Noble Energy Consent Decree (90-5-2-1-10811) – 1:15-cv-00841 RBJ

Third-Party Verification Final Audit Report
Second Audit

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Third-Party Verification Final Audit Report
Second Audit

Prepared for:

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This document has been prepared by SLR International Corporation. The material and data in this report were prepared under the supervision and direction of the undersigned.

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DEFINITIONS

For purposes of this report, every term expressly defined in this section shall have the meaning given that term herein. Where noted, the terms have the meaning expressly defined in the Consent Decree ("CD")[1].

As defined in Section III of the CD, "condensate" means hydrocarbon liquids that remain liquid at standard conditions (68 degrees Fahrenheit and 29.92 inches mercury) and are formed by condensation from, or produced with, natural gas, and which have an American Petroleum Institute gravity ("API gravity") of 40 degrees or greater.

As defined in Section III of the CD, "Engineering Design Standard" means an engineering standard developed by Noble pursuant to Paragraph 9 of the CD.

"Engineering Evaluation" means application of the Modeling Guideline and Engineering Design Standard to determine if the Vapor Control System at each Tank System is adequately designed and sized to handle the Potential Peak Instantaneous Vapor Flow Rate pursuant to Paragraph 10 and 11 of the CD.

As defined in Section III of the CD, "EPA" means the United States Environmental Protection Agency and any of its successor departments or agencies.

As defined in Noble's Modeling Guideline, "Flash," "Flashing," "Flash Losses" or "Flash Vapor" means the released hydrocarbons and other entrained gases from liquid that are emitted to surroundings when the liquid changes temperature and/or pressure.

"Flash Factor" means the volume of gas at standard conditions (60 °F and 29.92 inches mercury), standard cubic feet (scf), flashing from each U.S. Petroleum barrel (bbl) at stock tank conditions (scf/bbl).

As defined in Section III of the CD, "IR Camera Inspection" means an inspection of a Vapor Control System using an optical gas imaging infrared (IR) camera designed for and capable of detecting hydrocarbon and volatile organic compound (VOC) emissions, conducted by trained personnel who maintain proficiency through regular use of the optical gas imaging infrared camera.

As defined in Section III of the CD, "Modeling Guideline" means the modeling guideline developed by Noble pursuant to Paragraph 8 of the CD.

As defined in Section III of the CD, "Normal Operations" means all periods of operation, excluding Malfunctions. For storage tanks at well production facilities, normal operations include, but is not limited to, liquid dumps from the Separator.

As defined in Section III of the CD, "Parties" means the United States, the State of Colorado, and Noble.

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[1] CD between the United States, the State of Colorado, and Noble, Civil Action No. 1:15-cv-00841-RBJ, entered by the U.S. District Court of Colorado as final judgment on June 2, 2015.

As defined in Section III of the CD, "Potential Peak Instantaneous Vapor Flow Rate (PPIVFR)" means the maximum instantaneous amount of vapors routed to a Vapor Control System during Normal Operations, including flashing, working, breathing, and standing losses, as determined using the Modeling Guideline.

As defined in Section III of the CD, "Tank System" means one or more tanks that store Condensate and share a common Vapor Control System.

As defined in Section III of the CD, "Tank System Group" means one of the groupings of Tank Systems as set forth in Paragraph 10.a of the CD.

As defined in Section III of the CD, "Three Line Pressure Groupings" means the distribution of Tank Systems that are associated with Well Production Operations which produce gas into sales lines that, as of August 17, 2014, had line pressures within the following three ranges: (1) 233 psi or greater ("Group I"); (2) less than 233 psi and greater than or equal to 186 psi ("Group II"); and (3) less than 186 psi ("Group III"). If Noble later determines that another grouping of the Tank Systems is more appropriate, in consultation with EPA and CDPHE and subject to both agencies' prior written approval, the Tank Systems can be redistributed among Group I, Group II, and Group III.

As defined in Section III of the CD, "Vapor Control System (VCS)" means the system used to contain, convey, and control vapors from Condensate (including flashing, working, breathing, and standing losses, as well as any natural gas carry-through to Condensate tanks) at a Tank System. A Vapor Control System includes a Tank System, piping to convey vapors from a Tank System to a combustion device and/or vapor recovery unit, fittings, connectors, liquid knockout vessels or vapor control piping, openings on Condensate tanks (such as pressure relief valves ("PRVs") and thief hatches), and emission control devices.

ACRONYMS

API	American Petroleum Institute
bbl	U.S. Petroleum barrel (42 gallons)
CDPHE	Colorado Department of Public Health and Environment
COCR	Certification of Completion Reports
CPF	Central Production Facility
EPA	United States Environmental Protection Agency
ESD	Emergency Shut Down
°F	Degrees Fahrenheit
HPCV	High Pressure Control Valve
IR	Infrared
oz/in^2	ounces per square inch
PCCM	Post-Certification of Completion Modifications
PPIVFR	Potential Peak Instantaneous Vapor Flow Rate
psi	pounds per square inch
psia	pounds per square inch, absolute
psig	pounds per square inch, gauge
PRV	Pressure Relief Valve
scf	standard cubic feet
scfh/bbl	standard cubic feet per hour per U.S. Petroleum barrel (42 gallons)
STEM	Storage Tank Emission Monitoring
TLO	Tank Truck Loadout
tpy	tons per year
TVP	True Vapor Pressure
VCS	Vapor Control System
VOC	Volatile Organic Compound
VRT	Vapor Recovery Tower

EXECUTIVE SUMMARY

Noble Energy, Inc. (Noble) entered into a Consent Decree (Civil Action No. 1:15-cv-00841-RBJ) with the United States, the Department of Justice, and the State of Colorado entered by the United States District Court of Colorado as final judgment on June 2, 2015. The Consent Decree (CD) required Noble to develop a Modeling Guideline to determine Potential Peak Instantaneous Vapor Flow Rate (PPIVFR) "for purposes of designing and adequately sizing Vapor Control Systems." The CD also required that Noble complete Engineering Design Standards "to provide sufficient guidance to design adequately sized and properly functioning Vapor Control Systems at the Tank Systems." Noble completed its Vapor Control System (VCS) Engineering Evaluations, necessary modifications and verifications, and submitted its Certification of Completion Report ("Report") to the United States Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE) in accordance with prescribed timelines.

