SURFACE WATER DISCHARGES FROM ONSHORE STRIPPER WELLS

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Purpose of Report

Under current U.S. Environmental Protection Agency (EPA) rules, small onshore oil producers are allowed to discharge produced water to surface waters with approval from state agencies; but small onshore gas producers, however, are prohibited from discharging produced water to surface waters. The purpose of this report is to identify those states that allow surface water discharges from small onshore oil operations and to summarize the types of permitting controls they use. It is intended that the findings of this report will serve as a rationale to encourage the EPA to revise its rules and to remove the prohibition on surface water discharges from small gas operations.

Background

The EPA's national effluent limitations guidelines for the oil and gas industry, published on April 13, 1979 (44 FR 22069), prohibit discharge of produced water or drilling wastes from most onshore oil and gas operations (40 CFR 435.32 (a)). However, the EPA has two separate discharge subcategories for which onshore discharges are allowed. The first of these, the Agricultural and Wildlife Water Use Subcategory (40 CFR 435.50), applies to facilities located in the continental United States west of the 98th meridian for which produced water is clean enough to be used for wildlife and livestock watering or other agricultural uses. The 98th meridian extends from near the eastern edge of the Dakotas through central Nebraska, Kansas, Oklahoma, and Texas. Produced water may be discharged from such sites with limits placed on oil and grease.

The second subcategory for which onshore discharges are not prohibited is the Stripper Subcategory (40 CFR 435.60). This subcategory applies to facilities that produce less than or equal to 10 barrels per day of crude oil. The EPA has published no national discharge standards for this subcategory, effectively leaving any regulatory controls to states or EPA regional offices, depending on which has National Pollutant Discharge Elimination System (NPDES) primacy. The EPA's decision to provide an exception for small oil wells reflects the economic burden that an across-the-board zero discharge standard would impose. The stripper subcategory is intentionally inconsistent in that it applies only to small oil wells and not to small (marginal) gas wells (typically 60 thousand cubic feet (MCF) per day or less). In the absence of any regulatory exception for marginal gas well discharges, such discharges are prohibited by the general onshore standards. The cost of achieving zero discharge has resulted in early plugging of some producing marginal gas wells.

The issue of surface water discharges from marginal gas wells has been raised on several occasions by industry groups from states in the Appalachian region[1] (the

[1] The trade associations making up the Appalachian Producers represent Kentucky, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia

Appalachian Producers), but little progress has been made to date. In 1987, the Appalachian Producers filed a petition with the EPA to revise the oil and gas industry effluent limitations guidelines and to remove the prohibition on surface water discharges from marginal gas wells and allow permit writers to exercise their best professional judgement in setting permit limits (Flannery 1987). The petition suggested that zero discharge of produced water is not cost-effective or practical in the Appalachian region for several reasons. First, the rainfall in the region exceeds evaporation, thereby eliminating evaporation as a viable disposal option as it is in arid states. Second, although underground injection is used widely throughout the country for produced water disposal, the geological formations underlying much of the oil- and gas-producing sections of the Appalachian region are not conducive to injection. Finally, few commercial waste disposal companies are available and they often are not near to producing locations.

On November 8, 1989 (54 FR 46919), the EPA published a request for comments on the coastal (covers oil and gas discharges to inland and coastal waters and wetlands) and stripper subcategories of the oil and gas industry effluent limitations guidelines. The Appalachian Producers submitted comments addressing the marginal gas well surface water discharge issue (Flannery and Lannan 1990). According to those comments, 99% of primary oil wells and 92% of natural gas wells in the Appalachian region are considered to be stripper wells. Profit margins on these wells are typically low and the economic viability of the wells is sensitive to small incremental costs. The Appalachian Producers recommended that the EPA vest state regulatory agencies with the authority to decide whether produced water from marginal gas operations can be discharged and to establish streamlined permitting practices for small discharges.

