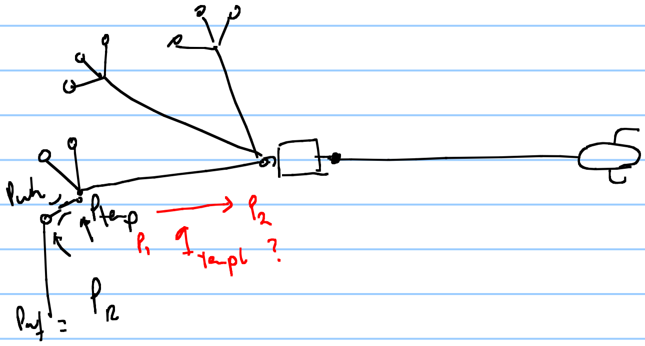
2018 03 13 Plan for today { brief on Snøhvit compressor calculations
- Surface networks
  • class exercise
- downhole networks

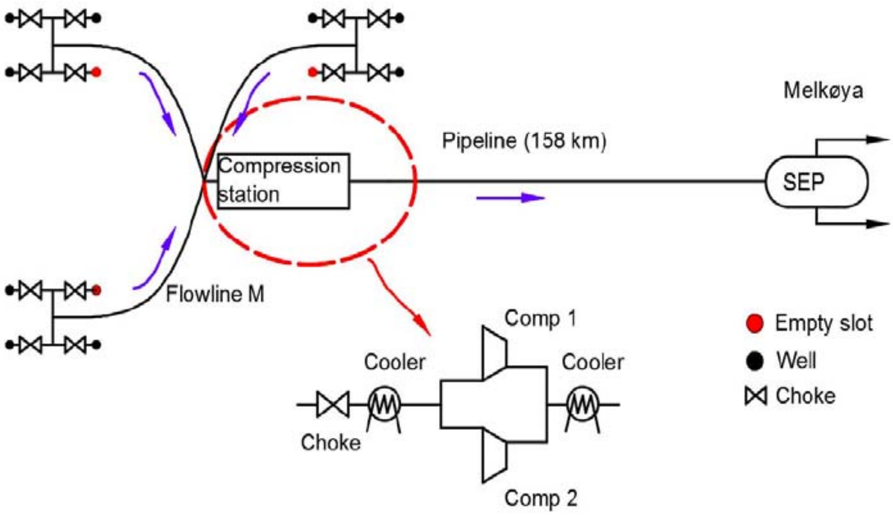


Calculate actual volume rate at compressor inlet

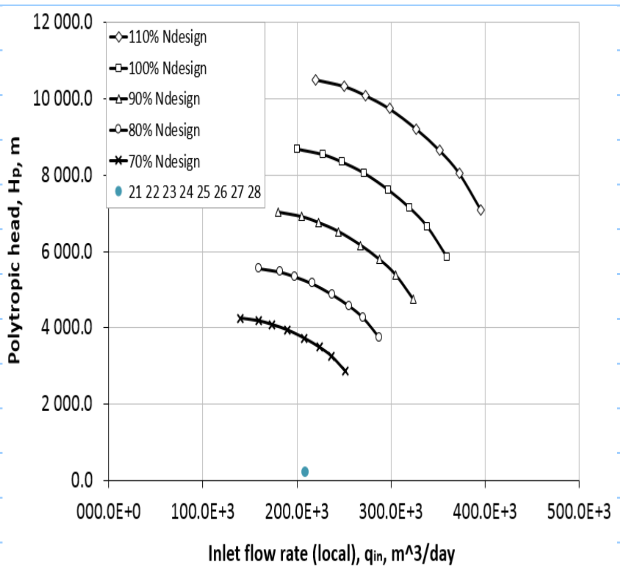
$$B_g(p,T) = \frac{V(p,T)}{V(p_{sc},T_{sc})}$$

$$B_g(p,T) = \frac{q(p,T)}{q_g} \qquad q(p_{suc},T_{suc}) = B_g(p_{suc},T_{suc}) \cdot q_g$$

Orientation about how to solve Task 4, exercise set 2.

