Modeling the production performance of a subsea satellite field using Prosper, GAP and MBAL.

In this exercise, your main task is to analyze the production performance of an offshore satellite field with three subsea wells using the suite IPM from Petroleum Experts. You will be creating several models: Well models (in the software Prosper), subsea network (in the software GAP) and reservoir (in the software MBAL). Then you will integrate all of them in GAP to analyze the production performance of the system with time.

The three wells are producing from the same reservoir and their production is commingled with a subsea network and transported to an FPSO.

Your main tasks is the following:

- Compute the production profile of the field for a period of 10 years. Use oil plateau rates of 1500 Sm^3/d, 2000 Sm^3/d and fully open choke. Plot all production profiles, water cut, GOR and report the plateau duration. Note: for plateau production, you will have to perform a prediction run in “optimization mode”.

NOTE: Be aware that each step of model creation has their individual sub-tasks!

1. **Creating the well model (Prosper)**

Fluid information:

Use the black oil correlation of Glasø (p_b, R_s, B_o) and Beal (viscosity) to model your PVT behavior.

Solution GOR = 142 Sm^3/Sm3 Producing GOR = 142 Sm^3/Sm^3 Oil gravity = 30 API (876 Kg/m^3) Gas gravity = 0.76 At initial conditions no water.	Formation Water salinity = 23000 ppm No H2S, CO2, N2. Heat capacity of oil = 2.219 KJ/Kg/K Heat capacity of gas = 2.1353 KJ/Kg/K Heat capacity of water = 4.1868 KJ/Kg/K

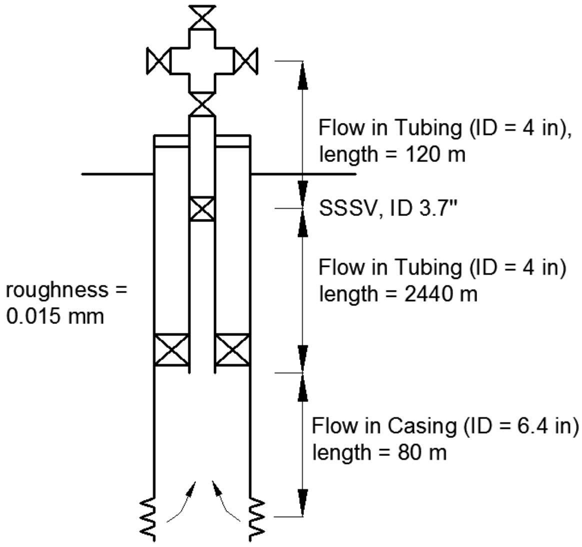
Well layout:

Deviation survey

MD [m]	TVD [m]
0	0
123	122
1059	1036
2164	2103
2640	2560

Geothermal gradient

MD [m]	T [C]
0	4
2640	100



Overall heat transfer coefficient = 45 W/m^2 K

Reservoir info:

Producing from a single layer

Reservoir pressure = 360 bara

Reservoir temperature = 100 C

Water cut = 0%

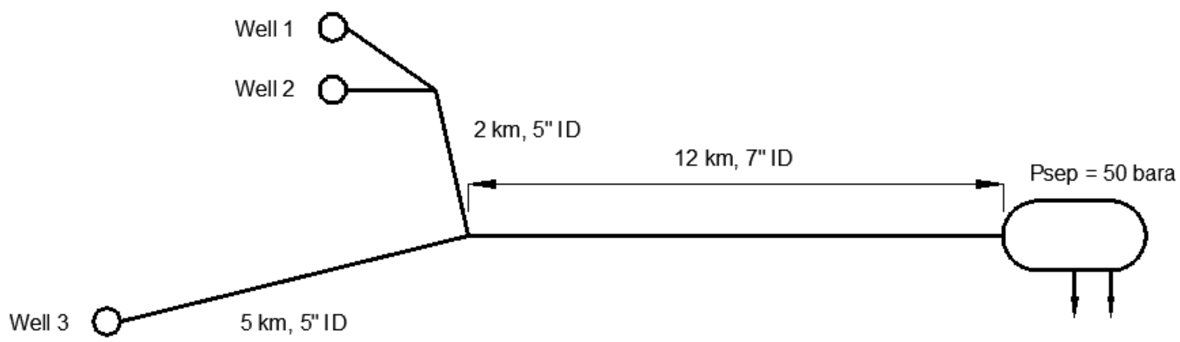
Productivity index = 12 Sm^3/d/bara

Tasks:

- Report the bubble point pressure at reservoir temperature as predicted by the black oil correlation.
- Estimate the producing rate using flow equilibrium assuming that the well is producing against a constant wellhead pressure of 100 bar.
- Generate and export lift curves to be used in GAP (in the following exercise). p_{wh} range: 30-150 bara, GOR range: 141 – 500 Sm^3/Sm^3. WC range: 0 – 50 %

2. **Creating the model of the gathering network**

The layout of the production network layout is shown below. The S riser is not included in the figure. Assume that the water depth is 300 m, and the separator is 30 m above the sea level. The production riser is a lazy "S" riser with a total length of 700 m.



The wells have the same layout as the well created in the previous section, but with different GOR, WC and PI as specified in the table below:

Well	**GOR [Sm^3/Sm^3]**	**WC [%]**	**PI [Sm^3/d/bara]**
Well 1	142	0	12
Well 2	200	40	8
Well 3	250	20	15

Tasks:

- Build the GAP model of three subsea wells producing to a FPSO.
- Calculate the natural equilibrium flow of the network. Report the maximum oil production rate of each well and calculate their split factor (well rate divided by field rate).
- Now, assume that the system has to be operated at a constant rate of 2000 Sm^3/d. Add an oil rate constraint to the separator, activate choke control on each well (calculated), and run an optimization.

3. **Creating material balance model (MBAL)**

Fluid information:

Use the black oil correlation of Glasø (p_b, R_s, B_o) and Beal (viscosity) to model your PVT behavior.

Solution GOR = 142 Sm^3/Sm3 Producing GOR = 142 Sm^3/Sm^3 Oil gravity = 30 API (876 Kg/m^3) Gas gravity = 0.76 At initial conditions no water.	Formation Water salinity = 23000 ppm No H2S, CO2, N2.

Temperature: 100 C

Initial pressure: 360 bara

Porosity: 0.3

Connate water saturation: 0.15

Original oil in place: 30 E6 Sm^3

Start of production: 09.04.2018

Water influx: Small Pot aquifer, 60 E6 Sm^3

Rel Perm: Corey Functions

	Residual Saturation	End Point	Exponent
	fraction	fraction	
Krw	0.15	1	1
Kro	0.15	0.8	1
Krg	0.01	0.9	1