ANSWER THIS PROBLEM USING EXCEL. WRITE THE PROCEDURE IN THE EXCEL FILE.

PROBLEM 1 (15 points)

Consider a topside facility that has a first stage oil-gas horizontal separator, operating at 50 bara and 70 °C. The separation capacities of the separator are:

$$q_{\bar{o},max} = 15\ 000\ Sm3/d$$

$$q_{\bar{g},max} = 3\ E06\ Sm3/d$$

Assume that the required separation time (residence time) for the gas is 30 s. The separation time required for oil is unknown and irrelevant for this task.

During normal operations, the oil level in the separator is exactly in the middle.

Assume that the ratio between the effective length and inner diameter of the separator is equal to 4.

Task 1. Determine the effective length and inner diameter of the separator. Provide an explanation about how you have solved the task.

Additional information

The local volumetric rates of oil and gas can be calculated from the standard conditions rates of oil and gas (in Sm^3/d) using the following expressions:

$$q_g = B_g \cdot q_{\bar{g}} - R_s \cdot B_g \cdot q_{\bar{o}}$$

$$q_o = B_o \cdot q_{\bar{o}}$$

Use the following values for the black oil properties:

B_g = 0.01 [m^3/Sm^3]

R_s = 50 [Sm^3/Sm^3]

B_o = 1.2 [m^3/Sm^3]

Solution:

Calculate the local rates of oil and gas in the separator

$$q_g = 0.01 \cdot 3E6 - 50 \cdot 0.01 \cdot 15000 = 22500 \frac{m3}{d} = 0.26\, m3/s$$

$$q_o = 1.2 \cdot 15000 = 18000 \frac{m3}{d} = 0.208 m3/s$$

Then calculate the effective volume of gas in the separator:

$$V_{eff,g} = q_g \cdot t_{res,g} = 0.26 \cdot 30 = 7.81\, m3$$

The effective volume of gas is also equal to

$$V_{eff,g} = L_{eff} \cdot \frac{\frac{\pi \cdot D^2}{4}}{2} = L_{eff} \cdot \frac{\pi \cdot D^2}{8}$$

Using the ratio between $\frac{L_{eff}}{D} = 4$, this gives

$$V_{eff,o} = 4 \cdot D \cdot \frac{\pi \cdot D^2}{8} = \frac{\pi \cdot D^3}{2}$$

Clearing out the diameter:

D= 1.7 m

Then Leff = 6.8 m

PROBLEM 2 (2 points)

What does SOC stand for?

- Statement of Commitment
- Statement of Commerciality
- Statement of Conflict
- Statement of Contribution

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

PROBLEM 3 (2 points)

The SOC is typically issued after:

- Preparing the PDO
- Completing the business case identification phase

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

PROBLEM 4 (3 points)

What subphases are in project planning:

- Feasibility studies, concept planning, detailed engineering
- Feasibility studies, concept planning, pre-engineering
- Business case identification, Feasibility studies, pre-eng

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

ANSWER THIS PROBLEM USING THE EXCEL PROVIDED. WRITE THE PROCEDURE AND ANSWERS IN THE EXCEL FILE.

PROBLEM 5 (10 points)

Using the excel sheet given, determine the field plateau rate that gives the highest net present value NPV (assume 350 operational days in a year). Assume that all expenses are executed in year 0 (no discount needed). Add text to explain your procedure in the Excel sheet.

Solution

See the excel file provided with the solution.

PROBLEM 6 (2 points)

In an offshore field, the build-up period usually takes place over a considerable number of years. Wells are drilled progressively to gather more information about the reservoir and the new information is used to design the field.

- True
- False

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

PROBLEM 7 (2 points)

In an oil field, bottlenecking can cause an early decline in a field producing in plateau mode because usually oil production must be reduced (choked) to make sure the production rates of gas or water are within the processing capacities of the topside facilities.

- True
- False

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

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PROBLEM 8 (10 points)

The offshore Alta-Gohta field consists of two separate reservoirs (Alta and Gohta). Each reservoir will be produced independently via a separate pipeline to a common FPSO. The field (and reservoirs) will be produced in plateau mode. The oil production potential of each reservoir can be estimated with following expression: qpp = Nw * qppow * (1 - 2.5 * (Np/N)). Nw is the number of producers in the reservoir, qppow is the maximum rate of oil produced by one well at initial time, Np is cumulative oil production from the reservoir and N is initial oil in place in the reservoir. This expression assumes all wells in a reservoir are identical. Data is provided in the Excel sheet.

Well tests indicate Alta has an API of 30 and Gohta of 35. The crude export department has indicated that API of the field must be of 32. The API of the field can be calculated with a weighted average of the APIs of Alta and Gohta using the production rates.

Task 1. If the field is to be produced with a plateau rate of 12 000 Sm3/d and using 6 producers in Alta and 3 in Gohta, determine the plateau duration, if the field API constraint is enforced.

