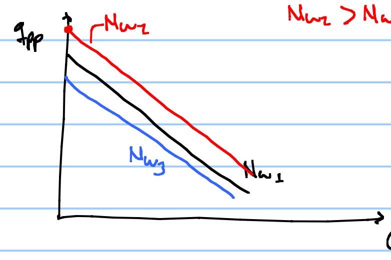
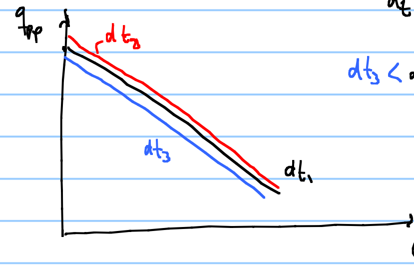
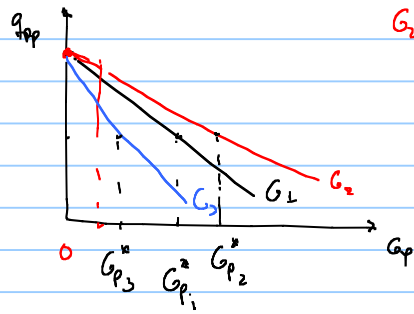
Some comments on production potential: changing nr. wells modifies the potential

d_t (tubing size)





changing G modifies the potential



$q_{plateau}$ which one gives me max $t_{plateau}$?

$$t_{plateau} = \frac{G_{p3}^*}{q_{plateau}} \quad \frac{G_{p2}^*}{q_{plateau}} \quad \frac{G_{p1}^*}{q_{plateau}}$$

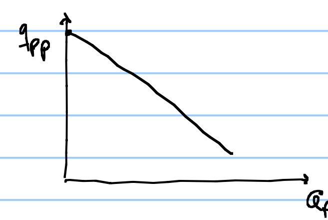
there is a big uncertainty in G during field development

- how can we use q_{pp} vs Q_p (either N or G) to estimate q_{field} post plateau?

1) Analytical derivation, if q_{pp} vs Q_p is easy to integrate

2) time-wise calculation: for each time, with Q_p^t, read in (curve / table) $q_{pp}(Q_p^t)$
   - if q_{pp}^t is greater than q_{target} then produce q_{target} and move to next time step $\Delta Q_p = \Delta t \cdot q_{target}$
   - if $q_{pp}^t < q_{target}$ then produce q_{pp}^t and move to next time step $\Delta Q_p = \Delta t \, q_{pp}^t$

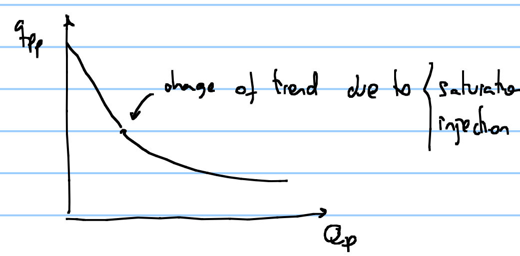
repeat



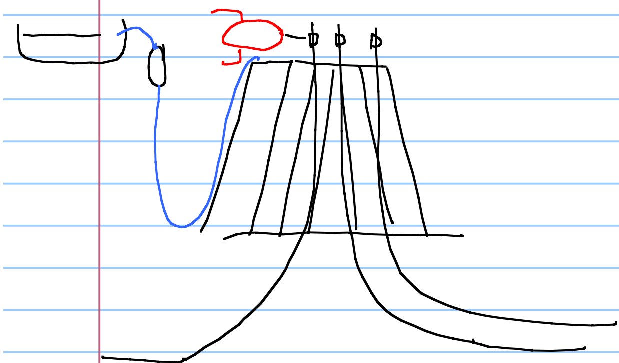
q_{pp} $y = -2.09E-04x + 5.17E+07$ (x = G_p)

time	Gp [Sm3]	qplateau [Sm3/d]	qpp [Sm3/d]	qfield [Sm3/d]
0	0.00E+00	3.00E+07	5.17E+07	3E+07
1	1.10E+10	3.00E+07	4.94E+07	3E+07
2	2.19E+10	3.00E+07	4.71E+07	3E+07
3	3.29E+10	3.00E+07	4.48E+07	3E+07
4	4.38E+10	3.00E+07	4.25E+07	3E+07
5	5.48E+10	3.00E+07	4.03E+07	3E+07
6	6.57E+10	3.00E+07	3.80E+07	3E+07
7	7.67E+10	3.00E+07	3.57E+07	3E+07
8	8.76E+10	3.00E+07	3.34E+07	3E+07
9	9.86E+10	3.00E+07	3.11E+07	3E+07
10	1.10E+11	3.00E+07	2.88E+07	2.9E+07
11	1.20E+11	3.00E+07	2.66E+07	2.7E+07
12				

