

EPA Region III

EnerVest Operating, LLC UIC Permit #VAS2D947BDIC "P-132"
(Nora and Haysi Fields, Dickenson County, Virginia)

Administrative Record Index

1. "Attachment 1" - EPA-Approved Plugging and Abandonment Plan (Jan 15, 2016).
2. Application (Jan. 15, 2016), including all attachments.
3. Notice of Deficiency (June 23, 2016).
4. Supplemental Application/Response to Notice of Deficiency, including all attachments (July 22, 2016; September 14, 2016; and December 8, 2016).
5. Maps. Including all maps from application and:
 - Seismic maps of Virginia. USGS "Information by Region-Virginia – All Earthquakes 1900-Present": (<http://earthquake.usgs.gov/earthquakes/byregion/virginia.php>)
 - GIS analysis performed by EPA Staff
 - Google Earth analysis performed by EPA Staff
6. Area of Review Calculations including Maximum Injection Pressure, Zone of Endangering Influence performed by EPA staff. Updated August 31, 2017.
7. National Academy of Sciences, *Induced Seismicity Potential in Energy Technologies*, National Academy Press (final), 2014, in particular Chapters 2 and 3.
<http://www.nap.edu/read/13355/chapter/1>

Virginia Department of Mines, Minerals and Energy, Division of Geology and Mineral Resources. "Earthquakes" <http://www.dmme.virginia.gov/dgmr/earthquakes.shtml> (last accessed Nov. 3, 2016). Endangered Species Act statements (record search Feb. 3, 2017). Standby trust agreement with bond (including independent plugging cost for well because they are a private company).
8. EPA, "Cementing Records Requirements in Direct Implementation Programs to Achieve Part II of Mechanical Integrity in Class II Injection Wells" (Jan. 27, 1999).
- 9.
10. "P-132 Historical Frac Gradient Table" provided by EnerVest on September 14, 2016.
11. Excel Document and Permit Application Narrative "EnerVest Disposal Wells Big Lime Fracture Gradients" provided by EnerVest on December 8, 2016.
12. USGS Documentation of the Lee Formation in VA, KY and the Conneault Group in NY.
Reference: <https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=VAPAL;0>
<https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=KYPAMI;0>

<https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=NYDct%3B4>

13. *Seismic maps of Virginia*. USGS “Information by Region-Virginia – All Earthquakes 1900-Present”: (<http://earthquake.usgs.gov/earthquakes/byregion/virginia.php>)
14. *A White Paper Summarizing a Special Session on Induced Seismicity*, Ground Water Research & Education Foundation, February 2013.
http://www.gwpc.org/sites/default/files/events/white%20paper%20-%20final_0.pdf
15. *Preliminary Report on the Northstar1 Class II Injection Well and the Seismic Events in Youngstown, Ohio Area*, Ohio Department of Natural Resources, March 2012.
<https://oilandgas.ohiodnr.gov/portals/oilgas/pdf/UICReport.pdf>
16. *Final Report and Recommendations*, Workshop on Induced Seismicity Due to Fluid Injection/Production From Energy-Related Applications, Lawrence Berkeley National Laboratory, February 4, 2012.
17. U.S. EPA UIC Technical Workgroup, *Minimizing and Maximizing Potential Impacts of Induced-Seismicity from Class II Disposal Wells: A Practical Approach*, Feb. 5, 2015.
<http://www.epa.gov/sites/production/files/2015-08/documents/induced-seismicity-201502.pdf>
18. US EPA Office of Drinking Water, *Final Injection Well Construction Practices and Technology*, October 1982.
<http://www.deq.utah.gov/ProgramsServices/programs/water/uic/docs/2010/03Mar/InjectonWellConstructionPracticesTechnology1982.pdf>
19. *Managing the seismic risk posed by wastewater disposal*, *Earth*, April 17, 2012.
<http://www.earthmagazine.org/article/managing-seismic-risk-posed-wastewater-disposal>
20. Horton, *Disposal of Hydrofracking Fluid by Injection into Subsurface Aquifers Triggers Earthquake Swarm in Central Arkansas with Potential for Damaging Earthquake*, *Seismological Research Letters*, Vol 83 March/April 2012, 250-260 pp.
[http://yosemite.epa.gov/oa/eab_web_docket.nsf/Attachments%20By%20ParentFilingId/8D96B3596E81A7A285257DE30050EE10/\\$FILE/T%20Arkansas%20EQ%20article.pdf](http://yosemite.epa.gov/oa/eab_web_docket.nsf/Attachments%20By%20ParentFilingId/8D96B3596E81A7A285257DE30050EE10/$FILE/T%20Arkansas%20EQ%20article.pdf)
21. Frohlich, *Two-Year Survey Comparing Earthquake Activity and Injection-Well Locations in the Barnett Shale, Texas*, *Proceedings of the National Academy of Science Early Edition*, 2012. <http://www.pnas.org/content/109/35/13934>
22. *Where are the Fault Lines in the United States East of the Rockies*, website, United States Geological Survey, Earthquake Hazard Program.
<http://www.usgs.gov/faq/categories/9838/3399>
23. R. Kerr, *Learning How to NOT Make Your Own Earthquake*, *Science*, Vol. 335, Mar. 23, 2012, pp. 1436-37. <http://science.sciencemag.org/content/335/6075/1436>

24. K. Keranen et al, Potentially Induced Earthquakes in Oklahoma, USA: Links between Wastewater Injection and the 2001 Mw 5.7 Earthquake Sequence, *Geology*, June 2013, vol. 41, no.6, pp. 699-702.
https://profile.usgs.gov/myscience/upload_folder/ci2013May3015351271984Keranen%20etal%20Geology%202013.pdf
25. EPA, “Cementing Records Requirements in Direct Implementation Programs to Achieve Part II of Mechanical Integrity in Class II Injection Wells” (Jan. 27, 1999).
26. PA Underground Injection Control Program – Guidance 11, Quality Assurance (Revised November, 1986).
27. Memo to file with all links to supporting documentation for cementing practices in SD, NY, MI, KY, PA.
28. PA Underground Injection Control Program – Guidance 7, Casing and Cementing Policy (Revised November, 1986).

For issuance of final permit (following public comment period):

29. Statement of Basis for the draft permit
30. Draft Permit
31. Public notices of draft permit
32. Public hearing transcript
33. Supplemental Statement of Basis
34. Public notice for reopening of comments
35. Public comments
36. Response Summary to comments.
37. Final Permit
38. Notice of Permit Issuance