A Simple and Cost-Effective Workflow for Engineered Perforations

Byron Cottingham[1]

[1]Linn Energy

ABSTRACT

In the current oil and gas industry, driven by resource plays and horizontal wells, there are large uncertainties around perforation cluster efficiency and how we manage it. The application of geometric cluster spacing usually leads to only effectively opening and propping a fraction of the total number of clusters. In order to combat this, we have developed a workflow to take currently acquired drilling and geologic data and apply them to a process for selectively engineering our perforations. This process uses gamma ray, drill cuttings, rate of penetration, mud-log gas shows, and gas chromatography to correlate each foot of the lateral and determine which sections of the lateral are in similar rock or the same stratigraphic interval. While this approach is, in general, not as accurate as that obtained from a full horizontal log suite, it is inexpensive and allows for more optimal completions than the purely geometric method.

Though we have used this basic approach to engineered perforations on every well we drill, we additionally have used some advanced techniques to improve our engineered perforation selection in certain applications. Recently we targeted a naturally-fractured limestone interval in an area that had not had a horizontal well drilled in the surrounding townships. Due to the lack of capacity to see natural fractures on our engineered perforation workflow, and the need to contact these natural fracture systems to enhance productivity, we determined it would be best to step up our game for engineered perforations on this well. In order to increase our certainty and enhance the productivity of the well, a high-resolution LWD resistivity imaging log was recorded in the lateral borehole. By integrating the image log into our engineered perforation design, we were able to mitigate geo-hazards, establish a relationship with resistive fracture networks for future wells, and enhance the productivity of the well.

This presentation discusses the application of engineered perforations, wherein each cluster is selected to be in the most productive and analogous mineralogy in relation to the rest of the clusters in each stage. In addition, the use of an LWD resistivity image log in the lateral allows for the enhancement of engineered perforation design. The resulting optimized completion in our naturally-fractured limestone reservoir provided excellent production results.