McHale & ASSOCIATES, INC.

Holland Energy Park
Holland, Michigan

FACILITY NET HEAT RATE PERFORMANCE TEST

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REV. NO.	REV. DATE	ORIGINATOR NAME/INITIAL	REVIEWER NAME/INITIAL	APPROVER NAME/INITIAL	DESCRIPTION
0	7/15/22	AS	GRR	LK	Initial Issue

APPROVED FOR ISSUE

Originator: By: Atul Shukla Date: July 15, 2022

Engineering Reviewer: By: Gabriel R. Ramos Date: July 15, 2022

Project Manager Approval: By: Lee Kirkpatrick Date: July 15, 2022

REVISION LOG SHEET

SECTION	DESCRIPTION OF CHANGES
Initial Issue	N/A

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EXECUTIVE SUMMARY

Facility Net Heat Rate Performance Testing at the Holland Energy Park in Holland, Michigan was conducted on June 14, 2022 by McHale & Associates, Inc. Testing was conducted in accordance with *22028.0 Holland BPW Facility Net Heat Rate Performance Test Procedure Rev. 0, Dated March 16, 2022.*

Performance Testing was conducted according to the Test Schedule as given in Table 1-1. A summary of the corrected Test Results are presented in Table E-1:

Table E-1: Summary of Corrected Test Result(1)

Parameter	Units	Guaranteed Performance	Corrected Performance	Result
Facility Net Plant Heat Rate	Btu/kWh (HHV)	≤ 8,361	7,658	Compliant

1. Corrected result presented in Table E-1 was calculated using the average of three (3) one (1) hour Test Runs.
2. The Facility Net Plant Electrical Output value listed in Table E-1 was obtained from the Section IV.6 ofROP no.: MI-ROP-P0465-2018.

Further description of the plant disposition, testing methodology, and explanation of the Test Results are provided in this document. Detailed calculations, test data, and calibration records are also provided in the Appendix of this Test Report.

1 INTRODUCTION

1.1 GENERAL INFORMATION

Facility Net Heat Rate Performance Testing at Holland Energy Park was conducted on June 14, 2022 by McHale & Associates, Inc. Holland Energy Park is a combined cycle plant with two (2) Siemens SGT-800 gas turbines (CTG). Exhaust gases are routed through two (2) Vogt Heat Recovery Steam Generators (HRSG). Steam production is provided to a Siemens SST-400 steam turbine (SGT). Facility heat rejection is provided through an SPXsteam surface condenser and an SPX Clearsky Plume Abated Cooling Tower.

Performance Testing was conducted according to the Test Schedule listed in Table 1-1.

Table 1-1: Test Schedule

Test Run	Date	Start Time	End Time
Stability	June 14, 2022	12:30	13:30
Test Run 1	June 14, 2022	13:30	14:30
Test Run 2	June 14, 2022	14:30	15:30
Test Run 3	June 14, 2022	15:30	16:30

1.2 TEST GOAL

Performance Testing was conducted with the goal of determining the Facility Net Plant Heat Rate. The Test Goals were corrected to the Base Reference Conditions in accordance with the Test Procedure provided in this Test Report as Appendix A. Corrected Test Results from each Test Run were arithmetically averaged and were calculated without uncertainty tolerances or degradation correction factors.

1.3 PARTIES TO THE TEST

The following are the Parties to the Test and their designated representatives:

Owner: Holland Board of Public Works
Representative: Trista Gregorski

State Agency: Michigan Department of Environment, Great Lakes, and Energy
Representative: Kaitlyn DeVries

Testing Contractor: McHale & Associates, Inc.
Representative: Gabriel Ramos

1.4 TEST EXCEPTION

There are no exceptions from the Test Procedure.

2 OPERATION

Unit operational configuration was as follows for all Performance Tests:

- Both gas turbines and the steam turbine were operating at Base Load. The Facility MWcontroller was set to 130 MW.
- Gas Turbines were fired on natural gas fuel with the fuel properties shown in Appendix C (McHale Fuel analysis report).
- All cooling tower cells were in service, VFD set to manual and 100% output.
- Water treatment system was out of service during the test.
- Two (2) exhaust ventilation fans were in service and three (3) were out of service.
- Auxiliary Boiler was out of service.
- CTG Anti-icing system was out of service.
- Snowmelt system was out of service and recirculation mode from Circulating Water system with approximately 3000 gpm to the system and a 10 °F temperature drop across the system.
- Condenser Makeup isolated.
- Sample panel isolated except for condensate feed system.
- NOx and CO emissions from the stack were measured by the Facility CEMs and were within the operating limit as mentioned in Section 2.1 of the Test Procedure.

