Applicability of Emission Guidelines to Existing Stationary Combustion Turbines: FAQs

Memo to the Docket

New Source Performance Standards for Greenhouse Gas Emissions from New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions from Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule Proposal

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Office of Air and Radiation

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On May 23, 2023, the EPA published proposed emission guidelines to limit greenhouse gas (GHG) emissions from existing fossil fuel-fired electric generating units (EGUs). Since publication, the EPA has received specific questions seeking clarification of the applicability requirements proposed in 40 CFR part 60, subpart UUUUb, which pertains to certain existing stationary combustion turbines. These questions include:

> Question 1: Based on construction or reconstruction date, which stationary combustion turbines are existing sources that may be subject to UUUUb?
>
> and
>
> Question 2: How do you calculate whether a stationary combustion turbine is potentially affected by the proposed existing source emission guidelines under UUUUb based on electric generating capacity (MW)?

This memo provides detailed responses to these questions.

Question 1: Based on construction or reconstruction date, which stationary combustion turbines are existing sources that may be subject to UUUUb?

Answer 1: Stationary combustion turbines that commenced construction or reconstruction before May 23, 2023, are existing sources that may be affected EGUs under the proposed UUUUb. See the proposed provision at §60.5845b(a)(2):

> **§ 60.5845b What affected EGUs must I address in my State plan**?
> (a) The EGUs that must be addressed by your plan are:
> …
> (2) Natural gas fired stationary combustion turbines that commenced construction or reconstruction before May 23, 2023.

There are no exclusions under the proposed UUUUb that are based on construction or reconstruction date and that are specific to stationary combustion turbines. For the proposed exclusions at §60.5850b (b) and (c), the term "EGUs" refers only to steam generating units (*i.e.*, utility boilers), not stationary combustion turbines. This reference is consistent with the discussion of the EPA's proposal in section X.B. of the preamble titled, *Applicability Requirements for Existing Fossil Fuel-Fired Steam Generating Units*. This reading of §60.5850b(b) and (c) is also consistent with the proposed revision to the standard for modified coal-fired steam generating units under TTTTa. See 40 CFR 60.5509a(a) (prop.) (providing that the GHG standards apply to certain "coal-fired steam generating unit[s] or IGCC" that commence a modification after May 23, 2023).

> **§ 60.5850b <u>What EGUs are excluded from being affected EGUs</u>?**
>
> EGUs that are excluded from being affected EGUs are:
>
> ….

(b) New or reconstructed EGUs that are subject to 40 CFR part 60 subpart TTTT of this part as a result of commencing construction after the subpart TTTT applicability date;

(c) Modified EGUs that are subject to 40 CFR part 60 subpart TTTTa of this part as a result of commencing modification after the TTTTa applicability date;

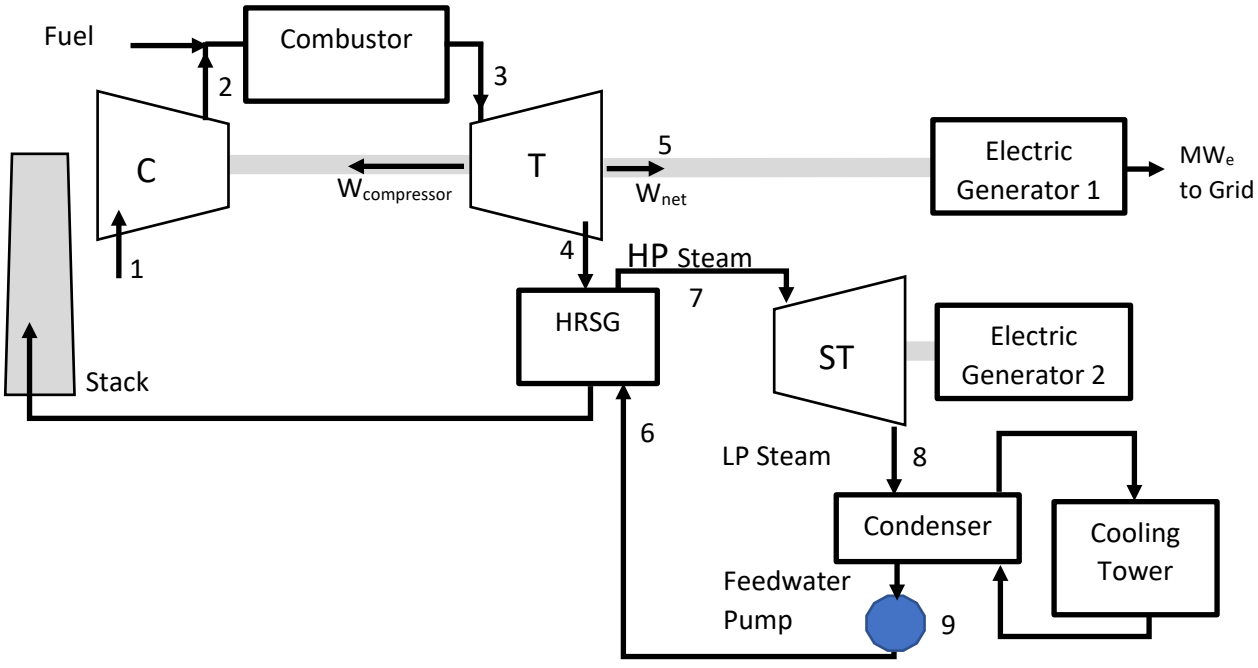
Question 2: How do you calculate whether a stationary combustion turbine is potentially affected by the proposed existing source emission guidelines under UUUUb based on electric generating capacity (MW)?

