

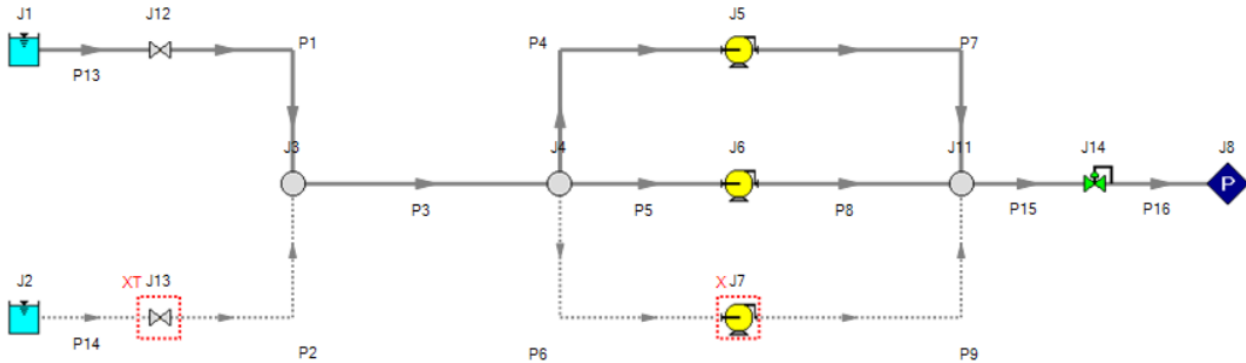
# Analysing Tank / Vessel Transfer

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# Process Situation



- Multiple tanks / vessels in parallel – can be Oil / LPG / Propane / Butane etc
- Multiple pumps taking suction from tank / vessel outlet manifold
- One of the tanks / vessels is taken isolated from pumps
  - E.g. was under maintenance or receiving off-spec oil
- Isolated tank / vessel needs to be brought online → HOW?
- Timing of opening of isolated tank outlet valve to manifold critical

# What Can Go Wrong?

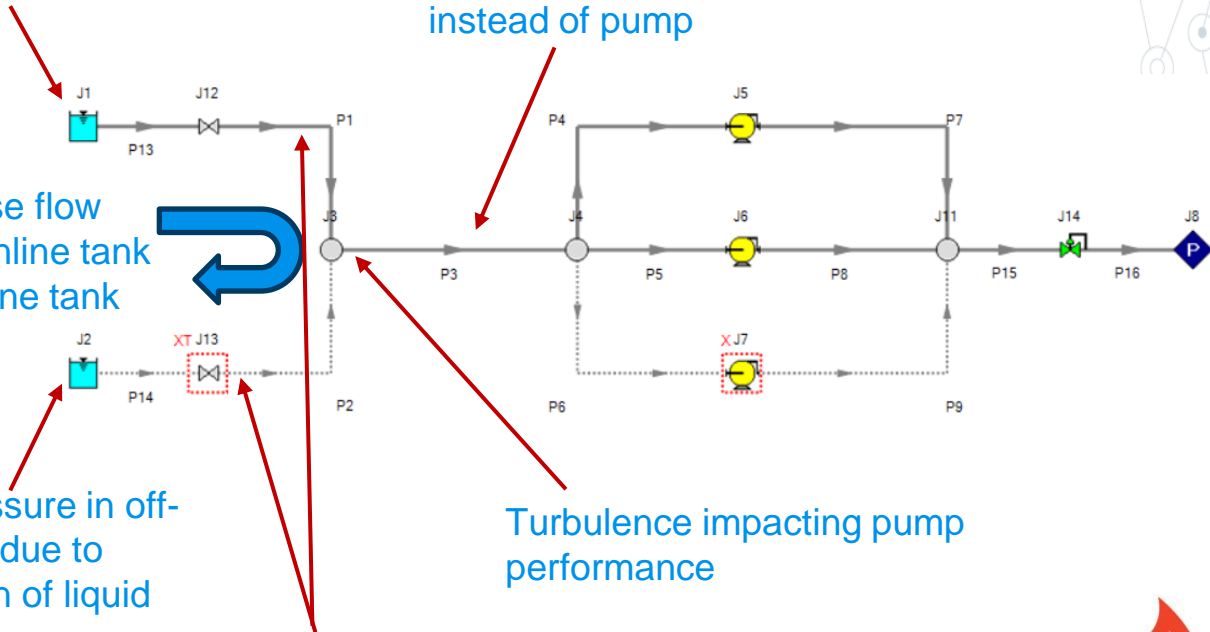
Vacuum / low pressure forms in on-line tank due to rushing out of liquid