In its 1989 request for comments, the EPA indicated that state and EPA regional offices have expressed concern over "reports of frequent and extensive damage to wildlife, vegetation, crops and livestock caused by discharges from stripper oil wells." Flannery and Lannan (1990) comment that (a) this statement is not accurate, (b) that the number of damage cases reported was small compared to the total number of stripper wells, (c) state and federal agencies have vigorously enforced laws and regulations to prevent or mitigate environmental damages resulting from stripper operations, and (d) adequate state controls are already in place.

This report reviews the types of permitting mechanisms and controls used by states that are currently authorizing surface water discharges from stripper oil wells.

Methodology

Oil and gas regulatory agencies in 32 states were contacted and asked if they issued any NPDES permits or state discharge permits for discharges from onshore stripper oil wells. If such permits were issued, the states were asked to provide information on the number of such permits issued and the types of controls placed in the permits.

Results

All but one of the states (Wyoming) responded to inquiries by fax or phone. The majority of those states that responded (20 of 32) do not allow surface water discharge of produced water from any onshore wells (see Table 1).

Four states (California, Colorado, South Dakota, and Utah) indicated that they issued NPDES permits to facilities that could be classified under the Agricultural and Wildlife Water Use Subcategory. These states do not authorize discharges under the stripper well subcategory, however. Alabama issues NPDES permits for discharges from coal bed methane wells but not for conventional oil and gas stripper wells, as described in the following section. The other six surveyed states issue NPDES or state discharge permits for produced water discharges from onshore stripper wells. Each of these states' programs is discussed below and is summarized in Table 2.

Alabama

Alabama does not issue NPDES permits for conventional onshore stripper wells but does issue NPDES permits for produced water discharges from coal bed methane wells. Clifton McRoy of the Alabama Department of Environmental Management (ADEM) provided information on Alabama's permitting practices. The ADEM Mining Section administers NPDES permits for coal bed methane operations. There are approximately 2,500 producing coal bed methane wells in Alabama. Some of these dispose of produced water through injection wells, but others use surface water discharge. NPDES permits for produced water discharges are issued to operational areas rather than to individual wells. However, these permits are not comparable to NPDES or state discharge permits issued by other states to onshore stripper wells for two reasons. First, produced water is collected from individual wells, which may or may not produce small enough volumes of coal bed methane to be considered "marginal," and is transported to a centralized treatment facility before discharging. Consequently, the volume of treated effluent discharged from the centralized treatment facilities is likely to be much larger than what is normally associated with a stripper well. Second, although coal bed methane wells produce a combustible "natural" gas, they are not subject to the oil and gas industry effluent limitations guidelines and, therefore, ADEM can set whatever limits it deems appropriate.

These permits are not comparable to permits issued for conventional onshore stripper wells; However, a quick overview of the permit contents demonstrates that ADEM is conscientious about regulating onshore produced water discharges, albeit discharges from coal bed methane wells rather than from oil or natural gas wells. ADEM uses a baseline permit that can be customized for discharges to small streams. The permit is quite detailed and contains numerical limits for pH, iron, manganese, biochemical oxygen demand, oil and grease, and dissolved oxygen; additional monitoring requirements for conductivity, chlorides, and effluent toxicity are included. Dischargers are required to install a diffuser on the end of their discharge pipes and to implement a best management practices plan.

Kentucky

Dan Juett of the Kentucky Department for Environmental Protection provided information on Kentucky's NPDES permitting practices for oil and gas wells. Mr. Juett reported that at one time, Kentucky had issued about 100 NPDES permits for onshore stripper wells but that presently, only about 25 permits were in effect. Individual permits are issued to produced water dischargers following a case-by-case review that considers protection of water quality. The permits generally contain the following limits: pH range - 6.0-9.0, oil and grease - 10 mg/L average and 15 mg/L maximum, total suspended solids - 30 mg/L average and 60 mg/L maximum, and chlorides - 600 mg/L average and 1,200 mg/L maximum. Some discharges in high-flow situations may have chloride limits of 1,200 mg/L average and maximum. Permits may require monitoring for radium-226 and -228, if those constituents are of concern at a particular location. Some permits include requirements for best management practices plans and spill prevention, control, and countermeasure plans.

