

**THE APPLICATION OF REGENCY GAS SERVICES WAHA, LP UNDER RULE 36 AND RULE 46 TO DISPOSE OF OIL AND WASTE CONTAINING HYDROGEN SULFIDE GAS INTO ITS WAHA PLANT LEASE, WELL NO. 1, WAHA (CHERRY CANYON H2S-DISP) FIELD, PECOS COUNTY, TEXAS**

---

**Heard by:** Margaret Allen, Technical Hearings Examiner

**Procedural history**

Application received: May 16, 2006  
Hearing held: June 30, 2006

**Appearances**

<u>Applicant</u>	Representing
James Man	Regency Gas Services Waha, LP
James White	
William (Mike) Johnson	
Terry Ramsey	
Mike Donovan	
David Truett Miller	
<u>Interested persons</u>	
Bill Spencer	Chesapeake Operating Inc.

**EXAMINER'S REPORT AND PROPOSAL FOR DECISION**

**STATEMENT OF THE CASE**

Regency Gas Services Waha, LP ("Regency") is seeking to inject sour gas in its Waha Plant Lease, Well No. 1. The application was filed in the Waha (Delaware) Field but the examiner recommends that a new field, the Waha (Cherry Canyon-H2S Disp) Field be set up for this disposal well. The application was originally protested by Chesapeake but that protest has been withdrawn, and a disposal permit can be issued administratively under Statewide Rule 9. However, Statewide Rule 36(c)(10)(A) requires that a public hearing be held before the injection of fluid containing hydrogen sulfide ("H<sub>2</sub>S" or "sour gas"), when "the hydrogen sulfide content of the gas or gaseous mixture to be injected has been increased by a processing plant operation."

The Notice of Hearing indicated the applicant must prepare a Contingency Plan in accordance with the provisions of Statewide Rule 36(c)(9) for review and approval by the Field Operations Staff of the Oil & Gas Division. The applicant filed a Contingency Plan before the hearing, which is being reviewed by the Field Operations section.

A representative of Chesapeake appeared at the hearing as an observer.

### DISCUSSION OF THE EVIDENCE

Regency operates a gas plant in the Waha area that removes CO<sub>2</sub> and H<sub>2</sub>S from the gas stream produced by its wells in the Waha fields. Regency has entered into an Agreed Order with TCEQ wherein it commits to injecting the waste CO<sub>2</sub> and H<sub>2</sub>S by February, 2007, rather than flaring it. The resultant waste, known as acid gas, will be compressed into a liquid.

The proposed disposal well is inside the fence of the Waha Plant. The radius of exposure (“roe”) to 100 ppm H<sub>2</sub>S from the plant is greater than the roe to 100 ppm from the disposal well. The Waha Plant has an input of about 90 MMCF per day. The estimated average daily injection rate of the disposal well will be 1500 barrels of acid gas per day with a maximum of 2000 barrels. The requested maximum surface injection pressure is 2000 psig, though typical pressures will vary between 700 and 1350 psi depending on wellhead temperature.

The Waha (Delaware) Gas Field was discovered in 1960 and has 17 active gas wells, 13 active oil wells, 2 disposal wells and 11 shut-in wells. Producing wells in the Waha (Delaware) Field are completed between 4700' and 4900' in the Bell Canyon Formation, the shallowest formation of the Delaware Group. The proposed disposal interval is into the underlying Cherry Canyon Formation which is regionally extensive. A special field designation of Waha (Cherry Canyon-H<sub>2</sub>S Disp) Field should be established to identify the non-productive disposal zone as a formation now containing hydrogen sulfide. Regency believes there are sufficient shale barriers to prevent the migration of acid gas upward from the Cherry Canyon into the Bell Canyon Formation.