3 INSTRUMENTATION

The data collection systems used for performance testing are listed below:

- DCS: The facility distributed control system (DCS)
- MDAS: McHale Data Acquisition System is a digital multiplexed HART data acquisition system constructed in accordance with ASME PTC 19.22

A list of the instruments used for Performance Testing is provided in Table 3-1. Instrument calibration records are provided in Appendix D.

Table 3-1: Test Instrumentation

Measurement	Temporary or Station	Data Collection Method	Elements Used in Test
CTG 10 Gross PowerOutput	Station	DCS	10CFA10CE001
CTG 10 Power Factor	Station	DCS	CT10 PF
CTG 11 Gross PowerOutput	Station	DCS	11CFA10CE001
CTG 11 Power Factor	Station	DCS	CT11 PF
STG Gross Power Output	Station	DCS	12MKA10CE069
STG Power Factor	Station	DCS	STG PF
Dry Bulb Temperature -Unit 10	Temporary	MDAS	TT000600,TT000027, TT000182,TT000506, TT000306,TT000663, TT000318,TT000728, TT000562
Dry Bulb Temperature -Unit 11	Temporary	MDAS	TT000738,TT000264, TT000320,TT000839, TT000644,TT000180, TT000256,TT000451, TT000824
Barometric Pressure	Temporary	MDAS	PTA10076, PTA10004
Measured Fuel Flow -CTG 10	Station	DCS	10MBP10CF005
Measured Fuel Flow -CTG 11	Station	DCS	11MBP10CF005
Fuel Gas Composition	Temporary	Manual	Fuel samples collected during Test. Samples analyzed at McHale laboratories
Relative Humidity Meter Unit10	Temporary	MDAS	DRH00031
Relative Humidity Meter Unit11	Temporary	MDAS	DRH00018

4 CALCULATIONS AND RESULTS

4.1 RESULTS SUMMARY

The corrected test results summary are listed in Table 4-1 & 4-2. Detailed calculations are provided in Appendix B.

Table 4-1: Corrected Test Results Summary – Facility Net Plant Electrical Output

Test Run	Units	Test Measured	Corrected Result
Test Run 1	MW	114.97	120.22
Test Run 2	MW	112.65	119.03
Test Run 3	MW	112.38	118.72
Average	MW	**113.32**	**119.32**

Table 4-2: Corrected Test Results Summary – Facility Net Heat Rate

Test Run	Units	Test Measured	Corrected Result
Test Run 1	Btu/kWh (HHV)	7,386	7,580
Test Run 2	Btu/kW (HHV)	7,398	7,685
Test Run 3	Btu/kWh (HHV)	7,403	7,708
Average	Btu/kWh(HHV)	**7,396**	**7,658**

4.2 STABILIZATION

Prior to commencement of Performance Testing the Facility in accordance with the Operated Disposition as mentioned in Section 2.1 for a minimum of one (1) hour. In addition to the stabilization period, the following operational parameters monitored during the test durations:

Table 4-3: Maximum Variations in Operating Conditions – Unit 10

Stabilization Requirements				
Parameter	Deviation	Test Run 1 6/14/2022 13:30 14:30	Test Run 2 6/14/2022 14:30 15:30	Test Run 3 6/14/2022 15:30 16:30
CT 10 Power Output	±0.65%	1.15%	0.85%	0.75%
CT 10 Fuel Flow	±0.65%	0.95%	0.69%	0.66%
Barometric Pressure	±0.16%	0.02%	0.01%	0.02%
Ambient Air Temperature	±1.3 °F	1.52	0.94	1.32

Table 4-4: Maximum Variations in Operating Conditions – Unit 11

Stabilization Requirements				
Parameter	Deviation	Test Run 1 6/14/2022 13:30 14:30	Test Run 2 6/14/2022 14:30 15:30	Test Run 3 6/14/2022 15:30 16:30
CT 11 Power Output	±0.65%	0.58%	0.71%	0.44%
CT 11 Fuel Flow	±0.65%	0.54%	0.60%	0.61%
Barometric Pressure	±0.16%	0.02%	0.00%	0.01%
Ambient Air Temperature	±1.3 °F	0.53	0.60	0.48