SLR International Corporation (SLR) was retained by Noble to conduct a third-party verification audit ("Audit") in calendar year 2016 ("First Audit") and in calendar year 2018 ("Second Audit") in accordance with Paragraph 20 of the CD. The First Audit pertained to Engineering Evaluations and any necessary modifications of Tank Systems completed as of December 31, 2015 and submitted in Noble's Report. The Draft Audit Report for the First Audit was submitted electronically simultaneously to all Parties, as stipulated in Paragraphs 20.f. and 105 of the CD, on March 30, 2017. The Final First Audit Report was electronically submitted simultaneously to all Parties on November 5, 2018.

The Second Audit pertained to all previously unaudited Tank Systems with modifications after December 31, 2015. SLR submitted the Draft Audit Report for the Second Audit ("Draft Report") electronically simultaneously to all Parties, as stipulated in Paragraphs 20.f. and 105 of the CD, on March 29, 2019.

The Audit was conducted in two parts. In the first part, SLR conducted a document review for each Tank System to: 1) Verify that Noble has applied the Modeling Guideline; 2) Verify that Noble has applied the applicable Engineering Design Standard; and 3) Verify that each VCS is adequately designed and sized to handle the PPIVFR. The Audit did not include field verification of modifications or of inputs to the Modeling Guideline or Engineering Design Standards. SLR completed the document review and IR camera inspections on or about December 31, 2018.

The adequacy of the design and sizing of the VCS for each Tank System was evaluated as part of the document review based on SLR's application of Noble's Modeling Guideline to determine PPIVFR and SLR's determination of VCS capacity using Noble's Engineering Design Standard in keeping with the mandate of the CD in Paragraph 20. The results of the document review verified the VCS was considered adequately designed and sized for 586 of the 587 (99 percent) of the Tank Systems reviewed. VCS were considered adequately designed and sized to accommodate the PPIVFR if SLR's calculated VCS capacity (burner capacity plus headspace surge capacity) was greater than SLR's calculated PPIVFR. Results of the document review for each Tank System are summarized in Table 1 and detailed in Appendix B.

In the second part of the Audit, GreenPath Energy Ltd. (GreenPath) conducted Infrared (IR) Camera Inspections of a subset of previously unaudited Tank Systems as stipulated in Paragraph 20.d. of the CD. GreenPath conducted IR Camera Inspections at 86 Tank Systems included in the Audit of the 587 (99 percent) of the Tank Systems reviewed. The field IR Camera Inspections were completed on or before August 30, 2018. GreenPath observed VOC emissions from the VCS of 10 Tank Systems (12%). In each case where VOC emissions were observed, the component was repaired and re-surveyed using an IR camera, either at the time of the survey of the subject Tank System, or at a later date. IR Camera Inspection and repair confirmation re-inspection results are summarized in Table 2 and detailed in Appendix C.

Noble completed its review of the Draft Report and the United States and State of Colorado reviewed and provided comment to the Draft Report to Noble. On March 27, 2020, Noble submitted its letter Comments to Consent Decree Third-Party Verification Draft Audit Report – Second Audit to the United States and the State of Colorado. By way of its March 27, 2020 correspondence (“Comments Letter”), Noble memorialized its comments to the Draft Report and provided additional requested revisions, comments, and clarifying information for the United States’ and State of Colorado’s consideration for inclusion in an updated Draft Report (“Revised Draft Report”). Noble suggested that if the United States and State of Colorado agree, that SLR revise the Draft Report to incorporate the information provided in its Comments Letter and that once the revisions are incorporated that the Draft Report be retitled to “Revised Draft Report” and recirculated for review prior to finalization. SLR received a copy of Noble’s March 27, 2020 Comments Letter on June 4, 2020 via electronic mail. This Revised Draft Report incorporates suggested revisions set out in the Review Letter, subject to confirmation and agreement by SLR. Noble’s Comments Letter Addendum is provided as Appendix D.

1. INTRODUCTION

1.1 THIRD-PARTY AUDITOR AND WORK PLAN APPROVAL

SLR's and GreenPath's qualifications, as well as an Audit Work Plan developed by Noble, were provided to Parties as required by Paragraph 20.b. The third-party auditors (SLR and GreenPath) and Noble's Audit Work Plan were approved by EPA and CDPHE on October 10, 2017.

1.2 AUDIT TEAM

Key auditors comprising SLR's Audit Team are listed below.

AUDITOR	TITLE	AFFILIATION	QUALIFICATIONS	ROLE
James Van Horne, P.E.	Associate Engineer	SLR Fort Collins, CO	B.S. Mechanical Engineering 10+ Years	Lead Auditor
Angela Oberlander, P.E.[2]	Senior Engineer	SLR Fort Collins, CO	B.S. Chemical Engineering, MBA. 22+ Years	Lead Auditor
Kenneth Malmquist	Principal Engineer	SLR Fort Collins, CO	B.S. Petroleum Engineering 32+ Years	Project Manager and Senior Review
Stephen Andersen	Principal Scientist	SLR Fort Collins, CO	B.S. Meteorology 46+ Years	Senior Review
Joshua Anhault	President	GreenPath Energy Ltd. Calgary, Alberta	Journeyman Instrumentation Tradesman	IR Camera Inspections
Jesse Hanshaw	Principal Engineer	SLR Charleston, WV	B.S. Chemical Engineering 18 Years	Senior Auditor
Craig Bock	Senior Engineer	SLR Pocatello, ID	B.S. Environmental Engineering 23 Years	Senior Auditor
Nick Michaelson	Senior Engineer	SLR Fort Collins, CO	B.S. Chemical Engineering 8 Years	Senior Auditor
Chris Driscoll	Senior Engineer	SLR Fort Collins, CO	B.S. Chemical Engineering 8 Years	Senior Auditor
Pat Dilsaver	Associate Scientist	SLR Denver, CO	M.S./B.S. Chemistry 5+ Years	Senior Auditor
Chris Boggess	Associate Engineer	SLR Charleston, WV	B.S. Chemical Engineering 8 Years	Senior Auditor

[2] SLR discloses that Angela Oberlander worked on the 2016 Third-Party Verification Audit ("First Audit") pursuant to paragraph 20 of the CD from January 2016 until December 2016. In January 2017, she began working under contract with Noble at its Greeley, Colorado field office in a seconded part-time position supporting Process Hazard Analysis, Process Safety Management, Stormwater Pollution Prevention and Spill Prevention, Control and Countermeasure program compliance, and other non-air quality-related duties for Noble. The seconded position ended on October 6, 2017. Ms. Oberlander began work on the 2018 Third-Party Verification Audit ("Second Audit") pursuant to paragraph 20 of the CD in November 2017.

