Crude Oil Tank Pressure-Vacuum Vent Damage

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Prince William Sound Regional Citizens' Advisory Council

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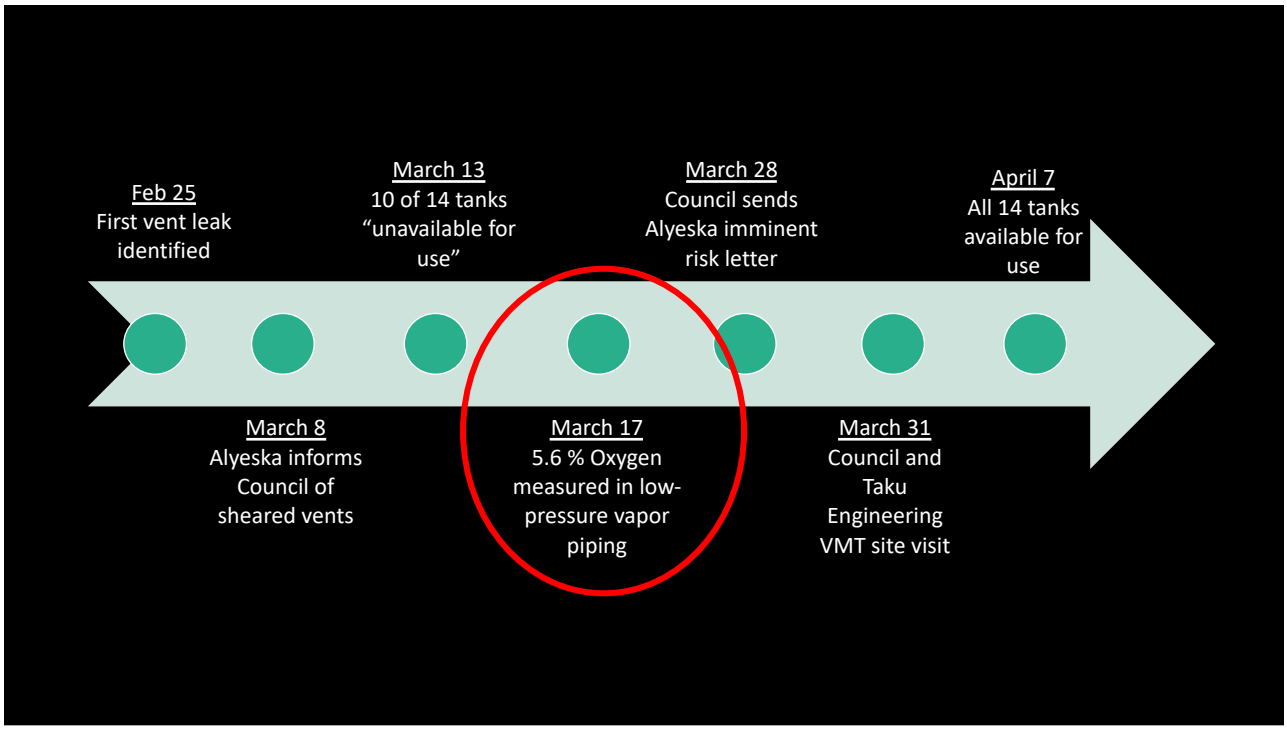

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KEY INFORMATION FROM ALYESKA (3/31/22 Meeting)

- The leaks were initially discovered through an “Olfactory Test”
  - The technician smelled hydrocarbons.
- The O_2 concentration monitoring in the Low-Pressure Vapor Header is limited to two points in the low-pressure header, one on the ETF header and one from BWT.
- Thief hatches were used to monitor the O_2 content of the tank headspaces to determine if it was safe for workers to access the tank tops for snow clearing.

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KEY INFORMATION FROM ALYESKA (3/31/22 Meeting)

- 12 pressure/vacuum pallets had been sheared off tanks (significantly damaged pallets).
- The crude tanks are normally operated at a slight positive pressure. The mode was shifted to a slight vacuum (negative pressure) once vapor leaks were discovered in a tank.
- The O_2 Concentration in the Low-Pressure Header peaked at 5.59% on March 17th 2022.

