Water Management Associated with Hydraulic Fracturing

API GUIDANCE DOCUMENT HF2
FIRST EDITION, JUNE 2010

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AMERICAN PETROLEUM INSTITUTE

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Upstream Segment

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Contents

Executive Summary

Hydraulic fracturing has played an important role in the development of America's oil and gas resources for nearly 60 years. In the U.S., an estimated 35,000 wells are hydraulically fractured annually and it is estimated that over one million wells have been hydraulically fractured since the first well in the late 1940s. As production from conventional oil and gas fields continues to mature and the shift to non-conventional resources increases, the importance of hydraulic fracturing will also increase.

The purpose of this guidance document is to identify and describe many of the current industry best practices used to minimize environmental impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing. This document focuses primarily on issues associated with the water used for purposes of hydraulic fracturing and does not address other water management issues and considerations associated with oil and gas exploration, drilling, and production. It complements two other API Documents; one (API Guidance Document HF1, *Hydraulic Fracturing Operations—Well Construction and Integrity Guidelines*, First Edition, October 2009) focused on groundwater protection related to drilling and hydraulic fracturing operations, [1] which specifically highlights recommended practices for well construction and integrity of hydraulically fractured wells, and the second (API Guidance Document HF3, *Surface Environmental Considerations Associated with Hydraulic Fracturing*, publication pending, but expected in 2nd Quarter of 2010) focused on surface environmental issues associated with the hydraulic fracturing process. [2]

This document provides guidance and highlights many of the key considerations to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids used in the hydraulic fracturing process, including the following.

1) Operators should engage in proactive communication with local water planning agencies to ensure oil and gas operations do not constrain the resource requirements of local communities and to ensure compliance with all regulatory requirements. Understanding local water needs may help in the development of water storage and management plans that will be acceptable to the communities neighboring oil and gas operations. Also, this proactive communication will help operators in understanding the preferred sources of water to be used for hydraulic fracturing by the local planning agency.

2) Basin-wide hydraulic fracturing planning can be beneficial upon an operator's entry into a new operating area or basin, depending on the scale of the planned operations. The planning effort may include a review of potential water resources and wastewater management opportunities that could be used to support hydraulic fracturing operations. This review should consider the anticipated volumes of water required for basin-wide fracturing in addition to other water requirements for exploration and production operations. Operators should continue to engage local water planning agencies when developing their hydraulic fracturing programs and consider a broad spectrum of competing water requirements and constraints, such as: location and timing of water withdrawal; water source; water transport; fluid handling and storage requirements; flow back water treatment/disposal options; and potential for water recycling.

3) Upon initial development, planning and resource extraction of a new basin, operators should review the available information describing water quality characteristics (surface and groundwater) in the area and, if necessary, proactively work with state and local regulators to assess the baseline characteristics of local groundwater and surface water bodies. Depending on the level of industry involvement in an area, this type of activity may be best handled by a regional industry association, joint industry project, or compact. On a site specific basis, pre-drilling surface and groundwater sampling/analysis should be considered as a means to provide a better understanding of on-site water quality before drilling and hydraulic fracturing operations are initiated.

4) In evaluating potential water sources for hydraulic fracturing programs, an operator's decision will depend upon volume requirements, regulatory and physical availability, competing uses, discussions with local planning agencies, and characteristics of the formation to be fractured (including water quality and compatibility

considerations). A hierarchy of potential sources should be developed based upon local conditions. Where feasible, priority should be assigned to the use of wastewater from other industrial facilities.

5) If water supplies are to be obtained from surface water sources, operators should consider potential issues associated with the timing and location of withdrawals, being cognizant of sensitive watersheds, historical droughts and low flow periods during the year. Operators should also be mindful of periods of the year in which activities such as irrigation and other community and industrial needs place additional demands on local water availability. Additional considerations may include: potential to maintain a stream's designated best use; potential impacts to downstream wetlands and end-users; potential impacts to fish and wildlife; potential aquifer depletion; and any mitigation measures necessary to prevent transfer of invasive species from one surface water body to another.

