STATEMENT TO: United States Senate Appropriations Committee,
Subcommittee on Energy and Water Development
REGARDING: Department of Energy Turbine R&D Programs
SUBMITTED BY: Dr. William H. Day, Managing Director,
Gas Turbine Association
510-705-1885; EMAIL BILLDAY 3@COMCAST.NET

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The Gas Turbine Association (GTA) appreciates the opportunity to provide the United States Senate Appropriations Committee, Subcommittee on Energy and Water Development with our industry's statement recommending FY12 funding levels for the **Department of Energy.**

While the GTA recognizes the need to reduce federal spending in today's fiscal environment, **we respectfully recommend** that the FY12 appropriation for **Fossil Energy include $20 million for the Advanced Turbines Program R&D** to meet critical national goals of fuel conservation, greenhouse gas reduction, fuel flexibility (including syngas and hydrogen), and criteria pollutant reduction. A spending level of $20 million is more appropriate than the Administration's recommendation $14.6 million considering the FY10 spending level was $32 million. A spending level of $20 million would still represent a significant cut of $37% and will result in pushing out the timeline for the development and deployment of environmentally advanced gas turbines by several years.

It is clear that dramatic reductions in greenhouse gas emissions are in the national interest. It is also clear that our economy needs more electric generation capacity to resume and promote further growth. Without new technology, the power generation industry will be hard pressed to produce additional electric capacity, while at the same time meeting the strict greenhouse gas emissions standards being set by states and the federal government.

Federal investment in research and technology development for advanced gas turbines that are more efficient, versatile, cleaner, and have the ability to burn hydrogen-bearing reduced carbon synthetic fuels and carbon-neutral alternative fuels is needed to ensure the reliable supply of electricity in the next several decades. Domestic coal based Integrated Gasification Combined Cycle (IGCC) with carbon capture and storage is one such approach that would significantly supplement available supplies of domestic natural gas to guarantee an adequate supply of clean and affordable electric power. Alternative fuel choices range from imported LNG, coal bed methane, and coal-derived synthetic or process gas to biogas, waste-derived gases and hydrogen. Research is needed to improve the efficiency, reduce capital and operating costs, and reduce emissions.

Technologies for Advanced IGCC/H_2 Gas Turbine – Reducing the Penalty for CO_2 Capture

At current rates of research and development it is unlikely that the nation will have available the gas turbine technologies to meet the needs of carbon capture capable power plants. The advancement of these technologies must be undertaken by the DOE since there is currently no pathway to the development, insertion, and maturation of these technologies into the nation's electric power infrastructure based on market forces. Thus, a combined effort by the public and private sectors is necessary.

The turbines and related technologies being developed under the DOE Fossil Energy Advanced Turbines program will directly advance the performance and capabilities of future power generation with CO_2 capture and storage. Advances are needed to offset part of the power plant efficiency and output reductions associated with CO_2 capture. Program funding is required to cost-share in the

technology development of advanced natural gas/hydrogen/syngas combustors and other components to realize the DOE goals.

Several GTA member companies are working cost-share programs with the DOE to develop technologies for advanced gas turbine power plants with carbon capture. These technologies will: 1) increase plant efficiency; 2) increase plant capacities; and 3) allow further reductions in combustion emissions of hydrogen rich fuels associated with CO_2 capture and storage. This will help offset some of the efficiency and output penalties associated with CO_2 capture. These programs are funding technology advancement at a much more rapid rate than industry can do on their own.

The need for Federal cost-share funding is immediate. The funding levels in past years for the Advanced Turbines program has been inadequate to meet DOE's Advanced Power System goal of an IGCC power system with high efficiency (45-50% HHV), near-zero emissions and competitive capital cost. To meet this goal, the researchers must demonstrate a 2 to 3 percentage point improvement in combined cycle efficiency above current state-of-the-art Combined Cycle turbines in IGCC applications.

The plan for the IGCC-based power plants is to develop the flexibility in this same machine with modifications to operate on pure hydrogen as the primary energy source while maintaining the same levels of performance in terms efficiency and emissions. The goal is to develop the fundamental technologies needed for advanced hydrogen turbines and to integrate this technology with CO_2 separation, capture, and storage into a near-zero emission configuration that can provide electricity with less than a 10 percent increase in cost over conventional plants by 2012.

The Advanced Turbines program is also developing oxygen-fired (oxy-fuel) turbines and combustors that are expected to achieve efficiencies in the 44 – 46% range, with near-100 percent CO_2 capture and near-zero NOx emissions. The development and integrated testing of a new combustor, turbine components, advanced cooling technology, and materials in oxy-fuel combustors and turbines is needed to make these systems commercially viable.

