Vapor Recovery Unit Capture/Control Guidance

There has been some concern regarding the appropriate capture efficiency to claim for Mechanical Vapor Recovery Units (mVRUs). In response to this concern, the TCEQ has established the following guidance to appropriately account for emissions from mVRUs. This guidance is intended to be a guideline for applicants on how to represent their respective capture efficiency for mVRUs. Furthermore, applicants are required to provide a thorough explanation of how their mVRU satisfies the agency's concern regarding the varying capture efficiencies attainable.

Control Efficiency Requirements:

This section explains what percentage of control efficiency can be claimed for mVRUs and the requirements associated with each percentage claimed. It should be noted that there is also more explanation in the Discussion section as to why these requirements are important. It should also be noted that mVRU on-line time must be considered when emission estimates are calculated. Any claimed control efficiency can only be claimed for periods when the mVRU is on-line; the claimed control efficiency cannot be claimed during the off-line time. This is also discussed in more detail in the Discussion section.

Requirements for Claiming Up to and Including 95% Control Efficiency:

In order for an applicant to claim 95% capture efficiency for an mVRU the applicant must satisfy the basic design requirements by providing detailed explanation and supplemental information as needed if the following questions are answered in the affirmative.

1. Is the mVRU designed to capture vapor?
2. Is there sensing equipment which enables the applicant to know that the mVRU is capturing vapor(s) at peak intervals? An example is a pressure sensor, which senses the pressure of the vapors in the tank and communicates to the mVRU compressor to turn on, meaning to start drawing suction on the tank.

No monitoring/recordkeeping is required. A vendor data sheet or some other supplemental information needs to be included in the permit application to show that the basic design requirements are met.

Requirements for Claiming Over 95% Control Efficiency up to and Including 100% Control Efficiency:

In order for an applicant to claim 100% capture efficiency for an mVRU the applicant must satisfy additional design requirements and monitoring/recordkeeping requirements such as those that are listed below by providing detailed explanation and supplemental information as needed if the following questions are answered in the affirmative. Starting at 95%, assuming the basic design requirements listed above are satisfied, one additional percentage can be claimed for each additional design requirement, up to 99% control efficiency. In order for 100% control efficiency to be claimed, monitoring/recordkeeping must be done.

It should be noted that the design requirements listed below are the general elements that allow an mVRU to function most efficiently. It is possible that certain mVRUs function differently, meaning that there are different design requirements that allow the unit to function efficiently or the design of a unit is such that the need for a certain design requirement is eliminated. Therefore, an efficiency percentage can be claimed if it is explained why a certain design requirement is not needed for the mVRU to maintain its claimed control efficiency.

1. Is there any additional sensing equipment associated with the mVRU that enables greater efficiency or control? Additional sensing equipment could consist of more of the same sensor type to ensure redundancy or varying sensor types to provide more information about the mVRU system and the units under control. These sensors shall include, but are not limited to, pressure sensors, flow meters, motion sensors or alarms, and temperature sensors. All sensing devices associated with maintaining claimed control efficiency must be able to cause appropriate responsive action. For example, sensors could be set up throughout the process in order to communicate to the mVRU when there is a reason to re-direct streams or close off streams, such as in the case of a tank with a leak.
2. Is there an appropriately designed bypass system which operates automatically and re-directs streams as needed? By re-direct streams as needed, this means that discharge volume is routed back to the inlet of the mVRU until the appropriate pressure is built up for the compressor to turn on, eliminating the possibility of a vacuum. It also means that if the mVRU fails, the controlled stream(s) will be re-routed to another control device or to atmosphere as designed. Furthermore, if one out of multiple controlled units fails, the mVRU will still be able to capture the stream(s) from other controlled unit(s) because the failed unit stream will be re-directed appropriately, eliminating the possibility of a vacuum. If there is only one controlled stream, the mVRU should turn off if the controlled unit fails. The vacuum occurs when back-pressure is not maintained, meaning that the pressure is lower on the inlet side to the VRU and higher on the outlet side, which does not facilitate the movement of gas, and thereby creates a hazardous condition.
3. Is there a system in place to ensure that no oxygen is allowed to be pulled into the system, such as a gas blanketing system?

4. Is a sufficient compressor capable of recovering both wet and dry gas used in conjunction with the mVRU? Is the compressor capable of varying the operating speed of the compressor to respond to conditions of varying environmental and operational conditions?
5. Continuous monitoring/recordkeeping is required in order to demonstrate that the mVRU is maintaining its claimed control efficiency. Also, a vendor data sheet or some other supplemental information needs to be included in the permit application to show that the basic and additional design requirements are met. The following are some examples of monitoring/recordkeeping that could be done to show that the the mVRU is maintaining its claimed control efficiency:
    a. If a pressure trigger is used to start a compressor to direct gases to the product line, a continuous pressure recording showing the pressure in the tank that would cause the gas to escape to the atmosphere through a pressure relief valve or hatch was never exceeded.
    b. If a tank is hard piped to the product line through a compressor and the only atmospheric relief is through a pressure relief valve on the tank, a continuous monitor recording on the valve position indicating that it never opened.
    c. The date and time that all tank hatches and relief valves are noted to be sealed and that they were resealed after each intentional opening.
    d. The date and time that that a periodic check was conducted of the controlled vessel and control device noting no holes, worn seals, or other defects are present that would allow an uncontrolled release to the atmosphere

For applicants wishing to opt-out of the recordkeeping requirements, control efficiency up to 99% may be claimed. As stated above, for each additional design requirement satisfied the applicant may claim 1% greater than the 95% capture efficiency achieved.

