

Arkansas Hydraulic Fracturing State Review

February, 2012



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INTRODUCTION

In 1990, the Interstate Oil Compact Commission (IOCC) and the U.S. Environmental Protection Agency (USEPA) jointly published a Study of State Regulation of Oil and Gas Exploration and Production Waste, which contained guidelines for the regulation of oil and gas exploration and production wastes by the IOCC member states (the “1990 Guidelines”). The published guidelines, developed by state, environmental and industry stakeholders, provided the basis for the State Review Process, a multi-stakeholder review of state exploration and production (E&P) waste management programs against the guidelines. The purposes of the State Review Process are to document the successes of states in regulating E&P wastes and to offer recommendations for program improvement. In 1994, the guidelines were updated and revised (the “1994 Guidelines”) by the IOCC, now named the Interstate Oil and Gas Compact Commission (IOGCC).

In 1999, administration of the State Review Process devolved to a non-profit, multi-stakeholder organization named State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER). STRONGER again revised, expanded and updated the Guidelines, which were accepted by the IOGCC and published in June 2000 as Guidelines for the Review of State Oil and Natural Gas Environmental Regulatory Programs (the “2000 Guidelines”). In 2005, STRONGER again revised, expanded and updated the Guidelines (the “2005 Guidelines”).

In 2009, STRONGER formed a Hydraulic Fracturing Workgroup consisting of stakeholders to review issues associated with hydraulic fracturing and develop guidelines for state regulatory programs to address identified issues. After several meetings and a round of public comment, the workgroup submitted to STRONGER a set of guidelines that represented the consensus of the workgroup. In 2010, STRONGER distributed the workgroup’s guidelines (the “2010 Hydraulic Fracturing Guidelines”) for state regulation of hydraulic fracturing. Those guidelines were used as the basis of this review.

In August 2011, the Arkansas Oil and Gas Commission (AOGC) volunteered to have its hydraulic fracturing program reviewed by STRONGER. The Arkansas oil and gas regulatory program has undergone one prior review. The report of the initial review of the Arkansas oil and gas regulatory program was published in 1993.

The current review began with a questionnaire that was sent to the AOGC. The questionnaire had been prepared by the STRONGER Board. STRONGER intended the questionnaire to capture the status of the Arkansas program relative to the 2010 Hydraulic Fracturing Guidelines. The AOGC prepared a response to the questionnaire which was then sent to the review team.

In November 2011 through January 2012 a seven-person review team appointed by STRONGER conducted a review to evaluate the AOGC program compared to the 2010 Hydraulic Fracturing Guidelines. The review team consisted of three members and four official observers. The three team members were: Lori Wrotenbery, Oklahoma Corporation Commission; Wilma Subra, Subra Company, Louisiana; and Jim Collins,

Independent Petroleum Association of America. The official observers were: Jamie Crawford, Mississippi Department of Environmental Quality; Debbie Doss, Arkansas Canoe Club; Jim Bolander, Southwestern Energy; and Nancy Johnson, U.S. Department of Energy.

The review team conducted a meeting, the in-state portion of the review, in conference facilities available to the AOGC in Little Rock, Arkansas on November 8, 2011. Mr. Lawrence Bengal, Director of the AOGC, presented an overview of hydraulic fracturing requirements in Arkansas. Following the presentation, Mr. Bengal and Mr. Shane Khoury, Deputy Director and General Counsel of the AOGC, Mr. Steven Drown of the Arkansas Department of Environmental Quality (ADEQ), and Mr. Ken Brazil of the Arkansas Natural Resources Commission (ANRC) responded to questions from the team members and official observers. In addition to the Arkansas state officials who participated in the review and the review team, there were three industry and five citizen attendees who observed the proceedings. Following the meeting and after review of the written materials provided by the AOGC, the team members compiled this review report.

This is the report of the review of the Arkansas program against the 2010 Hydraulic Fracturing Guidelines of STRONGER. The report contains the review team's findings and recommendations based on their review of the questionnaire and supporting information provided by the state, and information provided during the in-state meeting. Appendix A is a glossary of acronyms used in this report. Appendix B contains Arkansas's written response to the STRONGER questionnaire.

EXECUTIVE SUMMARY

A multi-stakeholder review team has completed an in-depth review of the Arkansas hydraulic fracturing regulatory program. During the course of the review, the review team members and official observers were granted full access to staff of the Arkansas Oil and Gas Commission (AOGC), and all questions were answered in a responsive and open manner.

The review team has concluded that the Arkansas program is well managed and professional and generally meets the 2010 Hydraulic Fracturing Guidelines. The review team identified a number of program strengths that warrant special recognition. The review team also made some specific recommendations for improvements in the program based on the guidelines.

Program Strengths

During the review, the review team identified strengths of the Arkansas program, which also are noted in several of the report's findings. The following offers an overview of some of the Arkansas program strengths.

1. Updated Rules

Since 2004, the Fayetteville Shale has been the center of significant gas well development in Arkansas. In the Fayetteville Shale, there are approximately 4,000 active wells currently and a potential for the development of over 14,000 wells. The Fayetteville Shale is being developed through the use of horizontal well drilling and hydraulic fracturing operations. Since 2006, the AOGC has reviewed and updated many rules to address environmental and production-related issues associated with this recent activity. The AOGC is commended for this process of continual program improvement.

Arkansas was among the first states in the nation to establish a system for the public disclosure of chemicals used in hydraulic fracturing operations.

2. Water Well Complaint Protocol

The AOGC has developed a water well complaint protocol that guides staff in the receipt and review of complaints, the prioritization of inspections, the identification of parameters for laboratory analysis, and the response to complaints. This well developed guidance document could serve as an example to other states.

3. Web Site

The AOGC web site contains a wealth of information on hydraulic fracturing of gas wells in Arkansas. It also contains links to other information, including a video demonstrating the hydraulic fracturing process and maps showing where hydraulic fracturing is occurring in the Fayetteville Shale. The web site is user friendly and educational.

