innovations to accommodate renewable and other non-traditional generation. Part load operation reduces overall plant efficiency and at the same time increases CO_2. Additionally, frequent ramping and start-up/shutdown cycles greatly impact the annual average plant operational efficiency. Hence, the operational requirements of the system – not the technical capability of the gas turbine or the combined cycle – will determine the final emission profile of the facility. In short, the proposed standard does not so much influence the plant (or gas turbine) design, which is already designed to achieve high efficiency operation, but how the plant can be operated.

III. Specific Comments

EPA Should Determine Compliance During Initial Performance Testing

EPA's objective in this proposal is to achieve demonstrable environmental improvement by promoting the deployment of most efficient and clean power technologies. As equipment manufacturers, the members of the GTA meet this objective by designing state-of-the-art gas turbines. As proposed, the burden of compliance is not solely with the gas turbine technology, but also the final facility design, which is almost always unique to each end user's requirements.

GTA believes that the ideal way to ensure that the best technologies are deployed is to determine overall performance (in lb/MWh) as part of the performance testing conducted during the commissioning phase of a combined cycle facility. Extensive performance test standards are already in place which for combined cycle facilities (ASME PTC 46)[3]. Nominally, this is carried out within the first 180 days of "first-fire". By basing the compliance evaluation at the maximum continuous rating point corrected to ISO standard conditions, uncertainties related to part load operation, and transients, can be avoided, and would not enter into the operational compliance. In essence this would be an efficiency evaluation, which is fundamentally what a performance test is.

However, the performance test should only apply to combined cycles using ASME PTC 46 (separate performance codes are defined for simple cycle gas turbines). As noted in

Figure 4, no simple cycle turbines operate below 1,000 lb/MWh, and most operate above 1,100 lb/MWh. Also, performance compliance testing would be limited to natural gas operation only.

EPA Should Exempt Simple Cycle Gas Turbines

GTA recommends that simple cycle gas turbines be fully exempted from the CO_2 requirements, as initially proposed in the April 13, 2012 rule. 79 Fed. Reg.1459. In the 2014 proposal, EPA eliminates that exemption. As a result, a simple cycle gas turbine is covered by the rule if it "supplies, one-third or more of its potential electric output and more than 219,000 MWh net-electrical output to a utility distribution system on a 3 year rolling average basis" To support its changed position, EPA explains that most simple cycle stationary combustion turbines will not be affected by the rule because they "typically" sell significantly less than one-third of their potential electric output to the grid. 79 Fed. Reg. 1434. EPA further asserts that such units

[3] American Society of Mechanical Engineers, Performance Test Code 46 on Overall Plant Performance

supply to the grid more than one-third of their potential electric output only in “rare instances.” 79 Fed. Reg. 1445.

GTA agrees a vast majority of simple cycle gas turbines historically operated at less than one-third capacity. However, for its 2014 changed position, EPA relies on historic operation of simple cycle gas turbines at less than one-third capacity. EPA also assumes that market forces will continue the role of simple cycle gas turbine (or peaking turbines) to operate at a similar capacity. Given the significant and rapid changes occurring in power production, however, EPA should not rely on historic data and assumptions to establish standards that will govern future operations in a dynamic energy market.

EPA’s historic analysis does not account for the many new federal and state regulatory policy changes that are currently incentivizing renewable and other non-traditional generation. A rational approach that anticipates the significant changes affecting power production would allow the market to dictate appropriate simple cycle turbine capacity factors. For reasons of grid reliability, EPA should not arbitrarily restrict the operation of simple cycle turbines.

Existing data demonstrate that few simple cycle gas turbines can achieve the proposed emission level of 1,100/1,000 lb/MWh. (*See Part II. Background and General Comments*). Theoretically, no commercially available simple cycle gas turbine is able to achieve 1,100 lb/MWh when operating under the real world highly flexible operation demanded of simple cycle turbines. Any reported data indicating emission levels below 1,000 lb/MWh are suspected to be measurement or reporting errors. And a new gas turbine would have an emission profile limited to the choices depicted in

Figure 4. And these data are only published results at the maximum continuous rating point of the gas turbine, not necessarily the same levels that GTA members would guarantee for their equipment performance. It is clear that simple cycle gas turbines are unable to meet the same emission standards as a combined cycle installation on an output basis (in this case lb CO_2/MWh).

Furthermore, EPA cannot in any way assume carbon capture and sequestration (CCS) has been adequately demonstrated for simple cycle units. There are no commercially operating carbon capture systems that extract CO_2 from the exhaust gas of a simple cycle gas turbine, making it unreasonable to assume that carbon capture would be used as a compliance strategy for the simple cycle gas turbine.

Thus, because simple cycle gas turbines cannot comply with emission limits that apply to units exceeding the one-third capacity and net output thresholds, they will be forced to adopt this arbitrary cap on their generation. Nowhere in the record has EPA analyzed the effects of its changed proposed position on the existing fleet or future fleet of simple cycle gas turbines. Nor has EPA considered the well-documented future demands anticipated in the energy markets and how barring reliance on simple cycle generation will affect energy markets, grid reliability and CO_2 emissions under this rule.

It is not rational to effectively limit all simple cycle gas turbines to a one-third operating capacity. We believe that there is a reasonable expectation that the full operating capacity will be necessary to ensure grid reliability and stability under any foreseeable operating scenarios.

This is particularly challenging as a large quantity of older thermal plants have announced retirements (not only coal, but gas, oil, and nuclear), see Figure 6. The volume of announcements is unprecedented, but it reflects the large post-war build out that took place in the United States after 1945. The following chart shows a recent snapshot of the quantity of announced retirements in the pipeline. These represent just the fossil thermal retirements. While it is expected that much of the replacement generation would be combined cycles, the chart suggests that any miscalculation could result in equipment demands that exceed the longer lead times nominally required for a combined cycle. The accelerated retirement of a substantial amount of thermal capacity could drive regional demands to select a faster construction schedule normally associated with a simple cycle turbine.

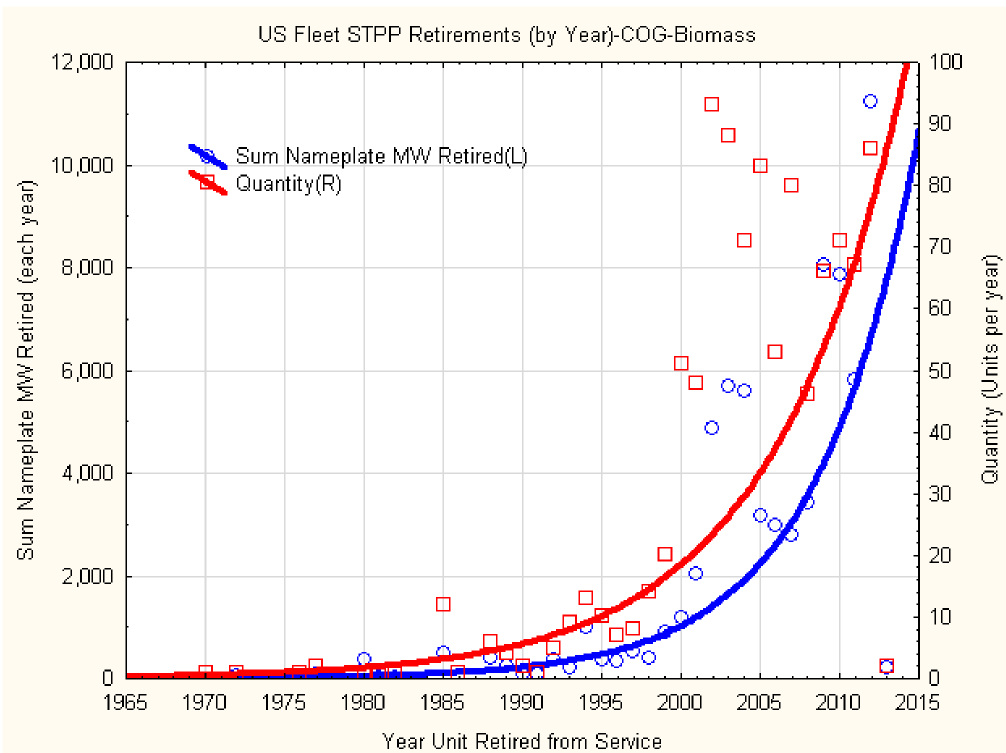

Figure 6. Announced US Thermal Plant Retirements per Calendar Year (MW and Quantity)

Regional grid operators compensate facilities on their capacity – or ability – to operate when electric supply is required to compensate for demand. This spare capacity is required to ensure sufficient margin to satisfy grid requirements. Limiting this class of facility to one-third capacity will decrease this reserve. Furthermore, this limitation will prevent any new simple cycle turbines from operating once the one-third threshold has been reached. This would have a negative impact as more non-dispatchable renewable energy is implemented. We believe this to be a burdensome regulatory mechanism, and it highlights the fact that there is no compliance technology available for the end-user because the method of control is essentially achieved by limiting the operation of the facility.

Recent economic data emphasize the need to maintain maximum potential generating capacity. The period from 2007 to 2011 was marked by a severe economic downturn coupled with an expansion of energy conservation that resulted in a significant downturn in total generation. We appear to be coming to the end of the slowdown. The Federal Reserve reports that in September 2013 US manufacturing reached the same index as 2007, just prior to the recession[4]. The implication here is that in the previous six months, there has been evidence of a growing economy as can be seen by the total megawatt hours generated in the power sector in Figure 7.

