

Multiphase Round Table Seminar April 2007 in Galveston, Texas

NEFTEMER - METERING MULTIPHASE FLOW FROM HEAVY-CRUDE-OIL WELLS.

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Neftemer is a clamp-on, non-intrusive nucleonic multiphase meter that has been developed over the last 30 years. It has been installed extensively in an oil field in Northern Russia to meter the multiphase flow from thermally stimulated heavy-oil wells.

Heavy oil is becoming increasingly important for the oil industry and there is currently a lack of cost-effective measurement techniques for this product. Typically the viscosity of the oil in the Russian oil field is 4700 cS and the watercut exceeds 75%. More than 200 meters have been installed on individual wells and there are plans to install a further 160 meters. This will allow comprehensive multiphase-flow monitoring of a defined section of the oil field.

The development story of Neftemer was told in the paper “Neftemer – a versatile and cost-effective multiphase meter” presented at the 2006 North Sea Flow Measurement Workshop at St Andrew’s in Scotland. That paper was intended to make the metering community aware of this different approach, tackling a different application area, namely, relatively low production, heavy-oil land based wells.

The paper covered the following topics:

- Development and field testing of Neftemer from the late 1970s to the present
- The working principles of Neftemer
- Laboratory testing carried out at Cranfield University, using their now extensive multiphase flow test facility
- An analysis of preliminary data from a demonstration test carried out in July 2006 in Arctic Russia. This test had to be carried out on much lighter oil as there was no means at that time of verifying the performance of the Neftemers on heavy oil
- Discussion of the need to develop field calibration/verification methods for the many different conditions, and how to integrate these with laboratory testing

This presentation will cover:

- **The working principles of Neftemer**
These will be further illustrated with slides showing Neftemer measurements from producing wells.
- **The 2006 demonstration test and the outcome**
The current version of Neftemer was developed to meter heavy viscous oils, released from the reservoir by steam injection. For these wells conventional well testing techniques do not work – oil of 4700 cS viscosity cannot be metered using turbine or PD meters. A number of the Neftemers installed were indicating that well conditions were different to those expected by operational staff, but there was no way of easily confirming the Neftemer indications. Consequently, there was great interest in trying to find an alternative way of checking the performance of Neftemer in the field in the short term.
In the area there are also fields producing light oil (density about 820 kg/m³). These are

operated in a conventional manner and so far Neftemers have not been installed on these. The fluids from the wells of each of these fields are commingled and the field production then taken by multiphase pipeline to a common processing station where the oil, water and gas is separated. At one station, oil from three fields was processed. Accurate metering was available for the oil (Smith's Positive Displacement meters) and for the water (Halliburton turbine meters). The gas was not metered accurately. Some is flared, some is used for utility purposes on site, and some goes into the local area gas distribution network. This station was chosen for a comparative test of Neftemer against the station metering.

The plan for the test was to set up the instruments, seal the instruments and collect data for a month. The oil company was then commission an independent analysis of the results. We analysed data from the preliminary part of the test over the 11 day period from 6 to 17 July 2006. The results were very encouraging. The values for 2 x Standard Deviation of the measurements for liquid, water, oil and mass watercut were 2.4%, 6.8%, 10.9%, 3.5% respectively. These values give an indication of the uncertainties at the liquid production rate and watercut prevailing during the test period.

Data from the formal part of the test has not been released by the oil company. Production rates were less stable and apparently it was not practicable to analyse the results as planned. There was a visit by senior management to the Neftemer installations and a review made of the operational benefits. It was agreed that Neftemer was an essential tool for monitoring the production of the heavy-oil wells and for monitoring for fault conditions. Senior management decided to equip another 160 wells, provided that Neftemer could be certified for well measurements in compliance with the recently issued Russian standard GOST R 8.615-2005

- **GOST R 8.615-2005 and implications for multiphase metering**

This standard addresses two issues:

- a) Accuracies required in measuring fluids from individual wells and
- b) Accuracies required in measuring oil production from a "licensed area".

This presentation deals mostly with the first.

The requirements for individual well measurements are challenging: 2.5% of total mass of fluids produced, and then 6% of mass of oil produced up to a watercut of 70%. Any oil company operating in Russia will have to come to terms with this standard. An order has been given to develop equipment to allow verification according to both parts of the standard, and Neftemer will be tested for well measurements.

The approach taken by this standard is practical, and chooses mass units for liquid and oil flow; gas is still to be measured in volume units. If, instead of a "pass" or "fail" from the approval testing, the uncertainty figure were given, this standard could complement the uncertainty based allocation approach that has been put forward in recent years. So far, there has been little discussion on how to determine or to agree uncertainty figures for wet-gas and multiphase installations under field conditions. This GOST standard points to ways of doing this.