

PSD MAJOR-SOURCE THRESHOLD FOR ORGANIC RANKINE CYCLE

White Paper Submitted by Pacifico Energy to the Texas Commission on Environmental Quality

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EXECUTIVE SUMMARY

Pacifico Energy respectfully requests confirmation that adding the proposed organic Rankine cycle (ORC) to the Cedar Creek combustion turbines does not place the project within either of the following 100-ton-per-year named-source categories: (1) “fossil-fuel fired steam electric plants of more than two hundred and fifty million British thermal units per hour heat input,” or (2) “fossil-fuel boilers of more than two hundred and fifty million British thermal units per hour heat input.” 42 U.S.C. § 7479(1). For the reasons set forth below, neither category applies.

First, Cedar Creek is not a fossil-fuel-fired steam electric plant. The characterization of the proposed configuration as “combined cycle” is both irrelevant and incorrect. It is irrelevant because the PSD named-source category is not “combined-cycle plants” — it is “fossil-fuel fired **steam** electric plants.” Accordingly, the dispositive question is whether the facility (1) generates steam (2) by firing fossil fuels. **Here, the bottoming cycle vaporizes cyclopentane, not water, and produces cyclopentane vapor, not steam. Further, the heat to vaporize that heat transfer medium is provided by closed-loop heat transfer, not direct fire.** Because Cedar Creek unquestionably does not generate steam and the ORC is not fossil fuel-fired, that ends the inquiry.

For a similar reason, the characterization of the Cedar Creek configuration as combined cycle (even if relevant) would be incorrect. EPA rules define a “*Combined cycle unit* [as] 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.” 40 C.F.R. § 60.5580 (emphasis added). A HRSG is defined in Subpart KKKK as “a unit where the hot exhaust gases from the combustion turbine are routed in order to extract heat from the gases and generate **steam**, for use in a **steam** turbine or other device that utilizes **steam**.” 40 C.F.R. § 60.4420 (emphasis added). Again, **steam** must be involved, and here it is not.

Second, the ORC heat-recovery equipment is not a fossil-fuel boiler over 250 MMBtu/hr. The equipment is unfired: it combusts no fossil fuel and receives only recovered turbine-exhaust heat through a thermal-oil loop. Thus, even if the equipment were called a boiler, evaporator, or vaporizer, it is not a fossil-fuel-fired boiler and has no direct fossil-fuel heat input.

Cogeneration terminology does not provide an alternative path to the 100-ton threshold. Cogeneration is not an independent named-source category. EPA’s discussion of cogeneration is derivative of the steam-electric category and does not displace the statutory elements. In any event, Cedar Creek produces electricity from the recovered heat but supplies no thermal output to a host process, so it is not cogeneration.

From a policy perspective, treating this waste-heat-recovery configuration as a steam-electric plant would produce a perverse result. The Clean Air Act’s major-source thresholds exist to focus regulatory resources on facilities that present significant air-quality concerns. A simple-cycle

combustion turbine standing alone would not be a steam-electric plant; it would have a 250-ton major-source threshold. If adding unfired heat-recovery equipment — which combusts no additional fuel and generates no additional criteria-pollutant emissions — were to reclassify the facility as steam electric and subject it to a 100-ton threshold, the Act would penalize the very efficiency improvement it should encourage. Such a result would discourage waste-heat recovery and undermine the broader environmental objectives of the PSD program.

Pacifico has identified no EPA or TCEQ guidance that would support a contrary result. The statutory text compels the conclusion that neither named-source category applies, and TCEQ can so confirm without departing from any EPA regulation, guidance, or prior determination.

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I. The Proposed ORC Configuration

The ORC is a closed-loop waste-heat-recovery system that does not combust fossil fuel or generate steam. Instead, hot exhaust from the combustion turbines transfers heat to a thermal-oil loop. The thermal oil then vaporizes cyclopentane in an unfired heat exchanger. Cyclopentane vapor drives the ORC turbine-generator, is condensed in an air-cooled condenser, and is recirculated.

