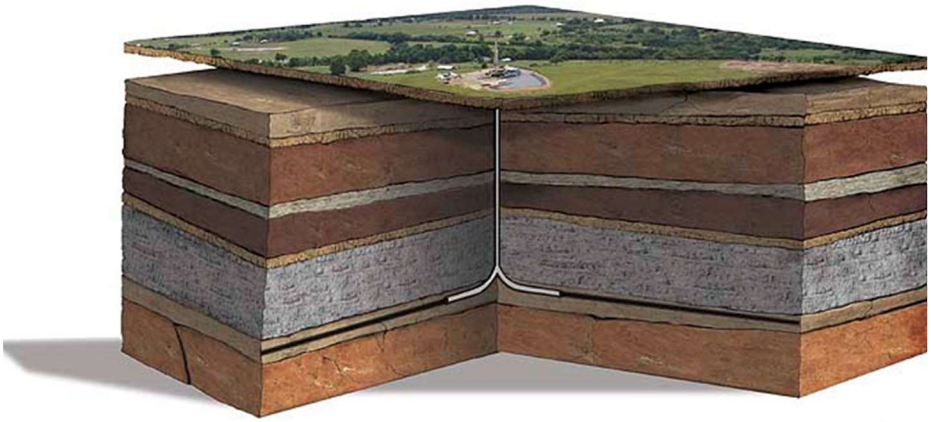
SPE International
Gulf Coast Section



Timely Technical Presentations

Crack the Unconventional Code

Vetted Case Histories

Network with Peers

MARCH 4, 2020 (8:30AM - 3:30PM)

SPE-GCS WESTSIDE STUDY GROUP PRESENTS TECHNICAL SEMINAR

VISION 2020
OPERATOR PERSPECTIVES
UNCONVENTIONAL RESERVOIR/COMPLETIONS

VENUE
Core Laboratories
6323 Windfern Road
Houston, TX 77040

SPE-GCS WESTSIDE STUDY GROUP

Online registration opens February 1, 2020

https://www.spegcs.org/events/4463/

This one - day technical seminar is designed to be one where operators present case studies/best practices/analysis on myriad topics to crack the unconventional code.

Topics to be discussed include, but not limited to:

- Completion design
- Diagnostic techniques
- Reservoir characterization
- Well spacing considerations

TECHNICAL PROGRAM COMMITTEE

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		Program Agenda
Time		***Presenter***
07:30-08:15		Light Breakfast/Registration Badge Pick Up
08:15-08:30		Safety Orientation/ Opening Remarks
Session 1		***08:30-10:00***
08:30-09:00		Shell
09:00-09:30		Devon Energy
09:30-10:00		Ovintiv (Encana)
10:00-10:30		***Coffee Break***
Session 2		***10:30-12:00***
10:30-11:00		HESS
11:00-11:30		Chevron
11:30-12:00		Southwestern Energy
12:00-13:00		***Lunch***
Session 3		***13:00-14:00***
13:00-13:30		Equinor
13:30-14:00		XTO
14:00-14:15		***Coffee Break***
Session 4		***14:15-15:15***
14:15-14:45		OXY
14:45-15:15		ConocoPhillips
15:15-15:30		***Closing Session/Wrap Up***

1. **Completion Design Optimization Journey: Stage/Cluster Design, Limited Entry, and Next Steps presented by Christopher Ledet - Shell**

Over the past year, Shell Permian has undergone a completion optimization journey, focusing on stage design, cluster count, and limited entry. An extensive trial was designed and executed, testing theories on higher cluster counts, tighter cluster spacing, perforation strategy, and stage length. Various cluster spacing/quantities were trialed within the same stage length. Alternatively, stage length has been expanded by 50% in parts of the trial, resulting in significant cost savings. The design of experiment will be outlined, including a phased implementation to make conclusions easier to obtain. Full results and trial learnings will be discussed, along with updates to baseline designs as a result of this trial.

2 **Monitoring the Pulse of a Well Through Sealed Wellbore Pressure Monitoring - A Multi-Basin Case Study presented by Jackson Haffener - Devon Energy**

A breakthrough patent-pending pressure monitoring technique using an offset sealed wellbore as a monitoring source has led to advancements in quantifying cluster efficiencies of hydraulic stimulations in real-time. To date, over 1,500 stages have been monitored using the technique. Sealed Wellbore Pressure Monitoring (SWPM) is a low-cost, non-intrusive method used to evaluate and quantify fracture growth rates and fracture driven interactions during a hydraulic stimulation. The measurements can be made with only a surface pressure gauge on a monitor well.

