Exercise set 02 (Deadline: 06 Mar, 2019)

Problem 1: Estimation of water content in the Aasgard subsea compression system.

Asgard is a subsea field producing oil, gas and condensate, at a water depth between (240-300) m, located about 50 kilometers south of the Heidrun field on the Halten bank in the Norwegian Sea. The field has been developed with subsea template wells tied-back to Åsgard A (FPSO) and B (semi-submersible). The sandstone reservoirs are located at a depth of approx. 4850 m.

In this task you will focus on the production system that produces from the Midgard reservoir and where the production from Mikkel and Yttergryta is tied-in. In 2015, the subsea layout was modified significantly to install two subsea compressors (depicted with the names "Train 2" and "Train 1" on the module SCSt-A), to increase production and avoid slugging issues in the main transportation lines. The system is producing mainly gas with some condensate and water. A sketch of the system is shown below.



Your main task is to perform water content calculations along the system. For that, assume that all water comes from condensation from the gas and that reservoir gas is fully saturated with water. Estimate the amount of total and free water (in kg/d) in:

- Suction manifold (1)
- Cooler discharge (2)
- Compressor suction (3)
- Compressor discharge (4)
- Discharge manifold (5)
- Separator in Asg B (6)



The production system can be simplified to the following layout:

• To avoid hydrate problems in the pipeline from the compression station to Asg. B, the flow assurance expert has determined that a weight % of 40% of TEG should be injected in the stream. Determine the amount of TEG to inject based on the amount of free water expected in the pipeline.

-The following conditions are provided:

| | P [bara] | T[C] |
|--------------------------|----------|------|
| Midgard Reservoir | 180 | 90 |
| Mikkel Reservoir | 300 | 130 |
| Suction manifold (1) | 45 | 20 |
| Cooler discharge (2) | 45 | 13 |
| Compressor suction (3) | 45 | 13 |
| Compressor discharge (4) | 80 | 80 |
| Discharge manifold (5) | 80 | 80 |
| Separator Asg. B (6) | 35 | 20 |

| | q _g [1E06 Sm3/d] |
|------------|--------------------------------|
| Template X | 4 |
| Template Y | 4 |
| Template Z | 3 |
| Template A | 10 |

Problem 2: Gas dehydration with TEG in the Aasgard B semi-submersible.

The gas produced from Midgard and Mikkel must be dehydrated before sent via an export pipeline to the Kårstø processing complex, north of Stavanger.



The dehydration will be performed using a TEG dehydration column operating at 52 bara and 30 C.



Assume that the wet gas that enters the column is saturated with water. The desired dewpoint for export is -10 C at 52 bara. Your tasks are the following:

- Estimate the amount of water to remove from the gas
- Estimate the amount of TEG needed to remove the water from the gas.
- Provide a rough estimate of the number of trays needed in the TEG contactor

• Assume that the TEG regeneration is performed by boiling the liquid mixture of TEG and water at 206.6 C and 1.24 bara. Determine the resulting mole fraction of the water in the liquid stream and estimate the rate of makeup TEG to compensate what is lost during the regeneration process.

Fill the excel sheet provided.