

US EPA ARCHIVE DOCUMENT

**Victoria Power Station
Proposed Standards VIC10**

Victoria will operate with the existing unit (VIC7), the new unit (VIC10), and the existing ST in a 2x2x1 configuration. Both CTs (VIC7 and VIC10) will supply steam to the ST. Victoria could also potentially operate in a 1x1x1 configuration with either CT (VIC7 or VIC10) in combination with the existing ST. Because only one CT will contribute to steam production, the ST will not be able to achieve its full capacity in a 1x1x1 configuration. Since VIC7 is an existing unit, it is not subject to a CO₂ output-based emission rate; therefore, this analysis is required only for VIC10. During operation in the 2x2x1 configuration, it is necessary to separate the emissions and power generation contribution of VIC10 from that of VIC7 to obtain a VIC10-specific output-based emission rate.

Compliance with the proposed CO₂ output-based BACT emission rate limit (940 lbCO₂/MWh) will be demonstrated on a 12-month rolling average and gross basis. This limit applies only during full load with and without supplemental duct burning. The lb/MWh BACT limit does not apply during part load maintenance, startup or shutdown (MSS) periods. VIC10 MSS emissions will be limited to 108 ton CO₂/hr on a 12-month rolling average basis.

Proposed Output-Based Emission Rate (Full Load)

Parameter	Units	VIC10 (Full Load, Gross Basis)		
		Unfired	Fired	Proposed
VIC10 CTG Nominal Gross Output ⁽¹⁾	MW	177.3	177.3	
STG Gross Output attributed to VIC10 ⁽²⁾	MW	89.8	101.5	
Max. Heat Input (HHV) ⁽³⁾	MMBtu/hr (HHV)	1,816	2,088	
Compliance Margin ⁽⁴⁾	%	10.0%	10.0%	
Annual Hours of Operation ⁽⁵⁾	hr/yr	3,385	4,375	7,760
Heat Rate, Gross Basis ^{(6), (7)}	Btu/kWh (HHV)	7,480	8,240	7,908
CO ₂ Emission Factor ⁽⁸⁾	lb _{CO2} /MMBtu (HHV)	118.9	118.9	118.9
CO ₂ Output-Based Emission Rate, Gross Basis ⁽⁹⁾	lb _{CO2} /MWh	889	979	940

Notes:

(1) Estimated units output per vendor and actual data. Final values may vary depending on final design and ambient temperatures:

- Mitsubishi 501F (VIC7) = 177.3 MW
- General Electric 7FA.04 or equivalent (VIC10) = 177.3 MW
- General Electric D5 Steam Turbine Unfired (ST) = 173.3 MW
- Duct Fired Capacity (total both units) = 11.7 MW

(2) ST Gross Output attributed to VIC10 has been estimated based on VIC10 Gross Output and 2012 actual heat balance data for current configuration with VIC7.

	VIC7 CT	ST (operating with VIC7)
Avg. Gross Capacity CY 2012	165.3 MW	83.7 MW

ST Gross Output attributed to VIC10 (Unfired) = ST Gross Output operating with VIC7 * VIC 10 Gross Output / VIC7 Gross Output

ST Capacity Operating with VIC10 (Unfired) = 83.7 MW * 177.3 MW / 165.3 MW = 89.8 MW

ST Gross Output attributed to VIC10 (Fired) = ST Gross Output operating with VIC7 * VIC 10 Gross Output / VIC7 Gross Output + DB Gross Output

ST Capacity Operating with VIC10 (Fired) = 83.7 MW * 177.3 MW / 165.3 MW + 11.7 MW = 101.5 MW

(3) Maximum Heat Input:

- CT Heat Input (HHV) = 1,816 MMBtu/hr (manufacturer data)
- DB Heat Input (HHV) = 483 MMBtu/hr (manufacturer data)

Max. Heat Input (HHV) (Fired) = CT Heat Input * Unfired Hours of Operation + (CT + DB) Heat Input * Fired Hours of Operation / Total Hours of Operation

Max. Heat Input (HHV) (Fired) = [1,816 MMBtu/hr * 3,385 hr/yr + (1,816 MMBtu/hr + 483 MMBtu/hr) * 4,375 hr/yr] / [3,385 hr/yr unfired + 4,375 hr/yr fired] = 2,088 MMBtu/hr

(4) Compliance margin is an adjustment factor to the design rates to arrive at the proposed efficiency standards.

It includes a margin to reflect actual vs. design differences, degradation between maintenance overhauls, and degradation of plant auxiliary equipment.

