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Caithness - Bellport Energy Center - Total Estimated Startup and Shutdown Emissions

W501FD Upgrade in Combined Cycle Operation on Natural Gas - No Aux. Boiler - With Stack Damper - Rev. 03

Mode	Total Emissions (in pounds) @ 0 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	410	2,354	862	77
"Warm" Startup	384	2,346	857	56
"Hot" Startup	107	739	167	26
Shutdown	64	423	92	12

Mode	Total Emissions (in pounds) @ 51 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	375	2,164	790	75
"Warm" Startup	351	2,157	785	54
"Hot" Startup	98	685	153	26
Shutdown	59	393	84	12

General Notes

1.) All data is ESTIMATED, NOT guaranteed and is for ONE unit (GT and HRSG).
2.) SCR efficiency is based on the SCR and ammonia vaporization system being in service and properly operating at design temperatures.
3.) VOC consist of total hydrocarbons excluding methane and ethane and is expressed in terms of methane (CH_4).
4.) Particulate (PM) emissions are based on USEPA Methods 5/202 and assume a max. fuel sulfur content of 0.35 gr S/100 scf.
5.) Gas fuel must be in compliance with the SWPC Fuel Specifications.
6.) Emissions are at the HRSG exhaust stack outlet and exclude ambient air contributions.
7.) Please be advised that the information contained in this transmittal has been prepared and is being transmitted per customer request specifically for information purposes only. Such information is not intended to be used for evaluation of plant design and/or performance relative to contractual commitments. Data included in any permit application or Environmental Impact Statement is strictly the customer's responsibility. SWPC is available to review permit application data upon request.

Startup / Shutdown Emissions Notes

1.) "Cold" Startup emissions estimates are based on being shutdown ~ 5 days or longer with a Steam HP/IP metal temp. of ~ 122 °F and assumes it takes ~ 400 minutes to reach GT Base load.
2.) "Warm" Startup emissions estimates are based on being shutdown ~ 48 hours with a Steam Turbine HP/IP metal temp. of ~ 320/428 °F and assumes it takes ~ 275 minutes to reach GT Base load.
3.) "Hot" Startup emissions estimates are based on being shutdown ~ 12 hours with a Steam Turbine HP/IP metal temp. of ~ 662 °F and assumes it takes ~ 145 minutes to reach GT Base load.
4.) Shutdown emissions based on the following times: 12 minutes from 100% Base to 70% load; 18-minute hold at 70% load; 28 minutes from 70% to minimum load; and a 5-minute hold at minimum load (FSNL) prior to fuel cut-off.
5.) Startup emissions estimates are based on a maximum of approximately 208 "Hot", 48 "Warm" and 4 "Cold" startups per year (and the subsequent 260 shutdowns per year). Any change in this value could affect the startup ramp rate and hold times and hence the startup emissions.
6.) Startup/Shutdown times are subject to change depending on commercial terms and conditions.
7.) ESTIMATED NO_X emissions assume 92% SCR efficiency from $\geq$ 60% to Base load and 60% SCR efficiency from $\geq$ 50% to 60% load.
8.) ESTIMATED CO emissions assume 90% oxidation catalyst efficiency from > 25% to Base load, 80% efficiency from $\geq$ 20 to 25% load and 60% efficiency from $\geq$ 10 to 20% load.
9.) ESTIMATED VOC emissions assume 50% oxidation catalyst efficiency from $\geq$ 30% to Base load, 40% efficiency from > 25 to 30% load and 10% efficiency from $\geq$ 20 to 25% load.
10.) Emissions mass flow rates are based on ambient temperatures of 0 °F and 51 °F as noted above and will be higher at lower ambient temperatures.
11.) Air Cooled Condenser is ready for operation and condensate receiver tank is filled prior to GT startup.
12.) HRSG is filled and ready for operation prior to GT startup.
13.) Steam chemistry adequate for ST operation (no waiting time included).
14.) Assumes SWPC standard BOP water/steam system design and SWPC steam piping warm up concept.
15.) Major equipment items (GT/HRSG/ST) are operated at their startup ramp limits with no abnormal holds or transients.
16.) BOP/Auxiliary equipment operation does not extend startup or shutdown.
17.) Condenser Hogging: mechanical vacuum pumps; Condenser Holding: Steam Jet Air Ejectors
18.) NO auxiliary boiler.
19.) Stack damper to aid HRSG heat retention during shutdowns.
20.) Operator actions do not extend startup or shutdown.
21.) It is assumed that there is no restriction from the interconnected utility for loading the gas turbine from synchronization to 100% load within the time considered for the startups.