Program Recommendations

The following are the primary areas where recommendations are made by the review team for improvements of the Arkansas hydraulic fracturing program. Discussion and findings for these recommendations can be found in the various sections of the report. Readers are encouraged to review the specific discussions.

1. Notification Prior to Hydraulic Fracturing

The AOGC does not require operators to provide notification prior to the beginning of hydraulic fracturing operations. The review team recommends that appropriate notification be required so that field inspectors have the opportunity to monitor hydraulic fracturing operations and related activities, including water management practices and spill prevention measures.

2. Funding to Continue Support of ADEQ Positions

The ADEQ recently increased its field staff by four inspectors and a supervisor to monitor operations on lands owned by the Arkansas Game and Fish Commission and other lands in the Fayetteville Shale development area. This staff increase was made possible through funding for a two-year period from the Arkansas Game and Fish Commission. The review team recommends that the ADEQ seek resources to provide for the continued funding of these positions.

3. Funding to Increase AOGC Staffing Levels

Since 2007, the AOGC has added twelve full-time and four part-time staff positions to address the increased workload associated with the development of the Fayetteville Shale. The AOGC currently has a total of 40 full-time and 10 part-time positions. Of the full-time positions, 13 are field inspector positions. There are approximately 15,000 active wells in Arkansas, and about 700 to 900 new wells are being drilled into the Fayetteville Shale each year. The AOGC has a goal of inspecting each active well once per year and once every two weeks during the drilling

process. New wells should also be inspected at various times during completion. The review team recommends that the AOGC continue to increase the number of field inspectors as necessary to maintain staffing levels sufficient to meet Commission inspection goals.

HYDRAULIC FRACTURING

BACKGROUND

There have been approximately 35,000 oil and gas wells drilled in Arkansas. The first oil well was drilled in 1919 in Ouachita County, located in the southern portion of the state. That well was followed by rapid development in the same general area of southern Arkansas. Oil production peaked in 1947 when 3,590 wells produced approximately 30 million barrels. Currently there are approximately 7,000 producing oil wells in the southern portion of the state operated by approximately 200 operators. About 85 percent of the oil wells are stripper wells, producing less than 10 barrels per day. Most of these wells have not been hydraulically fractured.

The northern portion of Arkansas has dry natural gas production, meaning there is no condensate or oil produced with the methane. Gas production in the Arkoma Basin, located in the northwestern portion of Arkansas, began in the early 1900s. There are currently around 4,000 gas wells under the control of about 100 operators producing gas from the Arkoma Basin. A portion of this production is from tight sandstone formations that have been hydraulically fractured.

Since 2004, the majority of the development in Arkansas has been occurring in the Fayetteville Shale located in north-central Arkansas, where three primary operators are producing almost all of the approximately 4,000 gas wells. Because of the development of the Fayetteville Shale, gas production has quadrupled since 2004, with production approaching one trillion cubic feet per year. The Fayetteville Shale is being developed at a rate of about 700 to 900 wells per year. Development initially followed the existing pipeline infrastructure. More than 2,300 miles of new gathering lines have been installed since 2004. Seismic surveys have been conducted across the Fayetteville Shale development area and regional fault systems have been delineated. There is a potential for 14,000 gas wells to be drilled in the Fayetteville Shale development area.

Horizontal drilling and hydraulic fracturing are commonly used for gas wells drilled in the Fayetteville Shale development area. The primary source of water used for hydraulic fracturing is impounded surface water runoff.

Both the Arkansas Oil and Gas Commission (AOGC) and the Arkansas Department of Environmental Quality (ADEQ) have responded to complaints of water well contamination within the Fayetteville Shale development area. To date, neither agency has found any evidence of contamination from hydraulic fracturing in any of the water wells tested. In addition, the United States Geological Survey office in Little Rock has recently completed a water well testing program in Van Buren County, one of the most heavily drilled counties where hydraulic fracturing operations have occurred. No evidence of contamination from hydraulic fracturing has been found in the water wells tested.

GENERAL

The AOGC is comprised of nine commissioners who are appointed by the governor. The commissioners hire a director to oversee the staff and day-to-day activities of the AOGC. The AOGC regulates oil and gas wells and has primary enforcement authority for all Class II injection wells under the Underground Injection Control (UIC) program.

Primary jurisdiction over oil and gas exploration and production rests with the AOGC. However, the ADEQ, the Arkansas Pollution Control and Ecology Commission (APCEC), and the Arkansas Natural Resources Commission (ANRC) share responsibilities for hydraulic fracturing through different programs they administer. The use of water is governed by regulations administered by the ANRC. Both the AOGC and the ADEQ respond to complaints of water well contamination.

Ark Code Ann. 15-71-110 is the primary statute providing authority to the AOGC for the regulation of oil and gas well activities, including hydraulic fracturing. The Arkansas Water and Air Pollution Control Act (Ark Code Ann. 8-4-101 et seq) is the primary statute governing pollution of water. Regulations describing requirements for oil and gas well development activities, including hydraulic fracturing, have been adopted under the authority of these statutes. AOGC General Rule B-1, which spells out procedures necessary for an application to drill an oil or gas production well, requires operators to indicate on the application (AOGC Form 2) whether the well will be hydraulically fractured. General Rules B-15 and B-19 govern well construction, including casing and cementing. General Rule B-19 also provides requirements for well completion using hydraulic fracturing and the reporting of hydraulic fracturing fluids, additives and chemical constituents. AOGC General Rule B-26 governs the siting, construction and operation of pits and tanks used for the holding or storage of well fluids and AOGC General Rules B-17, B-26, and B-34 address spill prevention and clean-up. AOGC General Rule E-3 governs the gathering, handling and transportation of E&P wastes. AOGC General Rule H-1 specifies requirements for Class II disposal and Class II commercial disposal wells permit applications.