Possible starving of pump due to flow rushing to off-line tank instead of pump

Reverse flow from online tank to off-line tank

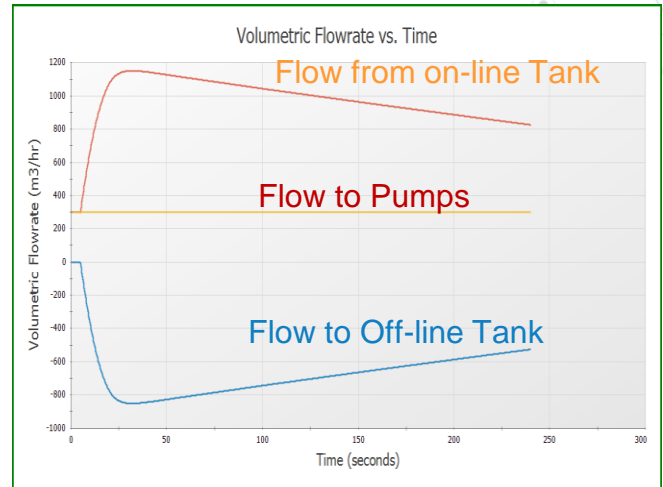
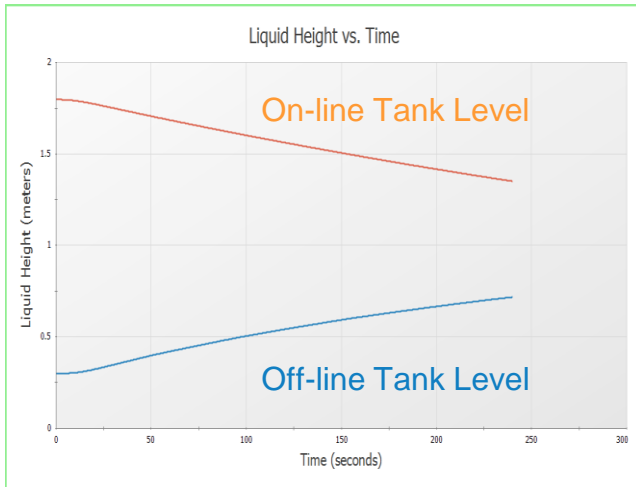
Overpressure in off-line tank due to rushing in of liquid

High velocity in lines (erosion), sloshing in vessels (foundation); transient forces



# Hypothetical AFT Impulse Model – HLL

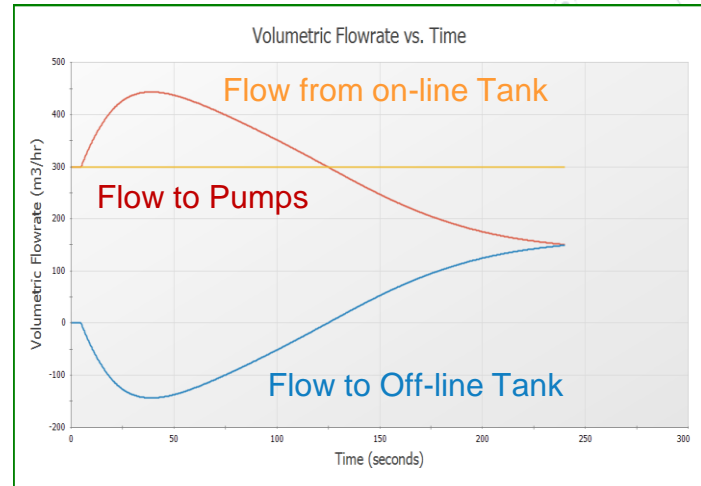
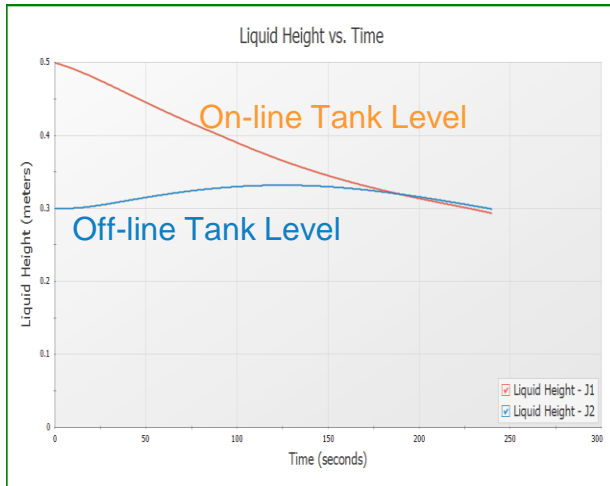
1. On-line tank at HLL; off-line tank at LLL, same pressure
2. Opening of outlet valve at 1" / second



