

INDUCED EARTHQUAKES SHAKE UP REGULATORY AND LITIGATION LANDSCAPE

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Earthquake risks continue prompting lawmakers and regulators in several oil and gas producing states to evaluate wastewater injection purportedly linked to seismic activity. This alleged link remains a hotly debated topic with various viewpoints presented. In the wake of recent seismic events and induced earthquake studies, energy industry operations remain under scrutiny by state and federal officials. Implications for potential regulation are emerging, with calls ranging from outright bans to greater monitoring and disclosure of fault locations and injection activity to those that advocate that no new regulations are needed. Recent court rulings raise issues about the appropriate liability framework for induced seismicity. As public opinion and geophysical research continue to evolve, a variety of policy trends and litigation theories are becoming apparent for hydraulic fracturing operators.

Regulatory trends in the states: mapping, monitoring, and moratoria

Research by geophysicist experts¹ and the U.S. Geological Survey (USGS) on induced seismicity² has fueled the focus by policymakers seeking to address underground injection activities purportedly linked to seismic activity. In addition, a Texas study raised questions about possible natural and anthropogenic causes of earthquakes within the state.³ These recent developments reveal implications for induced seismicity policy proposals, with disposal well regulatory regimes varying across jurisdictions. Currently, injection well regulations govern technical issues such as wellbore construction, allowable sources of injected fluid, and operational requirements such as maximum injection pressure and periodic testing. Going forward, it is likely that increased monitoring, disclosure, and perhaps even occasional moratoria can be expected to remain the key tools for regulators to weigh in on this debated seismicity risk, with variations in requirements and enforcement priorities among states.

On April 23 the USGS issued its first analysis of man-made earthquake risks associated with energy industry activities. The report is the first by a federal agency to entertain the possibility of induced quakes in eight states, and a departure from previous USGS commentary⁴ questioning the link between injection and induced seismicity. Speaking on behalf of the USGS, National Seismic Hazard Project chief Mark Peterson stated in late April, “We consider induced seismicity to be primarily triggered by the disposal of wastewater into deep wells.”⁵ The report’s

¹ *Special Section: Injection-Induced Seismicity*, The Leading Edge, Society of Exploration Geophysicists (June 2015), <http://library.seg.org/toc/leedff/34/6>.

² Mark D. Peterson, et al., *Incorporating Induced Seismicity in the 2014 United States National Seismic Hazard Model—Results of 2014 Workshop and Sensitivity Studies*, U.S. Geological Survey (Apr. 23, 2015), <http://pubs.usgs.gov/of/2015/1070/pdf/ofr2015-1070.pdf>.

³ Matthew J. Hornbach, et al., *Causal factors for seismicity near Azle, Texas*, Nature Communications (Apr. 21, 2015), <http://www.nature.com/ncomms/2015/150421/ncomms7728/full/ncomms7728.html>.

⁴ Bill Barnhart, et al., *Was the M5.3 Trinidad, CO Earthquake Natural or Induced?*, U.S. Geological Survey (Mar. 24, 2015), <http://earthquake.usgs.gov/research/ratonbasin/>.

⁵ Becky Oskin, *Fracking is not the cause of quakes. The real problem is wastewater.*, Washington Post (Apr. 27, 2015), http://www.washingtonpost.com/national/health-science/fracking-is-not-the-cause-of-quakes-rather-its-frackings-wastewater/2015/04/27/e87a6e82-e9f4-11e4-aae1-d642717d8afa_story.html.

recommendation to include induced seismicity in earthquake modeling calculations and maps has been advocated by researchers and anticipated for some time. Scientific models for how to account for possible induced seismicity risk are still being considered, however, as the April report was only preliminary, the product of a workshop co-hosted by the USGS and the Oklahoma Geological Survey (OGS) last November.⁶

Since publication of the report USGS commentary about earthquakes occurring in the mid-continent region has evolved. Recent statements by the USGS now display a more neutral tone on the cause of possible induced quakes than previous statements laying blame on the energy industry. The USGS notes: “Even within areas with many human-induced earthquakes, however, the activity that seems to induce seismicity at one location may be taking place at many other locations without inducing felt earthquakes.” The USGS also acknowledges that “regions with frequent induced earthquakes may also be subject to damaging earthquakes that would have occurred independently of human activity.” Nevertheless, the after-effects of the USGS preliminary report are currently being reviewed in state policymaking bodies throughout the country.

