

Natalie Eades

From: Reidar B. Schuller
Sent: Thursday, August 19, 2010 8:59 AM
To: Miller, Wayne O.
Cc: Ruben Schulkes; Stale.Selmer-Olsen@dnv.com
Subject: RE: Ready to start the HYDRO analysis

Dear Wayne

We have generated fluid property input for the Hydro choke model, and the model runs fine. The mass flow rate through the choke can readily be calculated for different pressure differences, upstream pressures, valve openings, gas mass fractions, etc.

However, the problem seems to be more complex than just choke behaviour. The geometry of the piping system with a contraction upstream of the choke and 3" diameter pipes both upstream and downstream the 4" choke may cause situations where the flow rate is controlled by other parameters than only the choke opening.

We are presently looking into this, but have not yet concluded.

I hope to give you an updated status with some results in the middle of next week.

Best regards,

Reidar

-----Original Message-----

From: Miller, Wayne O. [mailto:miller99@linl.gov]
Sent: 18. august 2010 20:10
To: Reidar B. Schuller
Cc: Ruben Schulkes; Stale.Selmer-Olsen@dnv.com
Subject: Re: Ready to start the HYDRO analysis
Importance: High

Hello Reidar,

Have you had any luck with the choke valve analysis? Please give me an update of how it looks and also your schedule.

Regards,
Wayne Miller

On 8/8/10 2:19 AM, "Reidar B. Schuller" <rbsc@statoil.com> wrote:

- > Dear Wayne
- >
- >
- > The firewall at Statoil does not allow zip files to get through.
- >
- > Please password protect the zip-file and rename the zip-file; e.g.
- > package.zip to package.abc and try again.
- >
- > Please send me the password in a separate mail.
- >
- >

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TREX 011021.0001

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> Best regards,
>
> Reidar
>
> -----Original Message-----
> From: Miller, Wayne O. [mailto:miller99@linl.gov]
> Sent: 5. august 2010 03:32
> To: Reidar B. Schuller
> Cc: Ruben Schulkes; Stale.Selmer-Olsen@dnv.com
> Subject: Ready to start the HYDRO analysis
>
> Dear Reidar,
>
> I am glad to say that we are now ready to go. It took time to get
> approval, and we also have a completed non-disclosure agreement
> (attached). This NDA allows us to exchange information in confidence and without liability.
>
> Please find attached my technical information package for you on the
> choke valve analysis. It is in a zip archive, and contains
> information on the analysis needs, on the choke valve geometry, and
> the PVTsim file for the equation of state.
>
> Thank you for your help. Please contact me with any questions you have.
>
> Kind Regards,
> Wayne Miller
>
> -----Original Message-----
> From: Reidar B. Schuller [mailto:rbsc@statoil.com]
> Sent: Monday, August 02, 2010 3:00 PM
> To: Miller, Wayne O.
> Cc: Ruben Schulkes; Stale.Selmer-Olsen@dnv.com
> Subject: FW: FW: Help with the HYDRO model
> Importance: High
>
> Dear Wayne
>
> Ståle has today forwarded email from you dated July 27th.
>
> See my email dated July 18th (pasted below). Please send information
> to me. I will do the calculations. Please copy Ruben and Ståle.
>
>
> Best regards,
>
> Reidar
>
> *****
> Reidar Barfod Schuller, B.Sc., Ph.D.
> Professor
> IKBM
> Norwegian University of Life Sciences
> P.O.Box 5003
> 1432 Aas
> Norway
> reidar.schuller@umb.no
> Phone: +47 64 96 58 51
> Mobile: [REDACTED]
> Private email: reidar@schuller.no
> *****
>

> Fra: Reidar Barfod Schüller
 > Sendt: 18. juli 2010 20:39
 > Til: Wayne Miller
 > Kopi: Ruben Schulkes; Ståle Selmer-Olsen; Reidar B. Schüller; Reidar B.
 > Schüller
 > Emne: SV: Help with the HYDRO model
 >
 > Dear Wayne
 >
 > Referring to previous emails I confirm that I can assist you in
 > carrying out calculations with the Hydro Choke Model.
 >
 > I will be travelling between different locations in Norway this week,
 > so please use my university mailbox:
 >
 > reidar.schuller@umb.no
 >
 > Mail to this mailbox is frequently synchronized with my mobile phone.
 >
 >
 > In order to run the model I will require the following:
 >
 > 1.
 > Fluid information. We normally obtain this from a PVTsim fluid
 > description. If you can send me a PVTsim-file, I can use this to
 > generate the required input to the choke model. If you do not have a
 > PVTsim-file, we must discuss how I can generate a suitable fluid input file.
 >
 > 2.
 > Mass fractions of each phase (gas, oil, water) at the choke inlet.
 > (You state mass ratio 70/30 oil/methane, but is this at the upstream
 > choke position? I expect that a significant amount of gas also flashes
 > from the oil phase as a result of the pressure drop.)
 >
 > 3.
 > Choke geometry information: CV-curve (I have received this) and
 > information about the hole sizes in the plug and cage geometry.
 >
 > 4.
 > Oil viscosity information.
 >
 > 5.
 > Your calculation matrix (upstream pressures, upstream temperatures,
 > phase mass fractions at choke inlet, valve openings, downstream pressures,).
 >
 >
 > I look forward to receiving more information.
 >
 >
 > Best regards,
 >
 > Reidar
 >
 >
 >
 > Reidar Barfod Schüller, B.Sc., Ph.D.
 > Professor
 > IKBM
 > Norwegian University of Life Sciences
 > P.O.Box 5003
 > 1432 Aas