The AOGC has adopted joint standards with ADEQ and the APCEC. AOGC General Rule B-17 and APCEC Regulation 34 govern the construction and operation of drilling and reserve pits, storm water associated with drill sites, and requirements related to hydraulic fracturing fluid reuse and recycling. Generally speaking, the AOGC has primary enforcement responsibility for the regulation of waste on the drill site and ADEQ has primary enforcement responsibility for regulation of the waste if it is moved or leaves the drill site. AOGC and ADEQ also coordinate their activities through a Memorandum of Agreement between the agencies.

APCEC Regulation 2 establishes water quality standards for surface waters in Arkansas. In general, streams in Arkansas have been designated as sources of drinking water, and the standards are designed to protect that use.

Since 2006, a number of rules have been updated to address issues related to the development of the Fayetteville Shale. Rules that were updated since 2009 include AOGC General Rules B-1, B-17, B-19, B-34, B-43, E-3 and H-1.

Finding 9.2.1.

The review team commends the AOGC, ADEQ and APCEC for updating the various rules identified above and the forms used to implement the rules in order to address issues in the Fayetteville Shale development area.

Finding 9.2.2.

The review team was impressed with the openness and interagency cooperation shown by the AOGC and ADEQ during the review, and hopes that it is representative of the ongoing working relationship.

STANDARDS

As indicated in the preceding discussion, the AOGC has updated its regulations to establish standards to protect groundwater and other resources from risks associated with hydraulic fracturing.

AOGC General Rule B-19 requires surface casing to be set to a depth of at least 100 feet below the deepest fresh water zone encountered. Surface casing in the Fayetteville Shale, where most of the hydraulic fracturing is occurring, is required to be set to a depth of 1,000 feet, or 500 feet below the lowest surface elevation within one mile of the well. The production casing must be cemented from the top of the Fayetteville Shale to the surface. These casing strings are the first line of defense in protecting fresh groundwater during hydraulic fracturing operations.

AOGC General Rule B-19 requires that anomalies encountered during the cementing and fracturing of a well must be reported to the AOGC, and authorizes the AOGC Director to order the cessation of operations until an investigation can be conducted. The rule authorizes the AOGC Director to require the running of a bond log or other tool to evaluate the integrity of the cement, and to require corrective actions if deficiencies are noted.

The rule also requires the operator to monitor all casing annuli and report any changes of pressure that indicate movement of fluid into the surface casing annulus or exceed the minimum yield pressure on any casing string.

The AOGC has reviewed the records of wells drilled in the Fayetteville Shale development area. Only 191 wells were drilled in the area prior to the recent development of the Fayetteville Shale, and very few of those wells penetrated the Fayetteville Shale formation.

AOGC General Rule B-17 and APCEC Regulation 34 contain standards for the siting, construction, operation, and closure of pits. AOGC General Rule B-26 contains standards for the construction, siting, and use of tanks.

Finding 9.2.1.1.

The AOGC has adopted standards that meet the criteria contained in the STRONGER hydraulic fracturing guidelines.

REPORTING

The ANRC requires notification 10 days prior to the pumping of surface water for hydraulic fracturing and other uses so that water use may be limited during periods that aquatic communities might be jeopardized by withdrawal.

The AOGC has developed several forms for operators to use when reporting hydraulic fracturing activities. These include:

- Form 3 – Producer’s Well Completion and Recompletion Report,
- Form 3A – Well Fracture Stimulation Report, and
- Form 37 – Claim of Entitlement to Withhold the Identity of a Chemical Constituent as a Trade Secret or Request for Trade Secret Exemption.

AOGC Form 3A is required to be submitted after the well is completed. AOGC Form 3A requires the reporting of the materials used, aggregate volumes of fracturing fluids and proppant used, fracture pressures recorded, calculated fracture height and estimated depth of the top of the fracture, as well as disclosure of information on chemical constituents used in fracturing fluids.

Service companies that perform hydraulic fracturing operations in Arkansas are required to provide AOGC with a master listing of all base fluids, additives and chemical constituents used during hydraulic fracturing operations in Arkansas. Chemical information is to be provided to medical personnel in the event of a health emergency.

Finding 9.2.1.2.

Arkansas was among the first states in the nation to require public disclosure of the chemicals used in hydraulic fracturing operations.

Finding 9.2.1.3.

The AOGC does not require operators to provide notification prior to the initiation of hydraulic fracturing operations. Inspection during hydraulic fracturing operations could provide an opportunity to review water management practices and preparedness for spills, as well as to witness the actual hydraulic fracturing operations.

Recommendation 9.2.1.3.

The AOGC should require appropriate notification prior to hydraulic fracturing operations. Notification should be sufficient to allow for the presence of field staff to monitor activities. (2010 STRONGER Guidelines, Section 9.2.2.)

STAFFING AND TRAINING

Since 2007, the AOGC has added twelve full-time and four part-time staff positions to address the increased workload associated with the development of the Fayetteville Shale. The AOGC staff currently consists of 40 positions divided between the Director's Office in Little Rock, two regional offices in Fort Smith and El Dorado, and a field office in Conway. Of the total positions, 13 are field inspectors, including three supervisors. There are also 10 part-time positions assigned to the AOGC. There are approximately 15,000 active wells in Arkansas. The AOGC indicated that, in addition to inspections conducted during drilling and plugging operations, they have a goal of inspecting all wells once a year.

Training is provided on an on-going basis, with safety training occurring at least once each year. Training is provided on each General Rule as it is adopted.

Finding 9.2.1.4.

Given the rapid development of the Fayetteville Shale and the adoption of new requirements under AOGC General Rule B-17 and other rules, the AOGC may need to further increase the number of field staff to meet the inspection goals, respond to complaints, and perform other assigned responsibilities.

Recommendation 9.2.1.4.

The review team recommends that the AOGC continue to increase the number of field inspectors as necessary to maintain staffing levels sufficient to meet AOGC inspection goals as well as receive, record, and respond to complaints of human health impacts and environmental damage resulting from hydraulic fracturing. (2010 STRONGER Guidelines, Section 9.2.3.)

Finding 9.2.1.5.