Oklahoma

The same day the USGS released its report, the Oklahoma Geological Survey issued a public statement that rates and geographical patterns of seismicity observed in the state “are very unlikely to represent a naturally occurring rate change and process.”⁷ The Oklahoma State Geologist, Richard Andrews, and State Seismologist, Dr. Austin Holland, concluded the “primary source for suspected triggered seismicity is not from hydraulic fracturing, but from the injection/disposal of water associated with oil and gas production.”⁸

Upon this announcement, the OGS disclosed on its website a preliminary map of known faults while state regulators disavowed a moratorium on injection operations.⁹ The OGS is compiling a fault database with voluntary contributions from the Oklahoma Independent Petroleum Association.¹⁰ Although perhaps the first of its scale, the concept is not new. For example, after the Guy-Greenbrier, Arkansas ground shaking in 2011, industry and regulators collaborated on a fault map used to set boundaries of an injection moratorium zone in northwest Arkansas. The recent OGS developments are merely the latest stage of attention to seismic issues in the past year. Last fall, the Oklahoma Governor established a coordinating council to study induced seismicity, the state’s energy industry regulator—the Oklahoma Corporation Commission—adopted new regulations for wells in seismically active areas, and Oklahoma held the nation’s first legislative hearings on induced earthquakes.

⁶ *Workshop on Hazard from Induced Seismicity*, U.S. Geological Survey, (Nov. 13, 2014), <https://sslearnquake.usgs.gov/regional/ceus/workshop/>.

⁷ Richard D. Andrews and Austin Holland, *Summary Statement on Oklahoma Seismicity*, Oklahoma Geological Survey, (Apr. 21, 2015) http://earthquakes.ok.gov/wp-content/uploads/2015/04/OGS_Summary_Statement_2015_04_20.pdf

⁸ *Id.*

⁹ Austin A. Holland, *Preliminary Fault Map of Oklahoma*, Oklahoma Geological Survey (Apr. 21, 2015), <http://wichita.ogs.ou.edu/documents/OF3-2015/>.

¹⁰ Andrews, *supra*, at 2.

In light of the recent reports and statements by authorities regarding induced seismicity in Oklahoma, one state representative is now calling for a moratorium on injection, whereas Oklahoma oil and gas regulators maintain they lack authority to stop operations.¹¹ Meanwhile, the state is encouraging property owners to protect themselves against the earthquake threat while further study continues. For instance, a directive passed after seismic events in 2011 purportedly caused building damage now requires Oklahoma insurance agents to take courses in earthquake coverage. Yet in light of uncertain science, authorities appear hesitant to prematurely over-react to fears about induced seismicity risks with excessive regulation.

Texas

Texas Railroad Commission officials continue to maintain a neutral stance toward the purported link between well activity and induced seismicity. Nevertheless, on April 24 the Commission issued show cause orders for two wells purportedly related to induced seismicity and on May 8 required additional testing from four wells, which well operators will have to temporarily close to test. State Seismologist Dr. Craig Pearson has emphasized that more research is needed as the agency seeks to make informed policy decisions. To this end, he conferred May 4 with the researchers behind the Azle study. The heightened visibility of the state's oil and gas regulatory body around this issue occurs amidst ongoing uncertainty about the correlation between faulting and injection practices.¹² Commentary by the Commission that nothing may come of the show cause proceedings¹³ stemming from the April 23 report¹⁴ demonstrates the agency will continue to emphasize the importance of research while insisting its policies be driven by its own methodical analysis. Although the Commission conducted a show-cause hearing in early June, no enforcement actions against any wells have yet been undertaken. Commission officials and legislators have expressed interest, however, in a mobile array monitoring system to have capacity to quickly assess seismic events with sensitivity to low levels of seismicity. The Kentucky Geological Survey recently implemented such a program with two mobile monitoring arrays.

No further future regulatory changes are currently expected in Texas at present, however. At a May 4 House Energy Resources Committee hearing, Pearson hinted that carefully crafted existing regulations are adequate, noting that the two Azle wells were permitted before the pre-permit seismic data review requirements now in effect for new wells. Under these requirements, applicants must submit data about existing risks in the formations intended for injection, information which Pearson testified the Commission carefully scrutinizes for all new wells. The Commission has also had authority since November to modify, suspend, or terminate existing well permits.