AUDITOR	TITLE	AFFILIATION	QUALIFICATIONS	ROLE
Ryan Bell	Project Engineer	SLR Charleston, WV	J.D./B.S. Petroleum Engineering 13+ Years	Auditor
Brian Cherwien	Project Engineer	SLR Fort Collins, CO	B.S. Mechanical Engineering 5 Years	Auditor
Erin Ehrmantraut	Associate Engineer	SLR Denver, CO	B.S. Environmental Engineering 6+ Years	Auditor
Justin Frahm	Project Engineer	SLR Fort Collins, CO	B.S. Engineering Physics 6+ Years	Auditor
Tom Kussard	Project Engineer	SLR Fort Collins, CO	B.S. Environmental Engineering 5 Years	Auditor
Alex Asbury	Staff Engineer	SLR Charleston, WV	B.S. Chemical Engineering 1+ Years	Auditor
Davis Neeper	Staff Engineer	SLR Fort Collins, CO	B.S. Petroleum Engineering 1+ Years	Auditor
Rachel Acker	Staff Engineer	SLR Fort Collins, CO	B.S. Environmental Engineering 1+ Year	Auditor
Leah Althoff	Staff Engineer	SLR Denver, CO	B.S. Chemical Engineering 2 Years	Auditor

1.3 AUDIT OBJECTIVES

The objective of the Audit required by paragraph 20 of the CD is to independently verify that Noble:

1. Applied its Modeling Guideline to determine the PPIVFR into each Tank System VCS;

2. Applied an appropriate Engineering Design Standard to determine if the existing VCS at each Tank System is adequately designed and sized to handle the PPIVFR ("Engineering Evaluation");

3. Made all necessary modifications to reduce the PPIVFR and/or increase capacity of the VCS for those Vapor Control Systems found to be inadequately designed and sized based on the Engineering Evaluation; and

4. Conducted an IR Camera Inspection of selected Tank Systems to confirm the VCS is adequately designed and sized and not emitting VOCs.

1.4 AUDIT SCOPE

SLR audited in calendar year 2018 those previously unaudited Tank Systems that were modified after December 31, 2015 and that were not included in the First Audit as stipulated by Paragraph 20.a. of the CD.

Consistent with Paragraph 20 of the CD, the Audit Work Plan stipulates the Auditor will:

1. Conduct a document review of each Tank System to verify that Noble has applied the Modeling Guideline and the applicable Engineering Design Standard to ensure that the Vapor Control Systems are adequately designed and sized to handle the PPIVFR; and

2. Conduct an IR Camera Inspection of the subset of Tank Systems subject to the Audit.

1.4.1 DOCUMENT REVIEW

SLR audited Noble's Engineering Evaluations of 587 Tank Systems. A detailed list of the Tank Systems audited is provided in Table 1.

1.4.2 IR CAMERA INSPECTIONS

SLR selected a subset of Tank Systems for IR Camera Inspections by GreenPath, including 86 Tank Systems selected from the following groups in accordance with Paragraph 20.d. of the CD:

1. One hundred percent (100%) of the Tank Systems with actual uncontrolled annual VOC emissions, as of September 2014, of 50 tons per year (tpy) or more – zero Tank Systems;
2. At least twenty percent (20%) of the Tank Systems with actual uncontrolled annual VOC emissions, as of September 2014, less than 50 tpy but greater than or equal to 12 tpy – 70 Tank Systems; and
3. At least five percent (5%) of the Tank Systems with actual uncontrolled annual VOC emissions, as of September 2014, less than 12 tpy – 16 Tank Systems.

SLR was notified by Noble that IR Camera inspections could not be completed at 23 of the originally selected Tank Systems because the facility was shut in. SLR chose 23 alternative Tank Systems to be inspected in place of those facilities that were shut in.

1.5 NOBLE ENGINEERING EVALUATION APPROACH

Noble used a spreadsheet that calculates storage tank pressure over time using various inputs. The spreadsheet, titled "STEM Engineering Evaluation", calculates both PPIVFR and the VCS capacity. This section describes the methodology used by Noble to apply the Modeling Guideline and Engineering Design Standard at each Tank System.

1.5.1 MODELING GUIDELINE

The methods and approaches used by Noble to determine PPIVFR as specified in its Modeling Guideline is detailed in the sections below. All general assumptions and inputs are summarized in Appendix A.

1.5.1.1 Flash Losses

Flash losses were determined based on the maximum design flowrate of Condensate and Produced Water from each separator to the Tank System and a Flash Factor.

Condensate and Produced Water maximum design flow rates were calculated using Equations 1 through 3 in the Modeling Guideline. The sources of the inputs to the equations are as follows:

- **Valve Flow Coefficient and Pressure Recovery Factor.** Noble used coefficients and factors from the valve manufacturer (Kimray). Noble primarily uses High Pressure Control Valves (HPCV) of various sizes and with various trim sizes. Noble also used Kimray 2-inch treater valves for produced water on a few separators. A list of the flow coefficients and pressure recovery factors for each valve size and trim combination can be found in Appendix A.
- **The API Gravity of the Pressurized Liquid.** Noble used an American Petroleum Institute (API) Gravity of 80 degrees for pressurized condensate in all Engineering Evaluations. Noble used a process simulator, Aspen HYSYS®, to determine the API Gravity of 127 pressurized condensate samples. The average pressurized liquid API gravity of the samples was 76.4 degrees. The flow rate calculated is proportional to liquid API Gravity; the calculated flow rate increases as API Gravity increases. API gravity of 10 degrees was used to calculate produced water flow rates for those Tank Systems that captured flash/working losses from produced water tanks.
- **Separator Pressure.** The maximum operating pressure of the vessel was used. The control methods used by Noble to limit the separator operating pressure included: pipeline emergency shut down (ESD) pressure, vessel PRV set pressure, and automated systems to shut in wells controlled by separator pressure. The method used varies site by site. Noble considered Vapor Recovery Towers (VRTs) as pass through vessels and used the maximum operating pressure of the vessel upstream of the VRT to calculate the maximum design flow. The flow rate calculated is proportional to separator pressure; the calculated flow rate increases as separator pressure increases.
- **Absolute Vapor Pressure.** Condensate vapor pressure was calculated using the lesser of either the separator pressure or a vapor pressure calculated using a linear regression of the known sample pressure and the True Vapor Pressure (TVP) predicted by the Aspen HYSYS® Model. The regression was based on 127 pressurized condensate samples. This approach results in the vapor pressure being equal to separator pressure when the separator pressure is below approximately 330 pounds per square inch, gauge (psig). The flow rate calculated is inversely proportional to vapor pressure; the calculated flow rate increases as vapor pressure decreases. A pressurized water vapor pressure of 0.947 pounds per square inch, absolute (psia), the vapor pressure of pure water at 100 °F, was used for all Engineering Evaluations.
- **Critical Pressure.** Condensate critical pressure was calculated using a linear regression of the known sample pressure and critical pressure predicted by the Aspen HYSYS® Model. The regression was based on 127 pressurized condensate samples. The flow rate calculated is inversely proportional to critical pressure; the calculated flow rate increases

as critical pressure decreases. A pressurized water critical pressure of 3,200 psia, the critical pressure of pure water, was used for all Engineering Evaluations.