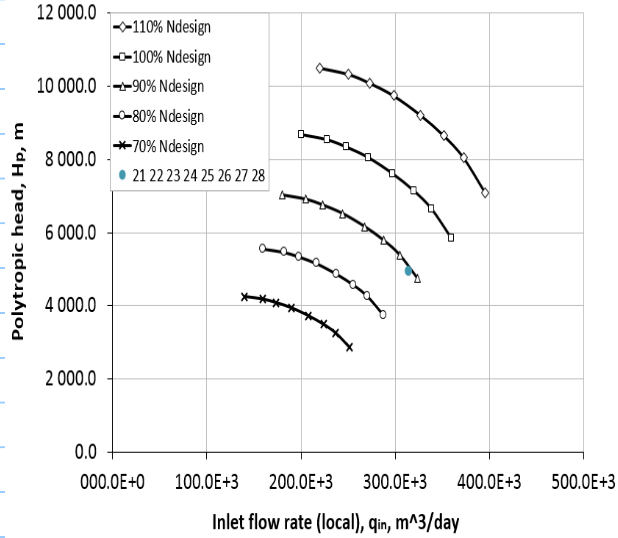


78.6	30.0	6.7E+6	68															Map/Test conditions		
78.6	30.0	6.7E+6	61				k	1.30										k	1.4	
78.6	30.0	6.7E+6	53				Polytropic effic	0.7										γg	1	
78.6	30.0	6.7E+6	46				Mech. Effic	0.95										Pin, bara	50	
78.6	30.0	6.7E+6	38															Tin, K	298.15	
78.6	30.0	6.7E+6	30															Zin	0.98	
78.6	30.0	6.7E+6	22															Mw	28.97	
78.6	30.0	6.7E+6	14																	
78.6	30.0	6.7E+6	6	Pplem avail/psuc	Tsuc	rp	deltap	np	n	Tdis	zsuc	zdisc	Bg @suc	qg_local	Δhp	m	Power	Hp test	qact test	qact test single comp
78.6	30.0	6.7E+6	0	[bara]	[C]	[-]	[bar]	[-]	[-]	[C]			[m^3/Sm^3]	[m^3/d]	[J/kg]	[kg/s]	[MW]	[m]	[m^3/d]	[m^3/d]
78.6	30.0	6.7E+6	0	76.6	67	1.03	1.94	0.70	1.49	69.81	0.93	0.93	14.5E-3	289.3E+3	4126.15	155.5	964.7E-3	219.4E+0	208961.4	

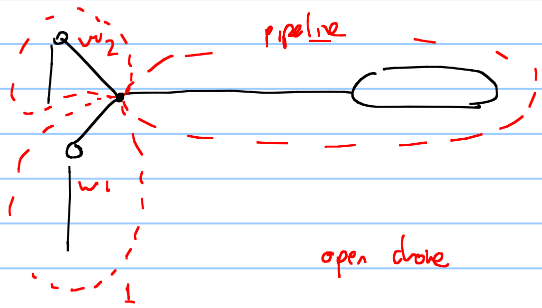


The point falls outside the operational map. We could use the inlet choke and inlet cooler to change the inlet conditions and try to move the point inside.

By choking at the inlet with DP = 30 bar and using the cooler such as Tsuc=20 C-->