The knowledge and confidence that generating equipment will operate reliably and efficiently on varying fuels is essential for the deployment of new technology. Years of continued under-funding of the Advanced Turbines program has already delayed the completion dates for turbine R&D necessary for advanced IGCC.

Mega-Watt Scale Turbine R&D

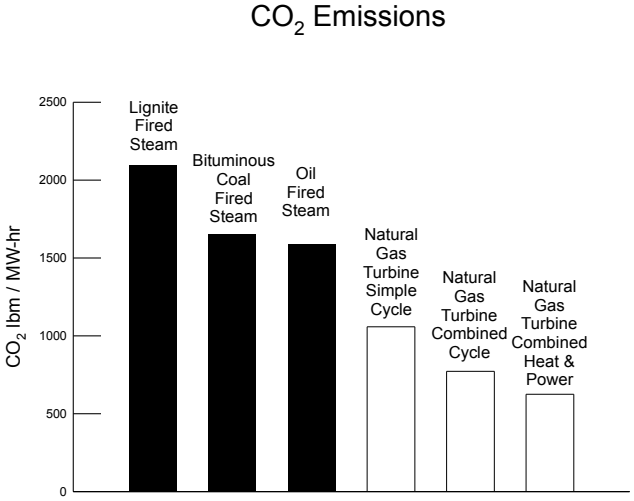
In the 2005 *Enabling Turbine Technologies for High-Hydrogen Fuels* solicitation, the Office of Fossil Energy included a topic area entitled "Development of Highly Efficient Zero Emission Hydrogen Combustion Technology for Mega-Watt Scale Turbines". Turbine manufacturers and combustion system developers responded favorably to this topic, but DOE funding constraints did not allow any contract awards. The turbine industry recommends a follow-up to this solicitation topic that would allow the developed combustion technology to be tested in machines at full scale conditions and allow for additional combustion technology and combustor development for both natural gas and high-hydrogen fuels.

The turbine industry believes that this technology is highly relevant to industrial coal gasification applications including: 1) site-hardened black-start capability for integrated gasification combined cycle applications [the ability to restart an IGCC power plant when the electric grid has collapsed]; 2) supplying plant electric load fueled on syngas or hydrogen; 3) increasing plant steam cycle capacity on hot days when large amounts of additional power are needed; and 4) in gas turbines for

compression of high-hydrogen fuels for pipeline transportation. The development of MW-scale turbines (1 - 100 MW) fueled with either natural gas or high-hydrogen fuels will promote the sustainable use of coal. In addition, highly efficient aeroderivative megawatt scale engines operate under different conditions than their larger counterparts and are installed for peaking or distributed generation applications. Funding is required to design efficient and low emissions combustors that accommodate the new fuels.

Gas Turbines Reduce Greenhouse Gas Emissions

The gas turbine industry's R&D partnership with the federal government has steadily increased power plant efficiency to the point where natural gas fired turbines can reach combined cycle efficiencies of 60%, and quick-start simple cycle peaking units can reach 46%. The gas turbine's clean exhaust can be used to create hot water, steam, or even chilled water. In such combined heat and power applications, overall system efficiency levels can reach 60 to 85% LHV. This compares to 40-45% for even the most advanced thermal steam cycles (most of which are coal fired).



Gas turbines already play a very significant role in minimizing greenhouse gas emissions worldwide. Gas turbines are both more efficient and typically burn lower carbon fuels compared to other types of combustion-based power generation and mechanical drive applications. The nation needs to reinvigorate the gas turbine / government partnership in order to develop new, low carbon power plant solutions. This can be done by funding research to make gas turbines both efficient and more capable of utilizing hydrogen and synthetic fuels as well as increasing the efficiency, durability and emissions capability of natural gas fired turbines. If Congress provides adequate funding to DOE's turbine R&D efforts, technology development and deployment will be accelerated to a pace that will allow the U.S. to achieve its emissions and energy security goals.

The GTA respectfully requests $20 million in FY12 appropriations for the Fossil Energy Advanced Turbines Program to meet critical national goals of fuel conservation, fuel flexibility (including natural gas, syngas and hydrogen), greenhouse gas reduction, and criteria pollutant reduction.

GTA MEMBER COMPANIES

Alstom Power, GE Energy,
Florida Turbine Technologies, Rolls-Royce, Siemens Energy, Solar Turbines,
Pratt & Whitney Power Systems, Strategic Power Systems, VibroMeter

Gas Turbine Association, William H. Day 510-705-1885, Email billday3@comcast.net