Gas turbine exhaust →	Thermal-oil loop →	Cyclopentane vaporizer →	ORC turbine + generator →	Air-cooled condenser
<i>Recovered heat</i>	<i>Heat transfer</i>	<i>No combustion</i>	<i>Additional power</i>	<i>Closed-loop return</i>

The operative project facts are straightforward:

- The only fossil-fuel combustion associated with the ORC configuration occurs in the simple-cycle combustion turbines, which unquestionably are not regulated as “fossil-fuel steam electric plants.”
- The ORC receives recovered exhaust heat through an intermediate thermal-oil loop; there is no supplemental firing.
- Cyclopentane is the working fluid. The bottoming cycle does not use water and does not generate steam.
- The ORC only produces additional electricity and supplies no thermal output to an industrial, commercial, heating, or cooling host.

II. Cedar Creek Is Not a Fossil-Fuel-Fired Steam Electric Plant Because the ORC Does Not Use Steam

The statutory text limits the steam-electric category to facilities that actually generate steam by firing water with a fossil fuel. Section 7479(1) does not list all combined-cycle plants, cogeneration plants, waste-heat-recovery plants, or facilities employing a second thermodynamic cycle. Congress selected the narrower category “fossil-fuel fired steam electric plants” above the specified heat-input level. Congress chose the word “steam” — not “vapor,” not “heated fluid,” not “any thermodynamic working medium.” That word has a fixed, universally understood meaning: water in its gas phase. Some ORC systems use pentane or butane as the working fluid; others use refrigerants like R-245fa. No engineer or court would call cyclopentane or refrigerant in its vapor phase “steam.”

EPA's own guidance on waste heat to power systems confirms this distinction. EPA explains that "[t]he steam Rankine cycle (SRC) is the most commonly used system for power generation from waste heat and involves using waste heat in combustion exhaust to generate steam in a waste heat boiler, which then drives a steam turbine." This is referred to as a "topping cycle." By contrast, "[o]rganic Rankine cycles involve using other working fluids" — not water — "with better efficiencies at lower heat source temperatures."¹ This is referred to as a "bottoming cycle." EPA's guidance treats ORCs and steam-based systems as fundamentally different technologies, distinguished in major part by the working fluid each employs. The Cedar Creek ORC falls squarely within EPA's description of non-steam waste-heat-recovery technology.

A general-purpose dictionary does not change this conclusion. The broadest lay entry in Webster's — "a vapor arising from a heated substance" — describes theoretical, non-standard usage; the dictionary's specific definitions, like the technical and regulatory sources above, define steam as vaporized water. When Congress uses a term with an established technical meaning in a technical statute, that meaning controls. And reading "steam" to reach any vaporized working fluid would render the word surplusage: Congress could simply have written "electric plants of more than two hundred and fifty million British thermal units per hour heat input." The word "steam" must be given effect, and its effect is to exclude equipment — like the ORC — that generates no steam.

The Supreme Court has confirmed that statutory interpretation begins with the ordinary meaning of the words Congress chose. For example, in *Sackett v. EPA*, the Court held that the Clean Water Act's coverage of "waters of the United States" must be interpreted according to its ordinary meaning, rejecting an expansive agency reading that would have extended the statute's reach. 598 U.S. 651, 671 (2023). Courts "presume that a legislature says in a statute what it means and means in a statute what it says there," and "[w]hen the words of a statute are unambiguous, then, this first canon is also the last: judicial inquiry is complete." *Connecticut Nat'l Bank v. Germain*, 503 U.S. 249, 253–54 (1992). The ordinary meaning of "steam" is water vapor — no broader reading is warranted.

EPA's regulatory usage confirms that "steam electric" describes a water-based cycle. The steam-electric effluent rule refers to a thermal cycle "employing the steam water system as the thermodynamic medium." 40 C.F.R. § 423.10(a). Federal technical usage is equally direct: EIA defines steam as "water in vapor form," while DOE explains that an ORC modifies the traditional steam Rankine cycle by using organic compounds "**instead of steam.**"²

Technical literature contemporaneous with the PSD amendments drew the same distinction. A DOE paper presented at a December 1978 conference cosponsored by DOE, EPA, EPRI, and an ASME section — and later published by EPA — discussed "the use of organic fluids instead of steam" and included an "Organic vs Steam Comparison."³ The proceedings are technical usage

¹ EPA, Waste Heat to Power Systems 3–4 (2022), <https://tinyurl.com/2nkbrrbm>.