Noble calculated the Flash Factor for condensate using the Valko-McCain (Valkó & McCain Jr., 2003) flash gas correlation. The sources of the inputs to the equations were as follows:

- **Separator Pressure.** Noble used a separator pressure equal to the maximum operating pressure of the vessel. The control methods used by Noble to limit the separator pressure included: pipeline ESD pressure, vessel PRV set pressure, and automated control systems used to shut in wells when the separator pressure reached a specified pressure. The method used varies site by site. For example, Noble used a 12 psig operating pressure for any condensate that is directed through a VRT. The flow rate calculated is proportional to separator pressure; the calculated flow rate increases as separator pressure increases.
- **Separator Temperature.** Noble used a separator temperature of 65 °F for all Engineering Evaluations. The value is within the published journal article limits. The Flash Factor calculated by the Valko-McCain correlation is inversely proportional to separator temperature; the calculated Flash Factor increases as temperature decrease.
- **Stock Tank API Gravity.** Noble used a stock tank API gravity of 60 degrees for all Engineering Evaluations. The value is above the published journal article limits[3]. The Flash Factor calculated by the Valko-McCain correlation is directly proportional to stock tank API gravity; the calculated Flash Factor increases as stock tank API gravity increases.

The Flash Factor for produced water used by Noble for all Engineering Evaluations was 4 scf/bbl. The value is based on multiple flash liberation studies of produced water from Noble's facilities.

1.5.1.2 Working and Breathing Losses

Noble used methods in API Standard 2000 (American Petroleum Institute, 2014) to calculate working and breathing losses from both oil and water tanks, as specified in Sections 6.2 and 6.3 of the Modeling Guideline. Noble used the working loss factor of 12 scf of air per barrel of liquid flow and a breathing factor of one scf of air per bbl of tank capacity[4]. These are the highest of the factors presented in API Standard 2000 and apply to liquids with a flash point under 100 °F or a normal boiling point under 300 °F. Volume of air (scf) was converted to hydrocarbon vapor volume (scf) using a hydrocarbon vapor specific gravity of 1.59.

1.5.1.3 Other Losses

Noble did not identify or include any other losses in its calculation of PPIVFR. Other vapor sources listed in the Modeling Guideline to be considered in PPIVFR calculations, if they exist, include vortex gas entrainment, separator vapor, VRT vapor, and truck loading vapor. Vortex gas entrainment was not included because Noble maintains liquid level height to a height greater than

[3] The journal article limits are greater than or equal to 36.2 °API and less than or equal to 56.8 °API

[4] The factor is less than 1 scfh/bbl capacity for tanks over 20,000 bbl. None of the Tank Systems included in the Audit contained any tank with a capacity greater than 20,000 bbl.

the “critical liquid height” as provided by the equipment vendor to prevent vortex gas entrainment. Separator and VRT vapors were not included because Noble stated that those vapors are directed to pipeline or to a VCS separate from the condensate tanks at every site audited. SLR found some Tank Systems where truck loading vapors are or may be directed to the same VCS as the condensate storage tanks. This is discussed further in Section 4.1.

Vapor losses from the loading of condensate into trucks were included by Noble in its calculation of PPIVFR at Tank Systems with Tank Truck Loadout (TLO) Control Systems in revised Engineering Evaluations, as discussed in Section 4.0. Noble used a vapor flow rate of 2,527 scf per hour[5] to calculate TLO losses.

1.5.2 ENGINEERING DESIGN STANDARD

Noble applied its site-specific design standard to each site using the STEM Engineering Evaluation spreadsheet. Noble did not complete Engineering Design Standards for Pressure Line Groupings pursuant to Paragraph 9 of the CD, as noted in the approved Work Plan and Certification of Completion Reports. Each Tank System has its own individual Engineering Design Standard determined by the STEM Engineering Evaluation spreadsheet. The spreadsheet calculates the Tank System pressure in one-second intervals over a 10- to 60-minute period based on the amount of vapor entering via flashing, working and breathing losses, and leaving the Tank System via the VCS.

Flashing and working losses only occur during a dump event. The frequency and duration of dump events from each separator is calculated based on the production rate, production cycles, and average time per cycle. Breathing losses are assumed to occur constantly. All separators that produce to the Tank System are assumed to simultaneously dump at the beginning of the modeling period (i.e., at 0 seconds) unless automation is installed to prevent simultaneous dump events. After time zero, the separators dump based on their individually calculated frequency for the remainder of the modeling period.

The amount of vapor leaving the tank via the VCS is determined based on burner curves and pressure drop through the VCS piping. Burner curves relating burner inlet pressure to flow rate were obtained from the combustion control device manufacturer or based on testing at Noble facilities. A list of the burners used by Noble, including the manufacturer and burner specifications, are provided in Appendix A. Noble also accounted for a burner management system typically used with Cimarron, Leed, and Tornado control devices. The burner management system prevents vapor from entering the control device until a certain pressure at the inlet to the device or in the tanks is reached, referred to as the “Turn On” point by Noble. Vapor is allowed to flow into the device once the “Turn On” point is reached and continues flow until the “Turn Off” point is reached. The most common “Turn On” point used by Noble was 5 ounces per square inch (oz/in^2) and the most common “Turn Off” point used by Noble was 2 oz/in^2. Pressure drop through VCS piping was calculated based on the Spitzglass Formula. The diameter and number of vapor collection lines were specified by the user. The spreadsheet calculated the equivalent length of piping based on the number of tanks entered. The correlation

[5] Based on an April 25, 2017 phone call with Noble’s engineer, this value was calculated based on the maximum loadout rate of 450 bbl per hour set out in Noble’s standard operating procedure for truck loading. Noble assumed as liquid enters the truck, the same amount of vapor is displaced and sent to the VCS and the vapor in the truck is at standard conditions.

of equivalent piping length based on the number of tanks was created based on actual measured pipe lengths and number fittings from a number of Noble's Tank System VCS.

