



## RAILROAD COMMISSION OF TEXAS

### HEARINGS DIVISION

**OIL & GAS DOCKET NO. 08-0288586**

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**THE APPLICATION OF CONOCOPHILLIPS COMPANY PURSUANT TO STATEWIDE RULE 9 AND STATEWIDE RULE 36 FOR A PERMIT TO DISPOSE OF OIL AND GAS WASTE CONTAINING HYDROGEN SULFIDE INTO A RESERVOIR NOT PRODUCTIVE OF OIL OR GAS; DORIS COLE LEASE, WELL NO 14D; HOWARD-GLASSCOCK (WOLFCAMP 7400) FIELD; HOWARD COUNTY, TEXAS**

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**HEARD BY:** Brian Fancher, P.G. – Technical Examiner  
Marshall F. Enquist – Hearings Examiner

**APPEARANCES:**

**APPLICANT:**

Jamie Nielson  
Greg Cloud, P.E.  
Chibuike P. Njoku  
Steven O. Moore  
Leo Gatson

**REPRESENTING:**

ConocoPhillips Company

**EXAMINERS' REPORT AND RECOMMENDATION**

**STATEMENT OF THE CASE**

The subject application is unopposed. The subject application is limited to ConocoPhillips Company(Applicant) request for a non-commercial permit to dispose of oil and gas waste in the Doris Cole Lease, Well No. 14D (API No. 42-227-37544) (the subject well or the well) pursuant to the Commission's Statewide Rule 36 (*Oil, Gas, or Geothermal Resource Operation in Hydrogen Sulfide Areas*) and Statewide Rule 9 (*Disposal Wells*). Applicant requests to dispose of oil and gas waste that includes up to four-hundred and ten thousand (410,000) cubic feet of gas per day made of roughly 850,000 parts per million (ppm) hydrogen-sulfide gas (H<sub>2</sub>S), or eighty-five percent (85%) H<sub>2</sub>S. The subject well has been drilled and completed, and is reportedly located fifteen miles southeast of Big Spring, Texas in the W&NW RR Co. Survey (A-1435), Block 29, Section 96.

The subject well's notice of application(NOA) was performed in accordance with Statewide Rule 9(5)(A), where the following persons were provided the NOA: (1) surface owner of the subject tract (Mr. Robert Keeley), (2) oil and gas operators within one-half mile of the subject well's surface

location (RK Petroleum Corp; Partee Drilling, Inc.) (3) the Howard County Clerk, and (4) a publication in the *Big Spring Herald*, a newspaper of general circulation in Howard County, Texas, on April 6, 2013 and July 31, 2014.

Prior to drilling the well, Applicant's proposed injection interval spanned from 9,100 feet to 10,400 feet<sup>1</sup>. As a result of an examiner's inquiry, Applicant requested to amend its proposed injection interval at the hearing to span from 9,150 feet to 9,850 feet. On July 24, 2014, Applicant provided notice to the well's surface owner, operators with 1/2-mile, and the Howard County Clerk. No protest was received by the Commission.

### **DISCUSSION OF THE EVIDENCE**

The subject application was rendered administratively complete by the Commission's Oil & Gas Division and no protest in opposition to the subject application was received by the Commission. The subject application would have been granted administratively if not for the volume and concentration of hydrogen-sulfide ("H<sub>2</sub>S") disposal in the well.

A public hearing is required by rule in the instant case because the application includes disposal of H<sub>2</sub>S where the 100 part per million radius of exposure of H<sub>2</sub>S exceeds 3,000 feet<sup>2</sup>. All persons required to be noticed of the subject application were provided notice in accordance with Statewide Rule 9. Statewide Rule 36, which is the governing rule that requires a public hearing, does not contemplate "affected persons" in the instant case nor does it offer any guidance as to what an Applicant must prove to be granted authority pursuant to Statewide Rule 36(c)(10).

### **Governing Statutes and Commission Rules**<sup>3</sup>

#### **Statewide Rule 36 [16 Tex. Admin. Code §3.36]**

In general, Statewide Rule 36 applies to each operator who conducts operations associated with hydrocarbon fluids that contain H<sub>2</sub>S as a gas constituent, where H<sub>2</sub>S is encountered through field production, transportation, and handling of said hydrocarbon fluids<sup>4</sup>. The subject application falls within the applicability of Statewide Rule 36 and must provide safeguards to protect the general public from the harmful effects of H<sub>2</sub>S.

