Field Laboratory for Emerging Stacked Unconventional Plays (ESUP) in Central Appalachia

Highlights from Research Performance Progress Report 3

Reporting Period: October 1, 2018 – December 31, 2018

Financial assistance for this work was provided by the U.S Department of Energy through the National Energy Laboratory's Program under Contract No. DE-FE0031576.

PROJECT GOALS

The Field Laboratory for Emerging Stacked Unconventional Plays (ESUP) in Central Appalachia project will investigate and characterize the resource potential for multi-play production of emerging unconventional reservoirs in Central Appalachia. The project is designed to improve characterization of the multiple emerging unconventional pay zones that exist in the established Nora Gas Field through the drilling and coring of a deep vertical stratigraphic test well up to 15,000 feet. Additionally, the ESUP Field Laboratory Team will explore and quantify the benefit of novel non-aqueous well completion strategies in this region. The project team will monitor the drilling of at least one multi-stage lateral well in the emerging (and technologically accessible) Lower Huron Shale for completion using non-aqueous fracturing techniques such as CO2 and advanced proppant technologies. Laboratory analysis, reservoir simulation, and monitoring observations will be integrated. An assessment will be made of the multi-play resource potential and a recommended strategy advanced for prudent development that considers regional environmental and socioeconomic impacts.

ACCOMPLISHMENTS

Work Related to Project Tasks

Task 1 – Project Management and Planning

The team received comments and suggested changes from DOE/NETL on the Project Management Plan (PMP) from the previous quarter. Changes were drafted and reviewed by team members (Virginia Tech, Gerald Hill and EnerVest) and submitted to DOE on November 11, 2018. The approved PMP is now in place. On December 7, 2018 EnerVest and Virginia Tech finalized an agreement focused on site access, liability, well plugging and reclamation, surety bonds, and cost-share that allowed the project to move into the next phase. This included finalizing site selection, drafting permitting documents and releasing geologic data and core to Virginia Tech for analysis. On December 12, 2018, Virginia Tech set up internal accounting to allow Virginia Tech and

subcontractors to bill for services. Virginia Tech and EnerVest met in person and on the phone multiple times with Virginia Tech's Office of Procurement to outline the steps needed to develop a Request for Proposal (RFP) for all items in excess of $50,000 necessary to drill and characterize the basement well test. This process is necessary for fair selection of competent vendors to drill the deep well according to Commonwealth of Virginia and federal regulations. Virginia Tech and EnerVest drafted an RFP that will be released for bids/proposals early next quarter.

Task 2 – Data Management Plan

The team received comments and suggested changes from DOE/NETL during the previous quarter based on a draft Data Management Plan (DMP). An updated version of the DMP was submitted to DOE/NETL on October 30, 2018. The initial DMP document included information on the type and format of data to be collected and how it will be shared and preserved, including core, cuttings and other geologic samples, well logs, time-series data, natural gas and water samples, and numerical modeling and computer simulations. The updated version included information on cataloguing all samples and sharing those with DOE/NETL annually as well as disseminating information through conference presentations and publications. The DMP is in place and includes information on preservation of data and on sharing data to interested parties.

Task 3 – Establishment of the ESUP Advisory Stakeholder Group

The Advisory Stakeholder Group (ASG) had their first meeting at EnerVest's offices in Abingdon, Virginia. The meeting was attended by 8 of the 9 members and included an overview of the project, details on project plans including drilling the deep characterization well and completing the Lower Huron horizontal well, selection of potential sites, outreach plans and finished with a site tour of the preferred site location. The ASG gave recommendations to the research team during each part of the presentation and then again after the presentation during a time dedicated to their input. The recommendations included information related to the deep well targets, drilling related issues that may be encountered, unknowns with respect to fracture development in completed Lower Huron wells, and input on locations and targets for public outreach. The kick-off ASG meeting and site visit occurred on November 1, 2018, and plans were made to have follow-up meetings on a quarterly or as-needed basis.

Task 4 – Risk Characterization, Management, and Mitigation

During Budget Period 1, activities will focus on the development of a Risk Management Plan as well as the development of individual risk profiles for candidate locations for the ESUP Field Laboratory, which will be based on geologic, regulatory, socioeconomic, and other site-specific risk factors. During Budget Period 2, a detailed Risk Register will be developed for the project to identify

and comprehensively document potential project risks, management strategies, and mitigation strategies.

On December 8th, Gerald Hill, Virginia Tech, and EnerVest conducted a preliminary risk workshop to identify major risks to the project. The most important of thee risks identified was the risk to loading the characterization wellbore with water to log and core the Lower Huron formation. There is a significant risk of losing the wellbore because of incompetent rock within the Lower Huron shale.

Task 6 – Site Selection

Nine potential sites were evaluated for the ESUP Field Laboratory based on geology, land and mineral ownership, existing infrastructure and cultural impact. The sites were evaluated based on geology separately for each of the distinct field tests: Basement Stratigraphic Test as well as the Lower Huron Horizontal Well, with a preference for selecting a single site for both tests. A site was selected that met geologic, ownership, infrastructure and cultural criteria in the priority area previously identified in Wise County, Virginia, on the southern border of EnerVest's holdings in Virginia.

The Recipient secured a site with favorable leaseholds and access agreements. The project team drafted a NEPA CX document based on the selected site with plans to submit to DOE/NETL early in the following quarter. The project team drafted a permit for the characterization well to be submitted to the Commonwealth of Virginia's Division of Gas and Oil early in the next quarter. There will likely be a Spacing Hearing requested by the Division of Gas and Oil, because there are conventional wells (in different formations of interest) within 2,500 feet of the proposed well location. Since there is no offset well production from the deeper targets, the team expects the permit to be approved. In addition to the deep characterization well, a 440-acre unit preliminary survey was drafted for the Lower Huron horizontal well in order to finalize land research of surface owners. This information was utilized for planning the number of geophones and locations for the surface micro-seismic array.

The site selected provides an optimal location for the deep characterization well nearest to the Floyd Embayment on EnerVest acreage, near some of the most productive Lower Huron horizontal wells. Selection also considered other extremely important factors (land, pipeline, compression, etc). In the following quarter, the Recipient will submit applications for the appropriate state and federal permits required to establish the ESUP Field Laboratory. An Environmental Questionnaire will be submitted to pursue categorical exclusion from further review under the National Environmental Policy Act and a well permit will be submitted to the Virginia Division of Gas and Oil.