¹¹ Michael Wines, *Oklahoma Recognizes Role of Drilling in Earthquakes*, N.Y. Times, Apr. 21, 2015 at A16, http://www.nytimes.com/2015/04/22/us/oklahoma-acknowledges-wastewater-from-oil-and-gas-wells-as-major-cause-of-quakes.html?_r=0.

¹² Terrence Henry, *As Texas Towns Shake, Regulators Sit Still*, State Impact (Dec. 6, 2013), <http://stateimpact.npr.org/texas/2013/12/06/as-north-texas-shakes-railroad-commission-sits-still/>

¹³ Gene Powell, *Earthquake Study on Disposal Wells Causes Texas Regulators to Act*, Powell Shale Digest, at 7 (Apr. 28, 2015).

¹⁴ Christi Craddick and David Porter, *Railroad Commission Orders "Show Cause" Proceeding for Azle Disposal Wells*, Texas Railroad Commission (Apr. 24, 2015), <http://www.rrc.state.tx.us/about-us/commissioners/porter/news/042415a/>.

Similarly, the Commission's May 8 order¹⁵ required additional testing of four wells near a seismic event in the vicinity of Venus and Midlothian, without calling for a shutdown of the wells. The request for testing was authorized by the Commission's new rules in 16 Texas Administrative Code Section 3.9(11).¹⁶ The actions in Texas demonstrate an information-gathering approach, in contrast to Ohio's abrupt moratorium in response to concerns about induced seismicity near Youngstown in late 2011.¹⁷ It remains to be seen what will happen as Texas geophysics continue to become better understood, an area of study characterized by many unknowns according to researchers who testified at a May 4 legislative hearing.

California

The recent USGS report has also reverberated in the California Assembly. On April 27, the Assembly's Natural Resources committee approved a bill dealing with seismic activity and the hydraulic fracturing industry, with the committee chair citing the recent USGS report as guiding the decision. A.B. 1490 would put a moratorium on nearby hydraulic fracturing operations if an earthquake surpasses magnitude 2.0, so-called "microearthquakes" with an intensity too low for most people to feel. Operations would not be permitted to resume until a determination by the California Division of Oil, Gas and Geothermal Resources that hydraulic fracturing does not heighten the risk of seismic activity. The bill does not yet identify how far a well could be sited from a quake's epicenter and still be allowed to continue operating. Under current California law well operations must only cease after a magnitude 2.7 event, suggesting that public concern over induced earthquake risk is intensifying in the state. The standard seems geared at the oil and gas industry, as geothermal energy operations routinely resume after nearby quakes of yet greater magnitudes.

In addition, proposed legislation in California would prohibit wastewater disposal wells and all well stimulation activity within ten miles of a fault active at any point in the past two centuries. The law could make California the state where a moratorium would be most easily triggered. This high degree of caution may be due to California's unique geology.

Impact of recent research on existing national regulatory framework

Throughout the United States, the Underground Injection Control ("UIC") program regulates the permitting and operation of approximately 50,000 Class II wastewater disposal wells under the authority of the Safe Drinking Water Act ("SDWA"). The SDWA authorized the EPA to delegate primary enforcement responsibility ("primacy") over underground injection control to the states to ensure safe drinking water for the public by protecting underground sources of drinking water from contamination by injected fluids.¹⁸ Most oil and gas producing

¹⁵ Christi Craddick, David Porter, and Ryan Sitton, *Railroad Commission to Require Testing of Disposal Wells in Johnson County*, Texas Railroad Commission (May 8, 2015), <http://www.rrc.state.tx.us/all-news/05082015/>.

¹⁶ Barclay Nicholson and Jim Hartle, *Seismic Events Shake Up Texas Rules on Injection Wells*, Law360 (Nov. 7, 2015), <http://www.law360.com/articles/594181/seismic-events-shake-up-texas-rules-on-injection-wells>.

¹⁷ *Preliminary Report on the Northstar 1 Class II Injection Wells and the Seismic Events in the Youngstown, Ohio, Area*, Ohio Department of Natural Resources (Mar. 2012), http://media.cleveland.com/business_impact/other/UICReport.pdf.

¹⁸ Mary Tiemann & Adam Vann, *Hydraulic Fracturing and Safe Drinking Water Act Regulatory Issues*, Congressional Research Service (Jan. 10, 2013), <http://www.fas.org/sgp/crs/misc/R41760.pdf>.

states exercise primary enforcement authority for Class II wells, but in a minority of states the EPA implements the UIC Class II program.

