RRC Technical Meeting on Seismicity

Summary and Recommendations

Introduction

On Friday, June 5, 2015, Commissioner Ryan Sitton and RRC technical staff met with authors of the study entitled, "Causal factors for seismicity near Azle, Texas." Also in attendance were Dr. Dan Hill, Chair of the Petroleum Engineering Department at Texas A&M University, and scientists from EnerVest Corporation. The meeting was open to the media and live streamed for the public to view.

The goals for the meeting were: (1) to understand the nature of this and similar studies; (2) to explore what additional data could contribute to better scientific understanding of the processes that may be involved; (3) to assess how these data might be efficiently and economically obtained; (4) to determine what additional information could be requested of operators; (5) to consider what regulatory changes the Railroad Commission could make to ensure that oil and gas continues to be developed safely yet with minimal unwanted impact in Texas; and (6) to discuss what future research and study is taking place that will enhance and further refine the scientific findings for Azle and other areas in Texas.

All in attendance agreed that the researchers' work was important and a good first step in beginning to understand very complex models, assumptions and preliminary conclusions regarding seismicity in Azle and across Texas.

Key Points

As it relates to the specifics of the study, there were some key findings based on explanations from the research team:

1. The researchers stated that hydraulic fracturing was not a cause of these earthquakes, and that this is a common misconception in the public and media that should be resolved.
2. The researchers made it clear that the vast majority of disposal wells do not have associated seismicity. The researchers stated that disposal wells in close proximity to critically stressed faults could change pore pressure and reduce effective stress, resulting in seismicity if faults are oriented in a particular way.
3. The researchers stated that their work is ongoing and that better data could enhance their modeling and research. As Dr. Ellsworth with the USGS stated, these are hard problems and they're not going to be answered quickly.
4. Figuring out how and if pressure was transmitted over 4 kilometers to the basement is a key question. The origination depth of the earthquakes seems uncertain. The study focused on pressure building up in the Ellenburger at a depth significantly shallower than the depth of the recorded earthquakes in the basement. The researchers hypothesize that

the deeper earthquakes are due to downward pressure transfer within the fault system. Enervest produced a document showing that the early sequence of events occurred in the basement along the primary fault at around a depth of 20,000 feet. The Ellenburger depth quakes were around 10,000 feet deep. The research model investigated pressure changes along the antithetic fault at Ellenburger depth and did not investigate pressure changes in the basement. The researchers said more study is needed to investigate the permeability and porosity along faults to understand how pressure could have been transmitted to basement depths, if in fact that is possible.

5. The study suggests that production of brine contributed to induced seismicity. However, when this issue was discussed it was clear that more research is needed to determine actual levels of brine production and what formation that water is being produced from. Enervest believes that the majority of produced water in the area is from the Barnett Shale and production of water from the Ellenburger is negligible. The statement in the abstract that "a combination of brine production and wastewater injection near the fault generated subsurface pressures sufficient to induce earthquakes," seems arguable given the discussion at the meeting, particularly if little to no Ellenberger water is being produced (the model assumed all reported water production came from the Ellenburger).
6. The researchers said that Well #2 did not play a significant role in causing seismicity (was not "very important"). The researchers also stated that because seismicity in the area had decayed, there was not much more for the RRC to do vis-à-vis these injection wells. They recommended keeping Well #1 at its current injection volumes and pressures and stated that they would continue seismic monitoring.

Recommendations

The following types of data and activities were suggested as starting points to enhance our understanding of seismicity in Texas and mitigate risks:

1. Look at GIS data to identify "shadow zones" to try to identify faults in Texas.
2. Assist researchers in collecting high-resolution seismic data in areas of known faults with oil and gas activity.
3. Work with interested parties (researchers, industry and other governmental entities) to develop detailed maps of fault stress orientations.
4. Work on ways to determine known fault characteristics in terms of permeability and porosity.
5. Work on coordinating more detailed and accurate modeling, by including a model of fluid transport and possible pressure changes along the fault from the injection depth to the basement.
6. The researchers have requested additional water production information in a more timely fashion. This request should be considered and we should explore if it is possible to designate from which zones that water is produced.

7. Work with operators of disposal wells in close proximity to identified critically stressed faults to place seismic monitors and develop pressure monitoring regimes.
8. Consider requiring more frequent pressure and volume reporting for disposal wells in close proximity to known critically stressed faults
9. Consider requiring more frequent bottom hole and fall-off pressure testing for disposal wells in close proximity to known critically stressed faults.
10. Consider trying to forge collaboration between industry and researchers including the possibility of pressure monitoring wells for particular injection formations near critically stressed faults.
11. Consider long-term stress monitoring (pressure over time) for injection formations near critically stressed faults.

We need to determine how and if we can collect this information in an efficient and affordable way. Much of this work will require coordination and collaboration between the RRC, industry and researchers.

The researchers stated that planned additional seismic monitors, if funded, would provide them the flexibility to deploy seismic monitors strategically across Texas and gather important seismic data to help them better locate epicenters and depth information for seismic events. These monitors would also help them study how and when earthquake activity builds and dissipates over time.

The researchers also expressed a desire to have ongoing meetings similar to this one to continue to exchange ideas and information as we seek to better understand seismic events in Texas.

Conclusion

This meeting was a good first step in bringing RRC technical staff, researchers and industry together to discuss an important and complicated issue in Texas. The researchers were incredibly generous with their time and the information they presented was very helpful – they are to be commended for their outstanding efforts.

The RRC should do everything in its power to mitigate risks of induced seismicity in the very small number of injection wells that may be in close proximity to critically stressed faults. Mapping faults, determining stress orientations, gathering data, deploying monitors, analyzing data and collaborating with researchers and industry will all take time and effort. We should act deliberately to get this process moving and make sure that we have a sound scientific basis before unnecessarily increasing regulatory burdens (e.g., mandating more frequent pressure testing in areas with no known critically stressed faults would be a waste of time and money). Universal rules to address seismicity concerns do not appear to be appropriate. Rather, the RRC should focus on areas where possible seismic activity could occur.