Other critical inputs into the spreadsheet include the volume of liquid in the tanks (liquid level), the tank PRV set pressure, and tank design pressure. The liquid level in the tanks is used to determine the vapor volume in the tanks, which in turn is used to calculate tank pressure. Noble assumed the tanks were filled to the liquid overflow line height. Typically, the overflow lines were located at a level 90% of the tank height. Noble, at some Tank Systems, disconnected one or more tanks from the liquid fill header to prevent them from receiving liquids and removed all liquids from the tank(s). The tank(s) remained connected to the VCS to act as a vapor surge vessel. The Tank System average liquid level used in the spreadsheet in these cases would reflect that some of the tanks had no liquid in them. Typical tank PRV set point and tank design pressures used by Noble were 16 oz/in^2 and 10 oz/in^2, respectively. Noble ensured that in each Engineering Evaluation the calculated peak tank pressure did not exceed the tank design pressure.

2. DOCUMENT REVIEW

Noble provided the following documents for each Tank System for SLR review in accordance with the approved Work Plan:

- Signed Facility STEM Plan – Tank System specific STEM Plan used to comply with Colorado Air Quality Control Commission Regulation 7, Section XVII.C.2.b;
- Signed Vapor Control System Engineering Evaluation – Signed Engineering Evaluation of the Tank System VCS and PPIVFR after any necessary modifications were completed;
- Work Request – Formal request to modify facility equipment and/or operating parameters based on the Engineering Evaluation;
- Walkdown Checklist – Documentation of a final inspection of the Tank System verifying the modifications directed in the work request were completed;
- IR Camera Verification Documentation Field Data Sheet – Documentation of IR Camera Inspection after modifications were complete;
- IR Camera Video Files – Videos of each IR Camera Inspection during normal operations, during a dump event, and immediately after a dump event; and
- Final Packet – A consolidated facility information document package that included the documentation mentioned above and possibly pre-evaluation documents, Tank System configuration drawings, construction job sheets, and confirmation of completion for requested automation modifications.

2.1 DOCUMENT REVIEW APPROACH

SLR utilized the following approach to audit each Tank System Engineering Evaluation and confirm whether Noble applied the Modeling Guideline and applicable Engineering Design Standard to verify each VCS was adequately designed and sized to handle PPIVFR:

1. Review pre-evaluation documentation to determine the facility pre-modification sources of vapor into the VCS, VCS configuration, and control equipment.
2. Review issued work requests to determine the impact of requested changes to facility equipment and any subsequent changes to PPIVFR or VCS.
3. Review walkdown and final packet information to substantiate the requested changes were completed.
4. Calculate PPIVFR based on methods and equations in the Modeling Guideline (Noble Energy, Inc., 2015) and the final confirmed Tank System configuration.
5. Assess the capacity of the final verified control device configuration using published manufacturer specifications. SLR used the capacity as published and did not correct for site-specific factors such as atmospheric pressure, gas density, or pressure drop through VCS piping.

6. Calculate the final verified Tank System headspace surge capacity using Noble's STEM Engineering Evaluation model.
7. Determine if the PPIVFR exceeds the combined control device and headspace capacity at the pressure relief valve set pressure.
8. Review the IR Camera Verification Documentation Field Data Sheet and IR Camera Videos to verify any detection of VOC emissions.

Each verification audit review was performed by an SLR Auditor and subsequently verified by a SLR Lead Auditor. All audit verified data, comparison calculation results, and any explanatory audit notes are captured in an Engineering Evaluation Verification Audit package for each Tank System included in Appendix B, Detailed Document Review Findings.

2.2 EVALUATION CRITERIA

SLR developed evaluation criteria to determine if Noble applied its Modeling Guideline and applicable Engineering Design Standard correctly and if each VCS was adequately designed and sized to accommodate PPIVFR.

2.2.1 APPLICATION OF THE MODELING GUIDELINE

SLR reviewed inputs, assumptions, and methods used for calculation of PPIFVR to assess the correct application of the Modeling Guideline. SLR calculated PPIVFR using Noble's selected approach, as specified in its Modeling Guideline, and compared those results with Noble's calculated PPIVFR at each Tank System. Alignment of PPIVFR determined by Noble versus what was determined by SLR generally indicated correct application of the Modeling Guideline. Potential discrepancies between PPIVFR results reported by Noble and results independently determined by SLR using the same methodology include but are not limited to:

1. Incorrect equations or conversion factors were used in determining maximum instantaneous condensate liquid flow rate;
2. Incorrect application of the Valko-McCain Correlation in the determination of Flash Factors;
3. Site-specific values, such as valve size, valve trim size, or maximum operating pressure used in Noble's Engineering Evaluation differed from what could be verified based on the documentation provided;
4. All sources of vapor were not included in Noble's calculation of PPIVFR; or
5. Assumptions or correlations used as inputs into the equations for determining PPIVFR were not representative of Noble's operations

2.2.2 APPLICATION OF THE ENGINEERING STANDARD

SLR reviewed inputs and assumptions related to Noble's calculation of the VCS capacity to determine whether or not the Engineering Design Standard was applied correctly. The VCS capacity is determined by the sum of the control device capacity and the Tank System VCS headspace surge capacity. SLR used manufacturer's published maximum control device capacities and independently determined VCS surge capacity using Noble's STEM Engineering Evaluation spreadsheet. SLR considered the Engineering Design Standard to be properly applied by Noble if the inputs and assumptions that affect the VCS capacity were correct or otherwise conservative. Examples where the VCS capacity determined using Noble's Engineering Design Standard may represent an overestimation of actual capacity include but are not limited to:

1. The calculated control device capacity in Noble's Engineering Evaluation is greater than the manufacturer published maximum capacity;
2. The number of control devices used in Noble's Engineering Evaluation is greater than the number installed;
3. The control device used in Noble's Engineering Evaluation has a higher capacity than the control device installed;
4. The number of vapor lines or the diameter of the vapor line(s) used in Noble's Engineering Evaluation is greater than the number of lines or the diameter of the line(s) installed;
5. The number of storage tanks or the capacity of the storage tanks used in Noble's Engineering Evaluation is greater than the number of storage tanks or the capacity of the storage tanks installed; and
6. The storage tank liquid level used in Noble's Engineering Evaluation is lower than the maximum liquid level, resulting in overestimation of headspace surge capacity.