The AOGC has developed a Water Well Complaint Protocol for use by staff when receiving and responding to complaints. The review team finds this to be an excellent tool to guide staff in the performance of their duties and recommends it as an example to other states.

Finding 9.2.1.6.

AOGC field staff does not inspect hydraulic fracturing operations because of safety concerns.

Recommendation 9.2.1.6.

The review team recommends that the AOGC re-evaluate their safety concerns related to conducting inspections during hydraulic fracturing operations. The review team further recommends that the AOGC develop field procedures to ensure that field staff conduct inspections in a safe manner during hydraulic fracturing operations. (2010 STRONGER Guidelines, Section 9.2.3.)

The ADEQ has 21 inspector positions and two supervisors in the Water Division. Approximately half conduct inspections of oil and gas activities. There are five positions dedicated to E&P inspections and eight additional positions that respond to complaints and perform other related duties. However, all ADEQ water inspectors have the training and can be utilized in the inspection of oil and gas activities.

Finding 9.2.1.7.

ADEQ added four inspector positions and a supervisor position to monitor activities on lands owned by the Arkansas Game and Fish Commission and other lands in the Fayetteville Shale development area. These additional positions were created using two-year funding from the Arkansas Game and Fish Commission.

Recommendation 9.2.1.7.

The review team recommends that the ADEQ seek resources for the continued funding of these positions as well as additional positions as needed in the Fayetteville Shale development area and to develop and maintain their data management capabilities. (2010 STRONGER Guidelines, Section 9.2.3.)

PUBLIC INFORMATION

Arkansas has open-records requirements that make most information held by state agencies available to the public for review.

The AOGC maintains a user-friendly webpage that provides information about wells and activities under its jurisdiction. Hydraulic fracturing information has been put into a database that is readily accessed by the public. The webpage also contains links to video demonstrations, maps and other information related to hydraulic fracturing.

Finding 9.2.1.8.

The review team commends the AOGC on its use of the web to provide information on hydraulic fracturing to the public.

Recommendation 9.2.1.8.

The review team recommends that the AOGC seek additional opportunities for the dissemination of educational information regarding well construction and hydraulic fracturing to bridge the knowledge gap between experts and the public. (2010 STRONGER Guidelines, Section 9.2.4.)

The AOGC utilizes the Risk Based Data Management System (RBDMS) to track information pertaining to wells under its jurisdiction. This data system is not currently linked to data management systems of the ADEQ or ANRC.

The ADEQ and the AOGC indicated that they have a goal of developing a paperless system where all information is maintained electronically and is available to staff and the public on the web.

Finding 9.2.1.9.

The review team applauds both the ADEQ and the AOGC for their efforts to provide all available information concerning activities under their jurisdiction to the public through their webpage.

Recommendation 9.2.1.9.

The review team recommends that the agencies continue their efforts to obtain additional funding for improvements to and integration of their data management systems. (2010 STRONGER Guidelines, Section 9.2.4.)

Finding 9.2.1.10.

The ANRC does not maintain records of complaints related to hydraulic fracturing, and can only determine this information by conducting a manual review of their files.

Recommendation 9.2.1.10.

The review team recommends that the ANRC develop a database to provide for the dissemination of information related to hydraulic fracturing information to the public. (2010 STRONGER Guidelines, Section 9.2.4.)

WATER AND WASTE MANAGEMENT

The ANRC regulates certain water uses. Arkansas water law recognizes both riparian and non-riparian rights to the use of surface water. If a person owns land adjacent to a waterway, they have certain riparian rights. In 1989, non-riparian provisions were recognized and non-riparian users were required to obtain a permit from the ANRC.

The ANRC develops basin reports that are used to determine, on a basin-by-basin basis, excess water by identifying riparian and existing uses. This information is used in determining water allocations.

Water used for hydraulic fracturing is essentially all non-riparian water. Over the past three years the ANRC has received about 1,500 permit applications for water to be used in hydraulic fracturing operations. They have issued around 900 active permits. The remaining applications were denied, have expired, have been determined to involve diffuse water (captured water not requiring a permit) or are pending. Permits are usually issued within 30 days of receipt, and have a duration of five years. They are subject to an annual compliance review. Reuse of water is not reported.

The ANRC has installed monitoring gauges on streams around the Fayetteville Shale development area to establish stream reach conditions. This information is used to establish criteria on when pumping can occur and is made available to the public. Permits contain a 10-day prior notification requirement so that in-stream communities can be protected during specific periods of low flow.

The ANRC does not regulate groundwater withdrawal. There is no program to register water wells. They can, however, meter new wells in critical areas, such as agricultural supply wells in a recharge area. There are no groundwater quality standards in Arkansas. ANRC and AOGC indicated that no groundwater is used for make-up water for hydraulic fracturing operations in the Fayetteville Shale development area.

The inclusion of multi-use reserve pits in the rules (AOGC General Rule B-17 and APCEC Regulation 34) encourages reuse and recycling of flowback for hydraulic fracturing purposes.

The ADEQ has lead responsibility for the protection of water in Arkansas. That agency regulates the disposal to surface facilities, including land application and treatment facilities with discharges to surface water. There are presently no known discharges of E&P waste, including flow-back from hydraulic fracturing operations, to surface waters. No publically owned treatment works (POTW) or industrial waste treatment facilities have been approved to accept flow-back from hydraulic fracturing operations.

Three centralized wastewater treatment and discharge facilities have received NPDES permits but have not yet been constructed. These facilities, when constructed, will receive drilling fluids and flow-back from hydraulic fracturing operations. The facilities will treat the wastewater by reverse osmosis or distillation.

The ADEQ administers the NPDES storm water program, and recognizes the storm water exemption for construction activities related to E&P. There is a general permit for pads and pits. That general permit requires the use of Best Management Practices (BMPs). The ADEQ has adopted the BMPs contained in the industry-developed Reasonable and Prudent Practices for Stabilization (RAPPS) guidance document. ADEQ accepts the use of site-specific RAPPS document BMP implementation in lieu of specific stormwater pollution prevention plans to control erosion and sediment run-off. However, with the recent adoption of APCEC Regulation 34, the general permit for pits will be phased out and the specific requirements of Regulation 34 will be implemented.