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<sup>1</sup> Exh. 2, pg. 1.

<sup>2</sup> See 16 Tex. Admin. Code §3.36(c)(10)

<sup>3</sup> The Commission's Statewide Rules 36 and 46 were the only rules considered; however, the subject well is not limited to Rules 36 and 46, and is required to comply with any and all applicable Commission regulations.

<sup>4</sup> See 16 Tex. Admin. Code §3.36(a).

Although a hearing is required by Statewide Rule 36, it offers no legal or technical requirements or guidance as to what must be shown to obtain authority from the Commission to inject H<sub>2</sub>S. Statewide Rule 36(c)(10) states the following:

(A) Injection of fluids containing hydrogen sulfide shall not be allowed under the condition specified in this provision unless first approved by the commission after public hearing:

(i) where injection fluid is a gaseous mixture, or would be a gaseous mixture in the event of a release to the atmosphere, and where the 100 ppm radius of exposure is in excess of 50 feet and includes any part of a public area except a public road; or, if the 500 ppm radius of exposure is in excess of 50 feet and includes any part of a public road, or if the 100 ppm radius of exposure is 3,000 feet or greater;

(ii) where the hydrogen sulfide content of the gas or gaseous mixture to be injected has been increased by a processing plant operation.

*(emphasis added)*

#### Statewide Rule 9

Statewide Rule 9 requires that a permit be approved to conduct injection operations into nonproductive zones of oil, gas, or geothermal resources. If no protest from any affected person is received by the Commission, the Commission's delegate may administratively approve the application without the need for a public hearing<sup>5</sup>. Statewide Rule 9(G)(ii) defines "affected persons" as the following:

[A] person who has suffered or will suffer actual injury or economic damage other than as a member of the general public or as a competitor, *and* includes surface owners of property on which the well is located and commission-designated operators of wells located within one-half mile of the proposed disposal well. *(emphasis added)*

#### Application History

Mr. Greg Cloud testified on behalf of the Applicant, with respect to the administrative history and petroleum engineering aspects of the application. Mr. Cloud is a expert in regulatory petroleum engineering. Mr. Cloud testified that the initial administrative application was filed on July 23, 2014. The initial application was rendered complete and a disposal permit was granted by the Oil and Gas Division ("Staff") on March 11, 2014.

On April 3, 2014, Staff issued a letter to Applicant stating that the subject well's disposal permit was issued in error, and that a public hearing is required pursuant to Statewide Rule 36(c)(10).

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<sup>5</sup> See 16 Tex. Admin. Code §3.9(5)(F)

On May 15, 2014, a Notice of Hearing (“NOH”) was issued for the subject application by the Commission. On May 29, 2014, Applicant published NOH in the *Big Herald Spring*, a newspaper of general circulation in Howard and Glasscock Counties. On July 10, 2014, the subject application was heard. On July 31, 2014, Applicant’s counsel submitted several late-filed exhibits requested by the examiners.

### **Well Construction (Drilling, Casing, Cementing, and Completion)**

On January 21, 2014, drilling of the well was completed<sup>6</sup>. Mr. Stephen Moore, chief drilling engineer for Conoco’s Mid-Continent Business Unit, testified as to the drilling, casing, and cementing of the well, which was completed in the following manner<sup>7</sup>:

1. **Conductor-pipe:** 20" set from surface to 98.5 feet; cement circulated to surface; hole-size of 30".
2. **Surface-casing string:** 13-3/8" set from surface to 905 feet; 765 sacks of cement; circulated cement to surface; drill-hole size of 16" .
3. **Intermediate-casing string:** 9-5/8" set from surface to 4,490 feet; 1,289 sacks of cement; cement circulated to surface; drill-hole size of 12-1/4".
4. **Production-casing string:** 5-1/2" set from surface to 9,159 feet; 985 sacks of cement; cement circulated to surface; drill-hole size 8-3/4".
5. **Open-hole completion:** drill-hole size 4-3/4".

Mr. Moore concluded that the materials for the well (*i.e.*, casing) were selected to meet the National Association of Corrosion Engineers’ (“NACE”) international standard for H<sub>2</sub>S exposure. Beyond that, Mr. Moore specified that the cement placed behind the production-string utilized a scavenger that is resistant to acid-gas.

