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Progress toward the establishment of an extended-duration gas hydrate reservoir response test on the Alaska North Slope

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Extended Abstract

Background of collaborative gas hydrate Research and Development in Alaska (the Project)
An international R&D collaboration between the United States and Japan is underway with the goal of conducting an extended-duration gas hydrate reservoir response test on the Alaska North Slope. The project is being conducted in accord with a Memorandum of Understanding signed between the U.S. Department of Energy – National Energy Technology Laboratory (DOE-NETL) and the Japan Oil, Gas and Metals National Corporation (JOGMEC) in 2014 with ongoing technical contributions from the U.S. Geological Survey, National (Japan) Institute of Advanced Industrial Science and Technology, and others.

To coordinate the scientific planning effort and implementation plan in support of the Project, a Cooperative R&D Agreement (CRADA) was concluded between DOE-NETL and JOGMEC. In December 2018, an initial Stratigraphic Test Well (the Hydrate-01 STW) was drilled, logged, and sampled. Subsequently, the project has continued data acquisition of subsurface temperature data utilizing a distributed temperature sensing (DTS) cable deployed in the STW. Periodic baseline elevation surveys are also being conducted. In March 2019, the project acquired a large 3D vertical seismic profile (VSP) utilizing distributed acoustic sensing (DAS) cables deployed in the STW. To move the Project forward, the existing CRADA will be modified to manage the production test phase of the Project.

Gas hydrate reservoir response tests in Japan and the U.S. have been of limited duration, in most cases less than one month. These tests have included Mallik 2002 (Canada), Mallik 2007/2008 (Canada), Mt Elbert 2007 (Alaska), Ignik Sikumi 2012 (Alaska), Nankai 2013 and Nankai 2017 (Japan) (Yamamoto et al., 2020). Although past gas hydrate scientific and engineering tests have confirmed that reservoir depressurization is the most promising technique for achieving the desired production response, many fundamental aspects of that response remain poorly understood due to the short duration of the previous tests. Therefore, extended-duration gas hydrate reservoir response testing is indispensable to understand key elements of production behavior, including the implications of reservoir heterogeneity, means for isolating reservoirs from free water, flow assurance, the potential for sand production, and the nature of dynamic processes such as heat flow, geomechanics, and petrophysics. In addition to having access to the site for extended periods, optimized plans for log and core data acquisition are required to enable measurement of in situ petrophysical and geomechancal properties. Further, comprehensive monitoring programs are being designed to assess reservoir changes during dissociation and to provide adequate data to enable validation and calibration of production forecasting techniques (Myshakin et al., 2020).

The Hydrate-01 well was drilled in December 2018 from the 7-11-12 pad within the western Prudhoe Bay Unit (PBU) on the Alaska North Slope. Logging while drilling data confirmed gas hydrate occurrence in two target reservoir sections in Units B and D (Boswell et al., 2020; Collett et al., 2020; Haines et al. 2020). Sidewall pressure core samples were also acquired and analyzed (Yoneda et al., 2020), to support production test well design. The Hydrate-01 well was completed with fiber optic cables along the borehole, which will be used to monitor temperatures and acquire acoustic geophysical data during the future planned flow test. Current activities include the ongoing planning for 1) a Geoscience Data Well to collect full-round pressure core samples and to serve as an additional monitoring well for temperature, pressure, and strain; 2) one or more Production Test Wells that will produce methane gas by

depressurization; and 3) required surface facilities for accurate measurement of gas and water production rates and handling/disposal of produced gas, liquids, and solids. Additional tests or implementation of potential reservoir stimulation are also being considered.

Data acquisition of subsurface temperature profile by utilizing DTS cable deployed in the Hydrate-01 well is being conducted, along with a series of baseline elevation surveys around 7-11-12 gravel pad area. In March 2019, the fiber optic cables deployed in the STW were used to acquire a DAS-based 3D vertical seismic profile (VSP) (Lim et al., 2020) that is being used to further inform the well test design effort. Going forward, in partnership with the Alaska Department of Natural Resources and the PBU Working Interest Owners, implementation plans for the gas hydrate production testing will be further refined, based on the information collected from the Hydrate-01 well and the experience of our industry partners.

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