Applications for permits issued by ADEQ are also reviewed by the Arkansas Department of Health, which regulates exposure to radiation including Naturally Occurring Radioactive Materials (NORM). Analyses of waste from the Fayetteville Shale development area have shown levels of radiation to be well below the action level of 50 picocuries. If waste streams above the action level were encountered, the Department of Health would require a permit with limits and monitoring. The NPDES permits issued by ADEQ for the three centralized wastewater treatment and discharge facilities contain conditions requiring monitoring for NORM.

Class II disposal wells are the primary means of disposal of E&P wastes, including flow-back from hydraulic fracturing operations. There are approximately 28 commercial disposal wells and over 500 non-commercial producer-owned disposal wells in Arkansas. There are approximately six commercial and nine non-commercial producer-owned disposal wells in the Fayetteville Shale development area, and approximately four commercial and two non-commercial producer-owned disposal wells in the Arkoma Basin. The remaining wells are located in southern Arkansas. E&P waste is also trucked to disposal wells in Oklahoma.

Following an increase in earthquake activity in the Fayetteville Shale development area, there was conjecture on the part of some that the increase in seismic events was the result of hydraulic fracturing. The AOGC, after consultation with the Arkansas Geological Survey and the Center for Earthquake Research and Information (CERI) at the University of Tennessee in Memphis, identified a possible correlation with underground injection at disposal wells located in close proximity to a previously unknown deep fault system. The studies concluded that there was no indication that hydraulic fracturing operations were the likely cause of the increased seismic activity. The AOGC issued an order requiring one disposal well in the area to be plugged, while the operators of three other disposal wells in the area voluntarily agreed to plug their disposal wells. The AOGC also placed a moratorium on new disposal wells within defined areas of the Fayetteville Shale development area.

Finding 9.3.1.

The review team recognizes the ANRC for installing stream gauges in the area of the Fayetteville Shale development area to gather information that assists in protecting critical stream uses.

Finding 9.3.2.

The review team recognizes the AOGC for its efforts to determine and manage the potential risk of induced and/or triggered seismicity.

APPENDIX A

Glossary of Acronyms

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| ADEQ | Arkansas Department of Environmental Quality |
| ADH | Arkansas Department of Health |
| ANRC | Arkansas Natural Resources Commission |
| AOGC | Arkansas Oil and Gas Commission |
| APCEC | Arkansas Pollution Control and Ecology Commission |
| API | American Petroleum Institute |
| CAS | Chemical Abstract Service |
| CERI | Center for Earthquake Research and Information |
| E&P | Exploration and Production |
| IOCC | Interstate Oil Compact Commission |
| IOGCC | Interstate Oil and Gas Compact Commission |
| NORM | Naturally Occurring Radioactive Materials |
| NPDES | National Pollution Discharge Elimination System |
| NRWU | Non-Riparian Water Use |
| POTW | Publically Owned Treatment Works |
| RAPPS | Reasonable and Prudent Practices for Stabilization |
| RBDMS | Risk Based Data Management System |
| STRONGER | State Review of Oil and Natural Gas Environmental Regulations |
| USEPA | United States Environmental Protection Agency |

APPENDIX B

Hydraulic Fracturing Questionnaire

(Note: Written responses to questions should be brief (i.e., 1 paragraph in length). Additional information may be requested by the review team during the in-state portion of the review.)

General [9.2]

Has the state evaluated potential risks associated with hydraulic fracturing, taking into account factors such as depth of the reservoir to be fractured, proximity of the reservoir to fresh water resources, well completion practices, well design, and volume and nature of fluids?

Yes. The Arkansas Oil and Gas Commission (AOGC), the Arkansas Department of Environmental Quality (ADEQ) and the Arkansas Natural Resources Commission (ANRC) has identified potential risks associated with hydraulic fracturing with respect to fresh water resources. Geologically, the ground water resources in the gas producing areas in North Arkansas are characterized by naturally occurring near surface fracture systems that are recharged with surface water. Consequently, the freshwater wells throughout the gas producing area are fairly shallow in depth and the primary risk to these freshwater resources is the handling of hydraulic fracturing fluids at the surface. Most of the wells in which hydraulic fracturing occurs are located within the Fayetteville Shale development area.

The application for a permit to drill (AOGC Form 2) used in accordance with General Rule B-1, requires the operator to report whether the well will be hydraulically fractured and the specific well construction parameters with respect to ground water protection. In addition, to protect fresh water resources, the AOGC and the ADEQ adopted joint standards (AOGC General Rule B-17 and Arkansas Pollution Control and Ecology Commission (APCEC) Regulation 34) governing the construction and operation of drilling and reserve pits and storm water runoff associated with drill sites, with specific requirements to facilitate hydraulic fracturing fluid reuse and recycling. APCEC Regulation 2 establishes water quality standards for all surface waters pursuant to the Arkansas Water and Air Pollution Control Act (Act 472 of the Acts of Arkansas for 1949, as amended; Ark. Code Ann. 8-4-101 et seq.) This Act, Ark Code Ann. 15-71-110, and the administrative rules adopted in accordance with said laws (specifically AOGC General Rules B-26 and B-34) govern contamination of surface waters of the state. Ark Code Ann. 15-71-110 and the administrative rules adopted in accordance with said statute (specifically AOGC General Rules B-15 and B-19) govern well construction with respect to surface and production casing, cementing requirements, and reporting of the type and amount of hydraulic fracturing base fluids, additives, and chemical constituents used in the well. AOGC General Rules B-26 and B-34 outline production fluid spill prevention and clean-up standards. AOGC General Rule E-3 governs the permitting and operation (including fluid manifesting) of tank trucks transporting exploration and production wastes in Arkansas.