SWPM provides insight into a wide range of fracture characteristics and can be applied to improve the understanding of hydraulic fractures in the following ways:

*Qualitative cluster efficiency/fluid distribution *Fracture count in the far-field *Fracture height and fracture half-length *Depletion identification and mitigation *Fracture model calibration *Fracture closure time estimation

The technique has been validated using low frequency Distributed Acoustic Sensing (DAS) strain monitoring, microseismic monitoring, video-based downhole perforation imaging, and production logging.

3 **Post Fracture Acoustic Imaging of Perforations for Plug and Perf Optimization presented by Blake Horton - Ovintiv (Encana)**

Plug and perf operations have been the go-to method for most operators to increase lateral lengths, reduce costs, and optimize well performance to increase cash flow. Common challenges related to plug and perf operations include optimizing stage length, cluster spacing, number of clusters, and perforation design.

In the STACK area of the Anadarko Basin Ovintiv (Encana) utilized multiple downhole technologies in tandem to measure perforations for post-fracture erosional analysis to optimize plug and perf designs. The effect of limited entry on cluster efficiency and proppant distribution will be discussed. Additionally, an unintended consequence of plug and perf operations, in the form of casing deformation was exposed.

4 Effective Fracture Length and Drainage Area: Lessons Learned from Bakken and Utica Field Experiments presented by Craig Cipolla - HESS

Understanding effective fracture length and characterizing drainage patterns is critical for optimum development of unconventional resources. The operator's approach to optimizing completions and well spacing utilizes a combination of advanced analytics and physics-based models. Advanced analytics leverage the large amount of production and completion data available to model relationships between completion parameters and production and have proven to be a key component in the optimization process. However, with the continuing evolution of completion strategies, it can be difficult even for advanced analytics to identify the optimum completion strategy and well spacing using data that is weighted in the past. Physics-based models provide a tool to evaluate numerous completion strategies and well spacing scenarios, eliminating the time and cost of drilling the many wells required for analytics based or "data driven" optimization. Successful physics-based modeling requires extensive input data and comprehensive calibration. To improve the reliability of physics-based models, the operator embarked on a multi-year journey to acquire key measurements to characterize hydraulic fracture geometry and map drainage that started in 2009 and continues today. Over the past ten years, nine comprehensive data acquisition projects have been completed in the Bakken and several in the Utica. This presentation summarizes the results from field experiments in the Bakken and Utica, where multiple fracture diagnostic/mapping measurements were combined with fracture modeling, geomechanics, and reservoir simulation to characterize effective fracture length, drainage area, and well-to-well connectivity.

5 Well Spacing and Completion Design Optimization in Unconventional Formations: Pushing the Boundaries in Numerical Simulation presented by Sahil Malhotra - Chevron

Well spacing and completion designs are two key field development decisions which can have a massive impact on the economics of an unconventional project. The industry approach towards optimizing well spacing and completion designs remains at trial and error in the field and/or leveraging designs that have appeared to work well in the neighbor or offset wells. Time, computer power limitations and technical implementation have been limiting factors towards numerically modeling and optimizing these field development decisions.

This talk presents a state-of-the-art work conducted to optimize completion designs in the Vaca Muerta formation. The approach utilizes numerical simulation with history matching and applying design of experiments (DoE) to select the optimal completion design and well spacing to reduce the development cost and increase project net present value (NPV). The work has been made possible with recent advancements in cloud computing functionalities resulting in parallel processing of numerous field development scenarios.

6 Merging Completion Engineering with Data Analytics presented by Ross Martin - Southwestern Energy

Supply and demand for oil and gas has driven operators to find and use new technology that expands margins and advances the conversion of resource to reserves. Due, in part, from the commoditization of computing power and the increase in horizontal shale well drilling, operators have been successfully leveraging data analytics and data science methods to further increase capital efficiencies. One area of our industry that has seen great value from the use of data analytics has been in the stimulation design optimization, where insights into the relationships between well performance and completion decisions and designs have been discovered and accurately quantified. But these derived relationships regularly come at a cost, as oftentimes the link between correlation and causation is not well understood and extrapolation outside of the dataset becomes difficult. This presentation will provide case histories from the Marcellus formation, discussing the challenges of reconciling data analytic solutions with physical models and methods we've used to reconcile both the data and first principal models.