- Flow change of ~800 m<sup>3</sup>/hr within 14 seconds → control systems may not cope that fast
- Must have a throttling valve at outlet for controlled opening / closing
- Flow to pumps not seemingly impacted
- Effect of turbulence on pump → no software can predict barring CFD
- Hydraulic models can help fix boundary conditions

# Hypothetical AFT Impulse Model – NLL

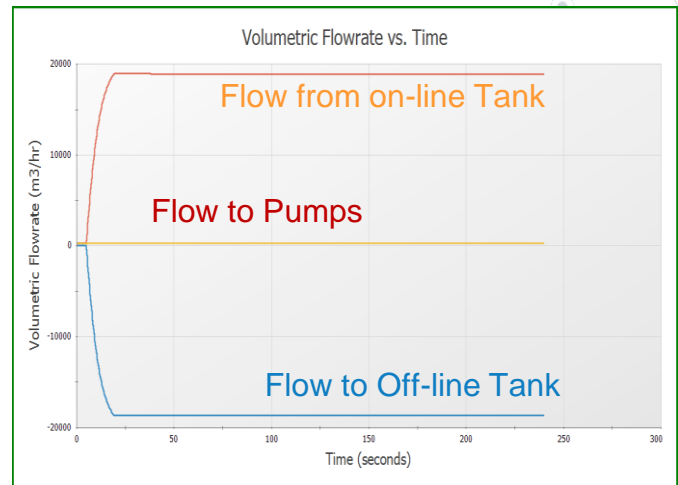
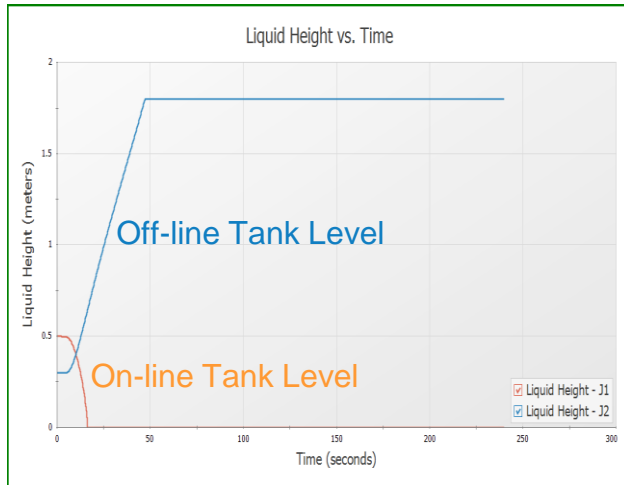
1. On-line tank at NLL; off-line tank at LLL, same pressure
2. Opening of outlet valve at 1" / second



- Quantification of performance possible with Hydraulic models
- Hydraulic transient models like AFT Impulse, PIPENET, TLNET or HYSYS Dynamics can do this
- Tank / vessel pressure, elevation and liquid levels critical
- Tanks to pump suction lengths and fittings critical