Discussion

One of the greatest concerns the agency has regarding mVRUs is the simple assurance that the unit will capture vapor(s) at optimum and appropriate times. Optimum and appropriate times are defined as periods when the unit being controlled is at the appropriate capacity to ensure that the mVRU is able to perform most efficiently at capturing vapor(s). The importance of ensuring capture at optimum and appropriate times is to ensure that the mVRU is sized appropriately to handle even the worst-case operating conditions. Additionally, if the mVRU is allowed to draw suction during inadequate periods there is the potential for damage to occur to the source under control.

To satisfy this concern the agency recommends the use of sensing equipment to ensure capture is both achieved and at the time of highest potential emissions. This sensing equipment should include, but is not limited to, devices specifically designed to record the information necessary to ensure that the mVRU is efficiently capturing vapor(s) from the source being controlled during optimum and appropriate times.

Another issue of concern is the assurance that the mVRU is appropriately sealed during periods of vapor capture but with the ability to bypass this seal when necessary. A properly designed bypass system is defined as a system designed to ensure that for periods when the source is being controlled there is consistent back pressure maintained. This ensures that the system is a closed loop, meaning that the unit can draw suction without leaks. Additionally, this bypass system is integral in ensuring that the controlled volume can be discharged appropriately. For example, if a vessel containing recoverable vapors is captured by an mVRU,an appropriate bypass system would allow for the captured vapor to be rerouted to either another capture/control device or to the atmosphere.

An additional concern the agency has is with the danger of tank implosion or explosion. For that reason the agency recommends the use of a gas blanketing system. An appropriate gas blanketing system ensures that no oxygen is allowed to be pulled into the system, which could potentially result in the fouling of the system or damaging of the controlled source.

Lastly, the agency has determined that the type of compressor used with an mVRU is important in determining the overall efficiency of the mVRU. The ability to effectively handle wet gas (containing oil/water that could condense to a liquid) is essential in this application. Furthermore, variations in pressures, temperatures, and volumes can occur multiple times within a tank resulting from seasonal temperature changes or changes in production. Therefore, having the capability to vary the operating speed of the compressor to respond to these changes is essential in capturing vapors under all operating conditions. This requirement goes hand in hand with the capturing of vapors at peak intervals. Hence, in order to ensure peak interval capture, the ability to vary the operating speed of a compressor to effectively capture said vapor is crucial to mVRU efficiency. For this reason, electrical driven compressors are preferred. If however, an electric compressor is not employed it is important that an applicant address how this mVRU will effectively capture vapor during peak interval and during varying environmental or production changes.

While it may seem difficult that the ability to be able to claim a 100% mVRU capture efficiency consider the following example. This example is meant to be a brief summary of how 100% mVRU control efficiency can be claimed; however, please see the “Control Efficiency Requirements” section for more details about what is required. If an applicant has an appropriate mVRU that has been proven to capture vapor through the use of sensing equipment an applicant can claim 95% capture efficiency. With the addition of an appropriate bypass system an applicant can claim 96% capture efficiency.

Add in an electrically driven compressor with the ability to vary operational speed to respond to changes in pressure, temperature, and volume, an applicant could claim 98% capture efficiency. The applicant would receive 1% for the compressor choice and 1% for ensuring capture at peak intervals through the use of further sensing equipment. If the applicant then addresses the concern of oxygen ingress then an applicant could claim 99% capture efficiency. Lastly, the agreement to maintain records ensuring sufficient design requirements have been met and that the operations necessary to ensure appropriate device operations are satisfied (i.e. tank hatches closed, relief valves sealed) an applicant could claim 100% capture efficiency.

An issue left to be addressed is how to account for periods of mVRU maintenance. Routine maintenance is often required regardless of compressor selection. For example, wet gas tends to foul the valves and seals in reciprocating compressors. Furthermore, as condensate falls out in the crankcase it can compromise the lubricating oil, resulting in component failure. For these reasons, reciprocating compressors are often most effective in dry gas (absent of condensate) applications, but ultimately are found to be unreliable for mVRU service. This is why it is important that an applicant account for inefficiencies inherent in the compressor. The applicant should provide an explanation about how maintenance is done to keep the compressor in good working order, allowing the mVRU to achieve its claimed control efficiency. Emissions from the engine should be accounted for as a separate emissions point (to account for fuel combustion emissions) and/or as fugitive emissions (to account for emissions from associated fugitive components).

At this time, the agency feels that on average applicants routinely spend 5% of a year's time performing maintenance procedures on mVRUs or facilities controlled by an mVRU. With that said the agency feels that applicants should account for this period of emissions as an alternate operating scenario. This period of time does not need to be the full 5% of the year. An applicant may in fact use far less time but the agency will not accept that maintenance operations are not performed. This downtime for maintenance will not affect the claimed capture efficiency of the mVRU only the amount of time the facilities will be under control in a given year. For example, if an mVRU is used to control a series of tanks and the mVRU has a control efficiency of 98% then the remaining 2% of the emissions should be accounted for at the tank. Additionally, this mVRU is down for maintenance for 2 weeks out of the year which equates to roughly 4% of the year. The tanks are not controlled during this 2 week period and are vented to the atmosphere. Therefore, there are two operating scenarios: the normal operating scenario and the alternate operating scenario. For the normal operating scenario the tanks emit 2% of emissions for 50 weeks, or 96% of the year, and for the alternate operating scenario the tanks emit 100% of emissions for 2 weeks, or 4% of the year. Hence, both scenarios should be reflected within the emissions summary table as emissions from tanks.