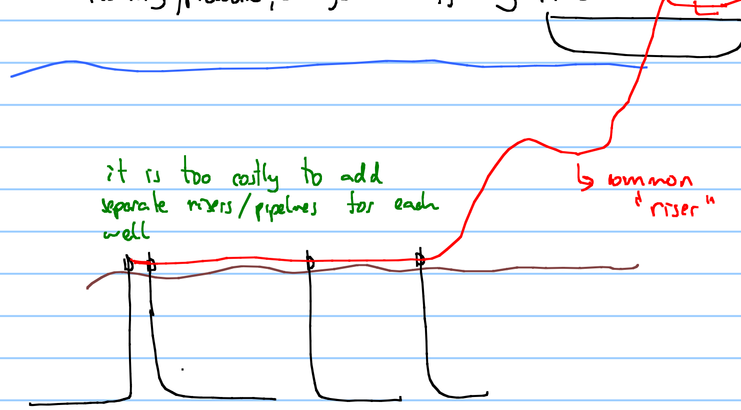
potential curves might have a non-linear behavior



Networks

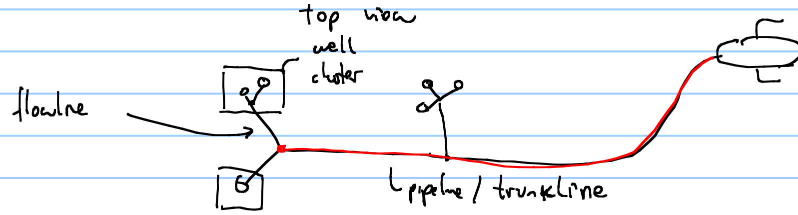


Floating, production, storage and offloading FPSO



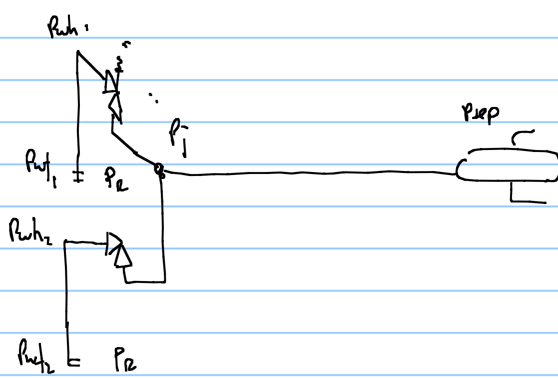
subsea gathering network

top view



each well depends / is affected by the production of other wells in the network

How to solve networks?