The primary source of water for hydraulic fracturing in the Fayetteville Shale development area is through the impoundment of surface water runoff, which is governed by regulations administered by ANRC.

Both the AOGC and the ADEQ have responded to complaints of water well contamination and to date have not found any evidence of contamination from hydraulic fracturing treatments in the water wells tested. In addition, the United States Geological Survey Office in Little Rock has recently completed a water well testing program in one of the most heavily drilled counties (Van Buren) where hydraulic fracturing operations have occurred and found no evidence of impacts to the water quality in private water wells from the hydraulic fracturing operations.

Has the state developed standards to prevent the contamination of groundwater and surface water from hydraulic fracturing?

Yes. AOGC General Rules B-15 and B-19 establish surface casing and production casing depths and cementing requirements for all oil and gas producing areas in Arkansas. For the Fayetteville Shale development area, where almost all of the hydraulic fracture operations occur, the general requirement is for surface casing to be set to 1000 feet, or 500 feet below the lowest surface elevation within 1 mile of the production well, and production casing is required to be cemented from the top of the Fayetteville Shale to the surface. In addition, AOGC General B-19 further requires the operator to set and cement surface casing at least one hundred feet below the deepest encountered freshwater zone.

AOGC General Rule B-17 and APCEC Regulation 34 establishes standards for drill and reserve pit construction, use of pit liners, pit operations, pit closure, and disposal of pit contents.

Hydraulic Fracturing Standards [9.2.1]

Describe how state standards for casing and cementing meet anticipated pressures associated with hydraulic fracturing to protect other resources and the environment.

The application for a permit to drill (AOGC Form 2) requires the operator to report whether the well will be hydraulically fractured and other specific well construction parameters prior to issuance of the drilling permit. Additionally, AOGC General Rules B-15 and B-19 establish surface casing and production casing depths and cementing requirements. AOGC General Rule B-19 specifically requires that cementing and casing operations performed in the well be sufficient to contain the maximum anticipated treating pressure of the hydraulic fracture operation. AOGC General Rule B-19 also requires the reporting of certain potential and actual cementing or casing failures. In certain cases, this rule also authorizes the Director to require a bond log or other cement evaluation tool to document cement integrity and require additional cement operations or other well workover efforts necessary to correct any deficiencies.

Discuss how the program identifies and, where deemed appropriate, manages risks associated with potential conduits for fluid migration in the area of hydraulic fracturing.

The Fayetteville Shale development occurred in an area of the State with little to no prior gas production or drilling activity. The primary potential conduit for fluid migration in the Fayetteville Shale development area is the movement of fluids up the backside of the production casing. As stated above, AOGC General Rules B-15 and B-19 establish surface casing and production casing depths and cementing requirements. In the Fayetteville Shale development area, the general requirement is for surface casing to be set to 1000 feet, or 500 feet below the lowest surface elevation within 1 mile of the production well, and production casing is required to be cemented from the top of the Fayetteville Shale to the surface to help prevent the movement of fluids up the backside of the production casing and minimize the potential movement of any gas from shallow gas zones encountered in the drilling of the well.

Describe program requirements that address actions to be taken in response to unanticipated operational or mechanical changes encountered during hydraulic fracturing that may cause concern.

As stated above, AOGC General Rules B-15 and B-19 establish surface casing and production casing depths and cementing requirements. AOGC General Rule B-19 specifically requires the operator to monitor all casing annuli during hydraulic fracturing operations and to report any change that would indicate movement of fluids into the annulus or any pressures that exceed the minimum internal yield pressure on any casing string. In certain cases, this rule also authorizes the Director to require a bond log or other cement evaluation tool to document cement integrity and require additional cement operations or other well workover efforts necessary to correct any deficiencies.

Briefly describe how surface controls associated with hydraulic fracturing, such as dikes, pits or tanks, meet Sections 5.5 and 5.9 of the guidelines.

As stated above, AOGC General Rule B-17 and APCEC Regulation 34 establishes standards for drill and reserve pit construction, use of pit liners, pit operations, pit closure, and disposal of pit contents. Additionally, AOGC General Rule B-26 governs the location, construction, and operation and containment requirements for produced fluid storage tanks. These requirements are designed to prohibit pollution of fresh water resources.

Briefly describe how contingency planning and spill risk management procedures related to hydraulic fracturing meet Section 4.2.1 of the guidelines.

AOGC General Rule B-34 requires reporting of all spills and discharges in excess of 1 barrel of crude oil or 5 barrels of produced water immediately, and not more than 24 hours of the event. Additionally, any spill or discharge that enters Waters of the State must be reported to the AOGC and the ADEQ, regardless of amount. AOGC General Rule B-34 also contains remediation requirements; and the operator is required to submit a detailed report every 90 days until the spill or discharge is fully remediated. AOGC General Rule A-5 also authorizes a temporary shut-down of the lease or facility for failing to provide emergency response of a spill or discharge. All well records are available to the public on the AOGC webpage.

Ark Code Ann. 15 -71-115 authorizes expenditures for emergency repairs to wells or production facilities endangering the public health and safety. In addition, the ADEQ also has statutory authority to make certain emergency expenditures for certain events endangering the environment.

Briefly discuss how hydraulic fracturing waste characterization requirements, including, as appropriate, testing of fracturing fluids, are consistent with Section 5.2 of the guidelines.

AOGC General Rule B-17 defines all wastes generated in the drilling and hydraulic fracturing process, and identifies the disposal methods for each type of waste. Additionally, AOGC General Rule E-3 governs the permitting and operation (including fluid manifesting) of tank trucks transporting exploration and production wastes in Arkansas.

In accordance with AOGC General Rule B-17 and APCEC Regulation 34, wastes disposed on-site or taken to ADEQ approved facilities require various testing, depending on the type of facility, to ensure the waste is approved for disposal.

Briefly describe how the waste management hierarchy contained in Section 5.3 of the guidelines (source reduction, recycling, treatment and disposal), including the provisions relating to toxicity reduction, are promoted for hydraulic fracturing.

