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Texas Tackles Permian Earthquake Problem

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Efforts to reduce the frequency and intensity of earthquakes linked to oil and natural gas activity in the Permian Basin appear to be working, according to Texas regulators.

State authorities have noticed a reduction in seismic activity in the Gardendale Seismic Response Area (SRA) in the Midland subbasin of the Permian Basin, a spokesperson for the Texas Railroad Commission (RRC), which oversees the state's oil and gas industry, told Energy Intelligence this week.

“The magnitude and frequency of earthquakes has decreased since late December 2021,” the spokesperson said. That’s when a directive from the RRC went into effect that sus

well permits to inject oil and gas wastewater into deep formations within the SRA, which covers parts of Martin, Midland and Andrews Counties. The rule followed a series of temblors in the region.

Seismic Response

Earthquakes had increased in Texas in the last few years as oil and gas activity boomed. The number of quakes of magnitude 3 or higher has risen from fewer than 10 per month in 2017 to about 40 currently, said Katie Smye, a geoscientist at UT Austin's Bureau of Economic Geology. The bulk of those events are happening in the Permian, with the majority concentrated in the Delaware subbasin, she added.

Simply put, there are two stratigraphic levels that operators are injecting water into. One is shallower than the Wolfcamp and Bone Spring shale targets. The shallower interval, called the Delaware Mountain Group, is composed primarily of sandstone. The other injection target comprises deeper carbonates that are Ordovician, Silurian and Devonian in age.

Research by the bureau and others is showing that the larger-magnitude earthquakes in the northern Delaware are tied to deep injection.

"There are faults in crystalline basement rocks that extend into those deep-injection intervals, and when those faults are perturbed by either increases in pore pressure or by pore elastic stressing, they can be reactivated, causing some of these larger-magnitude events," she said.

Meanwhile, shallow injection has played a bigger role in seismicity in the southern Delaware.

"Those intervals are also faulted, a separate set of faults from what we see in the deep section," she said. "And magnitudes do seem to be a bit lower there because the faults are cutting different rock types and they are contained to a specific stratigraphic interval. So they are not creating events of as large a magnitude as we see in the north."

Last year the RRC established an SRA in the Delaware covering parts of Culberson and Reeves Counties after the area experienced 15 magnitude 4.0 or greater earthquakes in fewer than two years. This year it established a third SRA following a 4.2 magnitude earthquake near Stanton, northeast of Midland.

Operator Response

While the RRC used its authority to suspend deep-injection permits in Gardendale, it has teamed up with the industry to mitigate induced seismicity in the North Culberson-Reeves and Stanton SRAs.

The program's mission is twofold: to better understand the impact of shallow-injection wells on seismicity, and to reduce wastewater volumes from deep wells over the long term.

The initiative calls for participants to limit the amount of water they inject each day, and allows operators with inactive deep-injection permits to either cancel them or apply for shallow permits.

"The terms of the various SRAs include either voluntary or permitted reductions in injection volumes," the RRC spokesperson said. "Operators report daily injection volume and pressure information, and RRC staff monitors this information. RRC has the authority to enforce permitted limits. If an operator had voluntarily agreed to reduce injection volume but does not do so, RRC staff can modify the permitted volume to create a permit condition that can be enforced."

Ben Sheppard, president of the Permian Basin Petroleum Association, said operators have adapted to the new challenges.

"Operators have chosen to shift disposal activity to less-sensitive areas, and while that has presented logistical challenges, we continue to see record production in both the Texas and New Mexico portions of the Permian Basin," he said.

Meanwhile, Texas Oil and Gas Association President Todd Staples said the industry was working with regulators and industry peers to gather information to guide industry practices.

"Oil and natural gas operators in the Midland Basin are actively using proven technology to improve all aspects of operations through practices such as pre-completion risk assessment, proper monitoring and mitigation protocols," he said.

In Northern Culberson-Reeves, the RRC hopes to see a reduction in 3.5-magnitude events by the end of 2023. For Stanton, the deadline is much shorter: The RRC hopes to see a decline in 3.5-magnitude events "once full implementation of curtailments is achieved on Nov. 15, 2022."

Smye said she's hopeful the efforts will continue to drive a decline in seismic activity.

"We hope that's where it's headed," she said. "The challenge in these systems, particularly the deep systems, is that injection may cause a regional pore pressure buildup over time. And the pace at which that diffuses throughout the geologic system is an open research question and one that we're looking at with our hydrogeologic modeling."

Topics: Policy and Regulation, Shale