

**APPENDIX G. PERFORMANCE CHARACTERISTICS FOR DUAL FUEL CTs**

The tables which follow show key performance characteristics for the GE 7FA CT in a 2x1 CC configuration, the GE 7FA CT in SC configuration, the GE LMS100 CT in SC configuration, the Siemens SGT6-5000F CT in a 2x1 CC configuration, and the Siemens SGT6-5000F in a SC configuration. Performance data were provided by manufacturer's representatives, and generally represent the most current version of the model, which may be slightly different than the performance data used by the Brattle Group in the 2014 PJM CONE Study or by NERA Economic Consulting in the 2013 NYISO Demand Curve Reset Study. In particular, the 7FA data provided by GE are for the 7F.05 version, while the 2014 PJM CONE Study was based on the 7F.04 version.

Manufacturer	General Electric					
Model	7FA .05					
Configuration	2x1 Combined Cycle					
Cooling (CC Only)	Evaporative Tower					
Short Name	GE 7FA CC					
Conditions	ISO 59 F, 60% RH, Sea Level		Winter Peak Day 20 F, 50% RH, Sea Level		Summer Peak Day 90 F, 60% RH, Sea Level	
Fuel	Natural Gas	ULSD	Natural Gas	ULSD	Natural Gas	ULSD
<b>Combined Cycle Operation</b>						
GT NOx Control Type	DLN	Water Inj'n	DLN	Water Inj'n	DLN	Water Inj'n
Post combustion NOx Control	SCR	SCR	SCR	SCR	SCR	SCR
CC Output (MW)	642	652	668	652	620	650
CC Heat Rate (Btu/kWh LHV)	5,880	6,505	5,935	6,515	5,965	6,535
CC Heat Rate (Btu/kWh HHV)	6,514	6,957	6,575	6,968	6,608	6,989
CO2 Emissions (lb/h)	498,945	733,197	524,082	734,254	488,729	733,788
CO2 Emissions (lb/MWh)	778	1,125	785	1,127	789	1,130
NOx Emissions at GT Exhaust (ppmvd)	9	42	9	42	9	42
NOx Emissions at HRSG Stack (ppmvd)	2	6				
NOx Emissions at HRSG Stack (lb/MWh)	0.049	0.162				
Water Injection Rate (gal/min)	0	700				
Boiler makeup Rate (gal/min)	38	38				
AGC Ramp Rate (MW/min)	80	80				
Turndown Ratio (Maintaining emissions)	28%	30%				
Minimum Fuel Gas Pressure (psig)						
Full Load Operation	425		425		375	
Maximum Load for Fuel Switching (%)	80%					
Time to Complete Switch (Min)	2					
<b>Major Maintenance Accrual:</b>						
Equivalent natural gas hours	1.0	1.5				
Equivalent natural gas starts	1.0	1.5				

Manufacturer	General Electric					
Model	7FA .05					
Configuration	Simple Cycle					
Cooling (CC Only)	na					
Short Name	GE 7FA SC					
Conditions	ISO 59 F, 60% RH, Sea Level		Winter Peak Day 20 F, 50% RH, Sea Level		Summer Peak Day 90 F, 60% RH, Sea Level	
Fuel	Natural Gas	ULSD	Natural Gas	ULSD	Natural Gas	ULSD
<b>Gas Turbine Operation</b>						
NOx Control Type	DLN	Water Inj'n	DLN	Water Inj'n	DLN	Water Inj'n
NOx Control Level at GT Exhaust (ppmvd)	9	42	9	42	9	42
GT Output (MW/GT)	216	222	229	224	207	220
GT Heat Rate (Btu/kWh LHV)	8,745	9,540	8,670	9,450	8,900	9,630
GT Heat Rate (Btu/kWh HHV)	9,688	10,203	9,605	10,107	9,860	10,299
Water Injection Rate (gal/min)	0	350				
CO2 Emissions (lb/h)	249,858	366,123	262,456	366,182	243,656	366,264
CO2 Emissions (lb/MWh)	1,157	1,649	1,146	1,635	1,177	1,665
<u>Without SCR:</u>						
Nox Emissions at Stack (lb/MWh)	0.329	1.659				
<u>With air dilution SCR:</u>						
NOx Emissions at Stack (ppmvd)	2	6				
NOx Emissions at Stack (lb/MWh)	0.073	0.238				
AGC Ramp Rate (MW/min)	40	40				
Turndown Ratio (Maintaining emissions)	46%	50%				
Minimum Fuel Gas Pressure (psig)						
Full Load Operation	425		425		375	
Maximum Load for Fuel Switching (%)	85%					
Time to Complete Switch (Min)		2				
<b>Major Maintenance Accrual:</b>						
Equivalent natural gas hours	1.0	1.5				
Equivalent natural gas starts	1.0	1.5				