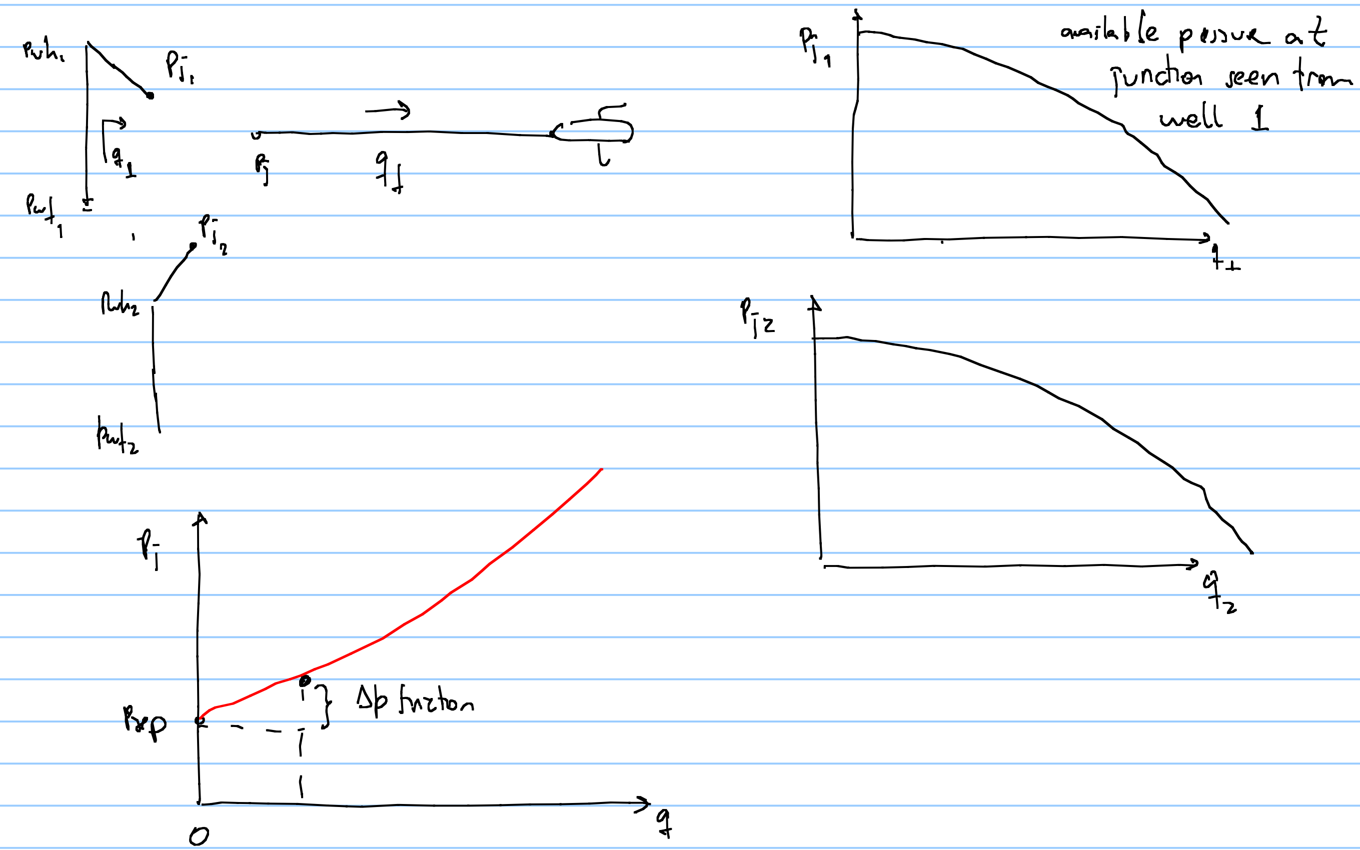


open choke

Dry gas networks

	nr. equations	nr. unknowns
IPR $q_{w} = C_R (P_R - P_{wf})^n$	2	4
TPR $q_w = C_T\left(\frac{P_{wf}^2}{e^s} - P_{wh}^2\right)^{0.5}$	2	2
FPR $q_{field} = C_{PL}(P_j^2 - P_{sep}^2)^{0.5}$	1	2
mass conservation in junction $q_f = q_{w_1} + q_{w_2}$	1	0
pressure balance in junction $P_{wh_1} = P_j$, $P_{wh_2} = P_j$ (if open choke and 1 and 2 close to junction)	2	0
	8	8

to find rates, solve this system of equations



Task 1 (9 POINTS). Calculate the operating flow rates when the chokes are fully open. Verify if the H2S concentration of the field is higher than the maximum value allowed (5.7 mg/Sm^3)

Task 2. (6 POINTS) If the H2S constraint is violated, please find an operational point that does not violate the H2S constraint (by choking one or two wells). Hint: Fix the rate on both wells. Report the pressure drop across the chokes.

$q_1 = 0.8E06$ Sm^3/d ?

$q_2 = 0.8E06$ Sm^3/d

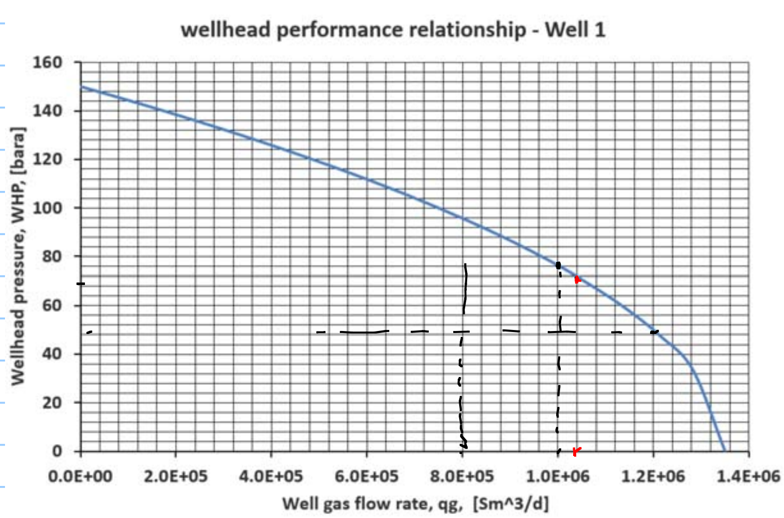
Is it possible to produce these rates?