2.2.3 VCS ADEQUATE DESIGN AND SIZING

The VCS was considered adequately designed and sized if SLR's calculated VCS capacity (burner capacity plus headspace surge capacity) was greater than SLR's calculated PPIVFR.

2.3 MISSING OR CONFLICTING DATA

SLR encountered missing or conflicting data used to verify inputs into some Engineering Evaluations. In cases where conflicting information was presented and additional information was not available, a hierarchy of documentation was used to determine inputs SLR would use in its calculations. The hierarchy is as follows:

1. Final facility walkdown checklist
2. Job Sheets and confirmation emails
3. Initial facility walkdown field data sheets

If the information could not be verified with the first document in the hierarchy, SLR would use information from the next one. SLR used conservative inputs in its calculations when information was missing.

3. IR CAMERA INSPECTIONS

The IR Camera Inspections were conducted by GreenPath August 20–30, 2018. Noble was notified via email of the list of Tank Systems to be inspected two weeks prior to such inspections to ensure site access, that Normal Operations were occurring, and that no Malfunctions existed at any of the selected Tank Systems.

3.1 SELECTION CRITERIA

The selection of Tank Systems for IR Camera Inspections was based on an initial review[6] of Noble's Engineering Evaluation for most of the Tank Systems (the audit for most of the Tank Systems was not completed until fall and winter 2018 after the IR camera inspections occurred). Tank Systems found to be inadequately designed and sized or having emissions visible in the IR camera videos provided by Noble were selected for an IR Camera Inspection as part of the audit. If an insufficient number of sites were identified in each category using the aforementioned criteria, then sites with the smallest difference between SLR's calculated VCS capacity and PPIVFR were selected for IR Camera Inspection.

IR camera inspections could not be completed on 23 of the originally selected Tank Systems because the wells associated with the Tank System were shut in. SLR provided Noble with 58 alternative Tank Systems to ensure an active facility could be inspected. A detailed list of the sites selected for IR Camera Inspection can be found in Table 2.

SLR made a best effort to ensure the IR Camera Inspections were divided proportionately among the Three Line Pressure Groupings[7] defined in the CD as prescribed by the approved Work Plan. The primary Tank Systems selected and inspected consisted of 14 Tank Systems from Group I, 32 Tank Systems from Group II, and 40 Tank Systems from Group III. The alternative Tank Systems selected and inspected consisted of 3 Tank Systems from Group I, 10 Tank Systems from Group II, and 11 Tank Systems from Group III.

[6] "Initial review" means the Tank System engineering evaluation had a first look by an Auditor. In order for a review to be considered complete the findings of the Auditor must be confirmed by a Senior Auditor and additional information from Noble may need to be requested and reviewed by both the Auditor and Senior Auditor. At the time Noble was informed of the Tank Systems selected for IR Camera Inspection 85% of the Tank Systems had an "Initial Review" but only 38% were complete.

[7] "'Three Line Pressure Groupings' shall mean the distribution of Tank Systems that are associated with Well Production Operations which produce gas into sales lines that, as of August 17, 2014, had line pressures within the following three ranges: (1) 233 psi or greater ("Group I"); (2) less than 233 psi and greater than or equal to 186 psi ("Group II"); and (3) less than 186 psi ("Group III"). If Noble later determines that another grouping of the Tank Systems is more appropriate, in consultation with EPA and CDPHE and subject to both agencies' prior written approval, the Tank Systems can be redistributed among Group I, Group II, and Group III." Consent Decree, Section III, Paragraph 6, kk.

4. FINDINGS

The results of SLR's document review and IR Camera Inspections are summarized below.

4.1 APPLICATION OF THE MODELING GUIDELINE

SLR found the Modeling Guideline was not applied correctly for 26 of 587 Tank Systems evaluated. Additionally, correct application of the Modeling Guideline could not be verified for 137 of 587 Tank Systems based on a comparison of field-verified information and information in the final signed evaluation. Table 1 provides a summary of findings. Detailed findings can be found in Appendix B.

1. The water or oil dump valve body size could not be confirmed and the largest valve body size with the confirmed trim size was not used in the signed Engineering Evaluation for 138 Tank Systems. Due to the large number of Tank Systems to which this finding applies, those Tank Systems are not listed here, but instead can be found in Table 1.

   In the First Audit, Noble stated: "The specific valve size and type is not a critical aspect of the engineering design. Field verification of the valve size would not impact the adequacy of engineering design determination, as the typical design targets a contingency of approximately 20-30%."

2. For the following nineteen (19) Tank Systems, the signed evaluation did not account for breathing losses for all tanks within the Tank System.
   1) 70 RANCH T5N-R63W-S21 L01 (TS# 329)
   2) BOULTER T4N-R65W-S14 L03 (TS#142)
   3) COALVIEW DINNER G01 ECONODE T4N-R65W-S1 L01 (TS# 236)
   4) DEGENHART ST USX T6N-R62W-S16 L01 (TS# 363)
   5) DIETRICH T4N-R64W-S7 L01 (TS# 623)
   6) EIFERT VANNOY T6N-R65W-S11 L01 (TS# 66)
   7) SATER T4N-R63W-S18 L01 (TS# 2374)
   8) SATER USX T4N-R63W-S19 L01 (TS# 1465)
   9) SAUER T5N-R65W-S33 L02 (TS# 2031)
   10) SCHMIDT T5N-R65W-S36 L01 (TS# 274)
   11) SHABLE FED T9N-R60W-S33 L01 (TS# 570)
   12) SLW RNCH B01 ECONODE T5N-R64W-S12 L01 (TS# 2026)
   13) SLW RNCH B12 ECONODE T5N-R64W-S12 L02 (TS# 2032)
   14) SLW ST PC T5N-R63W-S18 L01 (TS# 302)

15) STORIS E24 & MACKINAW A19 ECONODE T6N-R65W-S24 L01 (TS# 2343/1954)

16) WAHLERT AC33 ECONODE T7N-R63W-S3 L01 (TS# 1992)

17) WATKINS BARNETT T4N-R64W-S12 L01 (TS# 446)

18) WELLS RANCH AF T5N-R62W-S8 L01 (TS# 343)

19) WELLS RANCH USX BB T5N-R63W-S15 L06 (TS# 332)

For three (3) of those Tank Systems, the tanks were not banked, but the number of tanks included in the signed engineering evaluation was less than the number of tanks confirmed to be part of the Tank System in the field documentation provided. Noble agrees with SLR and submitted update documentation with Noble's Semi- Annual Report (10th) (on or before January 30, 2020) to accurately reflect the Tank System configuration for the following Tank Systems:

1) BOULTER T4N-R65W-S14 L03 (TS#142)
2) SATER USX T4N-R63W-S19 L01 (TS# 1465)
3) WATKINS BARNETT T4N-R64W-S12 L01 (TS# 446)

For sixteen (16) of those Tank Systems omission of certain breathing losses was due to the tanks being in a banked configuration[8].