5 CONCLUSION

The corrected Facility Net Plant Heat Rate results (7,657.6[(1)] Btu/kWh, HHV) from the Facility Net Heat Rate Performance Test conducted on June 14, 2022 met the expected Heat Rate (≤ 8,361 Btu/kW-hr (HHV)) listed in Section 1.4 of the Test Procedure. There were no exceptions to the Test Procedure, however, some stabilization criteria exceeded ASME PTC 22-2014 limits. In accordance with the Section 4.2 Stabilization Table 4-3, it can be observed that the CT 10 power output, fuel flow and ambient temperature parameters are deviating more than recommended stability criteria. Similarly, as per Table 4-4 it can be observed that the CT11 power output values are deviating more than recommended stability criteria. The deviation from the recommended stability limits are partially due to the location of the CT air inlets. The air inlets are located at the discharge of the steam turbine building ventilation which can cause variation in the CT inlet air temperatures. The deviations from the stability requirements does not preclude results of the heat rate performance test.

APPENDIX A

Test Procedure

Note: The Test Procedure is provided as an electronic attachment to this Test Report.

APPENDIX B

Calculations

Holland BPW
Holland Energy Park - Heat Rate Test
Stability

Stabilization Requirements				
Parameter	Deviation	Test Run 1 6/14/2022 13:30 14:30	Test Run 2 6/14/2022 14:30 15:30	Test Run 3 6/14/2022 15:30 16:30
CT 10 Power Output	±0.65%	1.15%	0.85%	0.75%
CT 10 Fuel Flow	±0.65%	0.95%	0.69%	0.66%
Barometric Pressure	±0.16%	0.02%	0.01%	0.02%
Ambient Air Temperature	±1.3°F	1.52	0.94	1.32

Stabilization Requirements				
Parameter	Deviation	Test Run 1 6/14/2022 13:30 14:30	Test Run 2 6/14/2022 14:30 15:30	Test Run 3 6/14/2022 15:30 16:30
CT 11 Power Output	±0.65%	0.58%	0.71%	0.44%
CT 11 Fuel Flow	±0.65%	0.54%	0.60%	0.61%
Barometric Pressure	±0.16%	0.02%	0.00%	0.01%
Ambient Air Temperature	±1.3°F	0.53	0.60	0.48