On June 23, 2014, a cement bond log was performed on the well prior to drilling the “open-hole” section below the 5-1/2-inch casing string. Mr. Moore testified that the cement bond log exhibits excellent bond in the Woodford Shale formation, good bond in the Fusselman formation, and excellent bond in the Sylvan Shale formation (Tr., Pg. 63, L. 20-23). Beyond that, Mr. Moore claimed that the bottom 200 feet of the 5-1/2-inch casing are sufficiently cemented to provide isolation of the Montoya and Ellenburger formations from the remainder of the well.

Mr. Moore testified that the well’s completion program also incorporates NACE requirements. The packer and stinger (*i.e.*, the tubing below the packer) are made of high nickel alloy material designed to be suitable for H<sub>2</sub>S exposure. The tubing above the packer is comprised of carbon steel and high nickel alloy materials. In summary, Mr. Moore concluded that the well is or will be completed in a manner that is suitable for use in an H<sub>2</sub>S environment, and that the well is completed in a manner to confine fluids to the proposed injection interval (Tr., Pg. 80, L. 7).

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<sup>6</sup> Exh. 3.

<sup>7</sup> Exh. 15a- As drilled wellbore schematic.

**Disposal Fluids**

Applicant’s proposed disposal stream is made of CO<sub>2</sub>, H<sub>2</sub>S, and RCRA-exempt oil and gas wastes<sup>8</sup>. Applicant seeks to dispose of up to four-million (*i.e.*, 410,000) cubic feet of gas per day (“CFGPD”) in the well, where it will be stored in the well’s proposed injection interval. The material that makes-up the 410,000 CFGPD (“injectate”) is more or less comprised of the following components and percentages, presented in molar fraction<sup>9</sup>:

	<u>Compound</u>	<u>Mole Fraction</u>
1.	Hydrogen-sulfide (“H <sub>2</sub> S”)	85%
2.	Carbon-dioxide (“CO <sub>2</sub> ”)	14%
3.	Water (“H <sub>2</sub> O”)	1%

In other words, of the total injectate to be disposed into the well approximately 85% will be H<sub>2</sub>S and 15% CO<sub>2</sub>, or 850,000 parts per million (“ppm”) H<sub>2</sub>S and 150,000 ppm CO<sub>2</sub>.

Mr. Moore testified that the fluids to be disposed in the well will go through a multi-stage compression with inner-stage cooling that results in a water fraction of about one percent of the total disposal fluids. At the temperature and pressure that the fluids will be disposed of, the one percent of water will not be in liquid phase. Thus, the acid gas disposed of in the well will not be corrosive to the well. Mr. Moore concluded that 130 reservoir barrels of liquid is the equivalent to 410 MCFGPD.

**Disposal Interval and Geologic Evidence**

Applicant’s proposed injection interval spans from 9,150 feet to 9,850 feet in the well, which incorporates the following geologic formations: Sylvan Shale; Montoya lime; and Ellenburger<sup>10</sup>. The Sylvan Shale, Montoya, and Ellenburger formations occur in a conforming sequence from shallowest to deepest. After the well was drilled, the tops of the Sylvan, Montoya, and Ellenburger formations occur at the following depths, respectively: 9,103 feet; 9,158 feet; and 9,244 feet.

The Ellenburger formation is the primary target for disposal through the well. Mr. Chibuike Njoku testified on behalf of Applicant with regard to the well’s economics, reservoir engineering, and plume modeling performed in conjunction with the subject application. Mr. Njoku is a senior reservoir engineer at ConocoPhillips. Mr. Njoku testified that the Ellenburger formation’s thickness is roughly 1,250 feet to 1,500 feet at the well’s location. Fracturing and karsting are part of the naturally occurring properties of the Ellenburger formation; however the top 100 feet of the Ellenburger formation exhibit low permeability, which increases with further depth into the Ellenburger. In other words, the fracturing and karsting predominately occur at depths well below

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<sup>8</sup> Exh. 33.