Solution

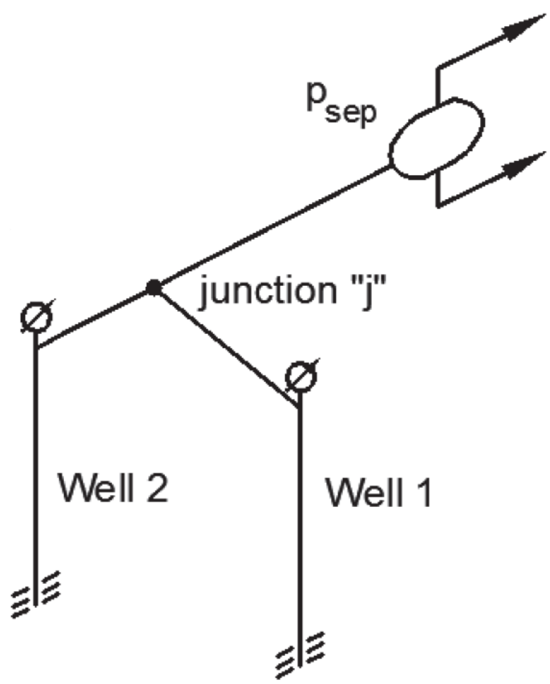
See the excel file provided with the solution.

ANSWER THIS PROBLEM USING THE EXCEL PROVIDED. WRITE THE PROCEDURE AND ANSWERS IN THE EXCEL FILE.

PROBLEM 9 (25 points)

You have been asked to perform production scheduling calculations on a very small dry gas field in the San Juan Area, New México, US.

The field consist of two wells that are producing from the same reservoir. The two wells have distinct performance. There is a flowline between the wellheads and a junction. There is a pipeline from the junction to the separator. Wells are equipped with wellhead chokes. Separator pressure is 28.6 bara. All information about the well IPR, TPR, flowline and pipeline are given in the Excel file attached (in the sheet named "network solving"). Information about the reservoir is provided in the sheet "Production_schedule".



Task 1. Consider that one wants to produce a plateau rate of 100 000 Sm3/d from the field. Perform production scheduling calculations until the rate reaches a rate of 33 000 Sm3/d.

Additional information.

- Use the Excel sheet provided to solve this problem. The Excel sheet contains VBA functions.
- Add text to the Excel file explaining your procedure.
- Use the rectangular rule to calculate yearly gas production $\boldsymbol{\Delta G_p}$ (using the value from the end of last year).
- Use the following equations (programmed in VBA):

Material balance: $$p_R = p_i \cdot \left(1 - \frac{G_p}{G}\right)$$	With G = 200 E06 Sm^3 Use 360 operational days per year when calculating G_p P_{Ri}, initial reservoir pressure is 150 bara.
Inflow equation: $$q_g = C_R \cdot \left(p_R^2 - p_{wf}^2\right)^n$$	C_R Inflow backpressure coefficient, Sm^3/bar^{2n} n, inflow backpressure exponent
Tubing equation: $$q_{gsc} = C_T \cdot \left(\frac{p_{wf}^2}{e^S} - p_{wh}^2\right)^{0.5}$$	C_T, tubing coefficient, Sm^3/bar S, tubing elevation coefficient
Flowline from choke discharge (dc) to junction: $$q_{gsc} = C_{FL} \cdot \left(p_{dc}^2 - p_j^2\right)^{0.5}$$	C_{FL}, flowline coefficient, Sm^3/bar
Pipeline equation from Junction to separator: $$q_{gsc} = C_{PL} \cdot \left(p_j^2 - p_{sep}^2\right)^{0.5}$$	C_{PL}, pipeline coefficient, Sm^3/bar p_{sep}, separator pressure.

Solution

See the excel file provided with the solution.

PROBLEM 10 (6 points)

Select the options that are most correct considering a 4 well subsea template

- The HIPPS are valves located in the manifold module that close and isolate the template if the pressure increases above certain value, protecting the system downstream from structural failure
- The weight of the well and x-mas trees are transferred to the soil through the suction anchors and the structure of the template
- Wells are typically vertical with little deviation
- A jumper connects the well template with the manifold template

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

PROBLEM 11 (6 points)

In platform wells with dry trees and for shallow-medium water depth:

- The tubing hanger and x-mas tree are located on the seabed
- Wells are drilled just like onshore and the conductor is extended to the platform deck
- The platform bears the weight of most of the tubulars strings and wellhead
- The weight of the tubulars strings and wellhead is transferred to the seabed soil through the conductor

THIS PROBLEM IS CORRECTED AUTOMATICALLY BY INSPERA

ANSWER THIS PROBLEM USING EXCEL. WRITE THE PROCEDURE AND THE ANSWER TO THE TASKS IN THE EXCEL FILE.

PROBLEM 12 (9 points)

Assume that the DRILLEX of a well exhibits a continuous normal distribution with mean = 100 and sigma = 20 (values are given in 1E06 USD).