² U.S. Energy Information Administration, Glossary: Steam, <https://tinyurl.com/yc8zn7z6>; U.S. Department of Energy, Organic Rankine Cycle System Basics, <https://tinyurl.com/mj943arb> ("Instead of steam, ORCs use organic compounds that have better generation efficiencies at lower heat-source temperatures as the working fluid.").

³ M.E. Gunn, Jr., Waste Heat Utilization and the Environment, in Proceedings: Second Conference on Waste Heat Management and Utilization, vol. 2, EPA-600/9-79-031b, at 830-35 (Aug. 1979), <https://tinyurl.com/2efj8v7b>.

evidence and confirm that engineers distinguished organic-fluid vapor from steam when Congress enacted the PSD provisions.

EPA's BART Guidelines reinforce this reading. EPA explained that "combined cycle turbines are also considered 'steam electric plants' because such facilities incorporate heat recovery steam generators," while "[s]imple cycle turbines, in contrast, are not 'steam electric plants' because these turbines typically do not generate steam." 70 Fed. Reg. 39104, 39159 (July 6, 2005). Cedar Creek's bottoming cycle produces cyclopentane vapor — functional similarity to a conventional combined-cycle plant cannot turn cyclopentane vapor into steam.

Finally, even if the rule were referring to any heat transfer medium (not just steam as commonly understood), still the ORC would not be a fossil-fueled steam generator. That is because the "steam" is not being generated by being fired with fossil fuels; rather it is generated by contact with a heated surface (namely the exterior of a thermal oil loop). No fire touches the cyclopentane or even the thermal oil loop that heats the cyclopentane. If the mere fact that fossil fuels were used to heat the turbine that heated the loop that heated the cyclopentane were enough to classify the unit as fossil-fuel fired, then even a boiler heated by electric resistance (e.g., an electric home water heater) could be said to be a fossil-fuel fired steam generator, assuming the electricity used to heat the coils came from some fossil-fueled plant on the grid.

III. The ORC Is Not a Fossil-Fuel Boiler Over 250 MMBtu/hr

The fossil-fuel-boiler category also does not apply to the proposed ORC. The Clean Air Act separately lists "fossil-fuel boilers of more than two hundred and fifty million British thermal units per hour heat input." 42 U.S.C. § 7479(1). This category warrants distinct analysis, but it does not cover the ORC for three reasons.

First, the ORC equipment is unfired and has no direct fossil-fuel heat input. The statutory modifier "fossil-fuel" limits the category to boilers that receive heat input from fossil-fuel combustion. No natural gas or other fossil fuel is burned in the ORC heat exchanger, and there is no duct burner or supplemental firing. The exchanger receives only recovered exhaust heat from the turbines through a thermal-oil loop.

Second, the analysis does not turn on equipment nomenclature. Some equipment called an evaporator can produce steam; some equipment called a boiler can vaporize a non-water fluid. The dispositive point is that the Cedar Creek ORC does not combust fossil fuel. An unfired heat-recovery exchanger does not become a "fossil-fuel boiler" merely because upstream combustion created the exhaust heat it recovers.

Third, the 250 MMBtu/hr threshold is not an independent basis for classification. A numerical rating matters only after the equipment qualifies as a statutory source type — here it does not. TCEQ's initial analysis communicated to Pacifico similarly recognized that a heat-recovery boiler falls outside the fossil-fuel-boiler category when it is not fired with fossil fuel.

IV. Combined Cycle and Cogeneration Are Neither Necessary Nor Sufficient

Whether the configuration is called combined cycle does not determine the outcome. Pacifico does not ask TCEQ to decide that the overall configuration can never bear that label. In a broad engineering sense, it does integrate two power-producing cycles. But combined-cycle status is neither necessary nor sufficient to trigger the steam-electric category. A traditional coal plant with a boiler and steam turbine is steam electric even without a HRSG; conversely, a two-cycle facility that uses an organic working fluid instead of water is not steam electric. The question is whether the facility generates steam — not whether it has two thermodynamic cycles.

