Reduce Natural Gas Venting with Fewer Compressor Engine Startups & Improved Engine Ignition

Technology/Practice Overview

Description

Compressors driven by internal combustion engines are often equipped with gas expansion starters. Pressurized gas is expanded across the starter turbine spinning the engine and initiating the startup. The discharge header of the compressor is typically vented to the atmosphere so the compressor is unloaded before the engine is started. The gas used to turn the starter turbine is also vented. Starter gas may be either high-pressure natural gas stored in a volume tank, or pipeline gas diverted to the starter. In either case, the starter and header gas are usually vented to the atmosphere.

Reducing the frequency of compressor startups avoids blowdowns and therefore reduces the volume of gas vented to the atmosphere with each startup. Poorly maintained ignition systems increase the incidence of failed engine starts and can

■ Compressors/Engines
□ Dehydrators
□ Directed Inspection & Maintenance
□ Pipelines
□ Pneumatics/Controls
□ Tanks
□ Valves
□ Wells
□ Other

Economic and Environmental Benefits

Methane Savings - Reduced frequency of compressor starts

Estimated annual methane emission reductions	*581 Mcf per compressor* [1]

[1] *Assumes 4.4 startups are eliminated each year, which would vent 132 Mcf per start*

Economic Evaluation

Estimated Gas Price	Annual Methane Savings	Value of Annual Gas Savings*	Estimated Implementation Cost	Incremental Operating Cost	Payback (months)
$7.00/Mcf	581 Mcf	$4,326	Minimal training	$0	Immediate
$5.00/Mcf	581 Mcf	$3,080	Minimal training	$0	Immediate
$3.00/Mcf	581 Mcf	$1,848	Minimal training	$0	Immediate

* *Whole gas savings are calculated using a conversion factor of 94% methane in pipeline quality natural gas.*

Additional Benefits:
- Greater overall efficiency of compressor operations
- Reduces fuel usage

Methane Savings - Improved ignition and automated control systems

Estimated annual methane emission reductions	*800 Mcf per compressor system*

Economic Evaluation

Estimated Gas Price	Annual Methane Savings	Value of Annual Gas Savings*	Estimated Implementation Cost	Incremental Operating Cost	Payback (months)
$7.00/Mcf	800 Mcf	$6,440	$1,750	$0	3.3 Months
$5.00/Mcf	800 Mcf	$4,600	$1,750	$0	4.6 Months
$3.00/Mcf	800 Mcf	$2,600	$1,750	$0	8.1 Months

* *Whole gas savings are calculated using a conversion factor of 94% methane in pipeline quality natural gas.*

Additional Benefits:
- Reduces labor and O&M costs
- Improves safety and efficiency of operations
- Reduces fuel usage

Applicable Sector(s)

■ Production
■ Processing
■ Transmission
■ Distribution

Other Related Documents:

Replace Gas Starters with Air or Nitrogen, PRO No. 101

Install Electric Compressors, PRO No.103

Install Electric Motor Starters, PRO No. 105

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stall the compressor once it is loaded. The compressor must then be unloaded and re-started. Each failed engine start wastes gas, produces unnecessary methane emissions, and reduces efficiency. Operational inefficiencies due to failed starts, shutdowns, and restarts are magnified in large multi-compressor installations operated by production and transmission companies.

Operating and maintenance schedules dictate how frequently compressor engines are scheduled for shutdown and restart. EPA's Natural Gas STAR Partners in the transmission and distribution sectors report that coordinating the maintenance and operating schedules for compressors can significantly reduce the total number of startups. Operating requirements are closely monitored to eliminate unnecessary shutdown of the compressors. Set schedules for shutdowns and maintenance are established. Repair needs that develop in the interval between planned shutdowns are evaluated to determine those that can wait until a scheduled maintenance shutdown.

Natural Gas STAR Partners have replaced and upgraded old ignition systems with electronic ignition systems, eliminating emissions from failed starts and reducing operating costs. Some Partners further improve operating efficiency and reduce emissions by installing automatic control systems such as programmable logic controls (PLCs). PLC systems manage unit performance, unit load, power requirements and safety shutdowns, that together improve the efficiency and reliability of compressors. Many electronic ignition systems are equipped with PLC controls installed (or available as an option) to enhance operation of the system.

Operating Requirements

To reduce the frequency of engine starts, compressors should have set operating and maintenance (O&M) schedules, allowing maintenance to be performed during a planned compressor shut-down. A facility should also have procedures in place to review compressor function regularly to improve operating efficiency.