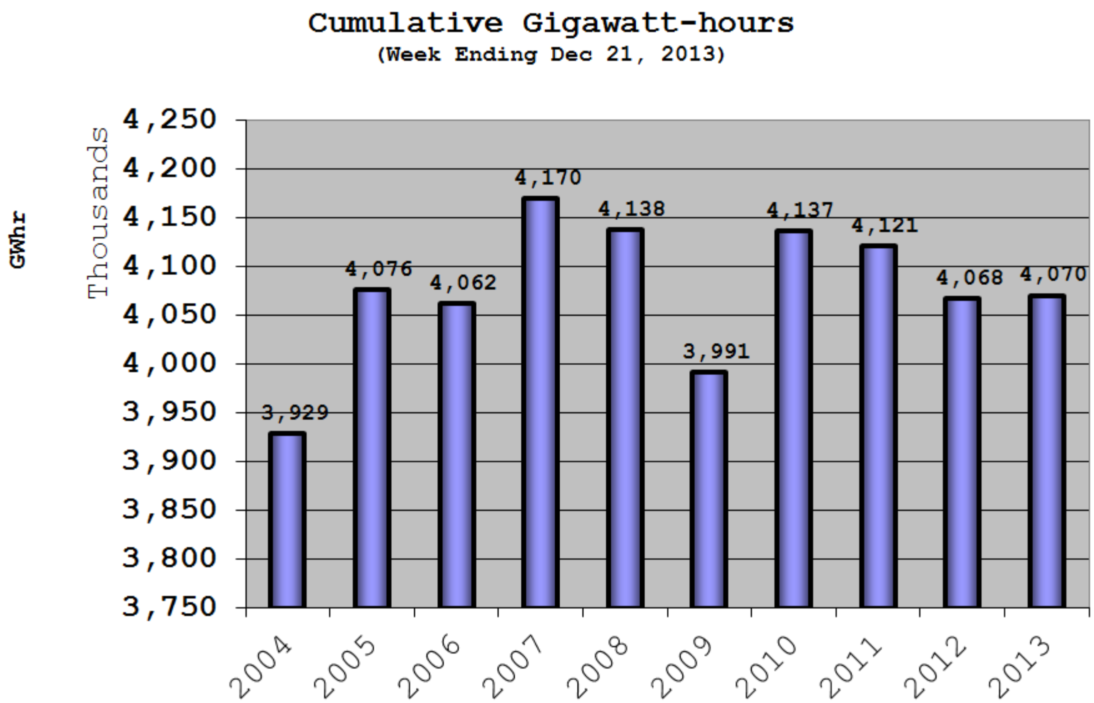

Figure 7. US Power Generation Cumulative Gigawatt-hours since 2004
Source: EEI Weekly Electric Output

Figure 8 is provided to indicate the measureable increase in generation that took place just in the last six weeks of 2013. This suggests a more sustained economic recovery than was evident between 2007 and 2011. We believe the data from the 2007-2011 time periods could under-represent gas turbine utilization since that period included such a severe economic downturn (see the year 2009 in Figure 7). Even though the cumulative year on year comparisons are not very strong in terms of growth, there is evidence of increased demand occurring in the last part of the year.

GTA anticipates from these data that there will be an increase in energy demand. This increase will be filled by increased generation by lowest-cost electricity generation, and when increased

[4] US Federal Reserve (INDRO), accessed 2 Dec 2013

reserves are required, new generation will be installed. Based on current market conditions, NGCC provides the lowest cost of electricity in base load and mid-merit load conditions and simple cycle provides the lowest cost of electricity in peaking load conditions. These data would indicate increased capacity factors for NGCC and to a lesser degree, increased capacity factors for peaking units especially in areas with increased renewable penetration.

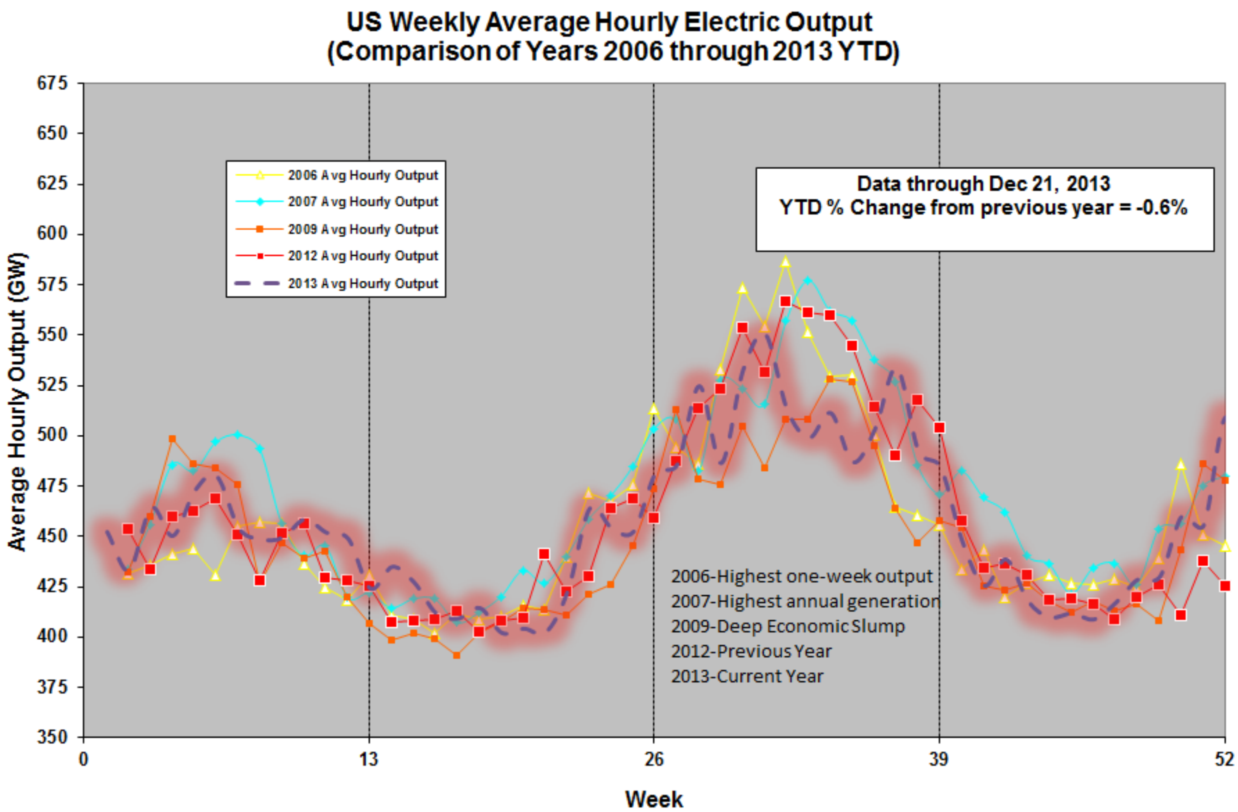

Figure 8. US Average Weekly Generation with History
Source: EEI Weekly Electric Output

EPA proposes to revise the averaging period for electric sales from an annual basis to a three year rolling average. The 3 year averaging period is unfortunately of limited benefit. Capacity is forward looking. An individual year of high energy demand, for unforeseen demand or supply issues, would decrease the available margin over the next 2 years.

Additionally, the provision to allow annual 219,000 MWh has the result of allowing smaller units to operate for additional hours, above the one-third capacity. This would produce the irrational result of allowing inherently less efficient turbines to operate additional hours while larger more efficient units would have their operating restricted.

EPA requests comments on a 2/5 (40 percent) capacity definition. While this is directionally better than the currently proposed one-third capacity level, GTA believes full exemption of simple cycle turbines is the most defensible and best solution, because it would provide grid reliability by not arbitrarily removing a subset of the generating capacity from availability. The highly flexible generation capability of simple cycle gas turbines is essential to support the deployment of variable renewable generation, and enable compliance with the range of renewable portfolio requirements enacted in various markets across the United States. If a capacity limitation is deemed to be necessary in the rule—and we believe such a limitation would be a mistake, nothing lower than a 50% capacity level is recommended.

Alternate Simple Cycle Capacity Limit to Reward Gas Turbine Efficiency

In the absence of a full exemption for simple cycle gas turbines, the GTA believes the EPA should provide incentives for simple cycle machines to drive to higher efficiencies and reduced levels of CO_2 at peak power conditions. One such proposal would limit utilization factor based on a sliding scale of the units' peak power CO_2 rate capability. For example a simple cycle machine operating at the proposed compliance level for combined cycle machines of 1,100 or below would be exempt from a utilization factor, whereas the lower efficiency simple cycle machines, say 30% efficiency or a CO_2 rate of 1450 or above, would be limited to a 33 % utilization factor. A linear sliding scale could be provided to define the utilization factor between these two levels, per Figure 9.