Redwood Energy Production, LP. has a sour gas disposal well, the Madisonville Disposal Well No. 1D, that has operated in Madison County for several years without problems. Regency has modeled its proposed disposal well on this well and on the nearby saltwater disposal well Enterprise Products Waha SWD-1. The average Cherry Canyon reservoir pressure in the saltwater disposal well is 3348 psi, net thickness of the Cherry Canyon disposal interval is 74' and porosity is 17.5%. Well test results from this saltwater injection well showed the Cherry Canyon has a permeability of 30 md and that injectate could be detected 734' from the disposal well after 22 years of injection. Cumulative injection since March, 1984, has been 3.9 million barrels of saltwater. None of the area disposal wells appear to have caused fracturing of overlying beds.

Regency's Waha Plant No. 1D will be drilled to 7000' and the applicant intends to inject through tubing set on a packer at 6050'. The requested injection interval is between 6170' and 6480'. The base of usable-quality water has been determined to be 2100'. Regency plans to set surface casing at 2200' and to cement the production casing from 6800' to the surface. All of the equipment installed in the wellbore and well head, and flowlines from it, that might come in contact with H<sub>2</sub>S, have been designed by specialists to be of H<sub>2</sub>S-resistant stainless steels and alloys that meet all Commission and industry standards for handling H<sub>2</sub>S.

There are five wells within 1/2 mile of the proposed location of the Waha Plant Well No. 1 that penetrated the Cherry Canyon. The Mobil Moore No. 21, drilled in 1991, produces from the Waha (Delaware) Field 1075' away. It was drilled to 6252' and has cemented production casing to 1881'. The Mobil Moore No. 6, drilled in 1989, is 2100' away and produces from the Waha (Delaware) Field. It has cemented production casing through the Cherry Canyon and perforations from 4802' to 4958'.

Both Waha (Delaware) wells have 14(b)(2) exceptions. The Mobil Moore No. 16 is an active well in the Waha (Mississippian) and (Montoya) Fields that was drilled in 1969. It is 425' away and has cemented intermediate casing through the Cherry Canyon to the surface. The Mobil Hodge J Howard No. 2 is actively producing from the Waha (Mississippian) 2475' from the Waha Plant No. 1. This well was drilled in 1984 and has cemented production casing from 9560' to the surface.

The log of the Kimball Moore No. 5-1 was used to model the proposed disposal well because it is only 550' away. It was drilled in 1976 and plugged and abandoned in 1977, with cement plugs at 9383' and 5355', bracketing the Cherry Canyon. It also has cemented intermediate casing through the Cherry Canyon. There are four other wells within ½ mile but the deepest of these is 5091'.

The Cherry Canyon consists of fine grained, interbedded sandstone and siltstone with less than 5% carbonate. The siltstone that makes up 70% of the section has sufficient porosity, permeability and thickness to adequately contain the proposed injection volume. The injection sandstones form an anticline updip from this well that will serve to limit the migration of injectate. The top of this anticline is 6085' in depth. The net sandstone thickness at the location of the Waha Plant No. 1 is 280' but an average thickness of 250' was assumed for modeling purposes.

Operation of the disposal well is anticipated to last 100 years at an average rate of 1500 barrels per day. The waste density is much less than that of the formation brine and a numerical well simulator, the SWIFT II Model, was chosen to model the effects of variable density injection. This has been accepted nationally for hazardous waste wells by the EPA and has been previously accepted by the Railroad Commission. The waste being disposed of consists of 10.2% hydrogen sulfide, 48.5% carbon dioxide and 1.8% methane. The porosity at the site of the proposed disposal well is assumed to be 13%. Model runs were made at permeabilities of 20, 30 and 50 md.

The initial pressure in the Cherry Canyon sandstones is assumed to be 3220 psi at the site of the proposed Waha Plant No. 1. After 100 years of injection, the pressure increase near the wellbore is calculated to be 200 psi if the permeability is 20 md and 90 psi if the permeability is 50 md. Under the 20 md. assumption, the 130 psi pressure increase contour is 5600' from the wellbore updip and 5000' downdip. The pressure increases are lower if the permeability is assumed to be higher. The 1% contour (where 1% of the formation fluid is injectate) is less than 3000' away even after 100 years of injection assuming 20 md. permeability.

