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RE: Safety Analysis of Proposed California Air Resources Board's (ARB's) Vapor Recovery Requirements under the Draft Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Operations

Background

I received a request from WSPA to review the vapor recovery requirements proposed in Sections 95668 (b) and 95671 under the Draft Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Operations and provide a professional review on its impact on safety. The options presented and reviewed were as follows:

- Capture and utilize vapors
    - Introduce vapors from circulation tanks into a "fuel system".
    - Introduce vapors from circulation tanks into sales gas system.
- Combustion of vapors
    - Introduce vapors from circulation tanks into a flare.
    - Introduce vapors from circulation tanks into an incinerator/furnace.

I have reviewed the proposed options and the following presents the basis of analysis, risk assessment and my conclusion.

Basis of Analysis

Tools utilized for the basis of analysis are sound and proven in the safety profession. These tools are utilized to ensure personal biases do not skew the data or facts and this analysis is based on tolerable risk criteria. The overlaying tool utilized in this report is "Risk Vs Benefit". Simply put the benefit of any action should outweigh the risk taken. The action taken should increase or better a situation. If the action taken decreases benefit or introduces additional or intolerable risk, then the action should not be undertaken and be reconsidered until a better process can be defined or developed.

There are many applications when using the "Risk Vs Benefit" tool so the parameters of analysis should be defined before starting, however all "Risk Vs Benefit" analysis is judged on the "Hierarchy of Safety" of risk:

- First – Risk to and Safety of People (workforce / public).
- Second - Risk to and Safety of the Environment.

For the purposes of this analysis, risk will be identified in the following categories:

- Intolerable Risk – Not in line with accepted safety practices or cannot be managed safely.
- Tolerable Risk – Risk that can be managed using current safety practices however increases additional risk not in place before. It must be noted that even with safety process in place, risk remains and therefore there is a potential for incident.

Risk Analysis

Intolerable Risk

Capture and Utilize Vapors

The major cause of accidents in the oil & gas industry is fire. There are numerous flammable & inflammable fluids & solids present in the oil & gas facilities, which can ignite to cause fire.[i] The vapors from circulation tanks are expected to contain high amounts of oxygen. The regulatory requirement to capture these oxygen-rich vapors from circulation tanks and introducing them into a closed fuel/sales system poses intolerable risk of fire and potentially disastrous results. This control option is against all process and safety engineering practices[ii].

This can be further understood by reviewing the basics of fire. The concept of fire can be well understood and explained using a simple model called the Fire Triangle. The three factors contributing to cause a fire are: Fuel, Oxidizing agent (Oxygen) & Heat. A fire is caused if all the three factors are present in mixture in the required concentration. Reverse is true for stopping the fire to happen i.e., if any one of the factors are eliminated or the concentration of any one can be kept below the required level then fire can be eliminated[iii]. In the Oil and Gas industry, it is a standard practice to eliminate oxygen from the process streams to eliminate any potential for explosion to occur.

Flaring or Incineration of Vapors

The technologies we have evaluated so far are still in the process of being proven, and process hazards and risks still need to be evaluated and not oversimplified. When some of these technologies have been tested in real life situations we will also need to evaluate the work process against OSHA regulations to ensure they comply process safety management practices[iv].

Flaring or incineration of vapors would require some method of pulling the vapors from the circulation tank due to the very low volume of gas returned during the clean out phase[v]. Operators would have to use a compressor for this purpose. However, due to the high volume of oxygen in the vapors from the circulation tanks, the compression equipment would cause an extreme hazard and risk.

Bladder technology is unsafe because the concept of transporting a partially charged bladder tank is both unsafe and is a violation of Department of Transportation, Title 49 Subchapter C—Hazardous Materials Regulations.

Tolerable Risk

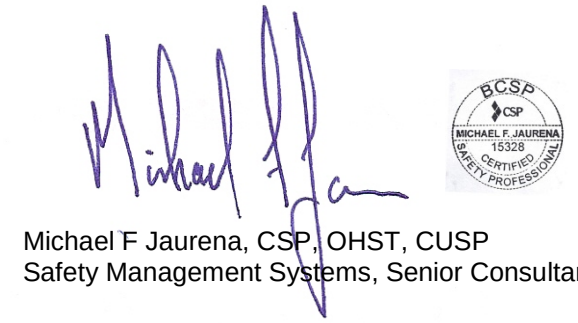
Flaring or Incineration of Vapors

- Due to the increased amount of equipment for the vapor recovery and flare system, a larger footprint would be necessary at the well location. However, many locations are very tight or have limited spacing. As such, vehicle traffic will increase to move equipment more frequently.
- The increased amount of process equipment due to the flaring or incineration process will increase vehicle traffic and the use of transportation equipment. This will also increase the emissions from the diesel combustion and increase the risk for incidents due to increased volume of traffic. The increased traffic risk can be managed (however not eliminated).
- Due to the increased process equipment, additional manpower, lifting, mobilization, and maintenance will be required leading to increased operational concerns. Again, while these processes can be managed it increases the potential for incidents.

Conclusion

The potential safety risks associated with the proposed control options on circulation tanks is grossly disproportionate to the emissions benefit of the proposed ARB regulation. Even where risk can be

managed, the total increased risk to the safety of people is not consistent with sound safety practices of protecting people over the environment. In this case, the proposed regulation increases both the risk to people and ultimately increases the total emissions to the environment.



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[i] http://www.piping-engineering.com/fire-and-explosion-in-oil-gas-industries-and-related-qas.html
[ii] HERSEY, M. D. (1924), A STUDY OF THE OXYGEN-OIL EXPLOSION HAZARD*. Journal of the American Society for Naval Engineers, 36: 231–243. doi:10.1111/j.1559-3584.1924.tb05446.x
[iii] http://www.piping-engineering.com/fire-and-explosion-in-oil-gas-industries-and-related-qas.html
[iv] https://www.dir.ca.gov/Title8/5189.html
[v] http://www.wspa.org/sites/default/files/uploads/Recirculation%20Tank%20Testing%20Report%201-29-16_Clean.pdf