APPENDIX A

ASSUMPTIONS AND REFERENCES

Third-Party Verification Final Audit Report
First Audit

Noble Energy, Inc.
1625 Broadway, Suite 2200
Denver, CO 80202

November 5, 2018

Assumptions

Parameter	Value	Units	Source
Atmospheric Pressure	12.5	psia	Noble Assumption
Separator Temperature	65	F	Noble Assumption
Water API Gravity	10	°API	API Gravity of Pure Water
Water Specific Gravity	1		Converted Value
Vapor Pressure of Water	0.947	psia	Vapor Pressure at 100 F
Critical Pressure of Water	3200	psia	Critical Pressure
Separator Oil API Gravity	80	°API	Noble Assumption
Separator Oil Specific Gravity	0.67		Converted Value
Stock Tank Oil API Gravity	60	°API	Noble Assumption
Gas Gravity	1.59		Noble Assumption
Water Flash Rate	4	scf/bbl	Noble provided value

Valve Coefficients

	Valve Size	Trim Size	Cf	Cv	Source
1" & 1/8"	1"	1/8"	0.58	1.06	
1" & 3/16"	1"	3/16"	0.59	1.51	
1" & 1/4"	1"	1/4"	0.78	2.17	
1" & 3/8"	1"	3/8"	0.91	3.22	
1" & 1/2"	1"	1/2"	0.94	5.72	Kimray 1 & 2 HPCV Valve Information Sheet for Nominal Trim Type Issued 4/15
2" & 1/4"	2"	1/4"	0.55	2.96	
2" & 3/8"	2"	3/8"	0.77	4.04	
2" & 1/2"	2"	1/2"	0.78	7.2	
2" & 3/4"	2"	3/4"	0.8	12.2	
2" & 1"	2"	1"	0.77	21.25	
2" & 2"	2"	2"	0.76	57	
3" & 2"	3"	2"	0.75	52.6	
3" & 3"	3"	3"	0.76	107	Kimray Pilston Balanced High Pressure Control Valve Information Sheet for Issued 4/15
4" & 3"	4"	3"	0.75	115	
4" & 4"	4"	4"	0.75	222	

Combustor Capacities

	Manufacturer Published (MSCFD)	Source
Cimarron 48 HV	109.3	
Cimarron 60	57.6	
Cimarron 48	30.0	EPA Performance Testing for Combustion Control Devices, Manufacturers' Performace Test NSPS 0000 and MACT HH/HHH [Updated 12/15/2015]
Cimarron 30	15.0	
Cimarron 24	9.2	
COMM 200 48"	157.0	
COMM 200 48" (1ry-only)	157.0	COMM Combustor 200 Performance Chart - Noble 2014_Dec 2014.pdf, 23 December 2014
COMM 200 48" (2ry-only)	157.0	
LEED 48" Gen 1 #7	140.0	
LEED 48" Gen 2	140.0	Leed 48-HEC-Data Sheet.pdf, 27 February 2014
LEED 36"	99.0	Leed 36-HEC-Data Sheet.pdf, 27 February 2014
LEED 24" Gen 1 #10	40.0	
LEED 24" Gen 1 #10 & #9	40.0	Leed 24-HEC-Data Sheet.pdf, 27 February 2014
LEED 24" Gen 2 #7	40.0	
LEED 24" Gen2 #7 & #9	40.0	
TEC 4-CS (48" Tornado)	86.4	TEC-3 & 4 CS SPECIFICATIONS-USA-Rev.4.pfd
TEC 3-CS (36" Tornado)	45.7	

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Notation	Reference
a	Per equation 3-2 in P.P. Valko, W.D. McCain Jr. "Reservoir oil bubblepoint pressures revisited;solution gas-oil ratios and surface gas specific gravities" Journal of Petroleum Science and Engineering 37 (2003) pg. 153-169
b	Per Noble provided regression of sample data
c	minimum of either the separator pressure or the Noble provided regression of sample data
d	Calculated via Equation 31, ISA-75.01.01-2007 (60534-2-1- Mod) - Flow Equations for Sizing Control Valves (Draft 1)
e	Valve is considered choked when $\Delta P \geq Cf(P1-Ff*Pv)$ see applicability equation for Equation 3 in ISA-75.01.01-2007(60534-2-1- Mod) - Flow Equations for Sizing Control Valves (Draft
f	Incompressible Fluids Non-Choked Flow Calculated via Equation 1, ISA-75.01.01-2007 (60534-2-1- Mod) - Flow Equations for Sizing Control Valves (Draft 1)
g	Incompressible Fluids Choked Flow Calculated via Equation 3, ISA-75.01.01-2007 (60534-2-1- Mod) - Flow Equations for Sizing
h	Per API 2000 - Venting Atmospheric and Low-pressure Storage Tanks, 7th Edition, March 2014, Table A.2, Out-Breathing Liquid Movement In
i	conversion from scfh(air) to scfh(vapor) is based equations on this website: http://www.enardo.com/solutions/solutions_equations.htm
j	Critical Pressure of Pure water from https://en.wikipedia.org/wiki/Critical_point_%28thermodynamics%29
k	Vapor pressure of pure water as calculated using antoine equation at 100 F. Antoine's Constants from https://en.wikipedia.org/wiki/Antoine_equation
l	Displacement equation. Assumes 1 bbl of water displaces equivalent ft^3 of vapor. Vapor is assumed to be at standard conditions
m	Per API 2000 - Venting Atmospheric and Low-pressure Storage Tanks, 7th Edition, March 2014, , Table A.4 Column 4 (FP<100 Deg, BP<300 Deg)
n	
o	
p	
q	

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