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October 4, 2021

**ADDITIONAL COMMENTS TO
Proposed Variance to Well Plugging Rules
For Limited-Scope Project
By Diversified
Pursuant to Notice dated February 12, 2021**

WVSORO first commented on March 15, 2021 within the deadline posed by DEP. New information on the measurement of methane leakage from plugged wells has come to our attention, and so we hasten to add these comments so that accurate, scientific measurement methods will be used in the final evaluation of the variance.

We affirm most of our earlier comments, particularly: Comment 3 that if plugging using the variance is cheaper, then operators should be able to plug more wells, not just pocket the savings.

We have minor disagreements with the DEP response to our earlier comments which will not be the subject of this additional comment; but we do not want our silence in this document to be taken as total agreement with the DEP responses.

The new information on measurement of methane leaks which gives rise to this additional comment comes from the attached article reporting on a study of methane leaks from plugged, unplugged and producing conventional wells in West Virginia. The article is "Measuring methane emissions from abandoned and active oil and gas wells in West Virginia," by Riddick, Mauzerall, Celia, Kang, Bressler, Chu and Gum.

We present the study only for the purpose of measurement. The study probably overestimates the number of unplugged wells since it used wells in an old oil producing area as a sample, though the low percent of the Volcano field wells on the State records is a little frightening. Also it made estimates assuming a 5 spot well location selection method that it says was in vogue long ago. I have never heard of it and doubt if it was uniformly used, but it is possible. I find it hard to believe that 11% of production is lost, though I suppose that is possible if leaks from old pipelines are considered. Also it acknowledges that some of its average "mean" estimates are heavily skewed by some fewer wells producing lots of emissions so median well emission might be more telling of estimated volumes of emissions from single wells. But again the main purpose for submitting the study is to show the proper method for testing the efficacy of the wells plugged with the new variance, and perhaps by whom. Certainly not one of your overworked inspectors.

I do not know what methods of testing the efficacy of the test wells for the plugging variance was planned. I have only seen leakage measurement performed by holding up a handheld meter in the air or hanging it on a well. For most purposes that may be enough. However, the attached paper uses much more involved testing methods that should be used to determine the efficacy of a proposed new plugging shortcut that may be used for plugging hundreds if not thousands of future wells either through more variances or, more appropriately, through rulemaking.

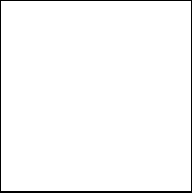
The paper used two testing methods depending, I believe, upon the condition of the wellhead etc. They are described in section 2.2 of the paper. They are 2.2.1 "dynamic flux chamber" and 2.2.2 "inverse dispersal".

Their testing of the wells they selected, although it was not a state wide random sample, was nonetheless a reasonably diverse assemblage, showed that 80% of the plugged wells tested equal to background methane, which means that 20% of the plugged wells were leaking methane! This is no small contribution to climate change. Very surprisingly the article says that there was no pattern based on age of the well or the operator. (Too bad they did not have the names of the plugging company or could not identify any other common characteristic for the leaking plugged wells vs. the plugged wells that were not leaking.) I have been around gas wells for many years, including plugged wells. I think only on one occasion did I get a whiff in my nose of a suspicious smell near a plugged well. I contacted one of the authors of the study about that, and he explained, quite rightly, that methane has no odor so my nose testing assumption of the general efficacy of plugging techniques was not accurate. Some unplugged wells still leak. My guess is others have been making my same assumption.

So it is important to test the plugging of these wells using the variance using the scientific methods in 2.2.1 and 2.2.2 of the paper. It may be that it is possible to compare to the data in the study or which was the basis of the study. It may be possible to hire the authors of the study to do the testing. The study does show that, with 80% having no methane leakage, it can be done right.

We wish to emphasize our position as stated at the end of our comment 6. We think all the uncemented casing should be pulled as has been traditionally the case. It works 80% of the time at least. We add to that comment based on the new article that some study should be made of the wells found to be leaking by the study to see what common factor there is for those that are leaking versus those that are not leaking.¹ If the DEP is not going to require that all the production casing be pulled, then we believe very strongly that at least the production casing down to depths below the water table should be cut and pulled. Steel exposed to water

1. When the preparer of these comments first got involved in this issue in the early 1980's he met a Mr. Dodd who was mature in age and then in charge of the oil and gas agency. He told the story in my hearing that when he first went to work in the industry in his youth he worked for a plugging company. They would make a contract to plug a number of wells. They would go to the site of the first well and using bags of cement, put enough cement into the well to match the required amount. They would then call the inspector. (The inspectors wore Halliburton hats at the time and were indistinguishable to the public from operator workers, but that is a story for another time.) When the inspector arrived they would point out the adequate number of empty bags of cement. The inspector would approve. The plugging company would then go to the next well site, sit around doing nothing for a while, put a bag or two of cement at the top of the hole, and then call the inspector again. They would show the inspector the same empty bags they had used on the first well.



eventually rusts. It may be, emphasize "may", that encasing the production casing in concrete will prevent water from getting to it. But the use of bentonite gel we understand involves the use of water and so it seems inevitable that water will reach the casing and it will corrode. And if it does rust, it provides conduit for gas to reach the surface. And this could be prevented by cutting and pulling the casing from an appropriate distance below the freshwater levels and cementing to the surface. Wall to wall cement has got to be better than cement with a string of metal pipe inside.

So property testing techniques should be used to evaluate the variance, and the testing should be done the same as, or even by the authors of, the paper. And a study should be done to determine what caused 20% to leak and 80% not.

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