1) 70 RANCH T5N-R63W-S21 L01 (TS# 329)
2) COALVIEW DINNER G01 ECONODE T4N-R65W-S1 L01 (TS# 236)
3) DEGENHART ST USX T6N-R62W-S16 L01 (TS# 363)
4) DIETRICH T4N-R64W-S7 L01 (TS# 623)
5) EIFERT VANNOY T6N-R65W-S11 L01 (TS# 66)
6) SATER T4N-R63W-S18 L01 (TS# 2374)
7) SAUER T5N-R65W-S33 L02 (TS# 2031)
8) SCHMIDT T5N-R65W-S36 L01 (TS# 274)
9) SHABLE FED T9N-R60W-S33 L01 (TS# 570)
10) SLW RNCH B01 ECONODE T5N-R64W-S12 L01 (TS# 2026)
11) SLW RNCH B12 ECONODE T5N-R64W-S12 L02 (TS# 2032)
12) SLW ST PC T5N-R63W-S18 L01 (TS# 302)
13) STORIS E24 & MACKINAW A19 ECONODE T6N-R65W-S24 L01 (TS# 2343/1954)
14) WAHLERT AC33 ECONODE T7N-R63W-S3 L01 (TS# 1992)
15) WELLS RANCH AF T5N-R62W-S8 L01 (TS# 343)

[8] Banked configurations consist of sets of producing and non-producing tanks connected to the same VCS. The non-producing tanks do not actively receive oil or water but breathing losses may still occur since the tanks may contain hydrocarbon liquids.

16) WELLS RANCH USX BB T5N-R63W-S15 L06 (TS# 332)

Consistent with the First Audit, Noble acknowledged that breathing losses were not incorporated for the non-producing storage only bank. However, Noble also chose not to incorporate the headspace surge capacity associated with the non-producing storage only tanks. Noble maintains, as a consequence, the single bank model results in a more conservative analysis to ensure design adequacy during all operating modes. SLR found when Noble's Engineering Evaluation model was run with all storage tanks included the increase in the headspace surge capacity was greater than the increase in breathing losses at these Tank Systems.

3. SLR found the evaluation did not account for all separator dumps for the following six (6) Tank Systems. Noble agrees with SLR and submitted update documentation with Noble's Semi- Annual Report (10th) (on or before January 30, 2020) to accurately reflect the Tank System configuration for the following Tank Systems

    1) SAUER T5N-R65W-S33 L02 (TS# 2031)
    2) SHOEMAKER T6N-R64W-S12 L02 (TS# 589)
    3) SLW RNCH B01 ECONODE T5N-R64W-S12 L01 (TS# 2026)
    4) SLW RNCH B12 ECONODE T5N-R64W-S12 L02 (TS# 2032)
    5) STORIS E24 & MACKINAW A19 ECONODE T6N-R65W-S24 L01 (TS# 2343)
    6) WAHLERT AC33 ECONODE T7N-R63W-S3 L01 (TS# 1992)

   In the case of the four Econodes and the Sauer Tank System, it appears that due to constraints of the Engineering Evaluation Spreadsheet, separators were "doubled-up" or "tripled-up,"[9] but the dump rate was not doubled or tripled as necessary when using this method.

4. The maximum separator pressure in the engineering evaluation is less than maximum pressure confirmed in the field documentation for the AVA ST T4N-R64W-S36 L02 (TS 968) Tank System. Noble agrees with SLR and has progressed documentation updates to accurately reflect the Tank System configuration. An updated Engineering Evaluation has been generated and will be submitted with Noble's Semi- Annual Report (10th) (on or before January 30, 2020).

5. The evaluation used a smaller dump valve size than was confirmed via the field documentation for four (4) Tank Systems.

    1) CERVI USX T4N-R63W-S23 L01 (TS# 457). A draft of this report was submitted to Noble after this facility was decommissioned and therefore Noble could not confirm the size of the dump valve and trim.
    2) FURROW FED T7N-R64W-S14 L01 (TS# 577)
    3) JOHNSON MARK ALTER AMANDA ZANE T4N-R64W-S9 L01 (TS# 652)
    4) SARCHET T3N-R65W-S24 L02 (TS# 1935)

[9] i.e. one separator entry in the STEM Engineering Evaluation spreadsheet is meant to represented two or three actual separators.

In the First Audit, Noble stated that “the specific valve size and type is not a critical aspect of the engineering design. Field verification of the valve size would not impact the adequacy of engineering design determination, as the typical design targets a contingency of approximately 20-30%.

6. The evaluation was completed with a smaller tank size than confirmed in field documentation provided for the SKYWAY T5N-R67W-S11 L02 (TS# 2202) Tank System. Noble agrees with SLR regarding SKYWAY T5N-R67W- S11 L02 (TS# 2202). An updated Engineering Evaluation has been generated and was submitted with Noble’s Semi-Annual Report (10th) (on or before January 30, 2020).

4.2 APPLICATION OF THE ENGINEERING DESIGN STANDARD

SLR found the Engineering Design Standard was not applied correctly for 70 of 587 Tank Systems evaluated and of Tank Systems evaluated. Table 1 provides a summary of findings. Detailed findings can be found in Appendix B.

1. For 59 Tank Systems, the evaluation states the certification maximum liquid level is 90 percent of the tank height and the control method is "Equalizer Height." In all cases, the Tank System consists of a single oil tank. An equalizer line is designed to allow liquid from one tank to spill into a second tank once the liquid reached the level at which the equalizer line is installed. As a consequence, there is no control on the maximum liquid level and the vapor headspace capacity is overestimated. Those 59 Tank Systems are listed in Table 1.

