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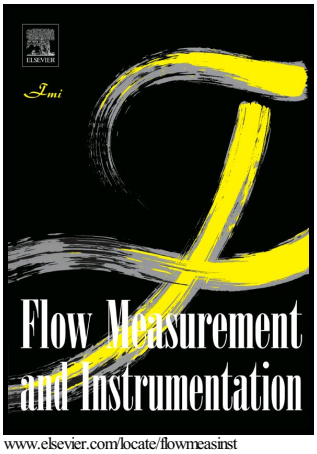

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Risk-cost-benefit analysis of custody oil metering stations

by

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1. Abstract

Custody transfer oil metering stations are traditionally equipped with spare meter runs and proving device with on-site calibration possibilities for the proving device. Whereas the CAPEX and OPEX of such layouts are high, the metering uncertainty is low and the economic risk related to measurement errors is low.

Currently, there is a major focus on cost-reduction in the oil industry. This has initiated increased focus on metering station costs, and increased need for cost-benefit analysis for proposed metering station layouts. Such analyses traditionally address balance between investment, operational costs and uncertainty.

Simplified metering stations may have higher measurement uncertainty than stations that are more complex. In addition, if a flow meter or other essential components fail, the metering station uncertainty may increase significantly in the period before repair or replacement. For metering stations with simpler layouts, it may also be more time consuming to take repairing actions, due to lack of access or the absence of spare meter runs. This increases the risk of loss of income from the exported oil.

In this paper, a new method including risks related to measurement uncertainty, meter failure and production shut down is presented. The methodology combines situations when flow meters are malfunctioning and when they are working. Typical response times for repair are included. Probabilities of the different states (functioning, malfunction, etc.) are derived using dynamic state Markov models and numerical simulations. Total risk due to normal and increased uncertainty over a metering station lifetime may then be calculated.

Several example metering station layouts, from complex to simple, are analysed using the new proposed method. The risk of loss due to normal and increased uncertainty is combined with CAPEX and OPEX to identify optimal metering station layout with respect to risk of loss of income for a given field.

The new methodology enables the derivation of the overall risk associated with the malfunction of one or several flow meters in a metering station. Enhanced cost-benefit analyses with this additional risk are presented, for a series of metering station layouts.

2. Nomenclature and abbreviations

Nomenclature

$\mathbf{I}$	identity matrix
$\mathbf{M}$	Transitional matrix
n	A given time
N_i	Number of possible states