Kentucky has also developed a general permit for stormwater discharges associated with industrial activities at oil and gas exploration and production operations. The general permit does not regulate produced water discharges in any way.

Nebraska

Ronald Asch of the Nebraska Department of Environmental Quality provided information on Nebraska's NPDES permitting practices for onshore stripper wells. Nebraska has issued 26 individual NPDES permits for stripper wells. The permits contain limits on pH range (6.5-9.0), oil and grease (10 mg/L maximum), conductivity, dissolved oxygen, and whole effluent toxicity. Limits on the last three parameters are based on a wasteload allocation for the specific stream segment. Mr. Asch reported that stripper well discharges may, on occasion, cause releases of oil to surface waters or cause exceedances of state water quality standards for conductivity. Those exceedances should be minimized when the Department of Environmental Quality updates its wasteload allocations on conductivity.

New York

N.G. Kaul of the New York Department of Environmental Conservation provided details on New York's permitting practices for onshore stripper wells. New York has issued 19 individual state discharge permits (which serve as NPDES permits) for stripper wells. These tend to be wells that are part of secondary or water flood operations and their produced water contains significantly lower pollutant concentrations than produced water from primary production facilities. The permits contain limits for oil and grease of 15 mg/L maximum and for pH range of 6.5 - 8.5 and monitoring requirements for benzene, toluene, and xylene. The Department is considering including additional parameters (e.g., total dissolved solids and chlorides) to ensure that state water quality standards are protected. Mr. Kaul reported that his Department was not aware of any significant environmental problems attributable to permitted discharges from these onshore stripper wells. He further noted that his Department's limited experience with produced waters from gas operations shows that they contain significantly

higher pollutant concentrations than produced waters from oil operations. He expressed doubt that produced water discharges from gas wells could meet permit limits to protect water quality standards.

Pennsylvania

Ron Gilius of the Pennsylvania Department of Environmental Protection provided information on Pennsylvania's permitting practices for stripper wells. The Department has developed a detailed wastewater permitting manual for oil and gas operations (Gilius et al. 1997). Pennsylvania has issued seven individual NPDES permits and has approved an additional nine discharges under a general NPDES permit that is available to stripper well discharges of less than 1,000 gallons per day that are not located in a special protection watershed. The general permit is a simplified permit with limited testing requirements and no application fee. The general permit contains the following limits: total suspended solids - 30 mg/L average and 60 mg/L maximum, oil and grease - 15 mg/L average and 30 mg/L maximum, total iron - 3.5 mg/L average and 7 mg/L maximum, acidity - less than alkalinity, and pH range - 6.0 to 9.0. Applicants must submit effluent data for barium, lead, silver, phenolics, benzene, chloride, total iron, total dissolved solids, osmotic pressure, and specific conductance. Operators must provide a Preparedness, Prevention, and Contingency Plan for the lease. The general permit also requires a minimum treatment program that includes the following steps: flow equalization, chemical addition, aeration, gravity separation and surface skimming, and settling or filtration. Operators may also employ innovative technologies, such as wetland treatment, if the technologies can meet effluent limits.

Individual NPDES permits are required for dischargers that cannot meet the eligibility requirements for the general permit. They contain the same limits as described for the general permit but may also include additional limits or monitoring requirements to ensure that state water quality standards are being met.

Pennsylvania also issues individual and general NPDES stormwater permits for both construction activities and industrial activities. Either or both of these may be required for a stripper well operation. Produced water discharges are not regulated under the stormwater permits.