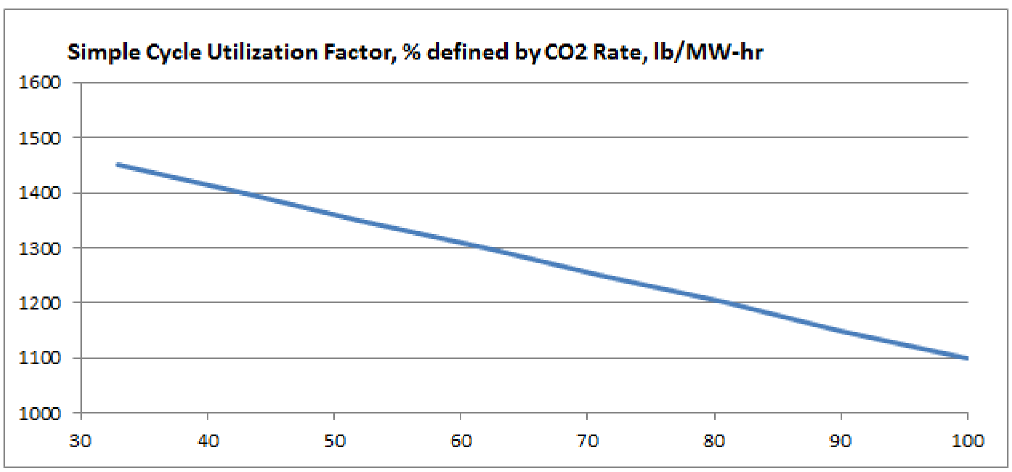

Figure 9. CO_2 Emissions Based on Gas Turbine Utilization

EPA Should Revise the Proposed Breakpoint of Large and Small Gas Turbines to 1,500 MMBtu/hr HHV

In the proposed rule, EPA notes that larger combined cycles are inherently more efficient than smaller combined cycles and suggests a higher (less restrictive) emission limitation for smaller NGCC units than larger NGCC units. The cut-point of 850 MMBtu/h proposed by the EPA is consistent with the current value designated in Subpart KKKK to regulate nitrogen oxide (NO_x) emissions. However, the design parameters that influence NO_x formation fundamentally differ from those that affect CO_2 formation, making the proposed cut-point inappropriate for CO_2.

A graph of the combined cycle CO_2 emissions versus heat input based on fuel higher heating value of the fleet for all commercially available gas turbines with a heat input above 250

MMBtu/hr is shown in Figure 10 (Same figure as Figure 5 on page 9, reproduced below for clarity). The gas turbine performance is based on data from Gas Turbine World 2013 data (as such, it would not account for any degradation in performance with time, nor any site specific requirements that would also impact efficiency). The original proposed level of 850 MMBtu/hr HHV is indicated, and the GTA revised value of 1,500 MMBtu/hr HHV is also depicted on the graph.

The 850 MMBtu/hr HHV cut-point, when compared to the existing fleet, does not result in an obvious cut-point (if a technology differentiation even exists) with a clear demarcation of higher emitting vs. lower emitting technology on either side of the cut point. Conversely, there is evidence of a break between the existing fleet of gas turbines, with clearly more efficient and lower emitting technology moving from left to right on this graph. The grouping of higher heat input, higher efficiency technology corresponds with the F class and higher class gas turbines, and is only evident because there are no equipment designs provided in the indicated gap. The cut-point value of 1,500 MMBtu/hr HHV recommended by the GTA was developed based on the largest of the "small" gas turbine heat input ratings, with added margin to allow for growth of the these gas turbine models as technology advancements become commercially available. The Gas Turbine World fleet data define a very clear-cut point at the level recommended by the GTA and further, the data shows no technical justification for the proposed cut-point. As a result the GTA strongly recommends the cut-point be revised to 1,500 MMBtu/hr HHV. However, GTA believes that technical innovations may fill-in this apparent technology gap, with turbines that will follow the same trend as the shown by the groups on the left and right.

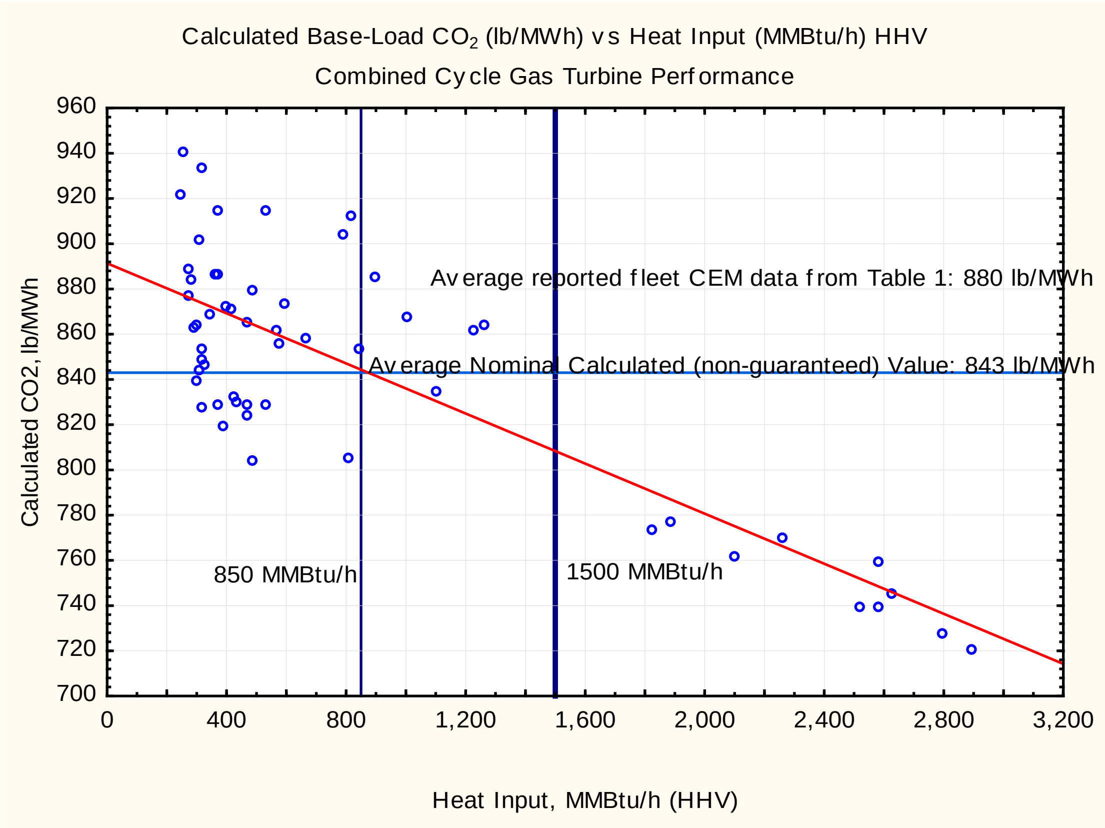

**Figure 10. Calculated CO_2 Emission Rate for Combined Cycles
Average of All Values Also Indicated (Gas Turbine World, 2013)**

EPA Should Exclude Startup/Shutdown and Part Load Operation

The rule should exempt periods of startup, shutdown and part load operation for simple and combined cycle gas turbines. Fast-start gas turbines will effectively operate as a simple cycle gas turbine for a portion of the start and ramp. GTA's analysis of the operating fleet reveals that part load operation is likely to be an increasingly important 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 startup and shutdown) will always result in higher CO_2 emissions (using an output metric). Even part load operation by itself has the potential of generating 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 are expected with virtually any new simple cycle gas turbines entering operation. Due to the basic physics of turbo-machinery, the thermodynamic efficiencies are less than 43.6% (on an LHV basis, the value is about 40% using an HHV basis), unless the steam cycle is added to recover additional energy.

The problem is exacerbated by any need to operate at partial power (where output based emissions, not the mass tonnage) will increase. 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.

An exemption from startup and shutdown will also support a rapidly growing installed base of non-dispatchable renewable generation. Since 2011 the total installed base of renewables had increased almost 31% reaching above 60,000 MW of installed capacity. This additional capacity only includes wind and solar additions. Hydroelectric capacity has not been included in this total because hydroelectric generation is not subject to significant hour by hour variability, although total installed base capacity is approximately 100,000 MW.

The rapid increase in the total renewable generation installed base can be seen in Figure 11 and Figure 12. Figure 11 shows the installed cumulative renewable capacity in United States from 1975 through 2013. Figure 12 shows the percentage of solar and wind capacity installed in the California NERC region where a large volume of renewables already is in place. In this region there is intense pressure to increase the total renewable footprint to levels as high as 33%. As is evident in Figure 11 the total percentage of the non-dispatchable capacity has increased rapidly in the last few years. We expect that this increasing footprint of renewables will put additional pressure on the dispatchable installed base by requiring additional ramping, turndown capability, starting, and stopping. These events are likely to be significantly different from the historical data reviewed in the original analysis. The United States is entering an era where traditional load dispatch is shifting. We expect to see more ramping starts and stops as the volume of the non-dispatchable renewables in the system increase.