Manufacturer	General Electric					
Model	LMS100 PA+					
Configuration	Simple Cycle					
Cooling (CC Only)	na					
Short Name	LMS100 SC					
Conditions	ISO 59 F, 60% RH, Sea Level		Winter Peak Day 20 F, 60% RH, Sea Level		Summer Peak Day 90 F, 60% RH, Sea Level	
Fuel	Natural Gas	ULSD	Natural Gas	ULSD	Natural Gas	ULSD
<b>Gas Turbine Operation</b>						
NOx Control Type	Water Inj'n	Water Inj'n	Water Inj'n	Water Inj'n	Water Inj'n	Water Inj'n
NOx Control Level at GT Exhaust (ppmvd)	25	42	25	42	25	42
GT Output (MW/GT)	112.1	109.2	112.0	111.1	100.6	96.1
GT Heat Rate (Btu/kWh LHV)	7,945	8,067	7,922	8,000	8,169	8,329
GT Heat Rate (Btu/kWh HHV)	8,802	8,628	8,776	8,556	9,050	8,908
Water Injection Rate (gal/min)	58.2	61.9	63.7	68.3	48.5	52.2
CO2 Emissions (lb/h)	117,809	152,283	117,325	153,777	108,674	138,438
CO2 Emissions (lb/MWh)	1,051	1,395	1,047	1,384	1,080	1,440
<u>Without SCR:</u>						
NOx Emissions at Stack (lb/h)	93	152	92	153	85	138
NOx Emissions at Stack (lb/MWh)	0.830	1.392	0.821	1.377	0.845	1.435
<u>With SCR:</u>						
NOx Emissions at Stack (ppmvd)	2.5	6.0				
NOx Emissions at Stack (lb/MWh)	0.083	0.199				
AGC Ramp Rate (MW/min)	60	60				
Turndown Ratio (Maintaining emissions)	25%	25%				
Minimum Fuel Gas Pressure (psig)						
Full Load Operation	910		910		910	
Trip Point	250					
Maximum Load for Fuel Switching (%)	85%					
Time to Complete Switch (Min)		2				
<b>Major Maintenance Accrual:</b>						
Equivalent natural gas hours	1.0	1.5				
Equivalent natural gas starts	1.0	1.5				

Manufacturer	Siemens					
Model	SGT6-5000F					
Configuration	2x1 Combined Cycle					
Cooling (CC Only)	Evaporative Tower					
Short Name	SGT6 CC					
Conditions	ISO 59 F, 60% RH, Sea Level		Winter Peak Day 20 F, 50% RH, Sea Level		Summer Peak Day 90 F, 60% RH, Sea Level	
Fuel	Natural Gas	ULSD	Natural Gas	ULSD	Natural Gas	ULSD
<b>Combined Cycle Operation</b>						
GT NOx Control Type	DLN	Water Inj'n	DLN	Water Inj'n	DLN	Water Inj'n
Post combustion NOx Control	SCR	SCR	SCR	SCR	SCR	SCR
CC Output (MW)	688.5	659.7	678.4	653.2	661.6	608.4
CC Heat Rate (Btu/kWh LHV)	5,894	6,431	5,946	6,370	5,909	6,437
CC Heat Rate (Btu/kWh LHV)	6,530	6,878	6,587	6,813	6,546	6,885
NOx Emissions at GT Exhaust (ppmvd)	9	42	9	42	9	42
NOx Emissions at HRSG Stack (ppmvd)	2	6				
NOx Emissions at HRSG Stack (lb/MWh)	0.049	0.162				
Water Injection Rate (gal/min)	0	252	0	188	0	276
Boiler makeup Rate (gal/min)						
AGC Ramp Rate (MW/min)	27	27				
Turndown Ratio (Maintaining emissions)	30%	30%				
Minimum Fuel Gas Pressure (psig)						
Full Load Operation	525		525		<525	
Maximum Load for Fuel Switching (%)	90%					
Time to Complete Switch (Min)	10					
<b>Major Maintenance Accrual:</b>						
Equivalent natural gas hours	1.0	1.5				
Equivalent natural gas starts	1.0	1.5				

Manufacturer	Siemens					
Model	SGT6-5000F					
Configuration	Simple Cycle					
Cooling (CC Only)	na					
Short Name	SGT6 Simple Cycle					
Conditions	ISO 59 F, 60% RH, Sea Level		Winter Peak Day 20 F, 50% RH, Sea Level		Summer Peak Day 90 F, 60% RH, Sea Level	
Fuel	Natural Gas	ULSD	Natural Gas	ULSD	Natural Gas	ULSD
<b>Gas Turbine Operation</b>						
NOx Control Type	DLN	Water Inj'n	DLN	Water Inj'n	DLN	Water Inj'n
NOx Control Level at GT Exhaust (ppmvd)	9	42	9	42	9	42
GT Output (MW/GT)	231.6	226.8	231.6	231.1	217.0	205.3
GT Heat Rate (Btu/kWh LHV)	8,844	9,233	8,819	9,017	9,124	9,557
GT Heat Rate (Btu/kWh HHV)	9,798	9,875	9,770	9,644	10,108	10,221
Water Injection Rate (gal/min)	0	124	0	94	0	138
<u>Without SCR:</u>						
Nox Emissions at Stack (lb/MWh)	0.319	1.659				
<u>With air dilution SCR:</u>						
NOx Emissions at HRSG Stack (ppmvd)	2	6				
NOx Emissions at HRSG Stack (lb/MWh)	0.073	0.238				
AGC Ramp Rate (MW/min)	13	13				
Turndown Ratio (Maintaining emissions)	30%	30%				
Minimum Fuel Gas Pressure (psig)						
Full Load Operation	525		525		<525	
Maximum Load for Fuel Switching (%)	90%					
Time to Complete Switch (Min)	10					
<b>Major Maintenance Accrual:</b>						
Equivalent natural gas hours	1.0	1.5				
Equivalent natural gas starts	1.0	1.5				