<sup>9</sup> Tr. Pg. 76. L. 6

<sup>10</sup> Exh. 26.

the Ellenburger formation's top 100 feet. Mr. Njoku confirmed that while faulting occurs in the well's area, there are no major faults at its location. Mr. Njoku concluded that the faults identified through the Applicant's regional faulting study are inactive, cemented faults only within the Ellenburger. In other words, no faulting extends outside the Ellenburger formation (Tr., Pg. 93, L. 6).

Applicant performed an open-hole well log on the subject well on July 1, 2014. Mr. Cloud testified that the top of the Sylvan Shale is at 9,103 feet, the top of the Montoya formation is at 9,160 feet, and the top of the Ellenburger formation is at 9,244 feet (Tr., Pg. 29, L. 15-25). Mr. Cloud testified that the Montoya is a limestone rock with low porosity and low permeability. The Ellenburger formation contains mostly dolomitic-rock, which provides good porosity for disposal into the well. Mr. Cloud concluded that the Sylvan Shale combined with the Montoya formation provide for good seals above the Ellenburger formation to prevent vertical migration of disposal fluids in the well (Tr., Pg. 31, L. 2).

### **Subsurface Injectate Plume**

As previously mentioned, the well's injectate will consist of roughly 85% H<sub>2</sub>S and 14% CO<sub>2</sub>. Mr. Njoku testified that a computer model ("the model") was used to create a plume model of the injectate. The model was created with simulation program known as PSIM, which incorporates a computer interface titled SMART<sup>11</sup>.

Mr. Njoku testified the model was created to study the injectate's plume migration over a 40-year injection period. After 40-years of operation, the plume will radially extend 2,800 feet from the well and will not encounter any wells that currently penetrate or are open to the Ellenburger formation in the area surrounding the well.

On July 1, 2014, Applicant performed a tracer survey on the well to identify the parts of the Ellenburger formation that will accept disposal fluids within the proposed injection interval (*i.e.*, 9,150 feet to 9,850 feet). The tracer survey was performed at a injection rate of 1,440 barrels per day, which exceeds the Applicant's requested 130 barrels of fluid disposal per day (*i.e.*, 410 MCFGPD). Mr. Njoku testified that the tracer survey results indicated that the best zone for disposal in the Ellenburger at the well occurs from 9,328 feet to 9,430 feet ("Zone 1")<sup>12</sup>. The tracer survey results indicate that approximately 65% of the total fluids injected in the well during the test were stored in Zone 1. The remaining 25% of the total fluids were stored in deeper parts of the Ellenburger formation.

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<sup>11</sup> Exh. 18.

<sup>12</sup> Exh. 19.

**H2S Radius of Exposure (ROE) Calculations)**

On March 5, 2014 the Oil and Gas Division approved the well's Form H-9, which indicates that the maximum escape volume of gas per day from the well will be 4,990 MCFGPD, or 4,990,000 million cubic feet of gas per day<sup>13</sup>. The examiners sought clarification as to why a discrepancy exists when one compares the well's maximum daily injection volume to the maximum escape volume of gas per day (*i.e.*, 410 MCF versus 4,995 MCF). Mr. Cloud's response was that the maximum escape volume was calculated in accordance with Statewide Rule 36, and that 4,995 MCFGPD represents the escape volume if the disposal well completely failed.

Based on 850,000 ppm of H<sub>2</sub>S and the calculated maximum escape volume, Mr. Cloud concluded that the well's 100 and 500 ppm ROEs extend 8,575 feet and 18,766 feet from the well, respectively. The 100 and 500 ppm ROEs fall on area oil wells and highways (*i.e.*, Farm-to-market road 821 and Ranch Road 2183<sup>14</sup>).

**H2S Contingency Plan**

The well's contingency plan indicates that FM 821 and RR 2183 are located within the well's 100 and/or 500 ppm ROEs. Applicant's contingency plan provides for measures to be taken to notify the public and emergency responders and to minimize risks to public health and safety in the event of a leak of a potentially hazardous volume of H<sub>2</sub>S. The contingency plan has been reviewed and approved by the Commission's Field Operations section.

