

Natalie Eades

From: Stale.Selmer-Olsen@dnv.com
Sent: Saturday, July 17, 2010 2:43 PM
To: Ruben Schulkes; Reidar B. Schuller
Cc: reidar.schuller@umb.no
Subject: RE: Help with the HYDRO model

Veldig bra!

mvh
Ståle

—Original Message—

From: Ruben Schulkes [mailto:rubsc@statoil.com]
Sent: 17. juli 2010 18:40
To: Selmer-Olsen, Ståle; miller99@ilnl.gov; Reidar B. Schuller; reidar.schuller@umb.no
Cc: Reidar B. Schuller; reidar.schuller@umb.no
Subject: RE: Help with the HYDRO model

Dear Wayne and Ståle

I have spoken to Reidar - he is able to start on the work at once. If the total amount of work does not exceed one week we do not need a contract. If the complexity or amount of the work is such that more time is required, we will have to establish some sort of contract.

Based on my conversation with Ståle I understand that the work from our side will consist of the following:

- based on input from LLNL perform calculations with the Hydro choke model to compute flow rates in the BP GoM well.

Results will be delivered in the form of curves (based on choke model calculations) and explanation of the curves.

I hope our contribution will be beneficial.

Regards
Ruben

Sent from my HTC

—Original Message—

From: Stale.Selmer-Olsen@dnv.com <Stale.Selmer-Olsen@dnv.com>
Sent: 17. juli 2010 00:19
To: miller99@ilnl.gov <miller99@ilnl.gov>
Cc: Ruben Schulkes <rubsc@statoil.com>; Reidar B. Schuller <rbsc@statoil.com>; reidar.schuller@umb.no <reidar.schuller@umb.no>
Subject: FW: Help with the HYDRO model

Dear Wayne Miller,

Since we spoke earlier today I have been in contact with Statoil (Dr. Schulkes and Dr. Schüller) regarding running the so-called HYDRO code on the choke flow in the current Gulf oil spill. Statoil is the owner of the HYDRO code after merger with Norsk Hydro.

Statoil says yes to assist you and run some cases using the HYDRO code. A contact should be made between you and Dr. Ruben Schulkes in order to move things forward. I expect Dr. Schüller (and possibly myself) will be involved afterwards.

Ruben Schulkes



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Reidar B. Schüller

e-mail: rbsc@statoil.com or reidar.schuller@umb.no cell phone: [REDACTED]

To speed up the process some additional info will be needed in addition to what you already provided.

We need a PVT-sim file describing the composition of the well stream, alternatively a compositional description including the C8+ components.

We should also know the oil viscosity.

We need to know the mass fraction of each component.

We need to know the mass fraction of produced water (if present).

And of course a definition of the cases you want to run (upstream pressure, upstream temperature, % open choke, internal dimensions of the choke. If you know, also sea water temperature.

If I understand right, upstream there is a straight well pipe and downstream the choke exhausts into the ocean at 150 bara.

The HYDRO code is based on a choke model that I developed partly inside and partly outside a contract I had with Norsk Hydro in 1992. The model was based on some of the results from my Ph.D. in 1991. The model was initially published in 1995 as:

1) S.Selmer-Olsen, H.Holm, K.Haugen, P.J.Nilsen and R.Sandberg (1995) "Subsea Chokes as Multiphase Flowmeters. Production Control at Troll Olje", Proc. 7th Int. Conf. on Multiphase Production, BHR Group, Wilson, A. (ed.), Cannes, 7-9 June, pp. 441-466.

Norsk Hydro later validated the model against a wider set of experimental data. It was recoded from handling two-component flows to multicomponent hydrocarbon systems and called the HYDRO code model. This resulted in two papers (2003 and 2006):

2) R.B.Schüller, T.Solbakken and S.Selmer-Olsen (2003) "Evaluation of Multiphase Flow Rate Models for Chokes under Sub-Critical Oil/Gas/Water Flow Conditions", SPE Production & Facilities Journal, August 2003, Paper SPE 84961, pp. 170-181.

3) R.B.Schüller, S.Munaweera, S.Selmer-Olsen and T.Solbakken (2006) "Critical and Subcritical Oil/Gas/Water Mass Flow Rate Experiments and Predictions for Chokes", SPE Production & Operations Journal, August 2006, Paper SPE 88813, pp. 372-380.

Best regards

Ståle Selmer-Olsen, M.Sc, Dr.
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—Original Message—

From: Wayne Miller [mailto:miller99@linl.gov]

Sent: 16. juli 2010 18:50

To: Selmer-Olsen, Ståle

Subject: Help with the HYDRO model

Dear Mr. Selmer-Olsen,

Thank you for talking with me about running the HYDRO model for two-phase flow through a choke valve. We are assisting the U.S.

Government and British Petroleum in understanding and stopping the current Gulf oil spill.

The well head is about 1.5 km below the ocean surface. The current configuration at the well head includes a choke valve that can be used as the only exit for oil from the well. This choke valve is used to turn off all oil flow so that the pressure integrity of the sealed well can be measured. The well pressure at the choke valve can vary from ocean ambient (~150 bara) when full open, up to ~600 bara when the choke is closed. The choke valve exhausts into the ocean. The well is producing oil and methane at a 70/30 mass ratio.

We have modeled the choke valve resistance to the flow using the manufacturers Cv data, and this does not produce physical results as the valve allows too much fluid to pass. I have also tried the Simpson's 2-phase multiplier you described in your paper, but this also allowed too much fluid to pass. I suspect we need a more sophisticated analysis of two-phase flow, perhaps at choked (sonic) conditions at the highest pressures. I am interested to know if your HYDRO model can be applied to this case.

The choke valve is a Cameron CC40 plug and cage control choke
http://www.coopercameron.com/content/products/product_detail.cfm?pid=2862&bunit=FLC

I've attached the vendor Cv curve for this valve.

Please let me know if you can provide HYDRO or even someone to run some cases for us and what kind of agreement this will require. I'm not sure what will be required to set up any kind of a contract for this help, and I will need to have any payment approved here before I can ask you to proceed with any effort requiring payment.

Kind Regards,
Wayne Miller

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