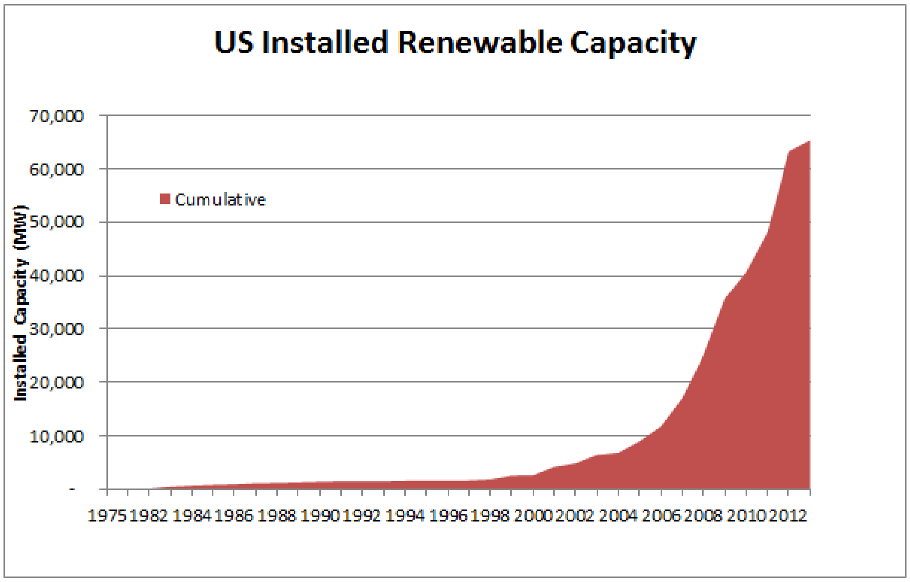

Figure 11. US Cumulative Installed Capacity of Solar and Wind Generation
Source: SNL Energy

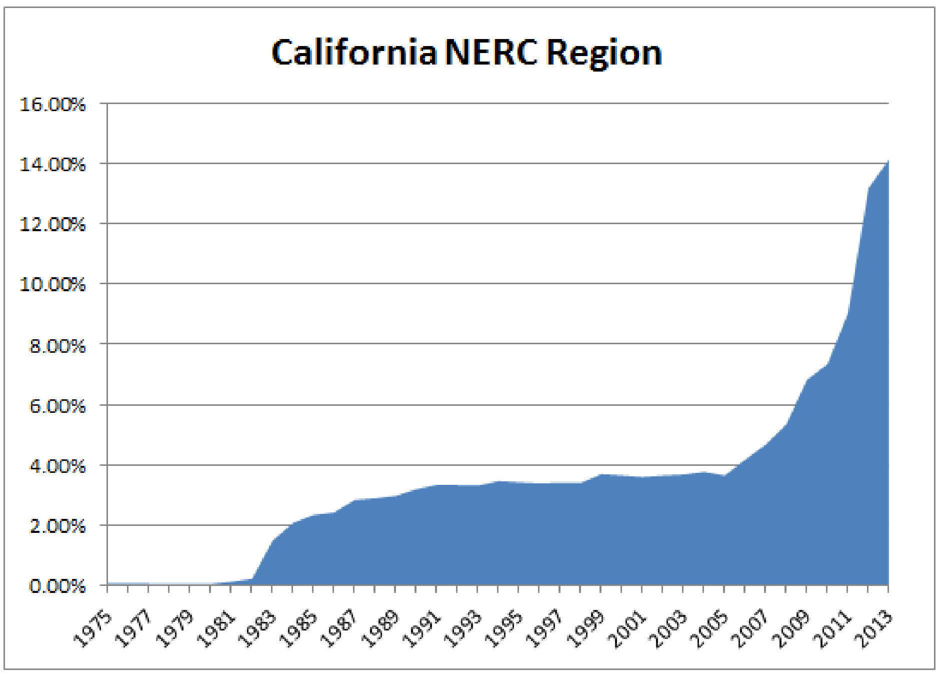

Figure 12. Percentage of Renewable Capacity within the Cal-Mex NERC Region
Solar and Wind Only Source: SNL Energy

Because of the unique nature of wind and solar generation, capacity (MW) cannot normally be dispatched when required. And when the renewable capacity is generating, other capacity (provided by gas, coal, and nuclear fuels) must typically scale back in output. One effect has been increasing "peakedness" that has been developing across the country. This is where capacity is brought on line (or output is increased from part load), but the average output from the dispatchable install base may actually be decreasing. For those units that are not shut down (i.e. the fuel flow is zero), the part load emission factor on an output basis is always higher than the base load emission factor. Looking forward, we expect to see more of this type of operation, as shown in data provided by the Energy Information Administration (EIA), in which the ratio of peak power demand to the average demand has been steadily increasing, Figure 13. This data is a clear indicator of increased variability of electric demand.

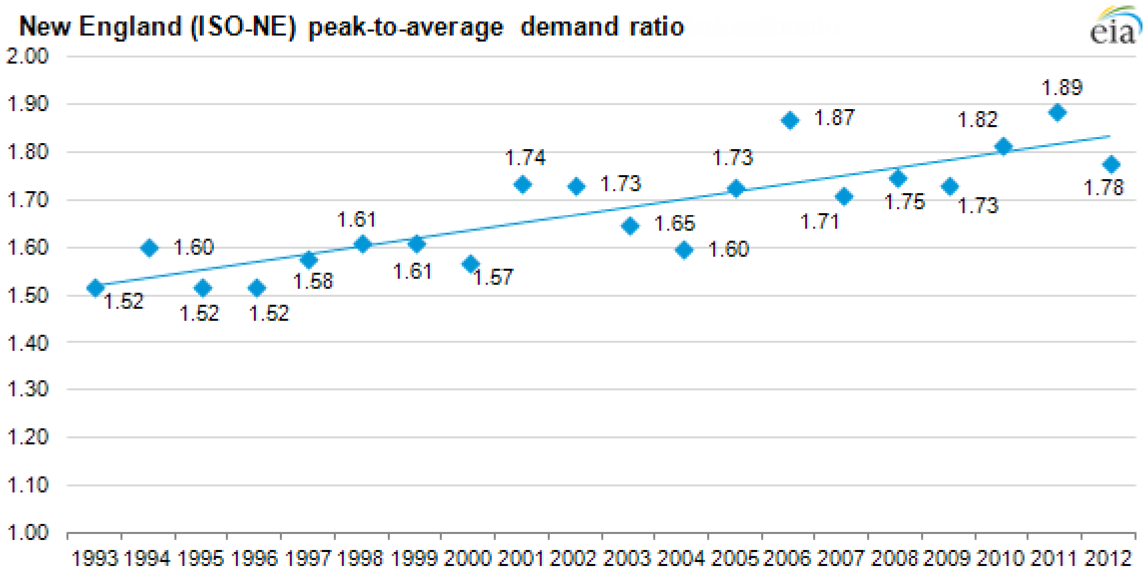

Figure 13. Shift in Peak Generation in New England ISO

While the data in Figure 13 may contain additional factors influencing the base load (e.g. declining manufacturing base), this same effect seems to be replicated in many of the areas where non-dispatchable additions have been significant. Either way, it appears that a new norm is a world where fast ramping and low load operation maybe become the standard.

EPA Should Exclude Combined Heat and Power (Cogeneration)

GTA recommends that EPA develop a specific exclusion for Combined Heat and Power (CHP) applications. CHP plants are inherently higher in efficiency than even a combined cycle plant. While EPA's proposed provisions for CHP reward this higher efficiency in allowing 75% credit for the useful exhaust energy and a 5% transmission allowance, the industry would be far better served and incentivized through a simple exemption of the technology from this rule.

CHP (or cogeneration) plants have a well-established history of improving industrial competitiveness. The thermal energy from CHP plants can be diverted to either energy production (kWh) or to thermal loads (steam supply, heating and cooling). It would be an unusual burden on the end-user to catalog each unit of thermal energy reduced or estimate the resistive losses in the transmission system. The best and most prudent approach to promote the President's plan to increase the amount of CHP in the US is to provide the technology a regulatory exemption. The proposed rule only applies to grid-connected generation. The rule could produce the unintended consequence that CHP facilities refuse to connect to the grid system so as not to be captured by this requirement. This would result in the additional negative consequence that CHP facilities deny their capacity to the grid foregoing their potential role as system support in unusual events.

Fuel Flow Analysis Is a More Accurate and Cost-effective Method for Determining Compliance

For gas/oil fuel turbines, the proposed rule offers CEMS or fuel flow measured (Part 75 Appendix G, Equation G-4) to quantify and report CO_2. Fuel analysis (fuel composition and consumption) is a more accurate, cost-effective method, making it the more reasonable method for measuring CO_2. Hourly reporting is not a necessity since the total fuel flow corresponds exactly to the total CO_2 mass emission and these data are already reported through regulatory channels (e.g. FERC). GTA recommends that fuel flow composition (weight percent carbon in the fuel) and fuel flow rate are sufficient metrics for reporting CO_2 emissions.

Complete combustion of natural gas involves conversion of all fuel carbon to carbon dioxide. Combustion systems in today's modern power plants operate at virtually 100% efficiency (in terms of oxidizing virtually all of the fuel carbon into carbon dioxide). Because of this, it is relatively easy to determine the total CO_2 released to the environment by assuming that carbon entering as fuel exits as CO_2. Since gas turbine facilities pay for the fuel they consume, very accurate data are generally available for total fuel purchases. From fuel consumption, it is relatively easy to make an assessment as to the total CO_2 released by that facility.

We examined the carbon dioxide that would have been produced based on the total fuel consumption[5], and compared this against the reported carbon dioxide based on measurements with a CEM system. Since the proposal does not provide for an exemption during transient conditions, such as startup and shutdown, total fuel consumption is expected to be more indicative of the total carbon released to the environment. Likewise, the total power generation is adequately documented (because the generator is compensated for power produced) and can be used in the evaluation to determine CO_2 emissions in terms of pounds per megawatt hour.

