C O M M E N T S

LDAR: A Problem and a Solution for Hydraulic Fracturing

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Valves, pumps, connectors, and other component parts are the crucial joints in an industrial plant's skeletal system. Without them, movement—or in the case of a refinery or chemical manufacturing facility, processing—would be impossible. And, just as with skeletal joints, without proper care and maintenance, normal wear and tear can cause component parts to become arthritic and leak, releasing contained gas and liquids into the environment. Leaking parts are particularly problematic to the expansion of high-volume hydraulic fracturing (HVHF), as they may undermine the greenhouse gas (GHG) reduction otherwise gained by transitioning to natural gas.

The U.S. Environmental Protection Agency (EPA) estimates that leaking component parts account for between 600-700 tons of volatile organic compound (VOC) emissions from a typical refinery or chemical manufacturing plant each year, for a total of over 70,000 tons of VOC emissions and more than 9,000 tons of hazardous air pollutant (HAP) emissions released by these industries annually. Not only do leaking component parts cause fugitive emissions, which contribute to the formation of ozone, but they also constitute a product loss that, according to EPA, can translate into lost revenue of over $1,300 per ton of leaked emissions per plant. In other words, leaking component parts are both an environmental and a bottomline business concern.[1]

To address the integrity of component parts and their associated leaks, Leak Detection and Repair (LDAR) programs are required as part of 25 federal regulatory programs, including New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAPs), and Resource Conservation and Recovery Act (RCRA)[2] requirements.[3] At their core, LDAR programs require a regulated facility to monitor its component parts, either electronically or through observational inspections; to identify leaks; to swiftly repair or replace component parts when necessary; and to thoroughly document such efforts.[4] Industry-specific LDAR methods exist to address both above-ground and below-ground parts. For example, refineries and pharmaceutical manufacturers deal extensively in above-ground LDAR protocols like Method 21, designed to detect and eliminate leaks in an array of above-ground process equipment. Water utilities and underground storage tank operators, on the other hand, benefit greatly from the institution of below-ground electronic leak-detection programs that allow operators to locate and address underground leaks that may, by their obstructed nature, otherwise go undetected.

To date, EPA has largely targeted its enforcement of LDAR requirements to the petroleum refinery and chemical manufacturing industries (such as pharmaceutical production facilities regulated by the Pharma MACT [maximum available control technology]), and has obtained millions of dollars in penalties for noncompliance. EPA also seeks the implementation of facility-specific Enhanced LDAR programs, which typically require increased monitoring frequency and lower leak thresholds, as injunctive relief. In the RCRA realm, release-detection monitoring is an essential component of the Agency's underground storage tank program, and EPA has brought suit to enforce its internal and interstitial monitoring requirements for below-ground pressurized pipes, parts, and tanks. While critics exist, LDAR is generally viewed as an effective tool to address fugitive emissions and product leaks from a system's component parts.

LDAR poses both a problem and a solution to HVHF. HVHF, or "fracking," is a method of natural gas extraction by which materials, typically water, sand, and chemical additives, are injected at high pressure through a wellbore-encased pump below several vertical layers of strata before veering horizontally into deep shale formations to create, or "drill out," fractures. The resulting fractures and per-

1. U.S. EPA Office of Compliance, Leak Detection, and Repair: A Best Practices Guide, U.S. EPA Compliance Assistance Publications, 2-3, 8 (Oct. 2007), *available at* http://www.epa.gov/compliance/resources/publications/assistance/ldarguide.pdf.
2. 42 U.S.C. §§6901-6992k, ELR Stat. RCRA §§1001-11011.
3. U.S. EPA, *supra* note 1, at 6.
4. *Id.* at 9.

forations allow for the release of natural gas, which is captured and diverted into the wellbore and then surged to the surface, along with residual flow-back fluids.

Generally, a HVHF system consists of a wellhead, a wellbore, separators, pneumatic controllers, pipes, casings, and above-ground water tanks, hydrocarbon tanks, dehydrators, compressors, processors, and flares. Certain HVHF component parts—like the wellbore, pipes, casings, compressors, and processors in particular—are susceptible to leaking, and are therefore prime for effective LDAR control.

The primary gas extracted by HVHF is methane (CH_4), the simplest hydrocarbon and a GHG. When burned as fuel, CH_4 is "cleaner"—i.e., produces far less carbon dioxide (CO_2) and other GHGs—than coal and oil. As a result, HVHF generally, and natural gas specifically, is touted as a transition fuel that can lead the way to a cleaner, greener economy. However, when released into the air, CH_4 traps heat at a much higher rate than CO_2, making it a much more potent GHG.[5] As a consequence, and to retain its potential as an instrument of GHG reduction, HVHF must minimize, and seek to eliminate, CH_4 leaks.