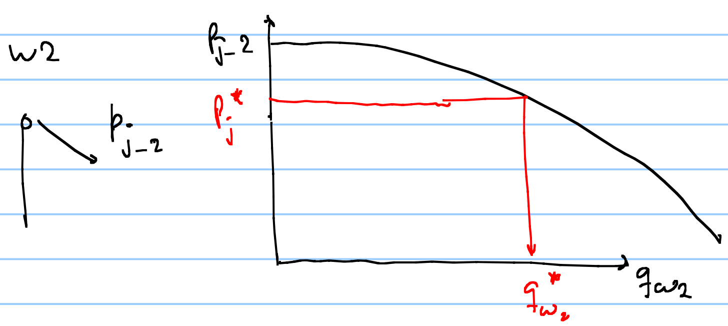


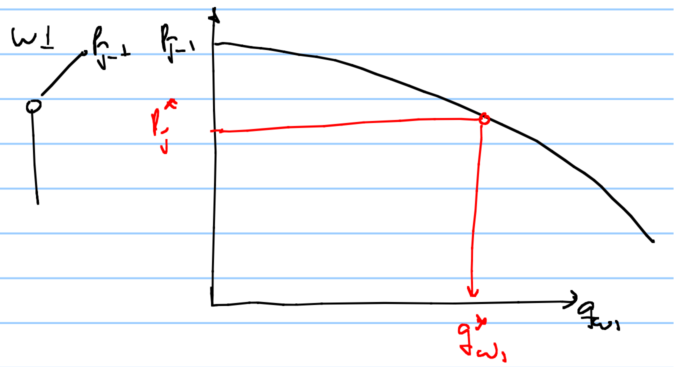
Surface networks

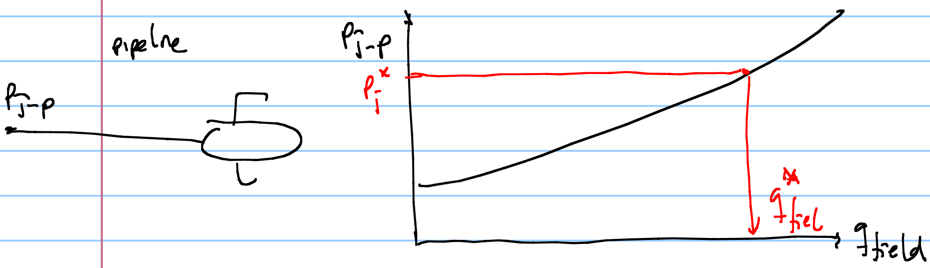


the assumption $q_w = \frac{q_f}{2}$ is NOT valid

how to compute the natural equilibrium point of this system?







$q_{field} = q_{w_1} + q_{w_2}$

assume p_J → calculate $q_{w_1}, q_{w_2}, q_{field}$

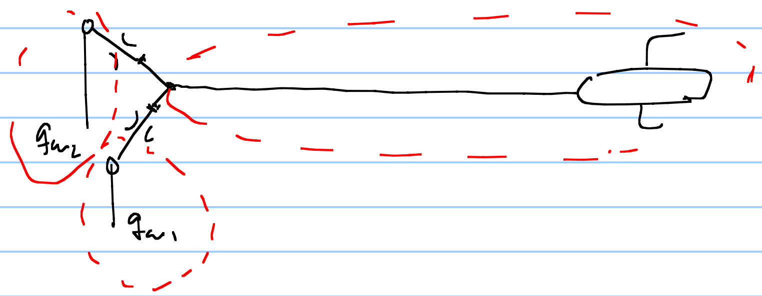
verify if $q_{w_1} + q_{w_2} = q_{field}$

NO ↺ ; yes → solution

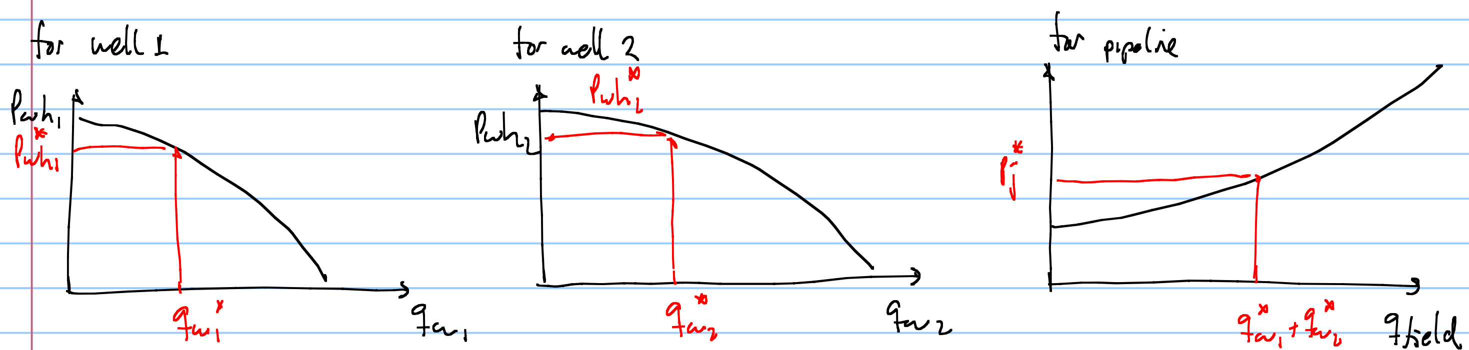
	Nr unknowns	Nr equations
IPR 1: $q_{w_1} = C_1 \left(P_{R_1}^2 - P_{wf_1}^2\right)^n$	2	1
IPR 2: $q_{w_2} = C_2 \left(P_{R_2}^2 - P_{wf_2}^2\right)^n$	2	1
TPR 2: $q_{w_2} = C_{T_2}\left(\dfrac{P_{wf_2}^2}{e^{S_2}} - P_{wh_2}^2\right)^{0.5}$	1	1
TPR 1: $q_{w_1} = C_{T_1}\left(\dfrac{P_{wf_1}^2}{e^{S_1}} - P_{wh_1}^2\right)^{0.5}$	1	1
FPR 1: $q_{w_1} = C_{FL_1}\left(P_{wh_1}^2 - P_J^2\right)^{0.5}$	1	1
FPR 2: $q_{w_2} = C_{FL_2}\left(P_{wh_2}^2 - P_J^2\right)^{0.5}$	0	1
PPR: $q_f = C_{PL}\left(P_J^2 - P_{sep}^2\right)^{0.5}$	1	1
$q_{field} = q_{w_1} + q_{w_2}$	0	1
	8	8

