

Appendix

Methane Abatement Activities from ONE Future Member Companies

PRODUCTION

- » Company requirement to have adequate takeaway capacity at wellpads to prevent venting or flaring of associated (or stranded) gas. All natural gas produced is sent directly to pipeline.
- » Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- » Quarterly aerial leak surveys and repairs across all unconventional wellpads and annual across all conventional wells. Desktop review of work orders and site data followed by field investigation of each emission event >10 kg/hr (intermittent and persistent).
- » Implementing large pilot of continuous monitoring system with multiple technologies for detection.
- » Wellpad pressure testing is conducted with an onsite Optical Gas Imaging team member to find emission sources prior to the start of production.
- » Wellpads are investigated daily or weekly for leaks using Audio, Visual and Olfactory (AVO) checks.
- » New wells are monitored with a density meter. If the density meter notes gas going to the tank the well is shut-in to perform a field investigation and possible maintenance of the dump valves associated with those tanks.
- » Install ultrasonic listening devices and Lower Explosive Limit (LEL) detectors within gas units. They are programmed to shut in the well pad if gas is detected.
- » Equip all well tenders with CH₄ detection monitors that are checked weekly to ensure there are no leaks.
- » Best management and operational practices integrated across construction and production sites with the goal of minimizing venting and flaring.
- » Best management and operational practices that limit number of compressor and vessel blowdowns to atmosphere only when needed.
- » Use of portable compression equipment to capture and recompress the gas blowdown from compressors and other vessels transferring the gas to a pipeline downstream of the isolated equipment or pipeline segment.
- » Installation of instrument air to replace gas starters on compressor drivers.
- » Automated plunger lifts are installed and monitored by a central control center to minimize liquids unloading emissions.
- » Tubing is installed either during initial construction or within 3 years of acquisition to support the installation of plunger lifts and minimize liquids unloading emissions.
- » Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/actuators with electric, solar, nitrogen or instrument air devices and implemented plans to design all new wellpads without any gas driven pneumatic controllers/actuators.
- » Installing solar power for chemical injection pumps.
- » Using glycol energy exchange pneumatic pumps resulting in minimal levels of CH₄ released.
- » Implementation of reduced emission completions during well completions and hydraulic fracturing.
- » State regulatory agency regulates/limits venting from well unloading (down to ~400 total unloads/month from ~1200/month in 2021) - mostly all on plunger lifts.

- » Routing of vented gas from pneumatic controller/ actuator to combustor/separator pilot fuel when it is not feasible to have a portable compressor to capture and recompress the small amount of gas vented from pneumatic controllers/actuators.
- » Began utilizing emission control devices (ECDs) to lower completions emissions.
- » Changed the facility design to perform bulk test separation vs. having separator units on every well.
- » Installed compressors on wells to enhance gas lift and/or boosting to minimize emissions from liquids unloading.
- » Glycol Dehydration units: all flash off-gas is captured and sent back to station inlet or controlled via VRU or combustion device (flare or enclosed combustor), all regen off-gas routed to BTEX condenser/sump and routed to combustion device for control.

GATHERING & BOOSTING

- » Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- » Installation of instrument air to replace gas starters on compressor drivers.
- » Pig launcher/receiver trap blowdowns: Some facilities utilize VRU/ECD/Flare to capture ~90% pig trap blowdown.
- » Pig launcher/receiver trap blowdowns: Auto Launcher and larger barrel to receive multiple pigs before depressuring trap to atmosphere.
- » Perform aerial leak surveys performed to identify methane slip due to combustion.
- » Perform regular preventative maintenance and burner tip maintenance on combustion units and flares (tuning of the unit).
- » Perform rod packing maintenance and replacement for all reciprocating compressor units regardless of whether they are subject to regulatory requirements.
- » Implement best management and operational practices by minimizing the frequency of blowdowns to the extent possible thru scheduling and grouping of maintenance activities.
- » Utilize vapor recovery units (VRUs), ECDs, or flares to combust or capture 90%+ of compressor or pipeline blowdowns.
- » Gas control continuous monitoring of significant changes in gathering pipeline pressures to minimize chances of gathering pipeline unplanned events/mishaps outside of the control of the operator. If event were to occur, the company gas control personnel can take immediate actions to close valves and isolate the pipeline to minimize the gas vented until personnel can make the repair.
- » Perform routine gathering pipeline walking leak surveys to minimize gathering pipeline unplanned events/mishaps outside of the control of the operator.
- » Best management and operational practices to minimize pipeline segment length and gas volume needing to be blown down during gathering pipeline planned events.
- » During gathering and transmission pipeline planned events, reduce the operating pressure on segment(s) of gathering and transmission pipelines as much as possible using portable compression and/or existing compression and route the gas downstream of the isolated segment being blown down.
- » Glycol Dehydration units: all flash off-gas is captured and sent back to station inlet or controlled via VRU or combustion device (flare or enclosed combustor), all regen off-gas routed to BTEX condenser/sump and routed to combustion device for control.
- » Utilize electric glycol pumps instead of energy exchange glycol pumps which do vent methane emissions.
- » Perform periodic maintenance on flare burner and blower (air-assisted) to improve flare efficiency and minimize methane slip due to combustion.
- » Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with instrument air devices at