Data from both evaluations (CO_2 reported by CEM and calculated by fuel flow) are shown in Figure 14 and Figure 15. The data are for gas-fired systems that are not operating either as cogeneration or combined heat and power (CHP). Extreme emission data points have been removed, for example emission rates less than 440 lb/MWh do not comprise any of the data sets. Emission rates greater than 4,000 lb/MWh were also excluded to avoid averaging that data into the total.

The trends for both methods of CO_2 evaluation are essentially identical: they simply reflect the relative overall efficiencies of each cycle (i.e. that a combined cycle is more efficient than the simple cycle turbine operating without energy recovery). The combination of the two cycles is reflected in the combined cycle on the left of both Figure 14 and Figure 15. As these data show, it does not appear to make any difference how the carbon dioxide emissions are determined for

[5] Based on using the total fuel consumption, in thousand standard cubic feet, which was converted to pounds per hour; and assumed to be 75% carbon by weight, essentially methane.

combined cycle, (i.e. its CO_2 emission profile on an output basis is always better than either a gas or steam turbine alone), but the median value is somewhat higher when determined using fuel consumption.

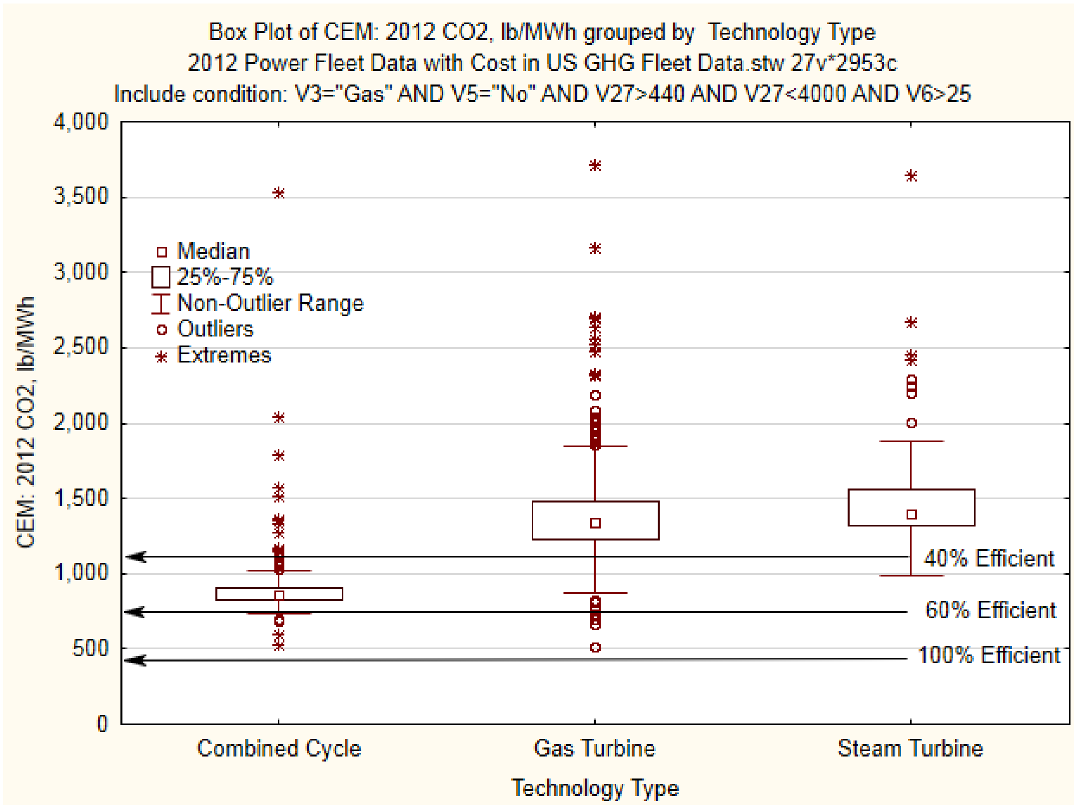

Figure 14. CO_2 Emissions from CEM Data

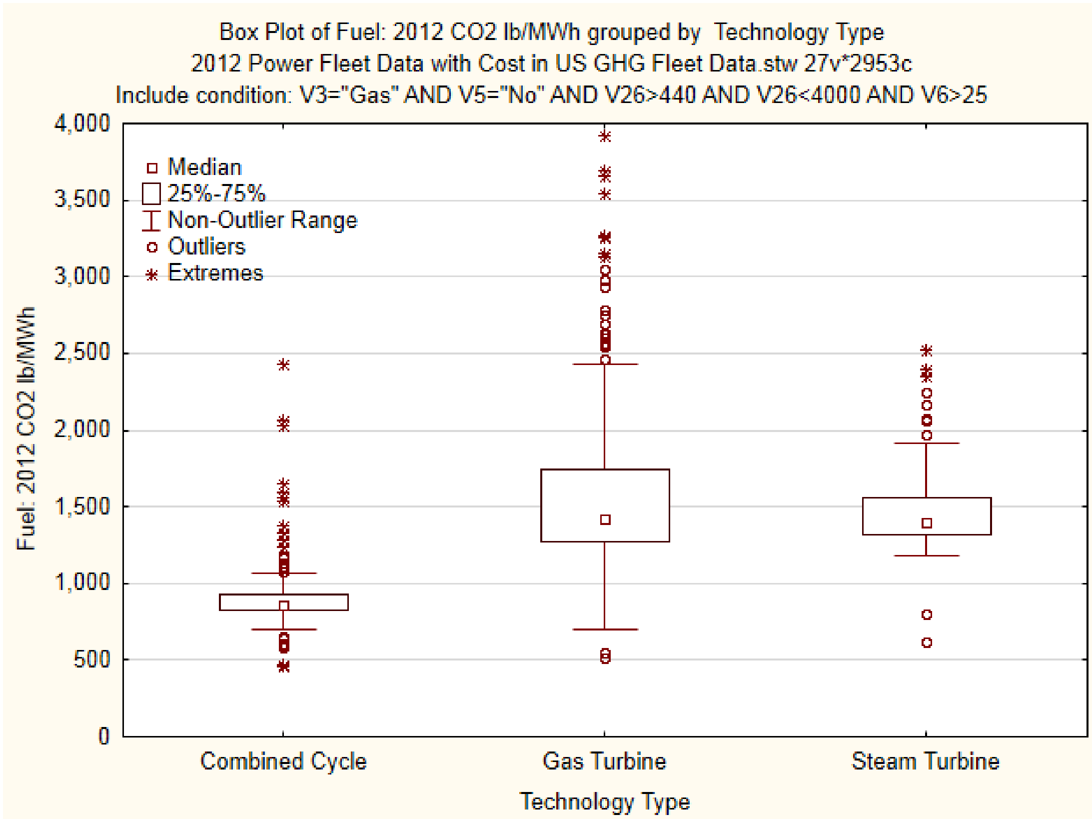

Figure 15. CO_2 Emissions Calculated from Fuel Consumption

The data shown in Figure 14 and Figure 15 reflect emissions and fuel measurements in the year 2012 (not the multi-year analysis noted earlier). These data represent a time period when larger amounts of renewable generation were delivered to the markets, and potentially greater economic activity was present. Given the increasing emphasis on renewable and alternative energy production, 2012 data are expected to be a better indicator of the demand on and operational responses of the gas turbine.

A more detailed comparison of the two emission assessment methods reveals some of the differences in the emission rates reported for the gas turbine-only configuration (simple cycle turbine). This is shown in Table 2. While engineering principals suggest that the fuel flow measurement method (which would include a fuel chemical composition) would be more accurate, the data also reveal that emission levels are nominally higher than reported by the CEM.

Table 2 Comparison of Emission Rates Measured by Fuel Flow and CEM
Simple Cycle Gas Turbines Only. Fuel Assumed to be 75% Carbon, or Essentially 100% Methane.

Calculation method	CO_2 emission rate, lb/MWh		
	Median Value	25% of reported values are below	75% of reported values are below
Fuel (total fuel reported)	1,424	1,277	1,739
CEM (as reported)	1,337	1,226	1,479

The values in the third and fourth columns reflect the range of values that are below a specific level (column 4 shows reveals that 75% of the results are 1,739 or *lower*, when calculated using the fuel flow, and 1,479 or *lower*, based on the CEM). The differences in the measured values in Table 1 are believed to result from inherent inaccuracies in the CEMs measurement systems, most notably during periods of start-up and shutdown. This is a common error in test measurement when attempting to mass balance the inputs and outputs. The reported CEMs data do not make clear whether the CEMs system was operational during periods of start-up. Some CO_2 emissions may not have been collected and reported. Also, during transient events, most significantly during start-up, there is a time delay between the fuel consumption and combustion parameters (which are measured almost instantly) and the CO_2 level measured by the emission measurement device. The delay is caused by the time required for the gases to leave the combustor, reach the exhaust stack, travel down the flow extraction umbilical tube, and then reach the monitor. In some installations this can be a minute or more. As a result, CO_2 concentration is measured and converted to a CO_2 mass flow based on exhaust flow measurements that may differ by several minutes. This time lag is not significant during steady operation, but can be significant during transient events, especially start-up or shutdown. (Note: this is a significant inherent error in start-up emission measurements for any pollutant). For CO_2, measurement error is substantially reduced if the fuel flow measurement technique is used. EPA should adopt a fuel flow method for measuring CO_2 for any gas turbine cycle due to its greater accuracy and ease of adoption by those units. *It would also support our claim that the actual benchmark should be above EPA's proposed 1,000-1,100 lb/MWh range.* Exempting startup-shutdown periods from reporting (and averaging) will allow the fuel flow and CEM methods to be better aligned.