For electronic ignition and automated control systems, a small electric power supply is required, which can be generated by solar power at remote sites.

Applicability

Although it is transmission and distribution Partners that report having successfully implemented this PRO at facilities with multiple compressors, this O&M 'best practice' could also apply to large compressors in the processing and production sectors. Electronic ignition systems can be applied to natural gas-fueled engines 100 hp and larger that drive equipment such as compressors and pumps. Smaller engines with less than 100 hp typically use electric starters. Automated control systems are most efficient when deployed in compressors stations, gas plants, and gathering facilities with large engine sets.

Methane Content of Natural Gas

The average methane content of natural gas varies by industry sector. The Natural Gas STAR Program assumes the following methane content of natural gas when estimating methane savings for Partner Reported Opportunities.

Production	79 %
Processing	87 %
Transmission and Distribution	94 %

Methane Emissions

Methane emissions from compressor engines are determined by several factors including the size and configuration of the compressor, prime mover and gas starter, as well as the frequency of restarts. For large compressors, methane emissions can add up quickly, even with an optimized O&M schedule. Methane emission reductions achieved by installing electronic ignition and automatic control systems depend on the size of the equipment and the operating schedule. Gas and methane emissions savings should be calculated or measured directly for individual equipment components; however, initial estimates of potential methane savings can be made using default emission factors.[1]

Partners report reducing compressor engine starts from 9.4 to 5 starts per year, saving 132 Mcf per start, for an annual methane emissions savings of 581 Mcf per compressor. These efforts resulted in total system-wide methane emission reductions of 15,065 Mcf per year by eliminating the unnecessary shutdown of engines. Other Partners installed new electronic ignition systems, achieving emissions reductions of 3,227 Mcf at one production facility and 5,925 Mcf at a gas processing plant. Partners also reported installing automated controls on 52 compressors reducing annual methane emissions by 800 Mcf per compressor set for total emission reductions of 41,600 Mcf. Another Partner

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achieved total annual methane emissions savings of 57,728 Mcf from installation of multiple automated control systems.

Economic Analysis

Basis for Costs and Savings

Calculations of gas saving are based on the average number of starts per compressor per year, the quantity of gas required per start and the number of startups or failed starts avoided for each engine. Reductions in natural gas emissions are converted to methane savings based on the methane content of the gas that would normally be vented before each restart. One transmission Partner reports methane emissions of 132 Mcf per compressor start, which represents approximately 140 Mcf of natural gas assuming 94% methane content in the gas. Reducing compressor engine starts by 4.4 starts per year saves one Partner approximately 616 Mcf of natural gas per compressor engine. At $5.00/ Mcf, the value of gas saved annually is $3,080 per compressor. The Partner's system-wide methane emissions reductions of 15,065 Mcf equate to natural gas savings of 16,027 Mcf, valued at approximately $80,135.

Partners report annual natural gas savings from installing automated control systems that range from approximately 920 Mcf per compressor set to 6,800 Mcf per gas processing plant to 66,350 Mcf for multiple installations of automated control systems. Assuming typical annual gas savings of 920 Mcf per compressor are achieved by implementing this PRO, at $5.00/Mcf, the value of gas saved is $4,600 per compressor system. Partners report capital costs for ignition and control system upgrades that range from $1,750 for upgrading an ignition system on a single compressor to $15,000 for automated control of a compressor station. Assuming a gas price of $5.00/Mcf and the reported cost of an ignition system upgrade, payback is expected in less than 5 months.

Discussion

Reducing the frequency of compressor engines starts requires incremental changes in facility operating and maintenance practices. Such practices are expected to be low cost, so rapid project payback is expected. In addition, some operators report savings on labor costs for equipment maintenance and operation. Partners report that upgrading ignition systems and installing automated engine controls provides quick project payback, especially when applied to poorly performing equipment. A unit with frequent failed starts and downtime is a costly inconvenience, requiring substantial man-hours to be committed to its repair. New automated control and ignition system installations are justified based on reduced labor and O&M costs, as well as improved efficiency and safety. The technologies presented in this PRO help reduce harmful air pollution as well as improve overall compressor performance.

[1]Methane emissions reductions can be estimated using a default emission factor of 15 Mcf per avoided compressor blowdown, plus the estimated volume of starter gas vented for each attempted engine start. The volume of starter gas can be estimated as 0.5 scf of gas at 250 to 350 psig per engine horsepower. For a 3,000-hp engine, approximately 1.5 Mcf of starter gas is vented per start attempt.