Answer 2: An existing stationary combustion turbine is an affected EGU subject to UUUUb if it has an electric generating capacity greater than 300 MW and operates with an annual capacity factor greater than 50 percent. The electric generating capacity of an existing stationary combustion turbine includes the electric generating capacity of the combustion turbine and the electric generating capacity of any associated steam turbines prorated (apportioned) to the combustion turbine. Additional background, details, and examples are provided in the following.

Background: Stationary combustion turbines

Stationary combustion turbines may be operated as combined cycle or simple cycle electric generating units (EGUs). Combined cycle EGUs are power plants using both a combustion turbine engine and a steam turbine to generate electricity. As shown below in Exhibit 1, fuel is first burned in a combustion turbine engine and the exhaust heat from the combustion turbine is recovered by a heat recovery steam generator (HRSG) to generate useful thermal output (*i.e.*, steam). The steam is then expanded through a steam turbine to generate additional power.

Exhibit 1: Simplified schematic of a combined cycle unit with a combustion turbine and a steam turbine.



1 – Ambient air enters the compressor.
2 – Compressed air [pre-mixed with fuel on dry low-nitrogen oxide (NOx) or DLN system] enters combustion chamber.
3 – High-pressure (up to 30 Bar) hot gases (900 to 1,400 °C) exit combustion chamber and enter combustion turbine.
4 – Hot (450 to 650 °C) exhaust gases [including nitrogen (N_2), oxygen (O_2), CO_2, NO_X, and carbon monoxide (CO)] exit turbine:
   a. In simple cycle units these gases are vented to the atmosphere through a stack.
   b. In combined cycle EGUs these gases are sent through an HRSG before being exhausted to the atmosphere through a stack.
5 – The net work (Wnet) available for turning an electric generator or mechanical drive system is the total energy extracted from the hot gases (4 minus 3) less the work necessary to operate the compressor.
6 – High-pressure feedwater enters the boiler (HRSG).
7 – Superheated, high-pressure steam exits HRSG and enters steam turbine (ST).
8 – Low-pressure steam exits turbine and enters condenser.
9 – Low-pressure condensate is routed to high-pressure feedwater pump.

Additional fuel can be combusted in "duct burners" that are located downstream of the combustion turbine. Furthermore, many combined cycle power plants are designed with multiple combustion turbines providing thermal energy (via HRSGs with or without duct burners) to a single steam turbine (*e.g.*, a 2-on-1 combined cycle unit).

For a simple cycle turbine, the total heat input and the total electric generating capacity of the unit is attributable directly to the fuel combusted (heat input, MMBtu/hr) and the electricity generated (capacity, MW). For a combined cycle turbine, the total heat input to the unit includes the fuel combusted in the combustion turbine and the fuel combusted in any associated duct burners. For a combined cycle EGU, the electric generating capacity is based on the electric generating capacity of the combustion turbine *and* the prorated (apportioned) electric generating capacity of the steam turbine.

Applicability by electric generating capacity

The total electric generating capacity of a stationary combustion turbine includes the electric generating capacity of the combustion turbine and any associated steam turbines. The electric generating capacity from any associated steam turbine(s) includes but is not limited to the energy derived from the heat input from the turbine exhaust and any ancillary combustion (duct burners) recovered via a heat recovery steam generator (HRSG). The electric generating capacity from the steam turbine is included in calculating the total electric generating capacity to determine whether a combustion turbine is potentially an affected source. In the definitions section of the proposed 40 CFR part 60, subparts UUUUb and TTTTa, as well as the NSPS finalized in 2015 (subpart TTTT), the following can be found *(emphasis added):*

Stationary combustion turbine means all equipment including, but not limited to, the turbine engine, the fuel, air, lubrication and exhaust gas systems, control systems (except emissions control equipment), *heat recovery system*, fuel compressor, heater, and/or pump, post-combustion emission control technology, and any ancillary components and sub-components comprising any simple cycle stationary combustion turbine, any combined cycle combustion turbine, and any combined heat and power combustion turbine based system plus *any integrated equipment that provides electricity or useful thermal output to the combustion turbine engine, heat recovery system or auxiliary equipment*. Stationary means that the combustion turbine is not self-propelled or intended to be propelled while performing its function. It may, however, be mounted on a vehicle for portability. A stationary combustion turbine that burns any solid fuel directly is considered a steam generating unit.