Task 1. Using the cdf, determine what is the probability that the cost will be equal to 120 1E06 USD or higher. TIP: use the built-in Excel function: “NORM.DIST”.

Task 2. As a follow-up to task 1, determine what is the probability that the cost will be equal to 90 1E06 USD or lower?

Task 3. Using the method of value discretization, discretize the well DRILLEX distribution provided using three values (bins) of 80, 100 and 120. What are the associated probabilities to each value? TIP: use the built-in function in VBA: “NORM.DIST”.

Additional information:

The Excel function NORM.DIST Returns the normal distribution for the specified mean and standard deviation.

Usage:

NORM.DIST(x,mean,standard_dev,cumulative)

The NORM.DIST function syntax has the following arguments:

- X Required. The value for which you want the distribution.
- Mean Required. The arithmetic mean of the distribution.
- Standard_dev Required. The standard deviation of the distribution.
- Cumulative Required. A logical value that determines the form of the function. If cumulative is TRUE, NORM.DIST returns the cumulative distribution function; if FALSE, it returns the probability density function.

Solution

See the excel file provided with the solution.

PROBLEM 13 (8 points)

Consider the scatter diagram of long-term wave statistics of the Aasta Hansteen region shown below:

	Spectral Peak period (T_p) [s]																							
Hs [m]	**0-3**	**3-4**	**4-5**	**5-6**	**6-7**	**7-8**	**8-9**	**9-10**	**10-11**	**11-12**	**12-13**	**13-14**	**14-15**	**15-16**	**16-17**	**17-18**	**18-19**	**19-20**	**20-21**	**21-22**	**22-23**	**23-24**	**24-25**	**Sum**
0-1	15	290	1367	2876	3716	3527	2734	1849	1138	656	362	192	101	52	26	13	7	3	2	1	0	0	0	18927
1-2	1	81	1153	5308	12083	17323	18143	15262	10980	7053	4169	2316	1229	631	315	155	75	36	17	8	4	5	1	96348
2-3	0	2	94	1050	4532	10304	15020	15953	13457	9752	5991	3403	1795	894	426	197	88	39	17	7	3	1	1	83026
3-4	0	0	2	72	686	2782	6171	8847	9189	7493	5082	2991	1577	762	345	148	61	24	9	4	1	0	0	46246
4-5	0	0	0	2	51	433	1645	3495	4807	4750	3638	2286	1229	584	251	100	37	13	5	1	0	0	0	23327
5-6	0	0	0	0	2	39	294	1037	2069	2664	2440	1709	968	463	193	72	25	8	2	1	0	0	0	11986
6-7	0	0	0	0	0	2	32	215	692	1264	1485	1228	767	382	159	57	18	5	1	0	0	0	0	6307
7-8	0	0	0	0	0	0	2	27	157	447	730	762	555	302	130	46	14	4	1	0	0	0	0	3177
8-9	0	0	0	0	0	0	0	2	23	112	276	392	355	223	104	38	11	3	1	0	0	0	0	1540
9-10	0	0	0	0	0	0	0	0	2	19	77	160	192	148	79	31	9	2	0	0	0	0	0	719
10-11	0	0	0	0	0	0	0	0	0	2	16	50	85	85	55	24	8	2	0	0	0	0	0	327
11-12	0	0	0	0	0	0	0	0	0	0	2	12	29	40	33	18	7	2	0	0	0	0	0	143
12-13	0	0	0	0	0	0	0	0	0	0	0	2	8	15	17	12	5	2	0	0	0	0	0	61
13-14	0	0	0	0	0	0	0	0	0	0	0	0	2	5	7	6	4	1	0	0	0	0	0	25
14-15	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2	1	0	0	0	0	0	9
15-16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	4
16-17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	16	373	2616	9308	21070	34410	44041	46687	42514	34212	24268	15503	8892	4587	2143	921	372	146	55	22	8	6	2	292172

Task 1. What does the chart shows? Explain the meaning of the variables shown in the x and y axis.

Task 2. Briefly describe how is this chart used for the selection of an offshore structure to operate in the area?

Solution

Task 1. The plot shows in the x axis the spectral peak period (Tp) and on the y axis the significant wave height (Hs). The numbers (and colors) indicate the number of sea states that exhibited a given combination of Hs and Ts. For example, for the figure shown, the combination Tp 8-9 s and Hs 1-2 is the most common.

The spectral peak period is found by finding the dominant frequency (e.g. with an FFT) of wave elevation data measured during a sea state (typically 3 hr duration)

The significant wave height is found by using the wave elevation data measured during a sea state (typically 3 hr duration). A frequency analysis is performed on the data and the significant wave height Hs is the average of the wave height in the range between the maximum wave height and the wave height for which 1/3 of all wave heights are greater or equal than it.

Task 2.

Each type of offshore structure typically has a natural period. If external forces like waves or wind excite the structure with that period, the structure could potentially exhibit big displacements that cause big stresses and eventually failure. Therefore, it is good to determine the most common wave periods and heights of the region and choose structures that have natural periods that do not coincide with them.