Combined Cycle as Best System of Emission Reduction (BSER)

GTA concurs that the combined cycle is a very effective tool to deploy in terms of a positive impact on the environment. GHG emissions are inversely proportional to the efficiency, and natural gas combined cycle power plants are the most efficient, lowest CO_2 emitting fossil fuel fired dispatchable electric generation technology under operational conditions where flexibility, low load operation, and multiple starts are not required. GTA supports the determination that NGCC represent BSER technology for stationary gas turbine technology in these circumstances.

NGCC does not represent BSER for simple cycle turbines, however. As detailed above, simple cycle units should be excluded from the proposed rulemaking due the fact that the majority of all simple cycle gas turbines operate at efficiencies that cannot achieve the standard for combined cycles. Without exclusion, simple cycle gas turbines would be severely limited in their operation, favoring a market for other, more polluting technologies at the expense of clean-burning gas turbines. If EPA fails to exclude simple cycle units from this rulemaking, EPA is required by the Clean Air Act to adopt adequately demonstrated and achievable, standards that reflect BSER for simple cycle turbines. Indeed, to do otherwise would contravene Section 111 because it would fail to consider the fundamental technical and operational differences between simple cycle and combined cycle turbines, thereby effectively and improperly redefining the source.

EPA's Proposed CO_2 Limit Should Not Be Set Below 1,200 lb/MWh

GTA believes the emission limit should be established at a higher level to account for the expected cycling (ramping from low loads to high loads). At a minimum the limit should be 1,200 lb/MWh if no exemption for part load operation is provided for the combined cycle. This will allow operation of combined cycle gas turbines that are designed for maximum ramping rates (the ability to reach full capacity in less than 10 minutes), while still providing capacity or reactive power VAR (volt-amp reactive) support at part power. Also, based on our previous statement, we would expect the fuel flow data to be more accurate than the CEM data, and also, slightly higher since it would include fuel consumed during the startup and shutdown and during periods when the CEM is being calibrated. Looking forward, in the Cal ISO forecast (2), the expectation is for a significant need for fast ramping as the region expands its non-dispatchable base (Figure 16).

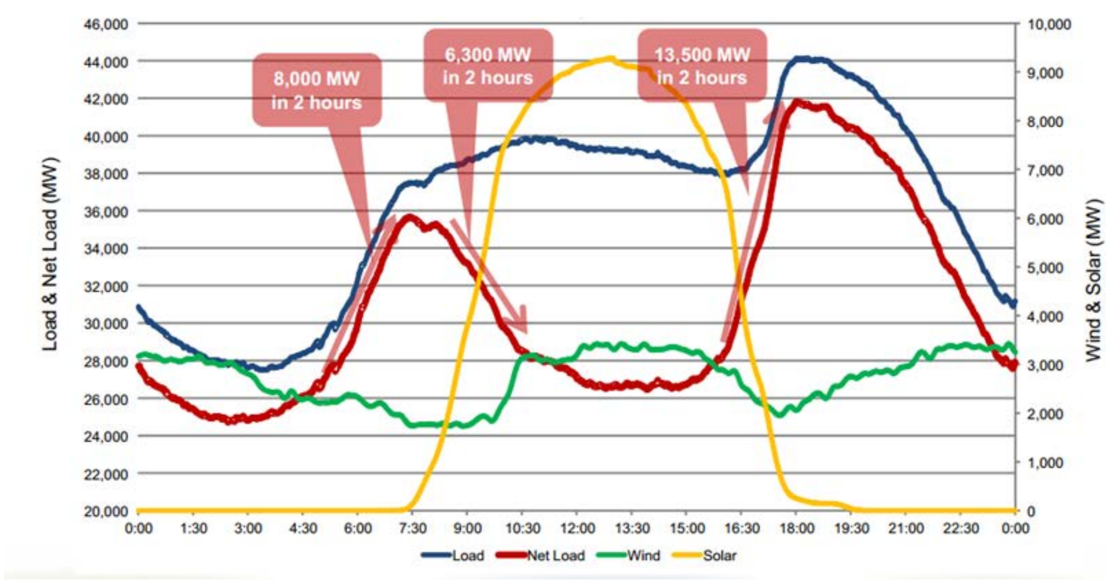

Figure 16. Forecasted California ISO Load in Year 2020

Depending upon the part-load demand of the combined cycle, it is possible for the operator to reach a low-load point that would yield emissions above EPA's suggested threshold, even though the published base load emission performance capability could be significantly below EPA's proposed benchmark. The contradiction here is that the facility would be incentivized not to operate the plant to support energy demand, but rather for compliance with emissions. Lacking the exclusion of data during transient events, or part load, would argue for a higher emission output standard.

Simplified Reporting Methodology

For facilities that must report their emissions, the most recent proposal offers a compliance assessment based on fuel flow monitoring and generation. As shown earlier, fuel monitoring and associated calculation of CO_2 is a more accurate, effective, and reproducible means of determining CO_2 emissions, it may also end up reporting a higher output value than the CEM. GTA recommends the fuel monitoring method be the preferred compliance methodology and CEMs be included as an alternative methodology.

In addition, with emission reporting averaged on an annual basis, GTA believes it is unreasonable to require documentation and reporting of hourly fuel consumption rates and hourly generation data. Plant operators must compensate for the purchase of their fuel, and receive compensation for the sale of the generation. Monthly data collection would be more than sufficient for reporting purposes. In fact, EPA could gather these data directly without imposing an additional regulatory burden on facilities. Substantial amounts of these data are already available through, for example, the Energy Information Administration (EIA) Electric Power Monthly.[6] The monthly report includes fuel consumption of natural gas, coal consumption, and the net production of electricity. This information is supplied through various power plant reporting forms, including: Form EIA-923, "Power Plant Operations Report;" Form EIA-826, "Monthly Electric Sales and Revenue With State Distributions Report;" Form EIA-860, "Annual Electric Generator Report;" Form EIA-860M, "Monthly Update to the Annual Electric Generator Report;" and Form EIA-861.

GTA urges EPA to make fuel consumption monitoring the compliance mechanism and CEMS the compliance alternative. In addition, where reporting is already underway, the rule should provide that these data be used as substitute in lieu of collecting and documenting hourly information.

EPA requested comment on the need for initial performance measurements at or near plant commissioning prior to the 12 month compliance period. GTA sees no value in this test. Compliance with the standard will be strongly dictated by the operational profile of the plant, not the base load emission rate at or near commissioning. Also, considering the very predictable performance, GTA does not see any necessity for requiring a separate performance certification run (noted on page 1497 of the CFR). Every combined cycle sold will have guarantee for the gas turbine and for the gas turbine plus steam cycle. This additional testing is unnecessary because the project owner always requires a performance validation. The simplicity of calculating the CO_2 emissions from a gas-fired combined cycle using the guaranteed heat rate makes special testing overly burdensome, especially because the owner will likely carry out the

[6] http://www.eia.gov/electricity/monthly/pdf/epm.pdf. For the data noted, *see* Tables 2.4.A, 2.1.C, 2.1.B and 1.1.

same tests to accept the project, and comparable testing to verify the priority pollutant emission levels.

Method for Computing the 12-Month Rolling Average

EPA's proposal "that initial compliance with the applicable emissions limit in kg/MWh be calculated by dividing the sum of the hourly CO_2 mass emissions values by the total gross output for the 12- or 84-operating-month period…"(79 Fed. Reg. 1451) is an improvement. However, we see no reasonable justification for the requirement to quantify each hourly emission period when the averaging period is 12 or 84 months. The GTA has alternately recommended compliance based on a simple performance test. The as proposed requirement imposes a burden on reporting entities without any corresponding environmental or other benefit. GTA recommends that the cumulative generation data be compared to the cumulative CO_2 emissions over the period without the need to report hourly emission values.

We note further that there is no public health or environmental protection benefit from compliance on a monthly basis or even to require continuous hourly data collection; these requirements are therefore not reasonable. 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.

Similarly, the requirement to determine daily violations (79 Fed. Reg. 1498), is not reasonable. If a 12-month averaging period is to be the basis for compliance, the inclusion of this section suggests that the hourly or daily emissions rate will become a determinant factor in establishing any potential penalty. If so, this only reinforces the GTA position that the regulatory threshold be moved to 1,200 lb/MWh.

EPA Should Exclude From Compliance Determinations Periods When Turbines are Forced to Use Alternative Fuels

Because of the stringency of the proposed emission limit, the emissions (or perhaps averaging of the data) should only be reported during periods of natural gas operation. During periods where gas supplies are curtailed (e.g. during 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 No. 2 distillate (or similar fuels), which have a significantly higher CO_2 emission profile. Because of the substantial cost differential, operators have an incentive to generate power on the lowest cost fuel for which the unit can operate. This is usually natural gas, but there are times when pipeline capacity may be constrained and generators may not have sufficient access to continue operation on natural gas.