Mr. Gilius also provided a report prepared by the Independent Oil and Gas Association of Pennsylvania describing its demonstration project for treatment of produced water from stripper gas wells (IOGA 1993). The intent of the project was to develop a low-cost, small-scale treatment facility that could comply with the Department's effluent limits and treatment requirements. IOGA (1993) indicates that after a one-year trial, the treatment system achieved its goals and was reliable under all weather conditions.

Texas

Windle Taylor of the Railroad Commission of Texas provided details on permitting activities in Texas. Texas does not have NPDES primacy, but has issued many state discharge permits for low-chloride produced water discharges from onshore stripper wells. Historically, the Railroad Commission has issued 128 such permits; 77 of these are currently active. Of the 77 active permits, 30 are located west of the 98th meridian and, therefore, can be covered under the Agricultural and Wildlife Water Use Subcategory, if appropriate. Also, of the 77 active permits, 45 have applied for coverage under the EPA Region 6 Coastal General Permit (TXG 290000) issued on January 9, 1995. The Coastal General Permit offers a unique permitting opportunity to those oil and gas dischargers that: (a) are located east of the 98th meridian; (b) produce from the Carrizo/Wilcox, Reklaw, or Bartosh formations; and (c) discharge produced water containing 3,000 mg/L or less total dissolved solids. Facilities electing to be covered under the Coastal General Permit must meet oil and grease limits of 25 mg/L average and 35 mg/L maximum.

Permits issued by the Railroad Commission are individual permits and must consider state water quality standards. If the Railroad Commission determines that a proposed discharge is likely to cause a violation of a water quality standard for metals, the permit is denied because treatment for metals is not economically possible for stripper well discharges. Likewise, requests to discharge highly saline produced water will be denied because such discharges would cause exceedances of water quality standards for chlorides. Permits require that the discharges may cause no visible sheen. Some permits contain limits on the allowable discharge volume. Mr. Taylor noted that occasional releases of oil and grease from the produced water holding pits associated with the permitted discharges have caused water quality problems.

West Virginia

Brett Loflin of the West Virginia Division of Environmental Protection provided information about West Virginia's permitting practices for stripper wells. West Virginia has developed a general NPDES permit for stripper wells; 33 facilities have been approved for coverage under the general permit. The general permit does not cover discharges to trout streams or streams used as public water supplies and is restricted to flow volumes of less than 1,000 gallons per day. The general permit contains the following limits: iron - 6.0 mg/L maximum, oil and grease - 15 mg/L maximum, total suspended solids - 60 mg/L maximum, and pH range - 6.0-10.0. Chlorides are limited to a discharge rate that will not exceed an instream concentration of 250 mg/L. A straightforward methodology is included in the permit for determining acceptable flow rates. The general permit also requires a minimum treatment system that includes the following steps: flow equalization, chemical addition, aeration, gravity separation and surface skimming, settling, and filtration. The permit includes a sheet showing a model treatment system with design criteria. Any persons who conduct or oversee discharges under the general permit must be properly trained and certified by the Division.

The Fact Sheet accompanying the permit states that if the EPA is willing to allow discharges from stripper gas wells, the general permit would provide coverage for those wells too.

Conclusions

Most oil- and gas-producing states do not allow surface water discharges of produced water from onshore stripper wells even though the EPA's effluent limitation guidelines do not specifically prohibit such discharges. Six states do issue NPDES or state discharge permits for onshore stripper wells. Those permits place limits on different combinations of pollutants and may also specify minimum treatment requirements. The permit limits and requirements from these six states are compared in Table 2. Although no two permits are identical, each permit provides a reasonable degree of water quality protection.

Unregulated or poorly regulated discharges of produced water from onshore wells can easily cause surface water quality impairment from excessive levels of chlorides or other substances. However, on the basis of the information collected for this study, these six states are fully capable of responsibly issuing NPDES or state discharge permits for onshore oil stripper wells. There is no reason to believe that these states could not also act equally responsibly in issuing permits for onshore marginal gas wells. Pennsylvania and West Virginia, in particular, have supported the Appalachian Producers' request to modify EPA effluent limitations guidelines to allow discharges from marginal gas wells. Both states have demonstrated a strong commitment to protecting water quality in their current permitting practices for stripper oil wells.