Given the state-based UIC framework to regulate induced seismicity through the SDWA, it seems likely that induced seismicity regulation will remain state-focused. The shape potential regulation could take is unclear, though the USGS report contains some clues. For example, the report discusses a proposal for an induced seismicity monitoring or disclosure program enabling regulators to require changes to injection when induced seismicity is observed on a susceptible fault.¹⁹ The report also calls for creating a publicly accessible database of injection activities and corresponding induced seismicity, as well as a fault and stress-field database, with voluntary industry cooperation. Because many oil and gas producing states like Oklahoma and Texas retain primacy to regulate underground injection control in their states,²⁰ expanded authority to regulate induced seismicity will likely come through legislative and administrative action at the state level, with authorities in those states in fact already considering related measures.

Despite the EPA's role in UIC program oversight and administration in some states, the UIC regime is not a ready federal policymaking vehicle.²¹ Nevertheless, the ten EPA UIC regions in the country influence state regulation by facilitating coordination between the EPA and the states, as well as among the states in each UIC region. As a result, there is often similarity in permitting regulations among states in the same UIC region, suggesting that new regulations in one state may spark trends in a neighboring state.

Some commentary about induced seismicity mitigation may influence operators as a result of the USGS report. The report acknowledges that safe levels of induced seismicity exist. It also stresses the need for an updated earthquake USGS hazard model relied upon by so-called traffic light guidelines for use in industrial operators. Some oil and gas companies voluntarily utilize traffic light protocols,²² which greenlight seismicity-inducing activity when observed seismicity levels are low, slow operations when seismicity reaches a certain threshold, and cut operations off entirely above a point. Federal authorities have discussed the use of these self-imposed traffic light guidelines for mitigating induced seismicity risk in enhanced geothermal systems, which inject fluid deep underground to stimulate energy production.²³ Due to the often superior geophysical knowledge of industrial operators, they maintain a unique capacity to address these issues.

¹⁹ See also Alan Harvie, *Canada's Northwest territories propose new hydraulic fracturing filing regulations for on shore wells*, The Hydraulic Fracking Blog (Apr. 20, 2015), <http://fracking.nortonrosefulbright.com/>.

²⁰ Emery G. Richards, *Finding Fault: Induced Earthquake Liability and Regulation*, Columbia Journal of Environmental Law Field Reports (Apr. 1, 2015), <http://www.columbiaenvironmentallaw.org/articles/2015/04>.

²¹ For a discussion of the UIC program and induced seismicity, see Emery G. Richards, *Finding Fault: Induced Earthquake Liability and Regulation*, Columbia Journal of Environmental Law Field Reports (Apr. 1, 2015), <http://www.columbiaenvironmentallaw.org/articles/2015/04>.

²² John Veil, *A White Paper Summarizing a Special Session on Induced Seismicity*, Groundwater Protection Council 33, Feb. 2013, http://www.gwpc.org/sites/default/files/white%20paper%20-%20final_0.pdf.

²³ Ernie Majer, et al., *Protocol for Addressing Induced Seismicity Associated with Enhanced Geothermal Systems (EGS)*, U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (May 31, 2011), <http://www1.eere.energy.gov/geothermal/pdfs/egs-is-protocol-final-draft-20110531.pdf>.

Evolving liability

The recent USGS and Azle reports may be relied on going forward by plaintiffs in need of causation theories for induced seismicity. In Oklahoma, for example, when a woman filed a personal injury suit after a magnitude 5.7 quake in Prague, Oklahoma toppled her stone chimney onto her legs, her complaint claimed research by the USGS established the quake's cause.²⁴ The plaintiff also alleged liability under the doctrines of strict liability and negligence. In the nascent field of earthquake litigation, other doctrines could apply as well, including trespass and nuisance.²⁵ The recent reports may be relied upon in ongoing litigation, but no courts have given credence to these causation theories, though these arguments may continue to confront defendants.

Although it remains uncertain what standard of liability a court would likely apply, recent cases provide some guidance. Furthermore, many states that have experienced induced seismicity linked to wastewater injection—such as Ohio, Colorado, Arkansas, Texas, and Oklahoma—have concussion damage case law, dating back decades to suits involving dynamite explosions and destructive vibrations, which often addressed whether strict liability or negligence governs. Which doctrines of liability will predominate in future litigation remains an open question.