7 PinPoint versus Multi-Cluster Completions and Well Performance: A Fresh New Look presented by Pandurang (Abi) Kulkarni and Andrew Eis - Equinor

The unconventional industry may be at the cusp of achieving a capability long sought after, but rarely achieved with the right balance of costs and operational risks. For years, resources across the unconventional industry supply chain have been devoted to delivering a highly reliable and cost-effective pinpoint completion system that achieves 'unlimited' stimulation stages, no internal casing diameter restrictions, full cement isolation, with no intervention required during or after fracturing. Some on the operator and supplier side believe we are now close, if not already there, with the latest set of technologies. Those same experts also understand that the journey has been fraught with project disasters and that well completion intensities, in terms of stages, volumes, and clusters, have increased so much that pinpoint technologies may not be widely applicable to deliver improved well economics in Unconventionals. To overcome that, engineers must be open-minded to the flexibility and potential that these systems may unleash, and that these technologies may be ready along with methods to achieve peak well stimulation quality and economics.

Then what does our data tell us is better in terms of well performance? The goal of this presentation is to provoke thought, discussion, and feedback from the technical audience by looking at cases where comparison between pinpoint and multi-cluster completions were achieved. The interpretation of these datasets indicates that production performance, at a fracture level, is superior with pinpoint fracturing compared to multi-cluster fracturing. We will present that analysis using production data, rate transient analysis and fracture modeling. The underlying physical mechanisms impacting the fracture-level performance will be illustrated. We think those results are real and repeatable to achieve improved hydrocarbon recovery and to optimize the drainage strategy.

8 **Impact of parent depletion on child well performance and strategies for optimizing development in the Bone Spring Sands in Permian Basin presented by Prasad Sumant - XTO**

Impact of parent wells on child well performance is becoming an area of increased focus in the Permian basin. At XTO, we have made several observations regarding impairment of child well production in the presence of parent depletion in several of our Bone Spring sand developments. By combining geologic characterization with well testing and modeling analyses, we have built a framework to characterize and quantify parent-child performance relationships. In this presentation, we will share some of our learnings and talk about how they have influenced our thinking with regards to optimizing our Bone Spring sand development planning and valuation.

9 **Leveraging Pressure Responses of Monitoring wells to improve Unconventional Reservoir Simulation workflow: Permian Case Study presented by Soodabeh Esmaili and Vivek Muralidharan - OXY**

Inaccurate characterizations of fracture height could result in either overcapitalizing the project or not draining the reservoir efficiently. The objective of this study is to show how vertical pressures from a monitoring well can be used to define the producing height of a hydraulically fractured horizontal well, calibrate the modeled hydraulic fracture geometry, and constrain reservoir simulation model inputs. Stochastic numerical simulation was performed to history match the production profile of horizontal well as well as the pressure response of multiple gauges along a vertical pressure monitoring well. In this study we will discuss how much incorporating the pressure response into reservoir simulation could change the development strategies of multi-stacked benches.

10 **Perforation Analysis: A Review of Findings from Downhole Camera Imaging Project's at ConocoPhillips presented by Bharath Rajappa - ConocoPhillips**

In recent years, multiple assets in ConocoPhillips unconventional asset's completion/reservoir team executed data gathering operations in which a downhole video camera was used to image perforations post stimulation. Objective was varied depending on each asset's goals, but main idea in most was to investigate erosion pattern that would then lead to improved stimulation design in future new horizontal wells.

The findings from the camera run yielded surprising results which then led the team to then seek out multiple scenarios for the observations based on added diagnostics comprising RA tracers, treatment pressure analysis and post frac production logging tools.

The presentation will review perforation strategy evolution with how completion engineers typically design "limited entry treatments" and is intended to highlight some of the challenges facing the viability of these completion designs. Post the presentation, audience will walk away with some pitfalls to be aware of especially when attempting to stimulate these laterals in today's efficiency dominated industry.