Both the AOGC and the ADEQ regulations encourage the reuse and recycling of wastes associated with drilling and hydraulic fracturing operations. The largest volume of waste is hydraulic fracturing flowback fluids. AOGC General Rule B-17 and APCEC Regulation 34 include provisions for the construction and operation of multi-use reserve pits to encourage and facilitate reuse and recycling of hydraulic fracturing fluids. The ability to use multi-use reserve pits results in a significant reduction of tank truck traffic and conserves water resources used in hydraulic fracturing operations.

Briefly describe how the tracking of hydraulic fracturing waste disposed at commercial or centralized facilities meets the requirements of Section 5.10.2.3 of the guidelines.

AOGC General Rule H-3 requires each commercial disposal well operator to file a monthly well status report detailing the maximum daily injection rates and pressures, monthly volumes of fluids injected, and an accurate log of each shipment of fluids disposed. The log must include the generator of the fluid, the origin of the fluid, amount of fluid, and date shipment was received. All well records are available to the public on the AOGC webpage.

As stated above, AOGC General Rule E-3 governs the permitting and operation (including fluid manifesting) of tank trucks transporting exploration and production wastes in Arkansas. General Rule E-3 requires each transportation operator of an exploration and production fluid transportation system to maintain a record of the generator of the fluid, date received, amount per load, type of fluid, and the name of the disposal facility to which the fluids were transported. These records must be maintained by the transportation operator for a period of at least three years.

The ADEQ has jurisdiction all other commercial or centralized facilities (land farms and landfills), and has specific testing and manifesting requirements depending on the type of facility.

Briefly describe how procedures in place for receipt of complaints related to hydraulic fracturing are consistent with Section 4.1.2.1.

All complaints received by the AOGC are forwarded to the appropriate Staff member for follow-up and investigation. The AOGC documents complaints in its Complaint Database, which contains the applicable information and result of any investigations. The AOGC also has developed a specific field inspection report for use by inspectors when conducting an investigation in response to a complaint. Additionally, the AOGC has developed a protocol for testing private water well complaints related to hydraulic fracturing operations. To date, no test results have indicated any contamination resulting from hydraulic fracturing operations.

The ADEQ also has a complaint process for handling and investigating complaints.

Reporting Associated with Hydraulic Fracturing [9.2.2]

Describe any required notification prior to, and reporting after completion of, hydraulic fracturing operations.

Operators are required to provide notification prior to performing hydraulic fracturing operations utilizing the “Application for a Permit to Drill” (AOGC Form 2). AOGC

General Rule B-1 requires operators to notify the AOGC prior to spudding the well. Additionally, operators in the Fayetteville Shale development are notify the AOGC prior to setting production casing, and most provide a weekly list indicating the location of drilling rigs.

All persons performing hydraulic fracturing operations in Arkansas must comply with the applicable provisions of General Rule B-19, which includes filing an “Organization Report” and providing master lists of all base fluids, additives, and chemical constituents which may be utilized within Arkansas. Following the completion of hydraulic fracturing operations, operators are also required to file both a “Producers Well Completion and Recompletion Report” (AOGC Form 3), and a “Well Fracture Stimulation Report” (AOGC Form 3A). This includes a list of all base fluids, additives, and chemical constituents utilized in the hydraulic fracturing operation in an individual well.

Is notification sufficient to allow for the presence of field staff to monitor hydraulic fracturing activities?

Most of the drilling and hydraulic fracturing operations take place in a five county area within the Fayetteville Shale development area. AOGC Inspectors routinely visit the well site during drilling operations, and are familiar with the locations that are being spud, horizontally drilled, and hydraulically fractured. As stated above, most operators in the Fayetteville Shale development area also provide a weekly list indicating the location of drilling rigs. Information regarding the status (permitted, spud, completed) of a well is available through RBDMS, and on the AOGC webpage. The information, including the status of the well indicated by color, is also portrayed on the webpage in a GIS format.

Describe reporting requirements for hydraulic fracturing activities and whether they include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded.

As mentioned above, operators are required to complete both a “Producers Well Completion and Recompletion Report” (AOGC Form 3), and a “Well Fracture Stimulation Report” (AOGC Form 3A). The AOGC Form 3A includes the information required by AOGC General Rule B-19, which includes the maximum pressures for each stage of the hydraulic fracturing operation, and a list of all base fluids, additives, and chemical constituents utilized in the individual well. For base fluids, the rule requires the type and the total volume to be reported. For additives, including proppant, the rule requires the name, concentration (lbs/1000 gallons or gallons/1000 gallons), actual volume used, and the percent volume of the total hydraulic fracture treatment volume to be reported. For the chemical constituents, the rule requires the specific chemical name and CAS number for each individual constituent to be reported, unless the chemical constituent qualifies as a trade secret. If a trade secret exemption is granted for a specific chemical constituent, then the chemical family name must be reported. In order for a

specific chemical constituent and associated CAS number to be withheld as a trade secret, General Rule B-19 specifically states that the chemical constituent and associated CAS number must meet the criteria set forth in subsection (a)(2) of 42 U.S.C. § 11042. All of this information is published on the AOGC website and available for the public to review.

Describe any mechanisms for disclosure of information on chemical constituents used in hydraulic fracturing fluids to the state in the event of an investigation or to medical personnel in the event of a medical emergency.

As stated in the preceding answer, AOGC General Rule B-19 requires a list of all base fluids, additives, and chemical constituents utilized in each well to be reported, and these reports are posted on the AOGC website. Additionally, AOGC General Rule B-19 specifically states that “[a]ll information required by a health care professional, a doctor, or a nurse shall be supplied, immediately upon request, by the person performing the Hydraulic Fracturing Treatment, directly to the requesting health care professional, doctor, or nurse, including the percent by volume of the Chemical Constituents (and associated CAS numbers) of the total Hydraulic Fracturing Fluids and Additives.”

Briefly describe how hydraulic fracturing information submitted that is of a confidential business nature, is treated consistent with Section 4.2.2 of the guidelines?