Combined cycle unit means an electric generating unit that uses a stationary combustion turbine from which the heat from the turbine exhaust gases is recovered by a *heat recovery steam generating unit (HRSG)* to generate additional electricity.

Net-electric output means the amount of gross generation the generator(s) produces (including, but not limited to, output from *steam turbine(s),* combustion turbine(s), and gas expander(s)), as measured at the generator terminals, less the electricity used to operate the plant (*i.e.,* auxiliary loads); such uses include fuel handling equipment, pumps, fans, pollution control equipment, other electricity needs, and transformer losses as measured at the transmission side of the step up transformer (*e.g.,* the point of sale).

Base load rating means the maximum amount of heat input (fuel) that an EGU can combust on a steady state basis plus the maximum amount of heat input derived from non-combustion source (*e.g*., solar thermal), as determined by the physical design and characteristics of the EGU at International Organization for Standardization (ISO) conditions. For a stationary combustion turbine, *base load rating includes the heat input from duct burners*.

These definitions necessitate that any associated steam turbine(s) be included when determining energy output from stationary combustion turbines operating as combined cycle units. The proposed language of the existing source regulations in 60.5850b reads in part as follows:

§ 60.5850b What EGUs are excluded from being affected EGUs? EGUs that are excluded from being affected EGUs are:

(a) Natural gas fired stationary combustion turbines with an electric generating capacity equal to or less than 300 MW or with an electric generating capacity of more than 300 MW and that operate at an annual capacity factor equal to or less than 50 percent.

In keeping with the above definitions, the electric generating capacity referred to in 60.5850b includes steam turbine(s).

An illustrative case occurs when multiple gas turbines are used in conjunction with one or more steam turbine(s). In such a scenario, the output from the steam turbine(s) should be apportioned ("prorated") to each of the combustion turbines. Methods for apportionment or proration follow from the below proposed sections in TTTTa (*emphasis added).*

> **§60.5509a Am I subject to this subpart?**
>
> (b) You are not subject to the requirements of this subpart if your affected EGU meets any of the conditions specified in paragraphs (b)(1) through (9) of this section.
>
> (4) Your EGU serves a generator along with other steam generating unit(s), IGCC, or stationary combustion turbine(s) where the effective generation capacity (*determined based on a prorated output of the base load rating of each steam generating unit, IGCC, or stationary combustion turbine*) is 25 MW or less.
>
> **§60.5535a How do I monitor and collect data to demonstrate compliance?**
>
> (e) Consistent with §60.5520a, if two or more affected EGUs serve a common electric generator, you must *apportion the combined hourly gross or net energy output to the individual affected EGUs* according to the fraction of the total steam load and/or direct mechanical energy contributed by each EGU to the electric generator. Alternatively, if the EGUs are identical, you may apportion the combined hourly gross or net electrical load to the individual EGUs according to the *fraction of the total heat input contributed by each EGU.* ….
>
> (g) In accordance with §§60.13(g) and 60.5520a if the exhaust gases from an affected EGU that implements the continuous emission monitoring provisions in paragraph (b) of this section are *emitted to the atmosphere through multiple stacks* (or if the exhaust gases are routed to a common stack through multiple ducts and you elect to monitor in the ducts), you must monitor the hourly CO_2 mass emissions and the "stack operating time" (as defined in §72.2 of this chapter) *at each stack or duct separately.* In this case, you must determine compliance with the applicable emissions standard in Table 1 or 2 of this subpart by summing the CO_2 mass emissions measured at the individual stacks or ducts and dividing by the total gross or net energy output for the affected EGU

The below examples illustrate how this proration should take place.

Example 1

A 650 MW Combined Cycle Turbine power plant is a collection of potentially affected combined cycle combustion turbines (units).

- The power plant has two combustion turbines (each 195 MW) that are combined with one steam turbine (260 MW).
- This is known as a 2-on-1 configuration (*i.e.*, two combustion turbines combined with one steam turbine).
- Assuming the two combustion turbines and associated duct burners are similar (*i.e.*, the same model and heat input), then the MW output from the steam turbine would be

apportioned 50% to each of the combustion turbines … and each combined cycle unit would be …

195 MW + (50% x 260 MW) = 325 MW

So, this 650 GW example facility would have two combined cycle units of 325 MW each … and if they operate over an annual capacity factor of 50% then they would both be covered sources under the proposal.

Example 2

A 650 MW Combined Cycle Turbine power plant is a collection of potentially affected combined cycle combustion turbines (units).

- This power plant has three combustion turbines (each 130 MW) that are combined with 1 steam turbine (260 MW).
- This is known as a 3-on-1 configuration (*i.e.*, three combustion turbines combined with 1 steam turbine).
- Assuming the three combustion turbines and associated duct burners are similar (*i.e.*, the same model and heat input), then the MW output from the steam turbine would be apportioned 33.3% to each of the combustion turbines … and each combined cycle unit would be …

  130 MW + (33.3% x 260 MW) = 216.6 MW

In this example, the 650 GW facility would have three combined cycle units of 216.6 MW each, therefore none of them would be sources affected by the proposal.