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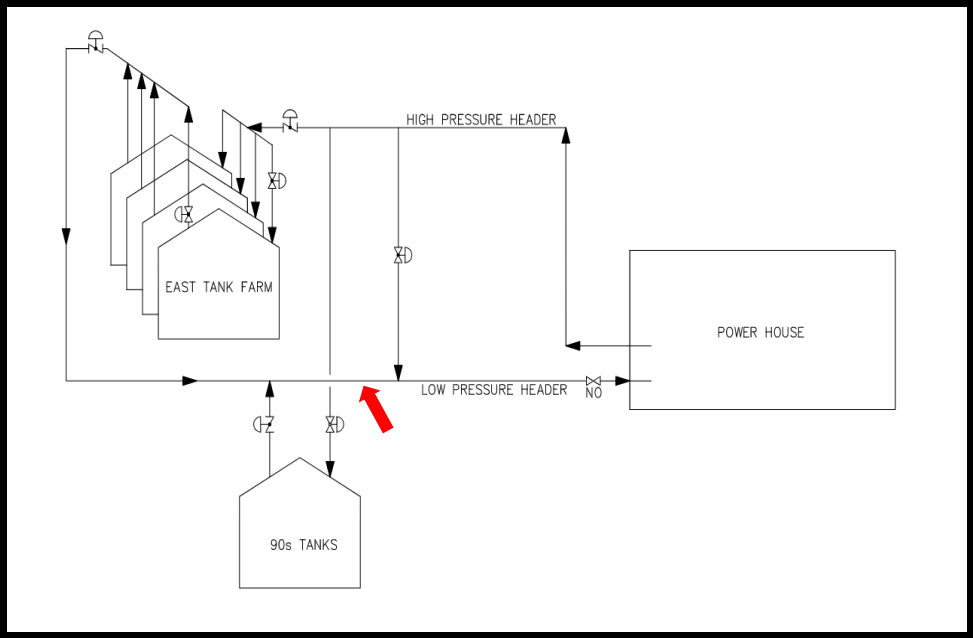

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PRIMARY KEY CONCERNS

1) The use of the "Olfactory Test" as the primary means to detect leaks in the vapor system within the East Tank Farm.
2) Elevated O_2 levels in the Low-Pressure Header should have triggered concerns over the O_2 content in the headspace of individual tanks.
3) Thief hatches were used to monitor the O_2 content of the tank headspaces.
4) Alyeska's measures to operate at a negative vacuum resulted in O_2 intake into the tank headspace, creating localized areas of the tank headspace containing a flammable gas mixture, which in the presence of an ignition source could have resulted in an accident.

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KEY CONCERN # 1

The use of the “Olfactory Test” as the primary means to detect leaks in the vapor system within the East Tank Farm.

- The sense of smell varies from individual-to-individual
- An individual may be subjected to a potentially hazardous environment in order to practice the olfactory test in the event of an upset

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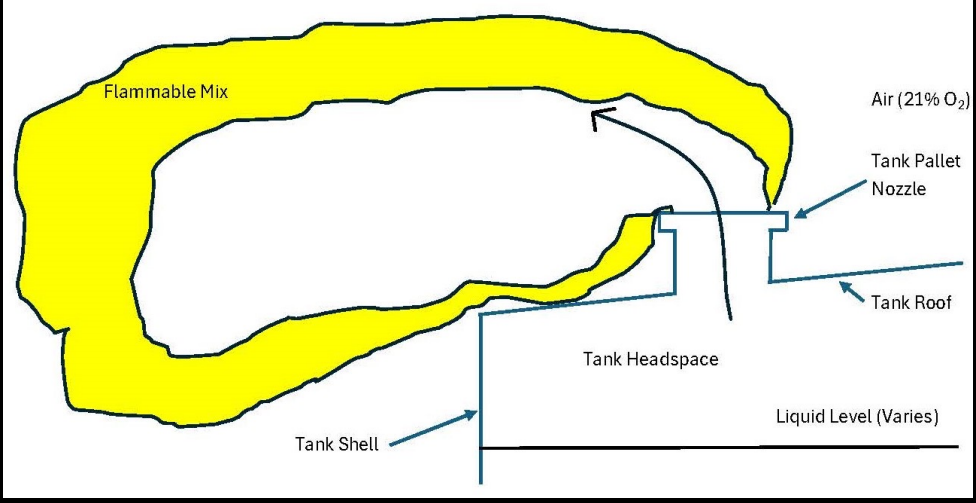

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KEY CONCERN # 2

Elevated O_2 levels in the Low-Pressure Header should have triggered concerns over the O_2 content in the headspace of individual tanks.