Fixed rate calculations for network

Flowline length is very short such as $P_{downstream\ choke} \approx P_J$



$q_{w_1}^*$, $q_{w_2}^*$ given by reservoir engineer.

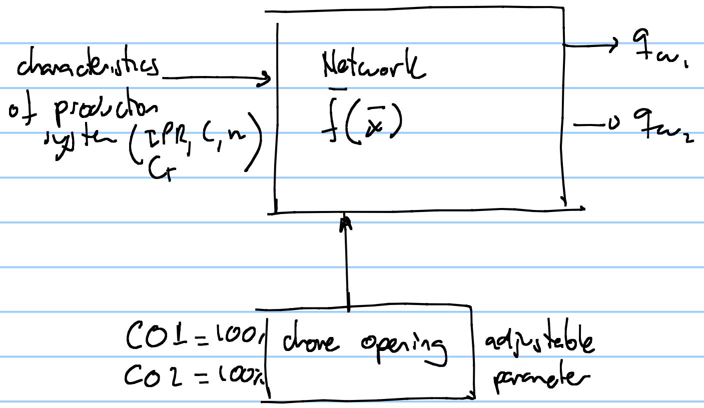


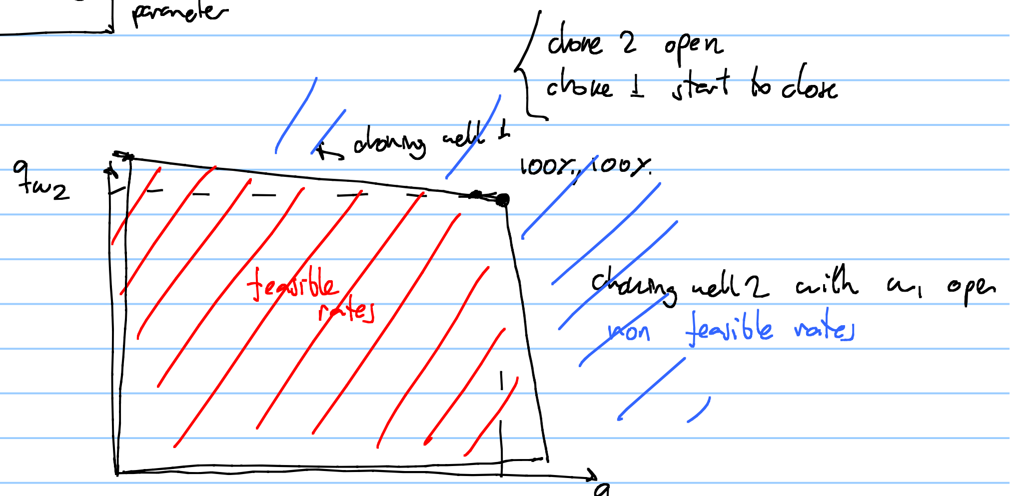
the rates will be feasible if

$P_{wh_1}^* > P_J^*$

$P_{wh_2}^* > P_J^*$

when I have chokes in the system, there are multiple combinations of q_{w_1}, q_{w_2} that can be achieved