Holland BPW
Holland Energy Park - Heat Rate Test
PTC 46 Model

Description	Units	Procedure Symbol	Design	Test Run 1	Test Run 2	Test Run 3	Average	Notes
Disposition								
Number of Cooling Tower Fans in Service	-	-	3	3	3	3	-	
Snow Melt Pump Status	-	-	OFF	OFF	OFF	OFF	-	
Primary Variables								
Electrical Power Data								
CTG 10 Net Power Output	MW	P_{CTG10}	42.9	38.84	37.56	37.64	38.01	10AEA00PRY003
CTG 10 Power Factor	-	-	1.00	0.99	0.99	1.00	0.99	10MKA10CE014
CTG 11 Net Power Output	MW	P_{CTG11}	42.9	37.48	36.84	36.52	36.95	11AEA00PRY003
CTG 11 Power Factor	-		1.00	0.99	0.99	1.00	0.99	11MKA10CE014
STG Gross Power Output	MW	P_{STG}	41.0	38.41	38.01	37.98	38.13	12MKA10CE069
Ambient Conditions								
Dry Bulb Temperature - Unit 10	°F	T_{DB}	84.00	93.12	96.23	95.57	94.98	Temporary Digital RTDs
Dry Bulb Temperature - Unit 11	°F	T_{DB}	84.00	93.12	94.38	95.34	94.28	Temporary Digital RTDs
Relative Humidity- Unit 10	%	T_{WB}	56.00	63.82	58.15	53.39	58.45	Temporary Relative Humidity Meter
Relative Humidity- Unit 11	%	T_{WB}	56.00	64.74	56.20	53.78	58.24	Temporary Relative Humidity Meter
Barometric Pressure - Unit 10	psia	P_{baro}	14.381	14.35	14.35	14.35	14.35	Rosemount 3051 Absolute Pressure Transmitter
Barometric Pressure - Unit 11	psia	P_{baro}	14.381	14.34	14.34	14.34	14.34	Rosemount 3051 Absolute Pressure Transmitter
Fuel Gas Conditions								
Measured Fuel Flow - CTG 10	lb/sec	m_{CTG10}	5.665	5.13	5.00	5.02	5.05	Unit Coriolis Meter: 10MBP10CF005
Measured Fuel Flow - CTG 11	lb/sec	m_{CTG11}	5.665	5.09	5.02	4.99	5.03	Unit Coriolis Meter: 11MBP10CF005
Fuel Gas Composition								
Methane (CH4)	mol %	-	95.046	91.05	91.07	91.06	91.06	McHale Laboratory Analysis
Ethane (C2H6)	mol %	-	2.682	7.22	7.21	7.20	7.21	McHale Laboratory Analysis
Propane (C3H8)	mol %	-	0.262	0.35	0.35	0.35	0.35	McHale Laboratory Analysis
I-Butane (C4H10)	mol %	-	0.038	0.06	0.05	0.05	0.05	McHale Laboratory Analysis
N-Butane (C4H10)	mol %	-	0.045	0.06	0.05	0.05	0.06	McHale Laboratory Analysis
I-Pentane (C5H12)	mol %	-	0.016	0.01	0.01	0.01	0.01	McHale Laboratory Analysis
N-Pentane (C5H12)	mol %	-	0.011	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Hexane (C6H14)	mol %	-	0.054	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Heptane (C7H16)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Octane (C8H18)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Nonane (C8H20)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Decane (C10H22)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Carbon Dioxide (CO2)	mol %	-	1.023	0.38	0.39	0.40	0.39	McHale Laboratory Analysis
Nitrogen (N2)	mol %	-	0.823	0.85	0.86	0.87	0.86	McHale Laboratory Analysis
Oxygen (O2)	mol %	-	0.000	0.02	0.01	0.01	0.01	McHale Laboratory Analysis
Helium (He)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Hydrogen (H2)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Carbon Monoxide (CO)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Hydrogen Sulfide (H2S)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Water (H2O)	mol %	-	0.000	0.00	0.00	0.00	0.00	McHale Laboratory Analysis
Sum	mol %	-	100.00	100.00	100.00	100.00	100.00	
Secondary Variables								
Electrical Power Data								
CTG 10 Gross Power Output	MW	P_{CTG10}	42.9	40.40	39.13	39.21	39.58	CTG 1-MW
CTG 11 Gross Power Output	MW	P_{CTG11}	42.9	39.23	38.58	38.27	38.69	CTG 2-MW
STG Power Factor	-	-	0.85	0.99	0.99	1.00	0.99	STG 12-PF