- The O_2 Concentration in the Low-Pressure Header peaked at 5.59 % on March 17th. While APSC noted that this was well below the alarm/actionable limit of 8% and therefore did not initiate any immediate action. Any measurable increase in the O_2 content of the Low-Pressure Header should initiate actions to ensure that each tank head space is not operating in the flammable range.
- The Low-Pressure Header normally contains blended gasses from 14 crude tanks and 2 ballast water tanks. A slight increase in the O_2 content of the Low-Pressure Header could be indicative of a significant increase in O_2 in one or more of the ETF storage tanks.

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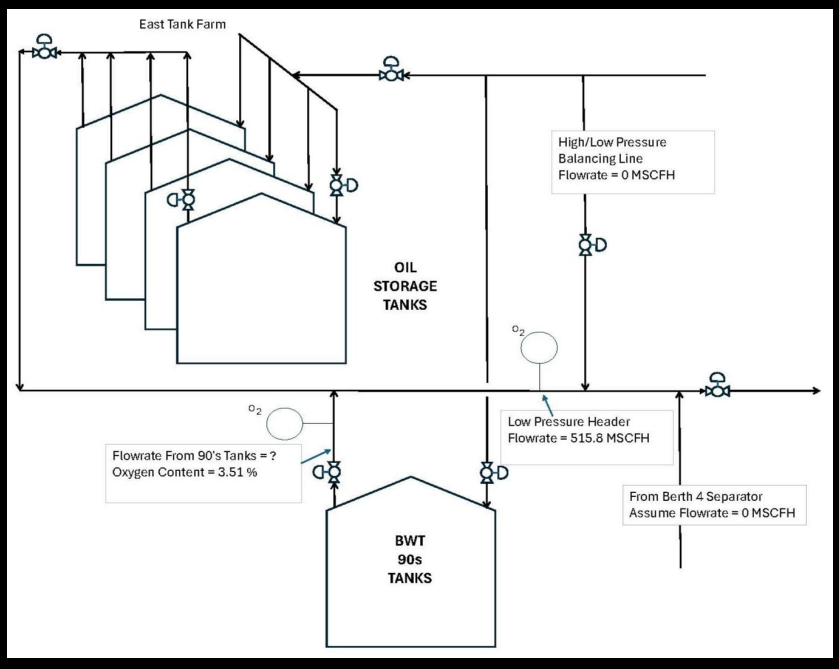

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KEY CONCERN # 3

Thief hatches were used to monitor the O_2 content of the tank headspaces.

- Tank mixing is limited to flow diverters on the vapor nozzles
- The tank headspace is not homogeneous. Use of a single point to monitor the tank headspace would not provide accurate information to make decisions needed to adequately protect tank-top workers or accurately inform them about the risks associated with this work.
- On ½ of the tanks (odd-numbered tanks), the thief hatches are located in a position that renders them unable to accurately estimate overall headspace quality.

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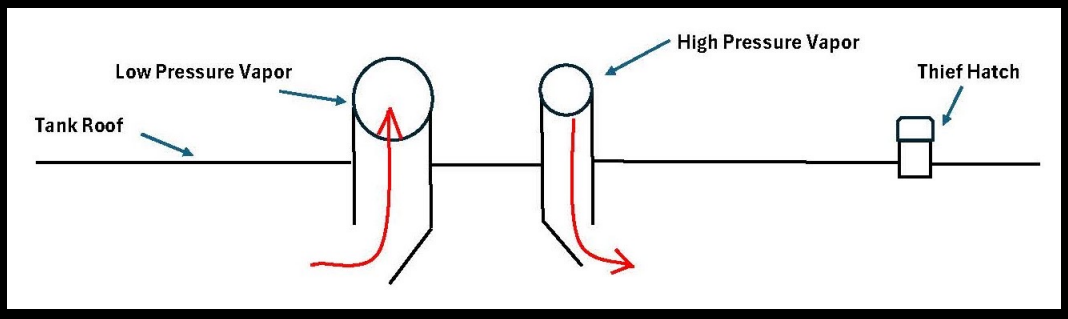

