Induced Seismicity

Industry Responding To Government And

Anyone working about anywhere in the Mid-Continent over the last several years is pretty likely to have heard a lot about induced seismic events or earthquakes related to the oil and gas industry in this area. Readers even may have experienced a couple of these events themselves.

While there is some debate about exactly how many of these events are tied directly to oil and gas production—specifically injecting produced water into disposal wells—studies are showing that there may be a relationship between oil and gas production and increased seismic activity. But studies also show that hydraulic fracturing is not, or at least rarely is the cause of these seismic events, as some folks would have you believe.

A report from the U.S. Department of Energy indicates that government agency believes much induced seismic activity may be tied to injecting produced water into disposal wells in various regions. Some of these events have reached magnitude ranges between 3.0 and 6.0. Over the last several years, there has been work going on to identify the risks associated with wastewater injection, to begin to predict the probability and impact of these events, and to develop strategies and technologies designed to mitigate the risks.

Anyone working in the Mid-Continent also knows injecting produced water into disposal wells is an established technology that has been in use for many years. What seems to be occurring has little to do with the injection itself, but rather the rate at which companies are injecting.

According to DOE, tectonic forces are responsible for the vast majority of earthquakes around the globe. However, in certain cases, human activities can trigger a seismic event. In Oklahoma, for example, as the number of seismic events larger than 3.0 began to increase, researchers began to correlate these events with wastewater injection deep into subsurface rock formations. According to the Oklahoma Geological Survey, the events occurring near unconventional oil and gas plays were unrelated to hydraulic fracturing, but rather to disposing the water associated with oil and gas production.

Geologically, there are certain features that must be present for an induced seismic event to occur. These features include an existing fault, some sort of subsurface stress that brings the fault close to failure, and a change in that stress caused by either injecting or withdrawing fluids. Additionally, there seems to be a relationship between the distance between a fault and a well, reservoir permeability of the rocks around the fault, and the rate of injection.

These events seem to occur in areas with older metamorphic rocks that underlie disposal reservoirs. According to the DOE, injection wells that are in these areas may be more prone to induce a seismic event, but can be managed simply by reducing the amount of water injected as well as the period of injection.

According to an article in the Wall Street Journal, data from the U.S. Geological Survey show that most of the seismic activity felt by large groups of folks is centered near Oklahoma City and Dallas-Fort Worth, and that high-risk states include Oklahoma, Kansas, Texas, Colorado, New Mexico and Arkansas.

In Kansas, as well as other states, operators are addressing the issue. A document from the Kansas Independent Oil & Gas Association illustrates Kansas’ history of earthquakes, which stretches for millennia—especially along the Nemaha Ridge, which spreads north and south across much of Kansas and Oklahoma. This area is also home to many of Kansas’ and Oklahoma’s significant and historical oil fields.

The document also states that because oil and gas are produced in almost every county in Kansas, the likelihood of an event being located near a disposal well is almost certain, and that ongoing analysis is required to differentiate between a seismic event that is related to human activity and one that is not.

While scientists tend to agree that under certain conditions, day-to-day oil and gas production can cause a seismic event, the risk appears to be extremely low, with fewer than 0.5 percent of all wells in Kansas being linked to a seismic event. That said, operators are working actively with state and federal governments and regulatory agencies to research these events and develop the best course of action moving forward.

As industry begins to develop business plans around the risks associated with induced seismicity, education is a key to addressing the issue head-on. In May, the Petroleum Technology Transfer Council will be hosting a single-day workshop in Tulsa designed to provide updated information about what we have learned so far, as well as the technology, monitoring, legal issues, and regulations that may impact operators moving forward. Visit pttc.org for more information.

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