**Public Interest**

Currently, Applicant operates roughly 400 oil wells in the nearby Howard-Glasscock (Consolidated) Field ("the field"), which produces about 1,200 to 1,400 MCFGPD of casing-head gas. Of the daily total casing-head gas produced from the field, approximately 150 MCFGPD is sold to market because the H<sub>2</sub>S concentrations of the casing-head gas are too high for third-party pipelines. The remainder of the total daily casing-head gas must be flared due to lack of pipeline capacity. Mr. Njoku testified that if the subject application is approved, there will not be a need to flare gas because all of the H<sub>2</sub>S will be removed and disposed of into the well leaving sweet gas that is marketable. Beyond that, Applicant has constructed a 20-mile long gathering pipeline to transport the processed sweet gas to market. In other words, the subject well will offer a safe and reliable means of disposing H<sub>2</sub>S and CO<sub>2</sub>, while significantly reducing H<sub>2</sub>S and CO<sub>2</sub> emissions from flaring the casing-head gas. Mr. Njoku concluded that as a result, the subject well will be in the public's interest.

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<sup>13</sup> Exh. 6 - Form H-9.

<sup>14</sup> Compare Exh. 2 - 2054 plume model aerial map with Tr., Pg. 81, L. 1

**Organization Report and Financial Security**

Applicant has an active Form P-5 (Organization Report) and has financial security posted with the Commission in the form of a \$250,000 bond<sup>15</sup>.

**FINDINGS OF FACT**

4. Pursuant to 16 Texas Administrative Code §§3.36 (“Statewide Rule 36”) and 3.9 (“Statewide Rule 9”), ConocoPhillips Co. (“Applicant”) seeks a non-commercial disposal permit for its Doris Cole Lease, Well No. 14D (API No. 42-227-37544) (“the subject well or the well”) to dispose of oil and gas waste.
5. Applicant seeks a non-commercial disposal permit for the subject well to dispose of up to 410,000 cubic feet of natural gas per day, which contains 85% Hydrogen-sulfide (“H<sub>2</sub>S”) and 14% Carbon-dioxide (“CO<sub>2</sub>”).
6. *Big Spring Herald*, a newspaper of general circulation in Howard County, Texas, on April 6, 2013 and July 31, 2014.
7. Applicant’s subject application was noticed pursuant to Statewide Rule 9.
8. The subject application requires a public hearing pursuant to Statewide Rule 36(c)(10).
9. Statewide Rule 36 does not require notice to persons for an application pursuant to Statewide Rule 36(c)(10).
10. Statewide Rule 36 does not stipulate any technical requirements for an Applicant to fulfill in order to be granted authority pursuant to Statewide Rule 36(c)(10).
11. Applicant’s subject application was rendered administratively complete by the Railroad Commission’s Oil and Gas Division’s Staff on March 11, 2014.
12. Applicant seeks a disposal permit for the subject well to dispose of H<sub>2</sub>S and CO<sub>2</sub> in the subject well from 9,150 feet to 9,850 feet (“the proposed injection interval”) at the subject well’s location.
13. Applicant’s proposed injection interval is limited to the Sylvan Shale, Montoya, and Ellenburger geologic formations.

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<sup>15</sup> Exh. 13.



14. The Ellenburger formation is approximately 1,250 feet to 1,500 feet thick at the subject well's surface location.
15. The Sylvan Shale formation is impermeable at the well's location and provides adequate confinement of disposal fluids to the well's proposed injection interval.
16. The subject well is cased and cemented in a manner that will confine injected fluids to the subject well's proposed injection interval at the subject well's location.
17. Usable quality water will be protected from harm at the subject well's location.
18. The gas to be disposed of in the subject well originates as sour casinghead gas.
19. The sour casinghead gas will be piped to the subject well, where sour casinghead gas will be processed for removal of H<sub>2</sub>S and CO<sub>2</sub>.
20. Operation of the subject well will provide for a means of disposal of H<sub>2</sub>S and CO<sub>2</sub>.
21. The subject well's 100 and 500 part per million radii of exposures were calculated to extend 8,575 feet 18,766 feet, respectively, at a maximum escape volume of 4,995,000 cubic feet of gas per day.
22. Applicant has a current approved Form P-5 (Organization Report) and has posted a \$250,000 bond as financial assurance.

**EXAMINERS' RECOMMENDATION**

The Examiners recommend that ConocoPhillips Co.'s application for its proposed Doris Cole Lease, Well No. 14D (API No. 42-227-37544) be APPROVED for commercial disposal.



Brian Fancher, P.G.  
Technical Examiner



Marshall F. Enquist  
Legal Examiner