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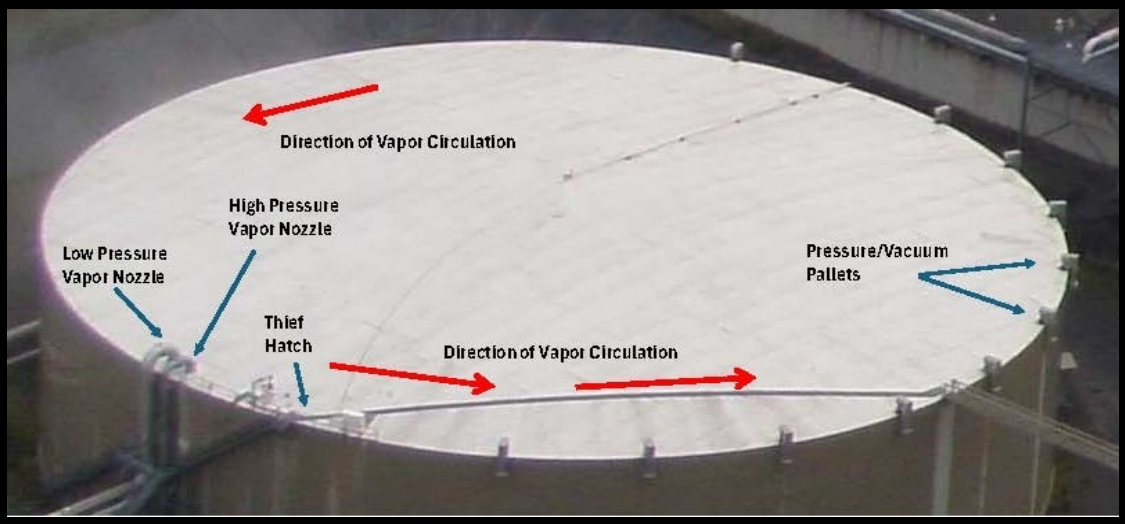

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KEY CONCERN # 4

Alyeska's measures to operate at a negative vacuum resulted in O_2 intake into the tank headspace, creating localized areas of the tank headspace containing a flammable gas mixture, which in the presence of an ignition source could have resulted in an accident.

- The crude tanks are normally operated at a slight positive pressure. The mode was shifted to a slight vacuum (negative pressure) once vapor leaks were discovered in a tank.
- In my professional opinion, once the tank operating mode was shifted to a slight vacuum in the headspace, localized areas of the headspace near the significantly damaged pallets contained a flammable gas mixture.

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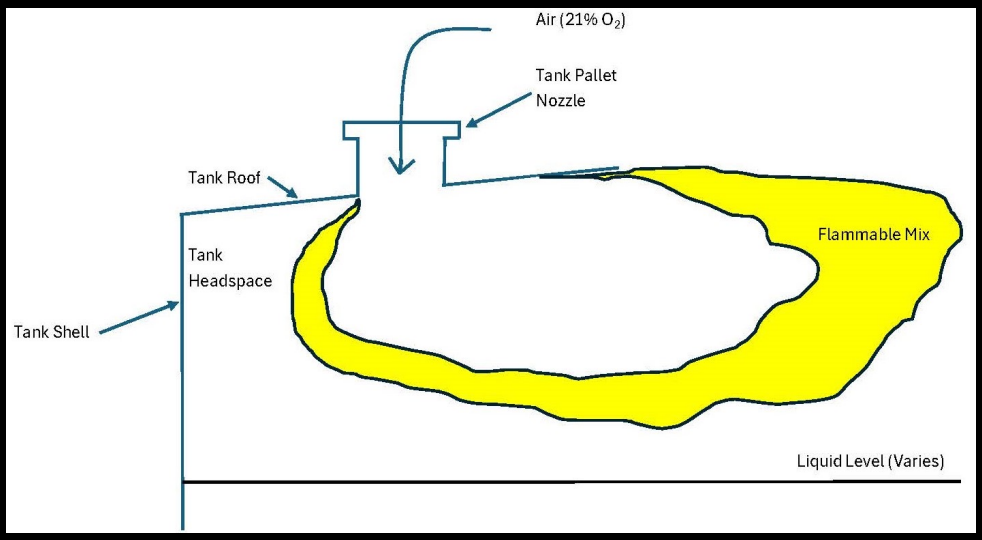

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TAKU RECOMMENDATIONS

- More oxygen monitoring locations are needed in the vapor system.
- No single access point should be used to monitor the headspace quality.
- Fixed Forward Looking Infrared Camera monitoring systems should be installed to monitor the tank vapor system for leaks.
- Alyeska should work closely and openly with Council to better model the vapor system.
- Lessons learned should include a clear definition of the risk of a flammable headspace and technically-informed hazard communications to the workers.
- Alyeska should conduct an open lessons learned assessment, soliciting Council participation.

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QUESTIONS?

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