The complete journal-edited version of this article was published in the Oil & Gas Journal (April 14, 2003 issue)

Vapor-Recovery Unit Passes South Texas Field Test

Introduction and Background

Approximately 252,000 natural gas production wells and 575,000 crude oil wells exist in the United States. Most of these operations produce large volumes of relatively low-pressure vent gas from different process equipment. According to two separate Environmental Protection Agency (EPA) methane emissions inventory estimates, about 30 billion cubic feet of CH_4 is annually vented from crude oil storage tanks [1, 2]. This is the most significant source of vented emissions from the production sector, representing between 35 and 44 percent of total emissions. A large fraction of the gas is CH_4 (30 to 60 percent) and the remaining gas species include non-methane organic compounds and hazardous air pollutants (HAPs). Depending on the site's size and emission potential, the low-pressure gas can be either disposed of (vented or flared), or recovered and used.

Disposal options are relatively easy to implement and can reduce hazardous and toxic air pollutants. However, disposal options do not make use of the high energy content associated with the gas, they produce large volumes of greenhouse gas (GHG) and other emissions, and when flared, the aesthetic quality of communities is lowered. Many sites use vapor recovery units (VRUs) to capture hydrocarbon vapors that normally vent from production area oil storage tanks. A booster compressor pressurizes the recovered gas and supplies it to a natural gas sales pipeline. VRUs are most often used when the recovered gas can be sold for the value of CH_4 (natural gas) and other hydrocarbons in the vapor.

COMM Engineering, USA, located in Lafayette, Louisiana, requested that the GHG Center perform an independent verification of their Environmental Vapor Recovery Unit (EVRU) at a gas and condensate production facility operated by TotalFinaElf E&P, USA, Inc. near McAllen, Texas. The EVRU collects low-pressure vent gas from the site's condensate storage tanks. The recovered gas is pressurized and injected into a natural gas pipeline for sale. The EVRU verification test quantified vent recovery rate, emission reductions, total installed cost, and annual gas savings.

The test was conducted in partnership with Environmental Protection Agency's (EPA) Natural Gas STAR Program, which is managed by the EPA Office of Air and Radiation under a partnership between EPA and the oil and natural gas industry. The program maintains a membership of over 90 partner companies, which are committed to implementing cost-effective CH_4 reduction technologies. The EVRU verification test was executed to provide objective performance data to this industry group, as well as to the GHG Center's Oil and Gas Stakeholder Group.

Technology Tested

The EVRU is a non-mechanical eductor or a jet pump that captures low-pressure hydrocarbon vapors. It requires high-pressure motive gas to entrain the low-pressure vapors emanating from condensate storage tanks. The combined discharge gas stream exits at an intermediate pressure, which can be used on site as fuel or re-pressurized with a booster compressor and injected into a natural gas transmission line for sale. It is a closed loop system designed to reduce or eliminate emissions of greenhouse gases (CH_4 and CO_2), volatile organic compounds, HAPs, and other pollutants present in vent gas.

Figure 1 shows a schematic of the EVRU. The core element is an eductor system which operates on the venturi principle. The EVRU contains flow safety valves, flow control mechanisms, pressure sensing, and temperature sensing devices which allow the system to operate under varying vent gas flow rates. Pressure and temperature isolating valves (not shown) are also installed in the motive gas line to allow replacing or repairing EVRU components.