Regency used a maximum injection well escape rate into the atmosphere that was determined by Fekete Wellbore Simulation. The maximum escape rate during normal operations of the Waha Plant No. 1, through tubing, is 15 MMCFD. During drilling or work-over operations, the size of the casing is considered in determining the maximum escape rate yielding a maximum rate of 71 MMCFD.

Regency used a dispersion model called CANARY by Quest, to determine the roe of exposure to H<sub>2</sub>S. This model calculates release conditions and the initial dilution of the vapor (based on the release conditions) and subsequent vapor dispersion. The model accounts for thermodynamics, mixture behavior, transient release rates, gas cloud density, initial velocity of the gas and heat transfer effects. This model has been previously accepted by the Railroad Commission. The calculated roe to 100 ppm H<sub>2</sub>S, due to the maximum catastrophic release on the proposed injection well, is 2765' and to 500 ppm is 1575', assuming unfavorable weather conditions. This radius intersects a county road to the north

that is used mostly to reach leases in the area.

Regency has drawn up an emergency response plan, which it has coordinated with local emergency responders such as volunteer fire departments. There are no residences, businesses or unoccupied structures the rose to 100 ppm during a catastrophic release from the Waha Plant No. 1. A list of telephone numbers for emergency responders and other notification requirements will be maintained and updated annually or more frequently if necessary. Persons in the area in the event of a leak will most likely be employees of gas companies or operators in the area. Plant personnel will monitor the disposal well and there are two persons on duty at all times in the plant.

The system is designed with numerous safeguards and the injection well compressor will shut-down if a monitor detects any of a number of unusual conditions, such as abnormally low or high pressure to or from the compressor or wellhead. The tubing, casing, surface and line pressure and temperature will be monitored at all times. There will be equipment to detect immediately any release of H<sub>2</sub>S. All personnel who will work at or near the facility will be trained in H<sub>2</sub>S safety and safety drills will be performed frequently. Regency's contingency plan, as proposed, satisfies the requirements of Statewide Rule 36.

#### **FINDINGS OF FACT**

1. Notice of this hearing to inject fluid containing hydrogen sulfide was issued to all surface owners, offset operators, and the Pecos County Clerk on June 16, 2006.
2. Notice of the disposal application was published on March 30; April 13 and 27; and May 4, 11 and 18, 2006 in the *Fort Stockton Pioneer*, a newspaper of general circulation in Pecos County.
3. Notice of this hearing to inject hydrogen sulfide was published on May 18 and 25, and June 1 and 8, 2006, in the *Fort Stockton Pioneer*, a newspaper of general circulation in Pecos County.
4. The proposed injection well, Regency Gas Services Waha L.P. Waha Plant Lease Well No. 1, will dispose of hydrogen sulfide (sour gas, or H<sub>2</sub>S) that is produced along with hydrocarbon gas from the Waha fields.
5. The H<sub>2</sub>S to be disposed of will be removed from the hydrocarbon gas at the Waha gas plant.
6. The Regency Gas Services Waha, LP Waha Plant No. 1 will inject waste gas which has been compressed, at daily rates up to 2000 barrels of liquid (known as acid gas), containing 10.2% H<sub>2</sub>S, 48.5% carbon dioxide and 1.8% methane.
7. The proposed H<sub>2</sub>S disposal well, the Waha Plant. 1, will be drilled, cased and cemented to confine the injected fluid to the basal Wilcox Formation.
  - a. The requested injection interval is between 6170' and 6480' into the non-productive Cherry Canyon Formation.
  - b. The base of usable-quality water has been determined to be at 2100'.