# Hypothetical AFT Impulse Model – Different Pressures

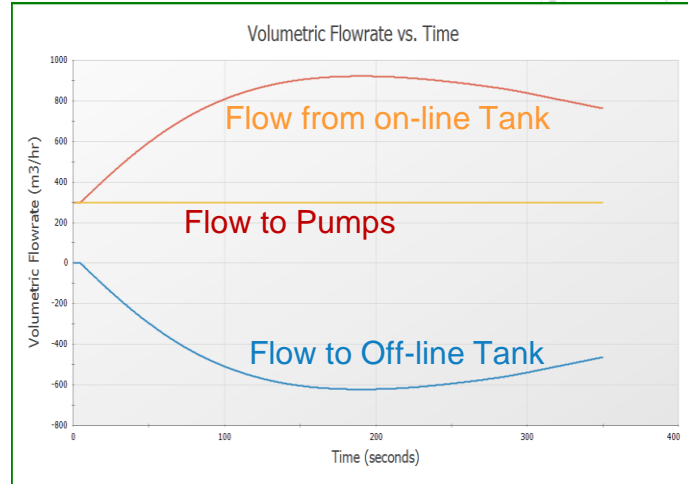
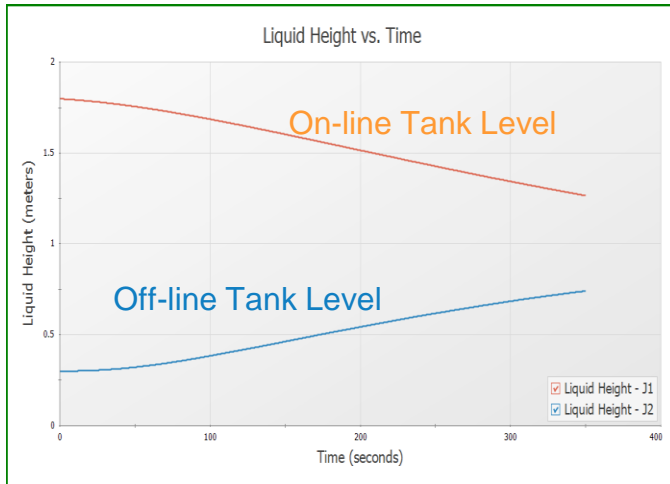
1. On-line tank at HLL; off-line tank at LLL, ~20 bar pressure difference
2. Opening of outlet valve at 1" / second



- HYSYS Dynamics can do better job of happenings at vessel / tank vapour space
- Critical to ensure pressures equalized before transfer
- Large pressure difference can impact pump performance

# Hypothetical AFT Impulse Model – Slow Opening

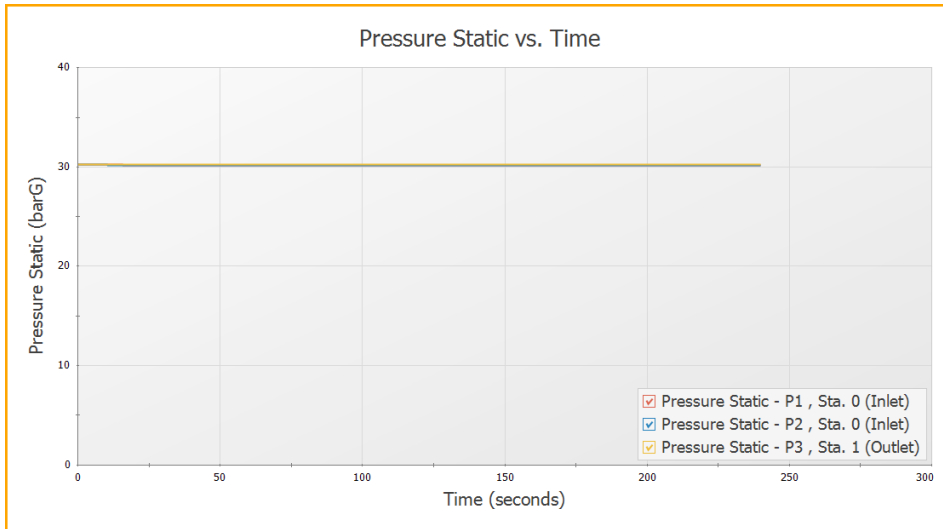
1. On-line tank at HLL; off-line tank at LLL, ~same pressure
2. Opening of outlet valve at 0.05" / second



- Magnitude of maximum flow lowered, but still peak is too high to be of comfort
- Must quantify rather than rely on “slow opening” → here 280 second opening of 12” valve at off-line tank / bullet is not adequate
- While quantifying, keep an eye on valve characteristics

# Surge predicted?

1. On-line tank at HLL; off-line tank at LLL, same pressure
2. Opening of outlet valve at 1" / second



- Big change in velocity, but still no surge pressure!
- Tried small time steps, opening of off-line tank valve in 1 second, still similar trend
- **Need to explore further → possibly presence of vapour cushioned tanks, short distances**



A decorative network diagram in the top-left corner, consisting of a complex web of interconnected nodes and lines. The nodes are represented by small circles, some of which are highlighted in blue or have a blue outline. The lines are thin and grey, creating a mesh-like structure.

*Thank you*



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