Holland BPW
Holland Energy Park - Heat Rate Test
PTC 46 Model

Description	Units	Procedure Symbol	Design	Test Run 1	Test Run 2	Test Run 3	Average	Notes
Intermediate Calculations								
Ambients								
Dry Bulb Temperature	°F	T_{DB}	84.00	93.124	95.305	95.454	94.63	Temporary Digital RTDs
Wet Bulb Temperature	°F	T_{WB}	72.00	64.283	57.171	53.585	58.35	Temporary Digital RTDs inside Box Psychrometer
Relative Humidity	%	RH	56.0%	64.28%	57.17%	53.58%	0.58	Calculated per ASHRE formulations
Fuel Gas								
Measured Fuel Flow - CTG 10	lb/hr	m_{CTG10}	20,393.0	18,450.3	18,015.2	18,059.2	18174.92	Coriolis Meter
Measured Fuel Flow - CTG 11	lb/hr	m_{CTG11}	20,393.0	18,309.3	18,066.3	17,974.6	18116.70	Coriolis Meter
Total Fuel Flow	lb/hr	m_{Fuel}	40,786.0	36,759.6	36,081.5	36,033.8	36291.62	$= m_{CTG10} + m_{CTG11}$
Fuel Gas Heating Value (HHV)	BTU/lbm	HHV	23,100.3	23,100.3	23,097.8	23,089.1	23095.74	=ASTM_D3588_2003(F30:F49,"HHVm")
Net Power Calc Power								
GSU 10 Transformer Losses	kW		193.5	127.4	120.4	122.7	123.49	Calculated Per Section 1.5 of Test Report
GSU 11 Transformer Losses	kW		147.9	120.8	120.8	119.6	120.44	Calculated Per Section 1.5 of Test Report
Net Power Output	kW		124,010.0	114,973.2	112,649.7	112,381.9	113334.91	$= P_{U10} + P_{U11} + P_{U12} + P_{GSU10} + P_{GSU11}$
Correction Curves								
Multiplicative Corrections to Power Output								
Ambient Dry Bulb Temperature	-	α_1	0.9963	1.0415	1.0544	1.0553	1.0504	From Curve MCH-16057.0-AB1-Rev.0
Ambient Pressure	-	α_2	1.0000	1.0013	1.0015	1.0016	1.0015	From Curve MCH-16057.0-AB2-Rev.0
Ambient Relative Humidity	-	α_3	1.0005	1.0027	1.0006	0.9994	1.0009	From Curve MCH-16057.0-A3-Rev.0
Total Multiplicative Corrections to Power Output	-	$\Pi\alpha_i$	0.9967	**1.0456**	**1.0566**	**1.0564**	**1.0529**	$=\Pi\alpha_i$
Multiplicative Corrections to Heat Rate								
Ambient Dry Bulb Temperature	-	β_1	0.9937	1.0723	1.0955	1.0972	1.0883	From Curve MCH-16057.0-AB1-Rev.0
Ambient Pressure	-	β_2	1.0000	1.0018	1.0022	1.0023	1.0021	From Curve MCH-16057.0-AB2-Rev.0
Ambient Relative Humidity	-	β_3	0.9999	0.9989	0.9997	1.0002	0.9996	From Curve MCH-16057.0-B3-Rev.0
Total Multiplicative Corrections to Heat Rate	-	$\Pi\beta_i$	0.9936	**1.0731**	**1.0976**	**1.0999**	**1.0902**	$= \Pi\beta_i$
Calculated Performance								
Corrected Net Power Output								
Measured Plant Net Power Output	kW	P_{Meas}		114,973.2	112,649.7	112,381.9	113,334.9	$=P_{Meas}$
Corrected Net Base Load Plant Output	kW	P_{corr}		120,219.8	119,030.1	118,721.8	119,323.9	$=(P_{meas} + \Sigma\Delta) * \Pi\alpha$
Corrected Net Base Load Plant Output	**MW**	P_{corr}		**120.22**	**119.03**	**118.72**	**119.32**	
Corrected Net Heat Rate								
Measured Heat Input	MMBtu, HHV	Q_{meas}		849.2	833.4	832.0	838.2	$= m_f * HV$
Measured Gross Heat Rate	Btu/kWh, HHV	HR_{Meas}		7,385.7	7,398.2	7,403.2	7,395.7	$= Q_{meas} / P_{meas}$
Corrected Net Base Load Plant Heat Rate	**Btu/kWh, HHV**	HR_{Corr}		**7,579.6**	**7,685.2**	**7,708.1**	**7,657.6**	$= [(Q_{meas} * \Pi\beta i) / (P_{meas} * \Pi\alpha_i)]$

APPENDIX C

Natural Gas Properties

McHale & ASSOCIATES, INC.
4700 Coster Road . Knoxville, TN 37912 . 865-588-2654 McHale.com

Natural Gas Analysis Report

Project No.:	22028.0	**Report ID:**	22028-30403
Customer:	Holland BPW		
Temperature:	19.5	**Sampling Location:**	Holland Energy Park
Humidity:	65%		1 Energy Park Way
Bottle:	30403		Holland, MI 49423
SampleName	1A	**Sampling Technician:**	G. Ramos
GC Method:	ASTM 04302015 (60s pump).met	**Methods Used:**	[1]ASTM D 1945
Sample Date:	06/14/2022 13:30	**Heating Values Calculated Per:**	[2]ASTM D3588, [3]GPA 2172, [4]AGA8
Report Date:	6/20/2022	**Instrument Used for Analysis:**	Agilent 3000A Micro GC- 2

Sample Composition[1]

Component Name	Normalized Mole %
Oxygen	0.0169
Nitrogen	0.8544
Methane	91.0380
CO2	0.3794
Ethane	7.2194
Propane	0.3455
i-Butane	0.0588
n-Butane	0.0647
i-Pentane	0.0189
n-Pentane	0.0040
Hexanes Plus	0.0000
Total:	100.0000