- c. Surface casing will be set to 2200', and the production casing will be cemented from total depth to the surface.
  - d. Injection will be through tubing set on a packer at 6050' and the fluid injected will be a mixture of CO<sub>2</sub> and H<sub>2</sub>S.
  - e. All of the equipment installed that might come in contact with H<sub>2</sub>S will be stainless steel, and will meet all Commission safety standards.
  - f. The field name of Waha (Cherry Canyon-H<sub>2</sub>s Disp) should be approved for the disposal interval to alert other operators in the area to the possibility of encountering sour gas in their wells.
  - g. If the injection fluid is not confined to the approved strata, then the disposal well permit will be suspended and disposal cease until the fluid migration from such strata is eliminated.
8. The disposal well is inside the fence around the Waha Plant which is continuously monitored.
  9. The Cherry Canyon is 280' thick at the site of the disposal well but the model has used 250' as a conservative value.
  10. Maximum dispersal of the acid gas underground will be less than 3000' from the Waha Plant No. 1.
  11. The maximum pressure increase, right around the disposal wellbore, will be 200 psi or less, depending on the permeability.
  12. The expected life span of the disposal well is 100 years.
  13. The estimated average daily injection rate of the disposal well will be 1500 barrels of acid gas per day with a maximum of 2000 barrels.
  14. The requested maximum surface injection pressure is 2000 psig, though typical pressures will vary between 700 and 1350 psi depending on wellhead temperature.
  15. During a catastrophic failure of the injection line and/or the injection well, a portions of a county road used for lease access will be within the radius of exposure to gas that is at least 100 ppm H<sub>2</sub>S.
  16. The injection well, compressor and flow lines transmitting sour gas, will be designed to contain the sour gas, and monitoring devices will immediately shut down the system if any leakage of sour gas is detected.

17. A contingency plan has been devised to warn residents, county officials, and law enforcement immediately if there is any hazardous release of sour gas.
18. The calculated exposure radius ("ROE") of 100 ppm H<sub>2</sub>S due to a catastrophic release during workover operations is 2765' and of 500 ppm is 1575', assuming unfavorable weather conditions.
19. There are no residences, businesses and other buildings within the roe of the Waha Plant No. 1.
20. None of the five wells within the 3000' underground radius of the injection plume will be a conduit for migration of injected fluid outside the disposal interval.
  - a. There are two wells assigned to the Waha (Delaware) that have 14(b)(2) exceptions. Both have production casing cemented through the Cherry Canyon.
  - b. The Mobil Moore No. 16 is an active well in the Waha (Mississippian) and (Montoya) Fields that has cemented intermediate casing through the Cherry Canyon to the surface.
  - c. The Mobil Hodge J Howard No. 2 is actively producing from the Waha (Mississippian) and has cemented production casing from 9560' to the surface.
  - d. The Kimball Moore No. 5-1 was drilled in 1976 and plugged and abandoned in 1977, with cement plugs at 9383' and 5355', bracketing the Cherry Canyon.
21. The Director of Field Operations has recommended approval of this application conditional on the filing and approval of a contingency plan prior to injection operations.

### CONCLUSIONS OF LAW

1. Proper notice was issued as applicable in all statutes and regulatory codes.
2. All things have occurred and been accomplished to give the Commission jurisdiction in this matter.
3. The application of Regency Gas Services Waha, LP to inject hydrogen sulfide gas (acid gas) into the Waha Plant Lease, Well No. 1, in the Waha (Cherry Canyon-H<sub>2</sub>S Disp) Field, Pecos County, complies with the applicable provisions of Statewide Rules 9 and 36, 16 T.A.C. §3.9 and §3.36.

### EXAMINER'S RECOMMENDATION

Based on the above findings and conclusions, the examiner recommends that the application of Regency Gas Services Waha, LP be **APPROVED**. A permanent marker should be placed on the

wellhead of the Waha Gas Plant No. 1 after injection ceases. A new field designation of Waha (Cherry Canyon-H<sub>2</sub>S Disp) should be approved for the disposal interval.

Respectfully submitted,

Margaret Allen  
Technical Hearings Examiner