> Norway
> reidar.schuller@umb.no
> Phone: +47 64 96 58 51
> Mobile: [REDACTED]
> Private email: reidar@schuller.no
> *****
>
> Fra: Wayne Miller [miller99@llnl.gov]
> Sendt: 18. juli 2010 02:09
> Til: Ruben Schulkes; Stale.Selmer-Olsen@dnv.com; Reidar B. Schuller;
> Reidar Barfod Schüller
> Kopi: Reidar B. Schuller; Reidar Barfod Schüller
> Emne: RE: Help with the HYDRO model
>
> Dear Ruben & Stale,
>
> Thank you very much for your fast approval for this assistance. I am
> discussing the matter with our management team on this project. I
> will need to get approval before I can send you the information you
> need to run HYDRO, as some of it may be business proprietary
> information. I will let you know immediately when I get an answer.
>
> This information will help us understand the rate that the well is
> producing (it is currently closed by this choke valve), and may be
> useful in future configurations for capturing oil. I consider this
> very valuable information, but it is not of an emergency nature so
> please do not give up your weekend (I have given up many weekends
> since this started).
>
> Tusen Takki
> Wayne
>
>
> At 7:40 PM +0200 7/17/10, Ruben Schulkes wrote:
>> Dear Wayne and Stale
>> 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 Stale 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@llnl.gov <miller99@llnl.gov>
>> Cc: Ruben Schulkes <rubs@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
>> e-mail: rubs@statoil.com
>> cell phone: [REDACTED]
>>
>> Reidar B. Schüller
>> e-mail: rbsc@statoil.com or reidar.schuller@umb.no cell phone: +47 92
>> 24 39 62
>>
>> 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 C6+
>> 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,
>> 7-8 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.
>> Associate Director, Cleaner Energy
>>
>> DNV Energy - Natural Gas, Cleaner Energy and Solutions (NCG)
>> Phone: +47 6757 8900 (switchboard)
>> Mobile: [REDACTED] (direct)
>> Fax: +47 6757 9911
>> E-mail: stasle.selmer-olsen@dnv.com
>> E-mail: stasle@online.no
>> Address: Det Norske Veritas, DNV Energy, Carbon Capture & Storage
>> (NCGNO693), P.O.Box 300,
>> N-1322 Høvik, Norway
>> Web: <http://www.dnv.com>
>>
>>
>>

>> —Original Message—

>> From: Wayne Miller [mailto:mliller99@hnl.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=28&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
>> —
>> _____
>> Wayne O. Miller
>> Thermal Fluids Group Leader
>> Associate Program Leader for Renewable Energy Lawrence Livermore
>> National Laboratory
>> 7000 East Ave., L-140
>> Livermore, CA 94551
>> [REDACTED]
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>> *****The

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> Wayne O. Miller
> Thermal Fluids Group Leader
> Associate Program Leader for Renewable Energy Lawrence Livermore
> National Laboratory
> 7000 East Ave., L-140
> Livermore, CA 94551
> [REDACTED]
> _____
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> _____

> -----Original Message-----
> From: Stale.Selmer-Olsen@dnv.com [mailto:Stale.Selmer-Olsen@dnv.com]
> Sent: 2. august 2010 23:33
> To: Reidar B. Schuller
> Cc: Ruben Schulkes
> Subject: FW: FW: Help with the HYDRO model
> Importance: High
>
> Dear Reidar
>
> Since you will do the calculations, please follow up on this e-mail request.

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> Contact me if you need to discuss.
 > Sorry for late transfer. I have not been on e-mail the last days.
 >
 > Best regards
 > Ståle
 >
 > Ståle Selmer-Olsen, M.Sc, Dr.
 >
 > DNV Energy - Natural Gas, Cleaner Energy and Solutions (NCG)
 > Phone: +47 8757 9900 (switchboard)
 > Mobile: [REDACTED] (direct)
 > Fax: +47 8757 9911
 > E-mail: staale.selmer-olsen@dnv.com
 > Address: Det Norske Veritas, DNV Energy, Carbon Capture & Storage
 > (NCGNO693), P.O.Box 300, N-1322 Høvik, Norway
 > Web: http://**www.**dnv.com
 >
 >

> —Original Message—

> From: Wayne Miller [<mailto:miller99@llnl.gov>]
 > Sent: 27. juli 2010 01:47
 > To: Selmer-Olsen, Ståle
 > Subject: Re: FW: Help with the HYDRO model
 > Importance: High
 >

> Dear Ståle,
 >

> I will request the internal choke dimensions from the vendor. Do you
 > have a list of what geometry you will need?
 >

> Thank you,
 > Wayne
 >
 >
 >>

>> 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 C6+
 >> 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.
 >>
 >>
 >
 > —

> _____
 > Wayne O. Miller
 > Thermal Fluids Group Leader
 > Associate Program Leader for Renewable Energy Lawrence Livermore
 > National Laboratory
 > 7000 East Ave., L-140
 > Livermore, CA 94551
 > [REDACTED]

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