The recent cold weather in the Northeast caused a significant increase in the price of electricity partially driven by limitations with the natural gas pipeline capacity (Figure 17). Where possible, some generators were likely forced to utilize a backup fuel. And in some cases the generators were operating under contracts with an interruptible supply of natural gas and could not continue operating on natural gas. In the PJM region, some of the demand response has been met by end-users disconnecting from the grid, making up their generation needs with oil-fired reciprocating engines. In practice, the CO_2 emission profile of any combined cycle operating with oil backup would be lower than the reciprocating engine using the same amount of fuel.

In most instances in which back-up fuel is being used in a gas turbine it is due to an interruption of the natural gas primary fuel supply. Interruption of natural gas is uncommon, but does indeed occur. Such situations are generally associated with either extreme weather events or malfunctions in the gas supply system. These events would generally be considered an emergency situation and exemption of emissions under such scenarios would be deemed appropriate. In the absence of a full exemption for back-up fuel operation an exemption during periods of interrupted primary supply is essential.

Routing plant firing on back-up fuel is commonly required for maintenance and performance demonstration. Operation during these periods is not specifically for generation using the back-up fuel but rather a necessity of routine operation. Exemption for these operating scenarios is necessary to ensure compliance with the annual rolling hour requirements. An allowance for back-up fuel operation of 500 hours annually is common in permits to accommodate such situations.

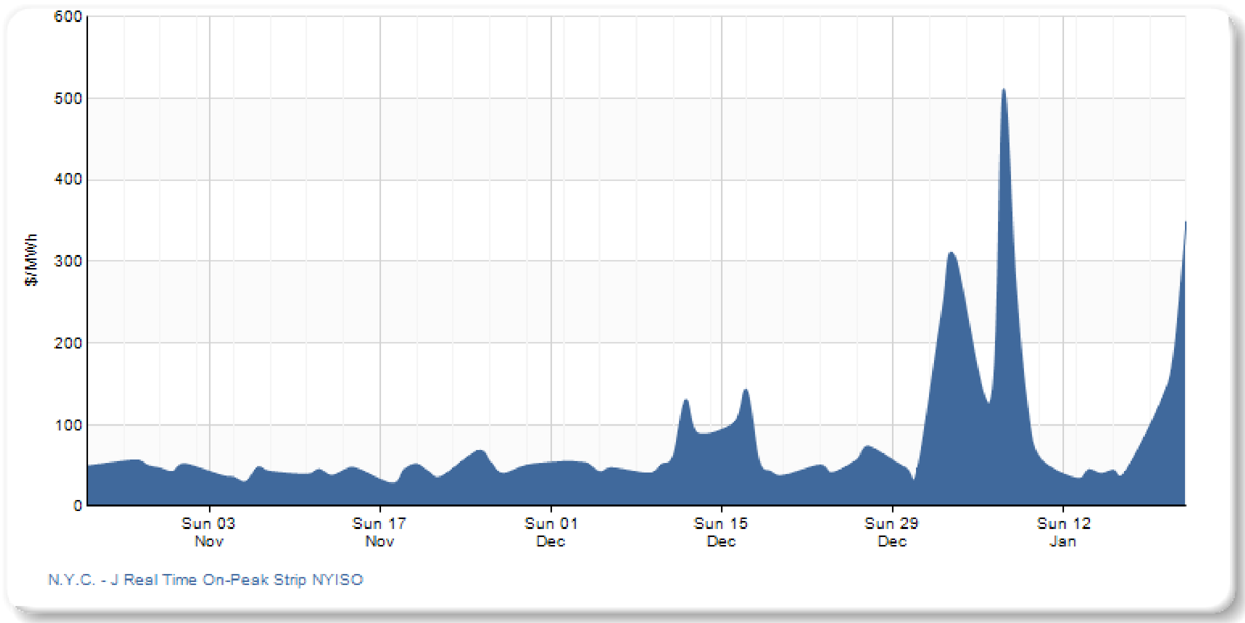

Figure 17. Real Time Power Costs in the New England Region (Showing Critical Winter Peaks)

As Figure 18 shows, there is a large difference between emission levels based on natural gas and other fuels. Clearly EPA recognizes that liquid fuel is critical as backup, as EPA proposes to fully exempt full-time operation on liquid fuel where natural gas is not available (Hawaiian Islands and Puerto Rico, for example). Like EPA's exemption of full-time operation on liquid fuel where gas is not available, EPA should also exempt the use of liquid fuel during emergency operation**.**

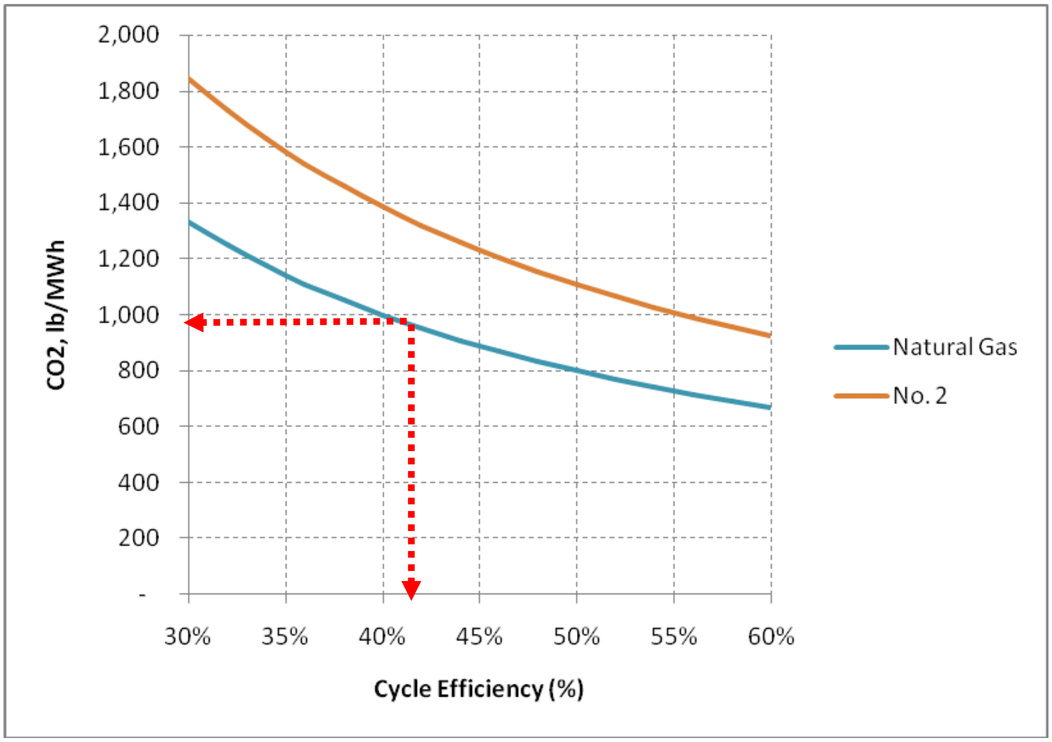

Figure 18. CO_2 Emissions as a Function of Fuel Type and Cycle Efficiency

Finally, it is not clear what standard would apply for a facility operating a gas turbine designed for oil operation principally, with the possibility of gas as a backup fuel. While this may seem an oddity, there is interest in providing LNG to Hawaii for power generation. This possibility would create an unusual generation situation on the islands (e.g. Hawaii and Puerto Rico), where they fuel oil (or some equivalent) could be used most of the time, but some operation would include natural gas. With the inordinately high electricity rates in Hawaii, there is an economic incentive to introduce a lower-cost fuel supply alternative to oil, with the possibility of gas as a backup fuel. It is questionable whether any simple cycle turbine on these islands could operate under this scenario and reach even some of the less stringent emission levels suggested in this proposal.

Fuel Quality

Another criterion for setting CO_2 emissions, not reflected in EPA's analysis, is the role of fuel quality in achieving any specific emission target. Because of the obvious influence of fuel carbon content on the CO_2 emission potential, GTA recommends the higher 1,200 lb/MWh threshold, a value that would permit users greater access to America's shale gas developments.

In recent years, larger amounts of heavier hydrocarbons have been introduced into the pipeline infrastructure. In particular, the amounts added have increased to a point where some pipelines simply will not accept additional gas injections from certain gas supplies. Under these conditions, there has been some interest in using these gases directly in a turbine. At some of the richer shale gas fields across the country (Marcellus, Utica and Eagle Ford) not only is ethane available but also propane, butane and some pentanes. These raise both the heating value and the carbon content of the fuel. The presence of these higher concentrations of heavier hydrocarbons is illustrated in Figure 19.

We summarized published performance data from Gas Turbine World for a range of gas turbines from 3 MW up to 300 MW. The color symbols on the chart reflect the calculated CO_2 emissions from a simple cycle gas turbine. The data are broken into three categories: < 50 MW; 50-100 MW; and > 50 MW. The scatter in the data reflects the range of heating values expected in most natural gas pipeline tariffs across the country. The lines indicate the minimum calculated thermodynamic efficiency required for any device (in this case a gas turbine) to achieve the emission rate noted on the right side of the line. As shown, only one or perhaps two gas turbines could comply with a 1,000 lb/MWh limit. Also, the minimum required efficiency increases with the fuel gas heating value, which is essentially a function of the presence of heavier hydrocarbons in the fuel supply. In setting CO_2 emission limits, EPA should account fuel quality and its effect on CO_2 emissions.