Negligence

In a first-of-its kind ruling on June 30, the Oklahoma Supreme Court weighed in on the induced earthquake issue holding that Oklahoma courts have jurisdiction over earthquake lawsuits like the one brought by a plaintiff whose legs were allegedly injured by her falling brick chimney during a 2011 quake.²⁶ The unanimous ruling over-turned the Lincoln County District Court's decision that it lacked jurisdiction to hear the case because of the Oklahoma Corporation Commission's exclusive jurisdiction over oil and gas regulatory matters. The Oklahoma Supreme Court ruled instead that under state law, these private tort actions belong in Oklahoma district courts.

Although the Oklahoma Supreme Court declined to address the merits, the opinion notes that “[w]hether Appellees are negligent or absolutely liable is a matter to be determined by a district court.” To date, no courts have addressed whether negligence or strict liability apply to induced seismicity claims. Texas and Arkansas, however, have rejected strict liability for concussion damage, favoring a negligence standard instead. Yet even negligence claims can lead to large damage awards. For instance, in a trial over property damage due to drilling operation vibrations, an Arkansas jury awarded \$300,000 in punitive and compensatory damages

²⁴ Sandra Ladra v. New Dominion, LLC, and Spess Oil Company John Does 1-25, No. CJ-2014-115 (Dist. Ct. of Lincoln Cnty., Oklahoma filed Aug. 4, 2014), <http://online.wsj.com/public/resources/documents/complaint20150330.pdf>.

²⁵ Darlene A. Cypser & Scott D. Davis, *Liability for Induced Earthquakes*, 9 J. Envtl. L. & Litig. 551 (1994).

²⁶ *Ladra v. New Dominion LLC et al.*, No. 113396 (Okla. June 30, 2015).

in a suit involving claims for negligence, nuisance, and trespass.²⁷ It will be interesting to see how the Lincoln County District Court addresses liability under Oklahoma law on remand.

Moreover, a federal court in Pennsylvania last year issued the first judicial opinion on whether strict liability or negligence should govern operations in the hydraulic fracturing industry.²⁸ The court found negligence to be the appropriate standard, denying hydraulic fracturing is an abnormally dangerous activity. Similar logic could apply to the risks associated with wastewater injection because it is not inherently linked to induced seismicity.

Trespass

An alternative to the negligence framework—trespass—may apply to wastewater injection damages, an issue recently raised before the Texas Supreme Court. Although in its February 6, 2015 decision the Texas Supreme Court did not answer whether deep subsurface water migration constitutes a trespass under Texas law,²⁹ it raised the question. It will be interesting to see how trespass law in Texas and other jurisdictions evolves.

Causation

Despite identifying ten geographic zones where oil and gas-related operations may have induced seismicity since 2011,³⁰ the April 23 USGS report and the June issue of *The Leading Edge* reiterate the difficulty of pinpointing how seismicity is induced.³¹ The USGS report targets needed scientific research and highlights the current indeterminacy of induced seismicity causation. The USGS report acknowledges uncertainty in scientific literature about the relationship between induced earthquakes and a variety of causes, including fluid injection rates, distance from injection wells, time between fluid injection and induced seismicity, and migration of pore pressure perturbations. Similarly, the Azle study claims that human activity in the area was more likely than not the cause of the seismicity, but cannot pin the exact cause. Lastly, papers in the special issue of *The Leading Edge* discuss the impact of injection volume, changes in earthquake hazards, characteristics of faults implicated in quakes in Oklahoma and other areas, as well as new research suggesting that induced seismic events may involve lower shaking intensity than natural events. Until scientific consensus about induced earthquake causation progresses, however, liability will remain difficult for plaintiffs to establish through earthquake damage lawsuits.

Conclusion

Recently emerging regulatory trends and liability theories surrounding induced seismicity raise a variety of potential issues for the energy industry. In tandem with the uncertainty surrounding the existence and causes of induced seismicity, uncertainty continues to characterize this relatively uncharted realm of the law energy companies may find themselves navigating.

²⁷ *Hiser v. XTO Energy Inc.*, No. 4:11CV00517 KGB, 2013 WL 5467186, (E.D. Ark. Sept. 30, 2013) aff'd, 768 F.3d 773 (8th Cir. 2014).

²⁸ *Ely v. Cabot Oil & Gas Corporation*, 38 F. Supp. 3d 518 (M.D. Pa. 2014).

²⁹ *Environmental Processing Systems, L.C. v. FPL Farming Ltd.*, No. 12-0905, (Tex. Feb. 6, 2015).

³⁰ Peterson, *supra*, at 13.

³¹ Peterson, *supra*, at 4.

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