Unintentional CH_4 releases can occur throughout the hydraulic fracturing process, both in the underground wellbore, and at wellhead, storage, and transmission points above-ground. Above-ground emissions are often the result of leaking valves and pipes, or inoperable flares. Below-ground CH_4 leaks are generally thought to be the result of poor well or pipe construction, cement bonding, and casing maintenance. And while above-ground emissions may lead to the release of toxic air pollutants, concerns exist that below-ground leaks of CH_4 and other fluids may migrate up to shallower zones and contaminate groundwater resources.

While below-ground contamination concerns have, to date, been rejected by several private research institutions, a 2011 Duke University study examined CH_4 in groundwater samples from 68 water wells along the Marcellus and Utica Shales and determined that wells in close proximity to hydraulic fracturing sites contained higher concentrations of thermogenic CH_4 than present in water wells a farther distance away. The Duke University team responsible for this study concluded that the identified CH_4 was released from inadequately sealed, ruptured, or leaking below-ground well casings.[6] Conversely, a 2013 Statement on Reported Fracking Study by the National Energy Technology Laboratory, a division of the U.S. Department of Energy, preliminarily found nothing of concern to indicate groundwater contamination as a result of hydraulic fracturing operations along the Marcellus Shale in Pennsylvania.[7] Federal studies remain ongoing, with a draft report of EPA's formal study of hydraulic fracturing's potential impact on drinking water expected sometime this year.[8]

Here in New York, where the debate over hydraulic fracturing continues to rage despite a de facto moratorium on the practice, the State's Department of Environmental Conservation (DEC) concluded that it is highly unlikely that groundwater contamination could occur from HVHF in the Marcellus and Utica Shales. Instead, the DEC pointed to the migration of naturally occurring CH_4 from wetlands, landfills, and shallow bedrock, which can contaminate water supplies independently of any nearby oil and gas activities.[9] Despite its findings, the DEC was, and continues to be, inundated with extensive public comments concerning the risk of groundwater contamination from gas migration and underground leaks at HVHF wells. To date, the standstill in New York continues as the State's Department of Health conducts its own study of HVHF's potential impacts to groundwater resources, with no completion date in sight.

The typical CH_4 leakage rate from above-ground HVHF parts is also the source of much study, investigation, and debate. A 2011 Cornell University study concluded, "3.6% to 7.9% of methane from shale-gas production escapes into the atmosphere in venting and leaks over the lifetime of a well."[10] Also on the higher end of the spectrum, a National Oceanic Atmospheric Administration study of Utah's Uinta Basin calculated an above-ground leakage rate as high as 11.7%. However, a more recent 2013 World Resources Institute Study calculated total annual CH_4 leakage rates from above-ground HVHF parts at between 2.27% (using 2012 EPA GHG inventory data) and 1.54% (using 2013 draft inventory data) of total CH_4 production.[11]

While significant regional variations exist and may serve to explain the higher Utah Uinta leakage rate, a September 2013 study in the Proceedings of the National Academy of Sciences (PNAS), based on direct onsite measurements of 190 natural gas production sites and over 500 wells throughout the country, found an overall CH_4 leak rate of only 1.5%.[12] However, the PNAS study concluded that

5. U.S. EPA, Overview of Greenhouse Gases: Methane Emissions, http://epa.gov/climatechange/ghgemissions/gases/ch4.html (last visited Mar. 27, 2014).
6. Stephen G. Osborn et al., Methane Contamination of Drinking Water Accompanying Gas-Well Drilling and Hydraulic Fracturing, 108(20) Proc. of the Nat'l Acad. of Sciences of the U.S., 8172, 8175 (2011), *available at* https://nicholas.duke.edu/cgc/pnas2011.pdf.
7. Nat'l Energy Tech. Lab., NETL Statement on Reported Fracking Study, netl.doe.gov (July 19, 2013), *available at* http://www.netl.doe.gov/publications/press/2013/studystatement.pdf.
8. U.S. EPA, Study of Hydraulic Fracturing and Its Potential Impact on Drinking Water Resources, *available at* http://www2.epa.gov/hfstudy.
9. NYSDEC, Revised Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program, dec.ny.gov (Sept. 7, 2011), *available at* http://www.dec.ny.gov/docs/materials_minerals_pdf/rdsgeisexecsum0911.pdf.
10. Robert W. Howarth et al, *Methane and the Greenhouse Gas Footprint of Natural Gas From Shale Formations*, 106(4) Climatic Change 679, 679 (2011), *available at* http://tinyurl.com/lvbykbt.
11. James Bradbury et al., Clearing the Air: Reducing Upstream Greenhouse Gas Emissions From U.S. Natural Gas Systems, World Resources Institute, 1, 15 (Working Paper Apr. 2013), *available at* http://www.wri.org/sites/default/files/clearing_the_air_full_version.pdf.
12. David T. Allen et al., Measurements of Methane Emissions at Natural Gas Production Sites in the United States, 110(44) Proc. of the Nat'l Acad. of Sciences of the U.S., 17768, 17768 (2013), *available at* http://tinyurl.com/m4bupez.