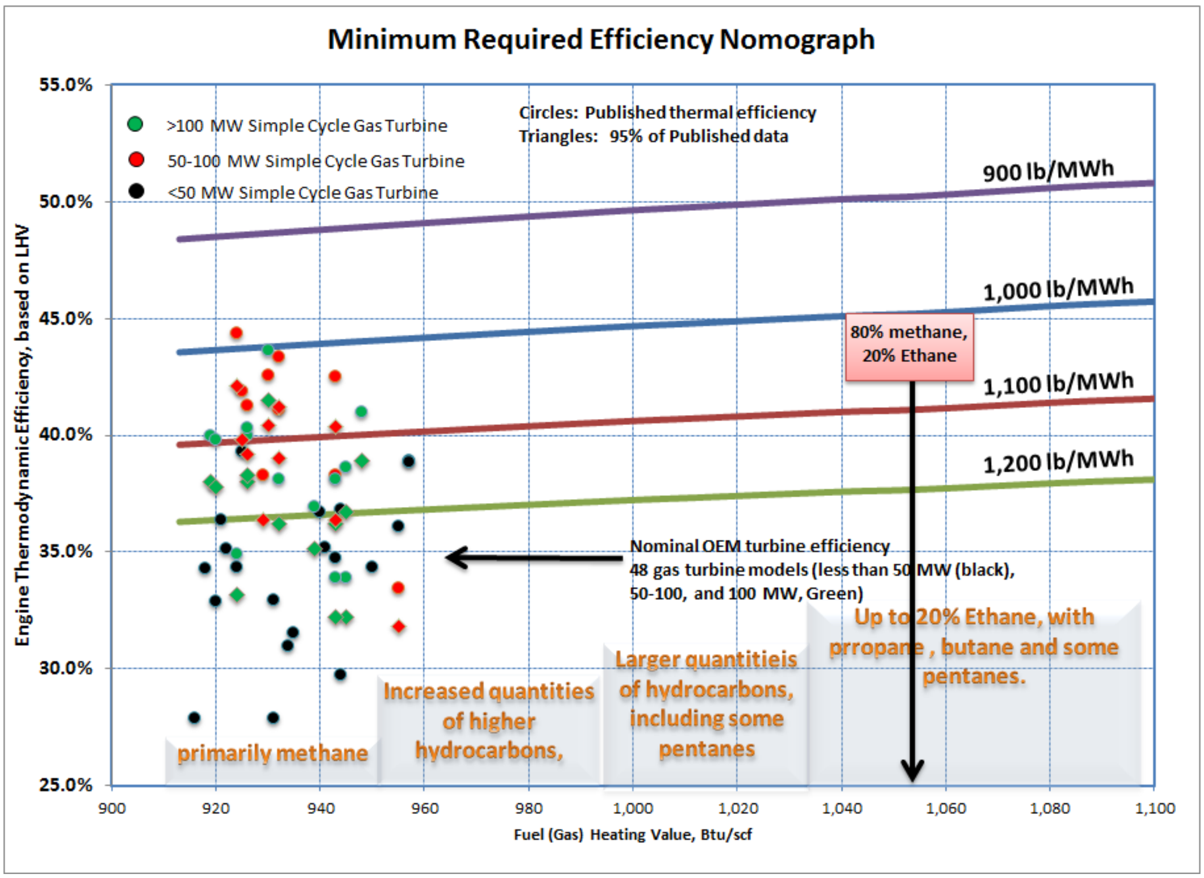

Figure 19. Impact of Fuel Quality on GHG Emissions at Indicated Compliance Levels

Presumptive Best Available Control Technology (BACT) Concern

As noted, simple cycle gas turbines operate at levels higher than EPA's proposed values necessary for meeting the emission limit. The appearance of compliance is achieved only through a generation capacity limitation on simple cycle turbines. Whether or not simple cycle turbines are excluded from this rulemaking, GTA is concerned that the NSPS levels may be misinterpreted and assumed to be BACT for all gas turbines, including large simple cycle projects. Such a misinterpretation would effectively ban simple cycle gas turbines. GTA requests that EPA include specific language to prevent an unintended adverse impact on simple cycle gas turbines.

GTA suggests that the proposed rule be amended to add the following:

> *Any emission limits established by this section are not intended to and shall not be used as a basis for establishing for simple cycle combustion turbines what constitutes "best available control technology (BACT)"*

This point is illustrated in Table 3 which summarizes a sampling of recent simple cycle turbine BACT determinations. The information was excerpted form a "Statement of Basis" prepared by EPA Region 6 (emphasis added).

Table 3. Recent Simple Cycle Turbine BACT Determinations

Company / Location	Process Description	Control Device	BACT Emission Limit / Requirements	Year Issued	Reference
Cheyenne Light, Fuel & Power / Black Hills Power, Inc.	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,600 lb CO_2e/MWhr (gross)** 365-day average, rolling daily	2012	PSD-WY-000001-2011.001
York Plant Holding, LLC	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,330 lb CO_2e/MWhr (net)** 30-day rolling average	2012	67-05009C*
Pio Pico Energy Center, LLC	300 MW **simple cycle** power plant	Energy Efficiency/ Good Design & Combustion Practices	**1,328 lb CO_2e/MWhr (gross).** 720 rolling operating-hour average	2012	SD 11-01
EFS Shady Hills LLC	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,377 lb CO_2e/MWhr (gross)** when firing natural gas	*	
LADWP Scattergood	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,271 lb CO_2e/MWhr (net)** 12-month rolling average	*	

Company / Location	Process Description	Control Device	BACT Emission Limit / Requirements	Year Issued	Reference
Puget Sound Energy, Fredonia Generating Station	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,299 lb CO_2e/MWhr (net)** for GE 7FA.05 **1,310 lb CO_2e/MWhr (net)** for GE 7FA.04 **1,278 lb CO_2e/MWhr (net)** for SGT6-5000F4 **1,138 lb CO_2e/MWhr (net)** for GE LMS100	*	PSD-11-05
El Paso Electric Company, Montana Power Station	**Simple cycle** combustion turbine	Energy Efficiency/ Good Design & Combustion Practices	**1,194 lb CO_2/MWhr (gross)** output on a 5,000 operational hour rolling basis.	*	PSD-TX-1290-GHG

* Permit not yet issued.

Note: two facilities were removed from the table as they were combined cycle/cogeneration.

GTA Recommends that EPA Establish a Separate Subpart TTTT

EPA has requested comment on whether or not to create a new subpart or to include the proposed rule requirements in Subparts Da or KKKK as appropriate. GTA recommends that EPA use a separate subpart for the EGU CO_2 NSPS.

The applicability of subparts Da and KKKK are significantly different from the applicability of the proposed EGU CO_2 NSPS. Examples of the differences include 1) coverage under Subpart KKKK of mechanical drive turbines while the CO_2 emission limits only apply to EGUs; and 2) Subpart KKKK has specific limits for modified and reconstructed units while the CO_2 emissions apply only to new units. These differences in applicability are anticipated to cause complexity and confusion in rule interpretation. Due to these and other substantive differences in the rule provisions, a separate NSPS standard is appropriate and recommended.

GTA Member Companies

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

Appendix: List of Items for which EPA Requested Comment and GTA's Response.

Page	CFR Page	Item	Comment
14	1442	N_2O and Other GHG	GTA recommends that only CO_2 be the basis for GHG emissions
19	1447	Gross Energy evaluation for IGCC	No comment
19	1447	Net Output basis, and whether different sub-categories are needed	Net Output is sufficient
19	1447	Net Output usage	GTA finds this acceptable
20	1448	Credit rating for thermal output	GTA recommends CHP exemption
20	1448	84 month vs. 12 month	No comment
20	1448	84 month/12 month averaging for coal EGU	No comment
31	1459	Capacity Factor exemption	GTA recommends SC exemption, but 50% as a minimum (to be consistent with air permits)
31	1459	One or three year applicability	See text
31	1459	One third/two-fifths Capacity	GTA recommends SC exemption, or 50% as a minimum
32	1460	Co-firing averaging period	GTA recommends that the longer averaging interval be used.
32	1460	CHP Classification	GTA prefers to exempt a SC turbine, the prime mover in the CHP
33	1461	Requested documentation	See text
49	1477	Comment on all aspects of CUA	See text
54	1482	84 Month average on IGCC	No comment
54	1482	Average period for coal with CCS	No comment
57	1485	PSD and geologic sequestration	No comment
59	1487	Range for large and small gas turbine category	See text
65	1493	Comments from state and local	No comment
68	1496	Stack monitoring	GTA recommends fuel flow monitoring, where applicable (see text).
68	1496	Comments on the RIA	See text

68	1496	Coal refuse	No Comment
69	1497	CAES Exemption	GTA recommends exemption
69	1497	District Heating	GTA recommends complete exemption based on the net benefit for CHP
69	1497	Thermal output adjustment	A simple CHP exemption obviates the need for measurement
69	1497	Grid Emergency	GTA recommends an exemption during this period
69	1497	Initial performance test	GTA recommended exemption for turbine only. See text on OEM statements.
70	1498	Co-located non-emitting sources	No comment. But this is highly convoluted.
70	1498	Calculation of Daily variations and fines	See Text
70	1498	Reporting other GHG	No Comment
68-69	1496-7	Coal combustion	No comment