   In response to this finding Noble stated that “ Noble reviewed records associated with the fifty-nine (59) Tank Systems identified by SLR. Noble agrees with SLR that an equalizer line on a single- tank system does not inherently control vapor headspace capacity. Noble consciously used the equalizer line as a reasonably foreseeable maximum in its application of the Engineering Design Standard. One of the primary roles of Noble’s production staff is to monitor produced volumes and dispatch oil hauling companies as tanks become full. While it is possible that a tank could be filled above the equalizer height, it is very unlikely as Tank Systems have weeks (and often months) of storage capacity. Conversely, applying the Engineering Design Standard with a completely full tank results in zero headspace volume, which requires an unreasonable combustion system capacity that would be difficult to maintain given the low volumes of gas produced by wells at single-tank facilities. Lastly, through the Tank Pressure Monitoring program and regular equipment inspections, Noble has not identified any instances of Reliable Information resulting from excessive tank fillage above the equalizer height. While Noble recognizes the accuracy of SLR’s finding, Noble disagrees that the Engineering Design Standard was incorrectly applied.”

2. SLR found evaluations were completed with a larger vapor line size than confirmed to be on site for six (6) Tank Systems. Noble agrees with SLR and has progressed documentation updates to accurately reflect the Tank System configuration. An updated Engineering Evaluation for each site has been generated and were submitted with Noble’s Semi-Annual Report (10th) (on or before January 30, 2020):

   1) 70 RANCH USX T5N-R63W-S9 L02 (TS# 331)

2) BECCA CODY T3N-R64W-S3 L01 (TS# 516-b)
3) DINNEL T4N-R64W-S26 L02 (TS# 492)
4) SCHMIDT T4N-R65W-S19 L03 (TS# 833)
5) UPRC CHWY FERGUSON MONFORT T5N-R64W-S23 L01 (TS# 310/1016)
6) WELLS RANCH USX AA T6N-R63W-S11 L02 (TS# 1559)

3. The evaluation was completed with two vapor lines in a section of the VCS but only one line was confirmed to be installed in the field documentation provided for two (2) Tank Systems. Noble reviewed records associated with the two (2) Tank Systems identified by SLR. For the two (2) Tank Systems, Noble agrees with SLR and has progressed documentation updates to accurately reflect the Tank System configuration. Updated Engineering Evaluations were submitted with Noble's Semi- Annual Report (10th) (on or before January 30, 2020):

    1) CONAGRA T5N-R64W-S30 L03 (TS# 321)
    2) RITCHEY T3N-R65W-S27 L03 (TS# 411)

4. The headspace surge capacity was reduced by more than half the value in the evaluation when the correct parameters that affect the modeling guideline were input into Noble's STEM Engineering Evaluation spreadsheet for the SLW RNCH B01 ECONODE T5N-R64W-S12 L01 (TS# 2026) Tank System. Noble reviewed records associated and is correcting issues identified with headspace surge capacity in addition to the simultaneous separator dumps in an updated engineering evaluation was submitted with Noble's Semi-Annual Report (10th) (on or before January 30, 2020).

5. The evaluation was completed with a larger combustor than confirmed to be installed in the field documentation provided for the OREDIGGER WILMOTH MCCLINTOCK T4N-R64W-S4 L01 (TS #627) Tank System. Noble reviewed records associated with the OREDIGGER WILMOTH MCCLINTOCK T4N-R64W-S4 L01 (TS# 627) Tank System identified by SLR. Noble agrees with SLR. An updated Engineering Evaluation has been generated and was submitted with Noble's Semi-Annual Report (10th) (on or before January 30, 2020).

6. The evaluation was completed with a larger tank size than confirmed to be installed in the field documentation provided for the MILE HI SHEEP T6N-R64W-S8 L01 (TS# 609) Tank System. Noble reviewed records associated with the MILE HI SHEEP T6N-R64W-S8 L01 (TS# 609) Tank System identified by SLR. Noble agrees with SLR. An updated Engineering Evaluation has been generated and was submitted with Noble's Semi-Annual Report (10th) (on or before January 30, 2020).

4.3 VCS ADEQUATE DESIGN AND SIZING

SLR found the VCS was not adequately designed and sized for one (1) Tank System.

1) SLW RNCH B01 ECONODE T5N-R64W-S12 L01 (TS# 2026): In light of the explanation provided in response to item 2 and 3 of Section 4.1 and item 6 of Section 4.2, Noble reviewed the updated engineering evaluation submitted with Noble's Semi- Annual Report (10th). The corrections to the headspace capacity, simultaneous separator dump, and PPIVFR confirmed the accuracy of the VCS Design Capacity.

Results of the document review for each Tank System are summarized in Table 1 and detailed in Appendix B.

4.4 IR CAMERA INSPECTIONS

GreenPath detected VOC emissions from the VCS at ten (10) Tank Systems, or 12 percent of the 86 Tank Systems inspected. The most prevalent sources of observed emissions were thief hatches and PRVs on oil and water tanks. Details of the IR Camera Inspections can be found in Table 2 and the detailed GreenPath Report found in Appendix C.

For each of the Tank Systems from which VOC emissions were detected, GreenPath notified Noble, Noble completed corrective action, and GreenPath re-surveyed the component to confirm that the indication of VOC emissions had been eliminated. Records documenting GreenPath's IR Camera Inspections, Noble's corrective action and GreenPath's re-survey of those components are provided in Appendix C.

IR camera inspection video files were provided on a flash drive to Parties, as required by the Work Plan.

5. REFERENCES

American Petroleum Institute. (2014, March). Venting Atmospheric and Low-Pressure Storage Tanks. *API Standard 2000*.

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Valkó, P., & McCain Jr., W. (2003). Reservoir oil bubblepoint pressures revisited; solution gas–oil ratios and surface gas specific gravities. *Journal of Petroleum Science and Engineering* (37), 153-169.

TABLES

APPENDIX A

ASSUMPTIONS AND REFERENCES

Third-Party Verification Final Audit Report
Second Audit

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

September 25, 2020

APPENDIX B

DETAILED DOCUMENT REVIEW FINDINGS

Third-Party Verification Final Audit Report
Second Audit

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

September 25, 2020

APPENDIX C

GREENPATH IR CAMERA INSPECTION REPORT

Third-Party Verification Final Audit Report
Second Audit

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

September 25, 2020

APPENDIX D

NOBLE COMMENT LETTER FOR THE DRAFT AUDIT REPORT FROM THIRD-PARTY AUDITOR – SECOND AUDIT

Third-Party Verification Final Audit Report
Second Audit

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

September 25, 2020