Results Summary

Result	Dry[2] 14.696 psia and 60°F	Dry[4] 14.73 psia and 60°F
Total Unnormalized Mole%[1]	100.4240	
Ideal Gas Net Heating Value (Btu/cu. Ft.)[2]	957.32	959.54
Real Gas Net Heating Value (Btu/cu. Ft.)[3]	959.55	961.77
Net Heating Value (Btu/lbm)[2]	20,845.1	
Ideal Gas Gross Heating Value (Btu/cu. Ft.)[2]	1,060.90	1,063.36
Real Gas Gross Heating Value (Btu/cu. Ft.)[3]	1,063.37	1,065.84
Gross Heating Value (Btu/lbm)[2]	23,100.6	
Real Gas AGA8 Density lb/SCF[4]	0.046034	0.046140
Ideal Gas Specific Gravity[2]	0.60181	-
Real Gas Specific Gravity[2]	0.60299	-
Gas Compressibility (Z) Factor[4]	0.99768	0.99767
Wobbe Index, BTU/SCF	1,366.2	1,369.4

Analysis Performed By: Anthony Knowles

Approved By:

End of Report

McHale & ASSOCIATES, INC.
4700 Coster Road . Knoxville, TN 37912 . 865-588-2654 McHale.com

Natural Gas Analysis Report

Project No.:	22028.0	**Report ID:**	22028-GSC0095
Customer:	Holland BPW		
Temperature:	19.5	**Sampling Location:**	Holland Energy Park
Humidity:	65%		1 Energy Park Way
Bottle:	GSC0095		Holland, MI 49423
SampleName	2A	**Sampling Technician:**	G. Ramos
GC Method:	ASTM 04302015 (60s pump).met	**Methods Used:**	[1]ASTM D 1945
Sample Date:	06/14/2022 14:30	**Heating Values Calculated Per:**	[2]ASTM D3588, [3]GPA 2172, [4]AGA8
Report Date:	6/20/2022	**Instrument Used for Analysis:**	Agilent 3000A Micro GC- 2

Sample Composition[1]

Component Name	Normalized Mole %
Oxygen	0.0119
Nitrogen	0.8520
Methane	91.0653
CO2	0.3902
Ethane	7.2198
Propane	0.3444
i-Butane	0.0537
n-Butane	0.0547
i-Pentane	0.0070
n-Pentane	0.0010
Hexanes Plus	0.0000
Total:	100.0000

Results Summary

Result	Dry[2] 14.696 psia and 60°F	Dry[4] 14.73 psia and 60°F
Total Unnormalized Mole%[1]	100.4740	
Ideal Gas Net Heating Value (Btu/cu. Ft.)[2]	956.54	958.76
Real Gas Net Heating Value (Btu/cu. Ft.)[3]	958.77	960.99
Net Heating Value (Btu/lbm)[2]	20,843.8	
Ideal Gas Gross Heating Value (Btu/cu. Ft.)[2]	1,060.07	1,062.52
Real Gas Gross Heating Value (Btu/cu. Ft.)[3]	1,062.53	1,065.00
Gross Heating Value (Btu/lbm)[2]	23,099.7	
Real Gas AGA8 Density lb/SCF[4]	0.045999	0.046106
Ideal Gas Specific Gravity[2]	0.60136	-
Real Gas Specific Gravity[2]	0.60254	-
Gas Compressibility (Z) Factor[4]	0.99768	0.99768
Wobbe Index, BTU/SCF	1,365.7	1,368.8

Analysis Performed By: Anthony Knowles

Approved By:

End of Report

McHale & ASSOCIATES, INC.
4700 Coster Road . Knoxville, TN 37912 . 865-588-2654 McHale.com

Natural Gas Analysis Report

Project No.:	22028.0	**Report ID:**	22028-GSC0073
Customer:	Holland BPW		
Temperature:	19.5	**Sampling Location:**	Holland Energy Park
Humidity:	65%		1 Energy Park Way
Bottle:	GSC0073		Holland, MI 49423
SampleName	3A	**Sampling Technician:**	G. Ramos
GC Method:	ASTM 04302015 (60s pump).met	**Methods Used:**	[1]ASTM D 1945
Sample Date:	06/14/2022 15:30	**Heating Values Calculated Per:**	[2]ASTM D3588, [3]GPA 2172, [4]AGA8
Report Date:	6/20/2022	**Instrument Used for Analysis:**	Agilent 3000A Micro GC- 2