There appears to be no economic, regulatory, or environmental protection justification for maintaining the 18-year old federal prohibition on surface water discharges from marginal gas wells. Marginal gas well discharges are similar to stripper oil well discharges. If states are trusted to prudently regulate stripper oil well discharges, they should also be given the authority to regulate marginal gas well discharges.

References

Flannery, D.M., 1987, petition submitted by Flannery, Robinson & McElwee law firm, Charleston, WV, to Lee Thomas, Administrator, U.S. Environmental Protection Agency, Washington, DC, July 14.

Flannery, D.M., and R.E Lannan, 1990, comments submitted by Flannery and Lannan, Robinson & McElwee law firm, Charleston, WV, to Karen Troy, Office of Water, U.S. Environmental Protection Agency, Washington, DC, March 7.

Gilius, R.P., J.S. Wetherall, and C. Morgeneier, editors, 1997, "Oil and Gas Wastewater Permitting Manual," 550-2100-002, prepared by the Pennsylvania Department of Environmental Protection, Bureau of Oil and Gas Management, Harrisburg, PA, April. Note: this document is also included as Appendix 5 to Pennsylvania's "Oil and Gas Manual," 550-0300-001, available from the same agency.

IOGA, 1993, "Stripper Natural Gas Brine Treatment Demonstration Project, September 1992 - September 1993, Independent Oil and Gas Operators Association of Pennsylvania, Harrisburg, PA, date unspecified.

Table 1 - States Not Allowing Surface Water Discharge of Produced Water from Onshore

Wells

Alaska
Arizona
Arkansas
Florida
Illinois
Indiana
Kansas
Louisiana
Maryland
Michigan
Mississippi
Missouri
Montana
Nevada
New Mexico
North Dakota
Ohio
Oklahoma
South Carolina
Virginia

Table 2 - Comparison of Onshore Stripper Well Permit Requirements

State	Kentucky	Nebraska	New York	Pennsylvania	Texas	West Virginia
Number and type of permits	25 individual	26 individual	19 individual	7 individual and 9 under general permit	77 under individual state permits and 45 of these are under EPA general permit	33 under general permit
Oil and Grease limits (mg/L)	10 avg/ 15 max	10 max	15 max	15 avg/30 max	EPA - 25 avg/35 max State - no visible sheen	15 max
pH range	6.0-9.0	6.5-9.0	6.5-8.5	6.0-9.0	* (see Other Permit Requirements)	6.0-10.0
Total suspended solids limits (mg/L)	30 avg/ 60 max			30 avg/60 max		60 max
Iron limits (mg/L)				3.5 avg/7 max		6 max
Chlorides limits (mg/L)	600 avg/ 1,200 max			monitor	* (see Other Permit Requirements)	variable
Other pollutants to be monitored or limited	radium	conductivity, dissolved oxygen and whole effluent toxicity (variable limits)	benzene, toluene, xylene	acidity, alkalinity, barium, lead, silver, phenolics, benzene, total dissolved solids, osmotic pressure, specific conductance; individual permits may have water quality-based limits	12 toxic metals, sulfates, total dissolved solids, dissolved oxygen, temperature, benzene, and cyanide; * (see Other Permit Requirements)	initial analysis required for barium, phenolics, methylene blue active substances, ammonia, and benzene
Other permit requirements	best management practices plan; spill prevention, control, and counter-measure plan		may add water quality-based limits	1,000 gpd limit; treatment system requirements; Preparedness, Prevention, and Contingency Plan	EPA - limited to low salinity wells in a specific geographic area; Individual State permits are not issued if application review suggests water quality standards for parameters indicated by an * will be violated	1,000 gpd limit; treatment system requirements; best management practices