Caithness - Bellport Energy Center - Total Estimated Startup and Shutdown Emissions

W501FD Upgrade in Combined Cycle Operation on No. 2 Fuel Oil - No Aux. Boiler - With Stack Damper - Rev. 03

Mode	Total Emissions (in pounds) @ 0 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	874	2,890	975	745
"Warm" Startup	832	2,852	953	497
"Hot" Startup	213	1,169	227	266
Shutdown	120	654	125	113

Mode	Total Emissions (in pounds) @ 51 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	799	2,661	894	684
"Warm" Startup	761	2,627	874	458
"Hot" Startup	195	1,087	209	243
Shutdown	110	608	115	104

General Notes

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2.) SCR efficiency is based on the SCR and ammonia vaporization system being in service and properly operating at design temperatures.
3.) VOC consist of total hydrocarbons excluding methane and ethane and is expressed in terms of methane (CH_4).
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5.) Gas fuel must be in compliance with the SWPC Fuel Specifications.
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8.) ESTIMATED CO emissions assume 90% oxidation catalyst efficiency from > 25% to Base load, 80% efficiency from ≥ 20 to 25% load and 60% efficiency from ≥ 10 to 20% load.
9.) ESTIMATED VOC emissions assume 50% oxidation catalyst efficiency from ≥ 30% to Base load, 40% efficiency from > 25 to 30% load and 10% efficiency from ≥ 20 to 25% load.
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Caithness - Bellport Energy Center - Total Estimated Startup and Shutdown Emissions

W501FD Upgrade in Combined Cycle Operation on Natural Gas - With Aux. Boiler - With Stack Damper - Rev. 01

Mode	Total Emissions (in pounds) @ 0 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	162	901	238	52
"Warm" Startup	136	893	233	31
"Hot" Startup	105	738	166	25
Shutdown	64	423	92	12

Mode	Total Emissions (in pounds) @ 51 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	147	833	219	51
"Warm" Startup	125	826	214	30
"Hot" Startup	96	685	153	24
Shutdown	59	393	84	12

General Notes

1.) All data is ESTIMATED, NOT guaranteed and is for ONE unit (GT and HRSG).

2.) SCR efficiency is based on the SCR and ammonia vaporization system being in service and properly operating at design temperatures.

3.) VOC consist of total hydrocarbons excluding methane and ethane and is expressed in terms of methane (CH_4).

4.) Particulate (PM) emissions are based on USEPA Methods 5/202 and assume a max. fuel sulfur content of 0.35 gr S/100 scf.

5.) Gas fuel must be in compliance with the SWPC Fuel Specifications.

6.) Emissions are at the HRSG exhaust stack outlet and exclude ambient air contributions.

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Startup / Shutdown Emissions Notes

1.) "Cold" Startup emissions estimates are based on being shutdown ~ 7 days or longer with a Steam HP/IP metal temp. of ~ 122 °F and assumes it takes ~ 300 minutes to reach GT Base load.

2.) "Warm" Startup emissions estimates are based on being shutdown ~ 48 hours with a Steam Turbine HP/IP metal temp. of ~ 320/428 °F and assumes it takes ~ 170 minutes to reach GT Base load.

3.) "Hot" Startup emissions estimates are based on being shutdown ~ 12 hours with a Steam Turbine HP/IP metal temp. of ~ 662 °F and assumes it takes ~ 135 minutes to reach GT Base load.

4.) Shutdown emissions based on the following times: 12 minutes from 100% Base to 70% load; 18-minute hold at 70% load; 28 minutes from 70% to minimum load; and a 5-minute hold at minimum load (FSNL) prior to fuel cut-off.

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15.) Major equipment items (GT/HRSG/ST) are operated at their startup ramp limits with no abnormal holds or transients.

16.) BOP/Auxiliary equipment operation does not extend startup or shutdown.

17.) Condenser Hogging: mechanical vacuum pumps; Condenser Holding: Steam Jet Air Ejectors

18.) Auxiliary boiler sized to supply pegging steam to HRSG and seal steam to ST.

19.) Stack damper to aid HRSG heat retention during shutdowns.

20.) Operator actions do not extend startup or shutdown.

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Caithness - Bellport Energy Center - Total Estimated Startup and Shutdown Emissions

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Mode	Total Emissions (in pounds) @ 0 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	318	1,370	320	557
"Warm" Startup	276	1,333	298	311
"Hot" Startup	209	1,166	225	246
Shutdown	120	654	125	113

Mode	Total Emissions (in pounds) @ 51 °F			
	Ignition to Gas Turbine Base Load			
	NO_X	CO	VOC	PM
"Cold" Startup	290	1,271	294	509
"Warm" Startup	253	1,237	274	285
"Hot" Startup	192	1,084	207	225
Shutdown	110	608	115	104

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