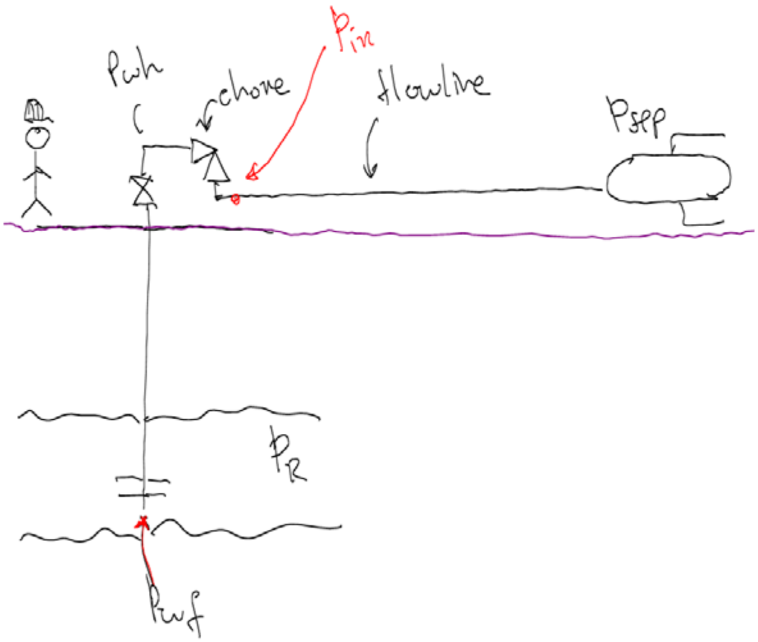
Problem 1 (50 points). Consider the **dry gas** production system shown in the figure below:



Answer the following questions (and explain how you performed your calculations):

1. **(20 points)** What is the choke pressure drop required (in bar) for the system to deliver a rate of 2.5 E6 Sm^3/d?
   - If wellhead temperature is 70 C, what is the expected temperature at the inlet of the pipeline after the expansion through the choke?
2. **(15 points)** What is the equilibrium gas rate of the system if the choke is fully open?
3. **(15 points)** Your group is considering using a smaller tubing (smaller diameter) that is less costly.
   - Calculate the new equilibrium rate with fully open choke (Task 2) for an ID of 0.1 m. Consider the current ID is 0.154 m, and that the equation to calculate the new tubing constant (C_{T,D_2}) with the current tubing constant (C_{T,D_1}) is:

$$C_{T,D_2} = C_{T,D_1} \cdot \left(\frac{D_2}{D_1}\right)^{2.61}$$

     Will there be a significant reduction in the equilibrium rate?
   - Explain briefly what are the considerations that must be taken into account when selecting tubing diameter.

Additional information:

- A table with the value of the m function ($m(p) = 2 \cdot \int_{p_{sc}}^{p} \frac{p}{\mu_g \cdot Z} dp$) versus pressure is provided in the Excel file attached. If you need to find the value of m at a given pressure, you can interpolate in the table using the VBA function "tabinterpol"

- A VBA function is provided to model the inflow: "ipr_gas_qg". This equation is the IPR equation for dry gas and vertical well using the m function.

$$q_{\bar{g}} = \frac{7.63 \cdot k \cdot h}{\left[ln\left(\frac{r_e}{r_w}\right) - 0.75 + s\right]} \cdot \frac{1}{T_{\bar{R}}}\left[m(p_R) - m(p_{wf})\right]$$

- The pressure drop in the tubing can be modeled with the following equation:

$$q_{\bar{g}} = C_T \cdot \left(\frac{p_{wf}^2}{e^S} - p_{wh}^2\right)^{0.5}$$

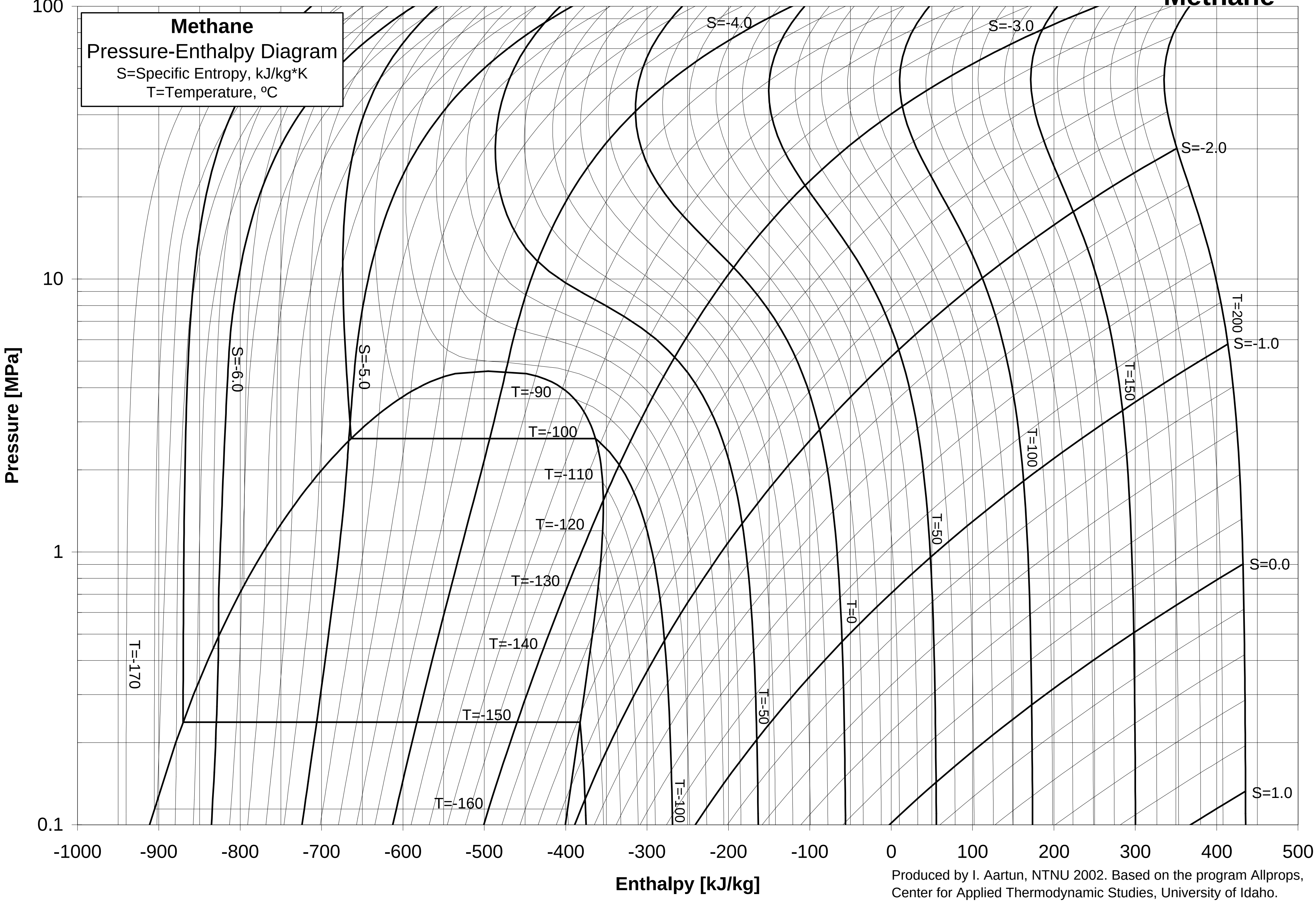
There are 3 VBA functions provided for this equation: "Tubingqg" (provides rate given pressures upstream and downstream), "Tubingp1" (provides upstream pressure given rate and downstream pressure) and "Tubingp2" (provides downstream pressure given rate and upstream pressure)

- The pressure drop in the flowline between the choke and the separator can be modeled with the following equation:

$$q_{\bar{g}} = C_{FL} \cdot \left(p_{in}^2 - p_{sep}^2\right)^{0.5}$$

There are 3 VBA functions provided for this equation: "Lineqg" (provides rate given pressures upstream and downstream), "Linep1" (provides upstream pressure given rate and downstream pressure) and "Linep2" (provides downstream pressure given rate and upstream pressure)

Methane



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