CH_4 leaks at specific points in the hydraulic fracturing process were significantly higher than EPA's earlier national inventory estimates. Specifically, the PNAS study found CH_4 emissions from valves controlling routine operations were up to 63% higher than EPA's earlier estimate, and that emissions from other equipment leaks were up to 69% higher than the Agency had previously estimated. It is these exact types of CH_4 emissions and leaks that a comprehensive LDAR program can protect against and mitigate.

Though complex, the problem with LDAR in the hydraulic fracturing context is not one of perceived or actual effectiveness. Indeed, EPA's recently updated NSPS for oil and natural gas production requires that LDAR be conducted at wellhead compressor points above-ground. This LDAR requirement, in addition to the NSPS' "green completion" control technology requirement that companies have voluntarily implemented in advance of EPA's deadline, has been credited for the capture of roughly 99% of CH_4 emissions at the wellhead point. In other words, when implemented in the HVHF context, LDAR methods appear to work.

Instead, the problem with LDAR in the HVHF context is that federal regulation of siting, construction, and operation of hydraulic fracturing wells, a natural avenue by which to require below-ground LDAR and electronic monitoring, was largely excluded by the Energy Policy Act of 2005 (which excepted non-diesel fuel-based hydraulic fracturing from EPA's Underground Injection Control program, Safe Drinking Water Act[13] jurisdiction, and certain Clean Water Act[14] and Clean Air Act (CAA)[15] requirements). Ominously dubbed the "Halliburton loophole," this exclusion is problematic not because federal regulation of the natural gas industry in this instance is necessarily best, and states can, and in at least one instance have, stepped in with comparable LDAR requirements. Instead, this exclusion is problematic because it fueled unwarranted conspiracies and turned valid concerns about proper well operation and maintenance into a basis for moratoria and bans.

According to Food & Water Watch, over 397 municipalities nationwide have instituted moratorium or bans on the HVHF practice.[16] The states of Vermont and Hawaii have symbolically banned the practice outright, while Maryland and New Jersey have placed moratoria on the issuance of well permits pending further study. Here in New York, where a de facto moratorium on the practice has existed for the last five years, over 50 municipalities have banned the practice outright, and an intermediary New York State court has upheld the legality of two such bans, pending review by the State's highest court in the near future. In part because of these nationwide prohibitions on HVHF, and despite its abundance in shale formations throughout the country, natural gas is actually an underutilized energy resource in the United States.

Stakeholder concerns about HVHF go beyond typical "not in my backyard" (NIMBY) criticisms and tend to center around CH_4 releases and the proper treatment of residual waste fluids. Visually, at least, impacts from alleged underground CH_4 releases have proven a most effective rallying point in the anti-fracking campaign. For example, opponents of HVHF successfully utilize vivid images of facet water ignition, like those recorded in the documentaries *Gasland I* and *II*, to validate their calls to ban the practice outright. But the exact risks identified by opponents as the basis for bans and calls for moratoria can be effectively addressed, in large part, by a comprehensive LDAR program.

Equally important, the Energy Policy Act exclusion left proponents of hydraulic fracturing without an important tool in the federal regulatory toolshed. A comprehensive LDAR program offers an effective, and necessary, method by which to address CH_4 leaks at all segments of new and existing well sites, both above- and below-ground. While EPA can, and should, expand its above-ground LDAR program under §111 of the CAA to address all potential fugitive CH_4 emissions, that would only address one-half the picture. The integrity and monitoring of below-ground component parts, like wellbore components and cement casings not currently capable of federal regulation, are nonetheless crucial to safe and sustained natural gas extraction.

HVHF-specific LDAR methods are the solution that proponents of HVHF must be able to propose and pursue in the national debate on hydraulic fracturing. In the absence of this important federal regulatory tool, states should take the lead and focus their efforts on expanding above-ground LDAR programs and instituting underground electronic monitoring release-detection regimes. Likewise, natural gas companies may wish to create, and adhere to, voluntary LDAR programs through a series of stringent best management practices. Not only can LDAR programs effectively address primary stakeholder concerns about CH_4 leaks from HVHF processes, potentially tempering a hotly adverse political climate, but they can do so in a cost-effective and rational manner appealing to regulators and industry alike.

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13. 42 U.S.C. §§300f to 300j-26, ELR Stat. SDWA §§1401-1465.
14. 33 U.S.C. §§1251-1387, ELR Stat. FWPCA §§101-607.
15. 42 U.S.C. §§7401-7671q, ELR Stat. CAA §§101-618.
16. *See* https://www.foodandwaterwatch.org/water/fracking/fracking-action-center/map/.