Sample Composition[1]

Component Name	Normalized Mole %
Oxygen	0.0130
Nitrogen	0.8622
Methane	91.0799
CO2	0.3937
Ethane	7.1937
Propane	0.3469
i-Butane	0.0528
n-Butane	0.0518
i-Pentane	0.0050
n-Pentane	0.0010
Hexanes Plus	0.0000
Total:	100.0000

Results Summary

Result	Dry[2] 14.696 psia and 60°F	Dry[4] 14.73 psia and 60°F
Total Unnormalized Mole%[1]	100.3240	
Ideal Gas Net Heating Value (Btu/cu. Ft.)[2]	956.12	958.34
Real Gas Net Heating Value (Btu/cu. Ft.)[3]	958.34	960.57
Net Heating Value (Btu/lbm)[2]	20,838.6	
Ideal Gas Gross Heating Value (Btu/cu. Ft.)[2]	1,059.61	1,062.06
Real Gas Gross Heating Value (Btu/cu. Ft.)[3]	1,062.07	1,064.54
Gross Heating Value (Btu/lbm)[2]	23,094.1	
Real Gas AGA8 Density lb/SCF[4]	0.045990	0.046097
Ideal Gas Specific Gravity[2]	0.60125	-
Real Gas Specific Gravity[2]	0.60242	-
Gas Compressibility (Z) Factor[4]	0.99768	0.99768
Wobbe Index, BTU/SCF	1,365.2	1,368.4

Analysis Performed By: Anthony Knowles

Approved By:

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End of Report

McHale & ASSOCIATES, INC.
4700 Coster Road . Knoxville, TN 37912 . 865-588-2654 McHale.com

Natural Gas Analysis Report

Project No.:	22028.0	**Report ID:**	22028-GSC0198
Customer:	Holland BPW		
Temperature:	19.5	**Sampling Location:**	Holland Energy Park
Humidity:	65%		1 Energy Park Way
Bottle:	GSC0198		Holland, MI 49423
SampleName	4A	**Sampling Technician:**	G. Ramos
GC Method:	ASTM 04302015 (60s pump).met	**Methods Used:**	[1]ASTM D 1945
Sample Date:	06/14/2022 16:30	**Heating Values Calculated Per:**	[2]ASTM D3588, [3]GPA 2172, [4]AGA8
Report Date:	6/20/2022	**Instrument Used for Analysis:**	Agilent 3000A Micro GC- 2

Sample Composition[1]

Component Name	Normalized Mole %
Oxygen	0.0139
Nitrogen	0.8831
Methane	91.0307
CO2	0.4042
Ethane	7.2070
Propane	0.3465
i-Butane	0.0538
n-Butane	0.0528
i-Pentane	0.0070
n-Pentane	0.0010
Hexanes Plus	0.0000
Total:	100.0000

Results Summary

Result	Dry[2] 14.696 psia and 60°F	Dry[4] 14.73 psia and 60°F
Total Unnormalized Mole%[1]	100.4440	
Ideal Gas Net Heating Value (Btu/cu. Ft.)[2]	956.02	958.23
Real Gas Net Heating Value (Btu/cu. Ft.)[3]	958.24	960.46
Net Heating Value (Btu/lbm)[2]	20,825.2	
Ideal Gas Gross Heating Value (Btu/cu. Ft.)[2]	1,059.49	1,061.94
Real Gas Gross Heating Value (Btu/cu. Ft.)[3]	1,061.95	1,064.41
Gross Heating Value (Btu/lbm)[2]	23,079.1	
Real Gas AGA8 Density lb/SCF[4]	0.046015	0.046121
Ideal Gas Specific Gravity[2]	0.60157	-
Real Gas Specific Gravity[2]	0.60274	-
Gas Compressibility (Z) Factor[4]	0.99768	0.99768
Wobbe Index, BTU/SCF	1,364.7	1,367.8

Analysis Performed By: Anthony Knowles

Approved By: Jeri McHale

End of Report

APPENDIX D

Instrument Calibration Records

Note: The Instrument Calibration Records are provided as an electronic attachment to this Test Report.