Second onshore production test of the methane hydrate in Mackenzie Delta, NWT, Canada

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The Mackenzie Delta located in the Northeastern part of the Northwest Territories of Canada, is well known for methane hydrate (MH) deposits below the permafrost. The results of the 1998 and 2002 programs in the field potentially indicated the de-pressurization method for MH gas production could be more effective than other method under certain condition.

Based on these results, the MH21 Methane Hydrate Research Consortium under the contract by Ministry of Economy, Trade and Industry embarked on the second onshore MH production test at the same location with Natural Resources Canada. The main purpose of this test is to verify if depressurization method is effective to produce gas from the hydrate reservoir. The plan involved re-entry of the well originally drilled in 1998, and drilling and completing the well to facilitate the production. Production testing would be carried out by pumping out fluid inside casing in order to draw-down the formation pressure. The physical parameters before/after the test must be measured through wireline logging and monitoring devices deployed behind the casing.

Testing site was only accessible through the ice road constructed on the frozen channel and sea shore. This location also overlaps with key arctic habitats and important harvesting areas. Therefore, the reduction of the potential damage to the environment must be taken into account and there was significant environmental regulation to be applied for designing the testing facility and operation plan. The program consists of two-year (2006 to 2007 and 2007 to 2008) winter operations. The winter of 2006/2007 (the first winter) operation has been conducted and this operation involved drilling, completing the well and short production testing. Based on this results, the winter of 2007/2008 (the second winter) operation was planned.

The gas hydrate zone continues from 890m to 1100m intermittently under the permafrost which has 650m thickness. The lowest gas hydrate occurrence zone (GHOZ) near above the basis of the gas hydrate stability zone was selected for production test. The 12m interval of the casing at the selected zone was perforated, and bottom hole assembly (BHA) with downhole pump below the perforated zone was deployed. The BHA was designed to inject produced water to the lower water bearing zone since the produced water could not be carried to the surface because of the regulatory restriction at that time. This method allowed us to draw down the bottom hole pressure from 11MPa to 7MPa successfully and flow of methane gas was measured. Although the pump was operating on several occasions, the pressure did not decrease. As a workaround, the pump was stopped and re-started after waiting a while. Then the situation was recovered. Eventually, the operation could not be continued when this happed for the forth time. The total amount of gas estimated during 12.5 hours of mean pump operation from the time of gas measured to the time of reaching maximum draw-down were 830m3 (calculated by surface and downhole pressures). Approximately 2.5m3 of the sand production inside the casing was also recognized. This indicated that the sand was produced with dissociated gas and water from the hydrate formation and this could explain the draw-down problem. The countermeasure of the sand production must be taken into consideration for the second winter operation.

For the 2007/2008 winter program, it is planned to execute production test with longer test period at the same perforated interval. The sand control device is planned to be deployed across the perforating interval. Unlike the first winter production, the water is produced to surface and injected to nearby well. It is expected to confirm the dissociation of gas hydrate in the formation by obtaining the pressures & temperatures data and also sampling the gas & water. This information will allow quantitative analysis of formation response.