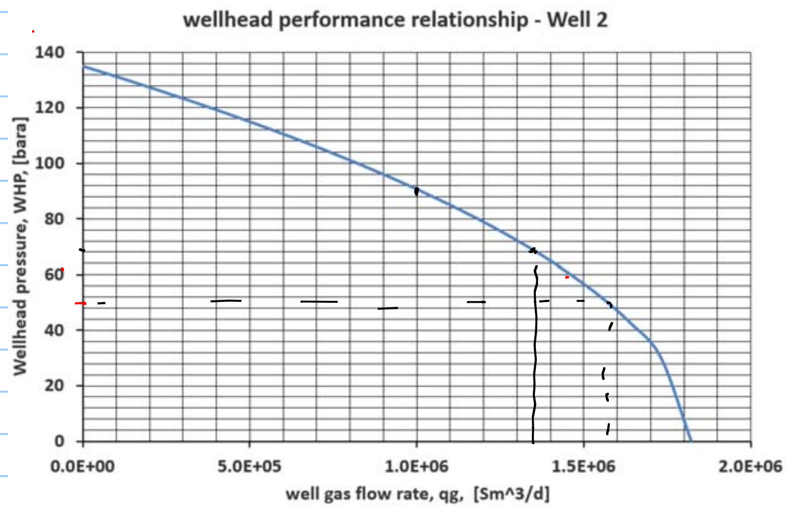
one possible option

guess $q_1 = 1E06$ Sm^3/d $P_{j1} = 76$ bara

$q_2 = 1E06$ Sm^3/d $P_{j2} = 90$ bara

$q_f = 2E06$ Sm^3/d $P_j = 54$ bara



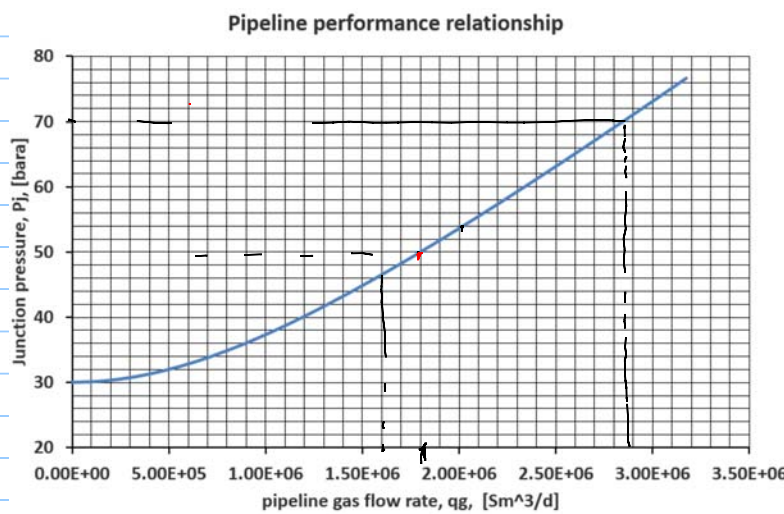


much better to iterate with p_j

$p_j = 50$ bara

$q_1 = 1.2$ E06 Sm³/d

$q_2 = 1.57$ E06 Sm³/d



$q_f = 1.8$ E06 Sm³/d

~ 1 E06 Sm³/d

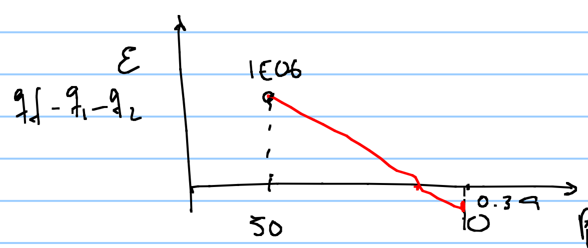
$p_j = 70$ bara

$q_1 = 1.06$ E06

$q_2 = 1.35$ E06

2.8 E06

− 0.39



$$\frac{1\text{E06} - (-0.39\text{E06})}{50 - 70} = \frac{1\text{E06} - 0}{50 - p_j^*}$$

the solution is $p_j = 64$ bara

$q_1 = 1.1$ E06 Sm³/d

$q_2 = 1.45$ E06 Sm³/d

impose rate $q_1 = 0.8E06\ Sm^3/d$

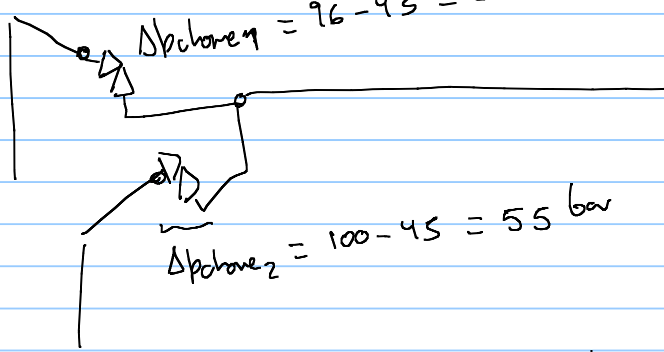
$q_2 = 0.8E06\ Sm^3/d$

calculate available pressure and required pressure at junction.

$P_{J1} = 96$ bara. $\rightarrow P_{wh1}$

$P_{J2} = 100$ bara.

$P_J = 45$ bara $\rightarrow P_{wh2}$



$\Delta p_{choke1} = 96 - 45 = 51$ bar

$\Delta p_{choke2} = 100 - 45 = 55$ bar

with depletion $P_{R1} \rightarrow P_{R2}$ the feasible area "shrinks"