EPA's regulatory definitions reinforce this conclusion. EPA rules define a "combined cycle unit" as "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." 40 C.F.R. § 60.5580 (emphasis added). The ORC does not use an HRSG — it uses an unfired cyclopentane vaporizer. The regulatory definition thus confirms what the statutory text already establishes: combined-cycle status depends on the presence of steam-generating equipment, not merely the sequential use of two thermodynamic cycles.

Cogeneration is not a listed source category. It does not appear among the source types in section 7479(1). EPA's 1993 gas-turbine memorandum discusses cogeneration only in determining when gas-turbine-based facilities fall within the steam-electric category.⁴ The cogeneration label is derivative, not an alternative statutory route to the 100-ton threshold.

Even if the cogeneration label applied, Cedar Creek would not satisfy the definition. Regulatory definitions of cogeneration require both electric or mechanical power and useful thermal energy supplied for an industrial, commercial, heating, or cooling purpose. See, e.g., 18 C.F.R. § 292.202(c)-(e); 40 C.F.R. § 72.2. Cedar Creek uses recovered heat solely to produce additional electricity; residual heat is rejected through an air-cooled condenser. The project supplies no useful thermal output to a host. Simply put, there is no "cogeneration" because the facility generates only one product: electricity.

V. EPA Guidance and NSPS Subpart Dc Do Not Expand the Statutory Categories

EPA's 1993 gas-turbine memorandum does not address ORC technology or non-water working fluids.⁵ The memorandum addressed conventional gas-turbine combined-cycle and cogeneration facilities. It assumes a steam-electric bottoming cycle and focuses on how to count combustion-turbine and supplemental-firing heat input once a facility is classified as a steam-electric plant. It does not analyze an ORC, cyclopentane, or any non-water bottoming cycle — and it does not erase the statutory word "steam."

NSPS Subpart Dc — the new source performance standard for small industrial-commercial-institutional steam generating units — does **not** govern PSD major-source classifications. Subpart Dc's definition of "steam generating unit" refers to equipment that heats water or "any other heat absorbing medium" to produce steam. 40 C.F.R. § 60.41c. But section 60.41c expressly limits its definitions to that subpart: "[a]s used in this subpart." Accordingly, specialized terminology in Subpart Dc does not — and cannot — override Congress's use of "steam" in section 7479(1) or expand the PSD named-source categories beyond their statutory text.

VI. Policy Considerations

Finally, sound policy counsels against extending the steam-electric category to organic Rankine cycles. Waste-heat recovery improves overall system efficiency and reduces emissions per unit of electricity generated. EPA has long encouraged such efficiency improvements as environmentally beneficial. Subjecting unfired heat-recovery equipment not using steam to the more stringent 100-ton major-source threshold would create a regulatory disincentive to adopt cleaner, more efficient technology — precisely the opposite of what the PSD program is designed

⁴ EPA, Determining Prevention of Significant Deterioration (PSD) Applicability Thresholds for Gas Turbine Based Facilities (Feb. 2, 1993), <https://tinyurl.com/muj9cxk3>.

⁵ See *id.*

to achieve. The statutory text does not support that result, and policy considerations confirm that it should be avoided.

EPA's guidance on waste heat to power systems reinforces this policy concern. According to EPA, ORC systems "can be utilized for waste heat sources as low as 300 °F, whereas steam systems are limited to heat sources greater than 500 °F."⁶ ORCs thus recover energy from lower-temperature exhaust streams that steam-based systems cannot economically capture. Treating an ORC as a "steam electric plant" would perversely discourage deployment of the more efficient technology — the technology better suited to capturing waste heat that would otherwise be lost to the atmosphere. Such a result would be contrary to EPA's and TCEQ's longstanding policy of promoting waste-heat recovery as an environmentally beneficial practice.

VII. Conclusion and Requested Confirmation

Based on the foregoing analysis, Pacifico respectfully requests that TCEQ confirm:

1. Cedar Creek is not a fossil-fuel-fired steam electric plant because the ORC uses cyclopentane vapor, not steam, and that vapor, in any event, is not generated by fossil-fuel firing.
2. The unfired ORC equipment is not a fossil-fuel boiler because it combusts no fossil fuel.
3. The project should be evaluated under the 250-ton-per-year PSD threshold.

⁶ EPA, Waste Heat to Power Systems 4 (2022), <https://tinyurl.com/2nkbrrbm>.