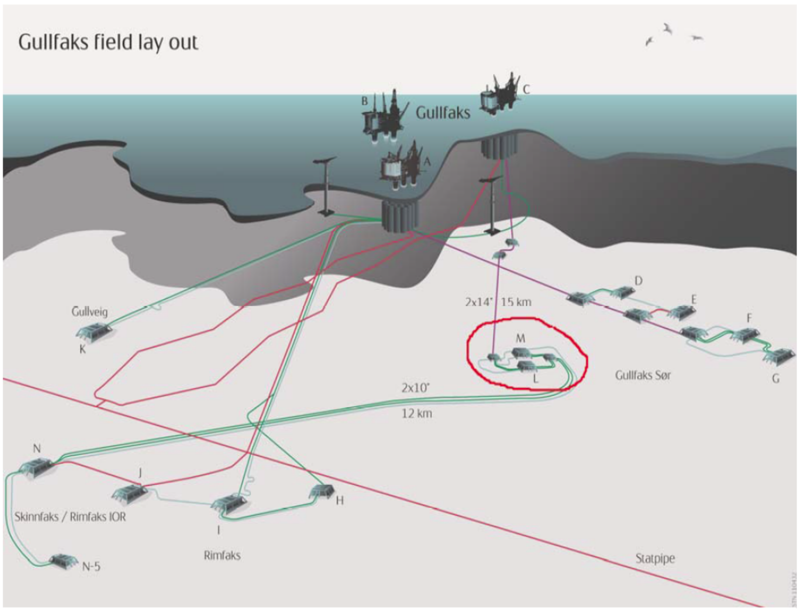




Class exercise: folk.ntnu.no/stanko/Courses/TPG4230/2018/Class_files/20180313

Problem 2: **Production network calculations for the Gullfaks South field.**

Two reservoir units in Gullfaks South field (Block 13 and Block 14) have been producing oil and gas since 1999 by two subsea templates (Template L and M). Template L has 4 wells and template M has 3 wells. For the purpose of this exercise, consider that all wells in a given template are identical (**However, the production of one well in the L template is not the same as the production of one well in the M template**). The production of the two templates is commingled in a towhead (junction) and transported further with a pipeline to the platform of Gullfaks C.

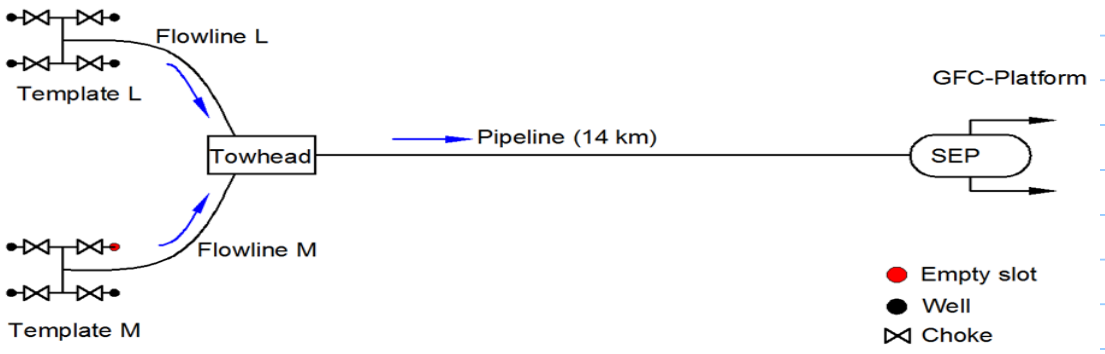


Issue on the choosing of the independent variable for the solving process: rate might give a problem of complex numbe if a too high value is used

IPR

$$q_{w_1} = C_1 \left(P_{R_1}^2 - P_{wf_1}^2\right)^n$$

$$P_{wf_1} = \left(P_{R_1}^2 - \left(\frac{q_{w_1}}{C_1}\right)^{1/n}\right)^{0.5}$$



TPG4230, Milan Stanko, 20180313													
Separator pressure, psep	60	bara											
	Nwells	pR [bara]	pwf [bara]	C [Sm^3/bar^2n]	n	qg [Sm^3/d]	Ct [Sm^3/bar]	S	pwh [bara]	qtemp [Sm^3/d]	Cfl [Sm^3/bar]	ptowhead[bara]	error [bara^2]
Template L	4	145	99.6	1000	0.8	1.72E+06	38152	0.43	66.7	6.89E+06	1403054	66.5	0.0
Template M	3	102	80.4	700	0.8	5.27E+05	41163	0.34	66.5	1.58E+06	1397663	66.5	0.0
Pipeline									qfield [Sm^3/d]=	8.47E+06	296439	66.5	0.0
											average p, [bara]=	66.5	0.0