6) If water supplies are to be obtained from groundwater sources, operators should consider the use of non-potable water where feasible and possible. Using water from such sources may alleviate issues associated with competition for publicly utilized water resources. Alternatively, the use of non-potable water may increase the depth of drilling necessary to reach such resources, and/or the level of treatment necessary to meet specifications for hydraulic fracturing operations.

7) On a regional basis, Operators should typically consider the evaluation of waste management and disposal practices for fluids within their hydraulic fracturing program. This documented evaluation should include information about flow back water characterization and disposition, including consideration of the preferred transport method from the well pad (i.e. truck or piping). Operators should review and evaluate practices regarding waste management and disposal from the process of hydraulic fracturing, including: The preferred disposition (e.g. treatment facility, disposal well, potential reuse, centralized surface impoundment or centralized tank facility) for the basin; treatment capabilities and permit requirements for proposed treatment facilities or disposal wells; and the location, construction and operational information for proposed centralized flow back impoundments.

8) When considering preferred transport options, Operators should assess requirements and constraints associated with fluid transport. Transportation of water to and from a well site may significantly impact both the cost of drilling and operating a well. Alternative strategies should be considered to minimize this expense in addition to potential environmental or social impacts.

9) Operators developing a transportation plan within their hydraulic fracturing program should consider estimated truck volumes within a basin, designation of appropriate off road parking/staging areas, and approved transportation routes. Measures to reduce or mitigate the impacts of transporting large volumes of fracture fluids should be considered. Developing and implementing a detailed fluid transport strategy, as well as working collaboratively with local law enforcement, community leaders and area residents, can aid in enhancing safety and reducing potential impacts.

10) In developing plans for hydraulic fracturing, Operators should strive to minimize the use of additives. When necessary, Operators should assess the feasibility of using more environmentally benign additives. This action could help with addressing concerns associated with fracture fluid management, treatment, and disposal. While desirable, elimination or substitution of an alternative additive is not always feasible as the performance may not provide the same effectiveness as more traditional constituents.

11) Operators should make it a priority to evaluate potential opportunities for beneficial reuse of flow back and produced fluids from hydraulic fracturing, prior to treating for surface discharge or reinjection. Water reuse and/or recycling can be a key enabler to large scale future development. Pursuing this option, however, requires planning and knowledge of chemical additives likely to be used in hydraulic fracturing operations and the general composition of flow back and produced water. Reuse and/or recycling practices require the selection of compatible additives, with focused efforts on the use of environmentally benign constituents that do not impede water treatment initiatives. The wise selection of additives may enhance the quantity of fluids available and provide more options for ultimate use and/or disposal.

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1 Scope

The purpose of this guidance document is to identify and describe many of the current industry best practices used to minimize environmental and societal impacts associated with the acquisition, use, management, treatment, and disposal of water and other fluids associated with the process of hydraulic fracturing. While this document focuses primarily on issues associated with hydraulic fracturing pursued in deep shale gas development, it also describes the important distinctions related to hydraulic fracturing in other applications.

Moreover, this guidance document focuses on areas associated with the water used for purposes of hydraulic fracturing, and does not address other water management issues and considerations associated with oil and gas exploration, drilling, and production. These topics will be addressed in future API documents. [3]

2 Definitions

2.1
aquifer
A subsurface formation that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

2.2
basin
A closed geologic structure in which the beds dip toward a central location; the youngest rocks are at the center of a basin and are partly or completely ringed by progressively older rocks.

2.3
casing
Steel piping positioned in a wellbore and cemented in place to prevent the soil or rock from caving in. It also serves to isolate fluids, such as water, gas, and oil, from the surrounding geologic formations.

2.4
coal bed methane/coal bed natural gas
CBM/CBNG
A clean-burning natural gas found deep inside and around coal seams. The gas has an affinity to coal and is held in place by pressure from groundwater. CBNG is produced by drilling a wellbore into the coal seam(s), pumping out large volumes of groundwater to reduce the hydrostatic pressure, allowing the gas to dissociate from the coal and flow to the surface.

2.5
completion
The activities and methods to prepare a well for production and following drilling. Includes installation of equipment for production from a gas well.

2.6
disposal well
A well which injects produced water into an underground formation for disposal.

2.7
directional drilling
The technique of drilling at an angle from a surface location to reach a target formation not located directly underneath the well pad.