- Design Margin = 2.0%
- Performance Margin on CTG and STG = 5.0%
- Degradation Margin for the Auxiliary Plant Equipment = 3.0%

(5) Estimated annual hours of operation are based on engineering knowledge of the plant performance but are not intended to contractually limit Victoria operation. Victoria will meet the proposed output-based CO₂ emission rate on a 12-month rolling average and gross basis, independently of the final hours running in each of the operational modes.

- Annual Hours of Operation Unfired = 3,385 hr/yr
- Annual Hours of Operation Fired = 4,375 hr/yr
- Annual Startup Hours = 1,000 hr/yr

(6) Heat Rate (Btu/kWh) = Heat Input (MMBtu/hr) * 1,000,000 Btu/MMBtu / (VIC10 Output + STG Output attributed to VIC10) (MW) * 1 MW / 1,000 kW * Comp. Margin

Heat Rate (Unfired), Gross Basis = 1,816 MMBtu/hr * 1,000,000 Btu/MMBtu / (177.3 MW + 89.8 MW) * 1 MW / 1,000 kW * 1.10 = 7,480 Btu/kWh (HHV)

Heat Rate (Fired), Gross Basis = 2,088 MMBtu/hr * 1,000,000 Btu/MMBtu / (177.3 MW + 101.5 MW) * 1 MW / 1,000 kW * 1.10 = 8,240 Btu/kWh (HHV)

(7) Proposed Heat Rate (Btu/kWh) = [[HR (Btu/kWh) * Annual Op (hr/yr)]_{Unfired} + [HR (Btu/kWh) * Annual Op (hr/yr)]_{Fired}] / [Annual Op (hr/yr)_{Unfired} + Annual Op (hr/yr)_{Fired}]

Proposed Heat Rate = [7,480 Btu/kWh * 3,385 hr/yr + 8,240 Btu/kWh * 4,375 hr/yr] / 7,760 hr/yr = 7,908 Btu/kWh

(8) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

- Carbon based F-factor, F_C: 1,040 scf/MMBtu
- Standard Molar Volume: 385 scf/lbmole
- Molecular Weight CO₂, MW_{CO2}: 44 lb/lbmole

CO₂ Emission Factor = 1,040 scf/MMBtu / 385scf/lbmole * 44lb/lbmole = 118.9 lb/MMBtu

(9) CO₂ Emission Limit (lb_{CO2}/MWh) = Heat Rate (Btu/kWh) * 1MMBtu/1,000,000 Btu * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1,000 kW/MW

CO₂ Output-Based Emission Rate (Unfired), Gross Basis = 7,480 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.9 lbCO₂/MMBtu * 1,000 kW/MW = 889 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Fired), Gross Basis = 8,240 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.9 lbCO₂/MMBtu * 1,000 kW/MW = 979 lbCO₂/MWh

CO₂ Output-Based Emission Rate (Fired), Gross Basis = 7,908 Btu/kWh * 1 MMBtu/1,000,000 Btu * 118.9 lbCO₂/MMBtu * 1,000 kW/MW = 940 lbCO₂/MWh

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Proposed MSS BACT Limit

Parameter	Units	VIC10
Max. Heat Input (HHV) ⁽¹⁾	MMBtu/hr (HHV)	1,816
CO ₂ Emission Factor ⁽²⁾	lb _{CO2} /MMBtu (HHV)	118.9
CO ₂ Emission Rate Limit (SU/SD) ⁽³⁾	ton _{CO2} /hr	108

Notes:

(1) Maximum heat input per manufacturer data

(2) CO₂ emission factor calculated per 40 CFR Part 75, Appendix G, Equation G-4, as referenced in §98.43(a), where:

Carbon based F-factor, F _C :	1,040	scf/MMBtu
Standard Molar Volume:	385	scf/lbmole
Molecular Weight CO ₂ , MW _{CO2} :	44	lb/lbmole

$$\text{CO}_2 \text{ Emission Factor} = 1,040 \text{ scf/MMBtu} / 385 \text{ scf/lbmole} * 44 \text{ lb/lbmole} = 118.9 \text{ lb/MMBtu}$$

(3) CO₂ Emission Rate Limit (SU/SD) (ton/hr) = Max. Heat Input (MMBtu/hr) * CO₂ Emission Factor (lb_{CO2}/MMBtu) * 1 ton / 2,000 lb

$$\text{CO}_2 \text{ Emission Rate Limit (SU/SD)} = 1,816 \text{ MMBtu/hr} * 118.9 \text{ lb/MMBtu} * 1 \text{ ton}/2000 \text{ lb} = 108 \text{ ton/hr}$$