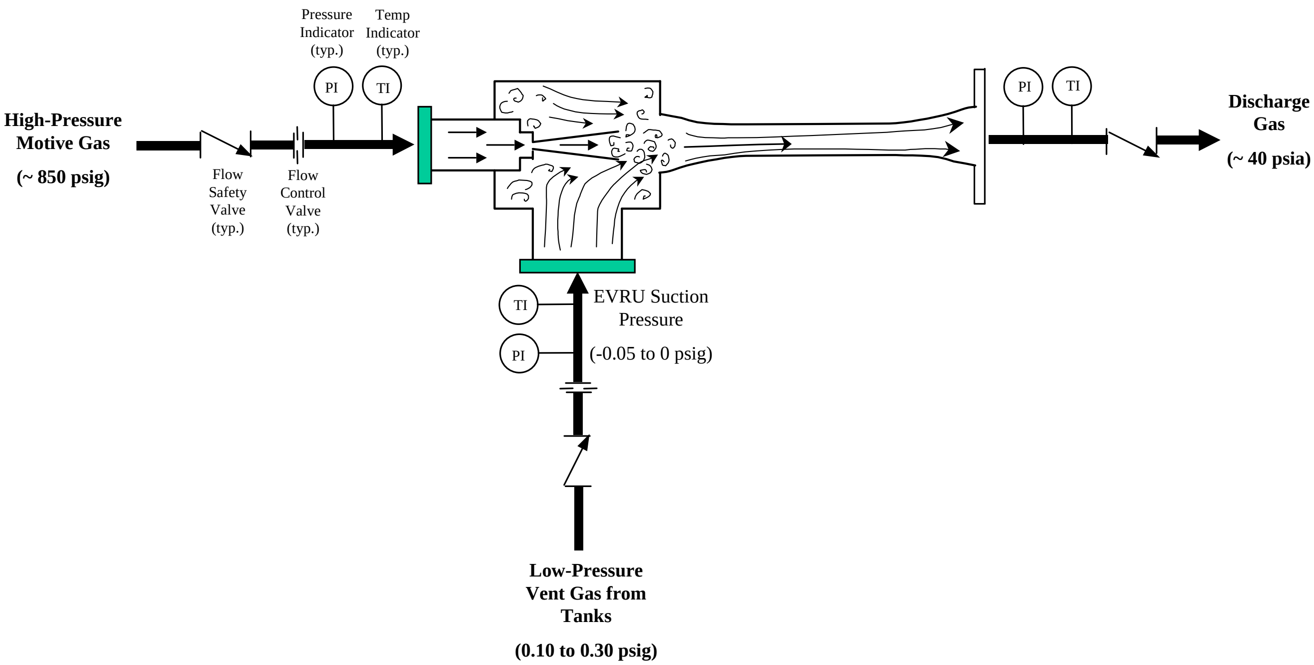

Figure 1. Schematic of the COMM EVRU

Performance Verification

The verification approach that was developed for the test included the following parameters: gas recovery rate, annual gas savings and emissions reductions, value of recovered gas, and total installed cost.

If the recovered gas was vented to atmosphere instead, the recovery rate integrated over one year represents annual gas savings. The amount of GHGs and HAPs in the vent gas multiplied by the annual gas savings represents the emissions reductions. The lower heating value of the volume of gas recovered annually multiplied by the market price at the time of the test yields the value of the recovered gas. The total installed cost is the sum of the capital equipment, accessory items, and labor costs.

Verification Results

Performance testing showed that the average vent-gas recovery rate for the testing period was 175 Mscfd. Annual gas savings amounted to 64 MMscf/year when compared with no recovery system in place, and amounted to 6.4 MMscf/year when compared with the facility's existing vapor recovery unit. Annual reductions of methane, HAPs, and other hydrocarbons amounted to 32.1, 1.5, and 30.1 MMscf/year, respectively, when compared with no recovery system in place, and were 3.2, 0.2, and 3.0 MMscf/year, respectively, when compared with the existing vapor recovery unit. The value of the recovered gas was estimated to be approximately $350,000. The total installed cost of the EVRU was approximately $108,000. Complete verification results for this test are available for free on two websites: www.sri-rtp.com and www.epa.gov/etv.

References

[1] *Methane Emissions From the U.S. Petroleum Industry*. EPA-600/R-99-010, Environmental Protection Agency, Office of Research and Development, Research Triangle Park, NC. February, 1999.

[2] *Estimates of Methane Emissions From the U.S. Oil Industry (Draft).* ICF Kaiser International, Inc., Fairfax, VA. November 1997.

About the Authors

David A. Kirchgessner has been a senior research scientist for the U.S. Environmental Protection Agency's Office of Research and Development in Research Triangle Park, NC for 29 years. The last 11 years have been spent on research directed toward the quantification and mitigation of greenhouse gases from the fossil fuel industries. Mr. Kirchgessner received a bachelor's degree in economics and a master's degree in geology from the University of Buffalo. He also holds a PhD in geology from the University of North Carolina and a master's degree in public health administration. He is a registered professional geologist in North Carolina.

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The Greenhouse Gas Technology Center is one of six verification organizations established by the U.S. Environmental Protection Agency's Office of Research and Development as part of its Environmental Technology Verification program. This program facilitates the deployment of new technology through voluntary performance verification and information dissemination. The Center conducts third-party verification testing of promising greenhouse gas mitigation and monitoring technologies. The Greenhouse Gas Center's verification process consists of developing verification protocols, conducting field tests, collecting and interpreting field and other data, obtaining independent peer-review input, and reporting findings.