As stated above, all records are posted on our website and available for review by the public. Said records remain on the website and in the well file permanently. The trade secret exemptions request forms (AOGC Form 37) are designed to ensure that AOGC receives all required by General Rule B-19. When a Form 37 is filed, we do not receive the exact name of the chemical constituent and corresponding CAS number, but rather a chemical family name. Additionally, the segregation of the list of additives from the list of chemical constituents and CAS numbers contained in the additives helps ensure protection of the formulation of each additive. Thus, the “confidential business” information is protected.

Staffing and Training [9.2.3]

Briefly discuss if, in addition to the personnel and funding recommendations found in Section 4.3 of the guidelines, state staffing levels sufficient to receive, record and respond to complaints of human health impacts and environmental damage resulting from hydraulic fracturing.

Since 2005, the AOGC has increased the number of full-time employees from 28 to 40, and the number of part-time employees from 6 to 10. Six of the additional full-time employees are full-time field inspectors. This increase has been in large response to the

increased activity in the Fayetteville Shale development area. AOGC staff is sufficient to respond to the number of complaints resulting from hydraulic fracturing. The ADEQ also has also increased its field inspection staff, and currently has adequate staff to respond to the number of complaints resulting from hydraulic fracturing.

Describe staff training to stay current with new and developing hydraulic fracturing technology.

Both the AOGC and the ADEQ conduct routine training of its respective field staff. This includes training conducted by each agency respectively, as well as outside training conducted by other governmental and industry experts.

Public Information [9.2.4]

Briefly describe how the state agency provides for dissemination of educational information regarding well construction and hydraulic fracturing to bridge the knowledge gap between experts and the public as provided in Section 4.2.2.2 of the guidelines. This is especially important in areas where development has not occurred historically and in areas where high volume water use for hydraulic fracturing is occurring.

As stated above, all well information and the information required by AOGC General Rule B-19 is available on the AOGC webpage. To ensure easy access by the public, certain hydraulic fracturing information has been segregated and compiled in a separate user friendly database. The AOGC webpage also has a link to an API video which demonstrates the hydraulic fracturing process, and specific information pertaining to hydraulic fracturing in the Fayetteville Shale development area. Additionally, this webpage includes interactive maps and other relevant information.

Water and Waste Management Associated with Hydraulic Fracturing [9.3]

Fundamental differences exist from state to state, and between regions within a state, in terms of geology and hydrology. Describe how the state evaluated and addressed, where necessary, the availability of water for hydraulic fracturing in the context of all competing uses and potential environmental impacts resulting from the volume of water used for hydraulic fracturing.

The ANRC is the State's water resources planning and management agency. The ANRC is responsible for state level planning, management, and protection of surface water resources. This is accomplished through several programs. One of these programs is the Non-Riparian Water Use (NRWU) Program. The NRWU Program is designed to monitor surface water use outside of the riparian zone through the evaluation of surface water diversions, and subsequent determination actions (to include permits where appropriate) associated with each use. A Non-Riparian Permit authorizes the use of excess surface water for activities on land that is not contiguous to surface water.

Permitting indicates a finding by the ANRC that the proposed surface water diversion will comply with state water law.

This finding further indicates that the ARNC has determined: 1) water to be used is excess surface water, 2) water is intended for a reasonable and beneficial use, and 3) diversion of water will cause no significant adverse environmental impact.

The ANRC calculates amount of excess surface water available for permitting based on Arkansas Water Plan basin reports. After determining the excess available in the drainage area for the withdrawal point, the ANRC may, by law, permit up to 25% of the excess. The term of a permit is specific to the details of the project. Typically, short-term uses such as hydraulic fracturing for gas drilling are issued for a one year period.

Describe how the availability and use of alternative water sources for hydraulic fracturing, including recycled water, is encouraged.

As stated above, AOGC General Rule B-17 and APCEC Regulation 34 include provisions for the construction and operation of multi-use reserve pits to encourage and facilitate reuse and recycling of hydraulic fracturing fluids. The ability to use multi-use reserve pits results in a significant reduction of tank truck traffic and conserves water resources used in hydraulic fracturing operations.

Briefly describe how waste associated with hydraulic fracturing is managed consistent with Section 4.1.1. and Section 7 of the guidelines.

AOGC General Rule B-17 defines all wastes generated in the drilling and hydraulic fracturing process. AOGC General Rule B-17 also identifies the disposal methods for each type of waste. Additionally, AOGC General Rule E-3 governs the permitting and operation (including fluid manifesting) of tank trucks transporting exploration and production wastes in Arkansas. AOGC General Rules H-1, H-2, and H-3 govern the permitting and operation of Class II Disposal Wells, which is the primary method for disposal of hydraulic fracturing fluid waste at the current time.

The ADEQ imposes requirements for the permitting and operation of other approved disposal facilities such as land farms, landfills, and certain commercial recycling facilities (oil-based drilling mud).

NORM in Arkansas is subject to the jurisdiction of the Arkansas Department of Health (ADH). ADH has adopted regulations establishing amounts subject to regulation.

Discuss how the state encourages the efficient development of adequate capacity and infrastructure for the management of hydraulic fracturing fluids, including the transportation, recycling, treatment and disposal of source water and hydraulic fracturing wastes.

Both the AOGC and the ADEQ support the reuse and recycling of hydraulic fracturing flowback fluids and produced water. As stated above, General Rule B-17 and APCEC Regulation 34 include provisions for the construction and operation of multi-use pits to encourage and facilitate reuse and recycling of hydraulic fracturing flowback fluids.

The state has over 500 Class II disposal wells, mainly in South and West Arkansas. In addition to transporting wastes to Class II disposal wells in the Fayetteville Shale development area, wastes are also transported to disposal wells in South Arkansas, West Arkansas, and Oklahoma. With the recent closing of several Class II disposal wells, and the moratorium imposed on any new Class II disposal wells in certain areas of the Fayetteville Shale development area, some operators may have experienced a temporary shortage of capacity.

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