gathering compressor stations, gas processing plants, transmission & storage facilities, and distribution systems.

- » Best management or operational practice by minimizing the operating frequency of gas driven pneumatic pumps.
- » Facility engineering incorporates pressure cuts prior to routing liquids to tanks to minimize storage tank venting.
- » Installation and maintenance of properly designed and weighted thief hatches on storage tanks to minimize frequency of venting from thief hatches.
- » Performing annual methane slip stack testing of reciprocating engines and comparing to gas engine rating pro (GERP) curves to improve

combustion efficiency and minimize methane slip.

- » Increasing the length of pressurized holds on compressor drivers to reduce the frequency of compressor unit blowdowns.
- » Implementation of emergency shutdown system procedures to more effectively isolate the station and close station block valves. This helps to manage and reduce the amount of gas blown down from the station if an emergency shutdown of the station occurs. During testing of the system, the blowdown valves/vents are capped to prevent blowdown to atmosphere.
- » Installation of solar powered generator at a station instead of a natural gas-fired generator.

PROCESSING

- » Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- » Perform aerial leak surveys performed to identify methane slip due to combustion.
- » Perform regular preventative maintenance and burner tip maintenance on combustion units and flares (tuning of the unit).
- » Utilize electric glycol pumps instead of energy exchange glycol pumps which do vent methane emissions.
- » Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/actuators with instrument air devices at gathering compressor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- » Utilizing the acid gas removal (AGR) system to exclusively treat the ethane stream rather than the methane stream.
- » Routing AGR system vents to emission control device such as combustor, flare or thermal oxidizer to reduce methane slip from combustion.
- » Utilize nitrogen gas purge prior to evacuation of equipment/piping to reduce the gas volume blown down to atmosphere.
- » During the repair of equipment leaks, nitrogen gas purges the locked-out equipment or piping before opening the vent to atmosphere.
- » Replacement of natural gas-fired compressor drivers with electric motor driven compressor drivers.
- » Replacement of wet seal centrifugal compressors with dry seal centrifugal compressors when feasible.
- » Route reciprocating compressor unit blowdowns to ECD, VRU, or flare to capture or combust the blowdown gas volumes rather than venting to atmosphere.
- » Perform rod packing replacement on reciprocating compressors equal to or more frequently than required by regulation.
- » Install mole sieve dehydration units in lieu of glycol dehydration units and implement best management or operational practices to minimize mole sieve bed changeouts to reduce frequency of venting during those changeouts.
- » Vapor recovery unit on flare header to recover vent gas from process with the flare only used as backup in the event the VRU goes down.
- » Route AGR vented gas to underground injection well.

TRANSMISSION & STORAGE

- » Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- » Installation of instrument air to replace gas starters on compressor drivers.
- » Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/actuators with instrument air devices at gathering compressor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- » Increasing the length of pressurized holds on compressor drivers to reduce the frequency of compressor unit blowdowns.
- » Perform rod packing replacement on reciprocating compressors equal to or more frequently than required by regulation.
- » Utilizing hot taps/Stopple® fittings during pipeline maintenance not requiring pipeline blowdowns to atmosphere.
- » Recovery of compressor unit blowdowns (Compressor Unit BDR).
- » Replace Bi-directional Orifice Meters with Ultrasonic Meters.
- » Directed Inspection and Maintenance (DI&M) – Atmospheric Pressure Gas Loss (AGL) Inspections and repairs of leaks.
- » Use of YALE Enclosures for Emergency Shut Down (ESD) Testing to prevent full station blowdowns.
- » Capture and recompression of dry seal vented gas and compressor process vented gas.
- » Installation of cathodically protected pipe.
- » Installation of “line break” valves to prevent a significant loss of gas to the atmosphere.
- » Reduce excessive compressor purging.
- » Install compressor rod packing case purging systems.
- » Perform valve maintenance.
- » Reduce “methane slip” through combustion efficiency improvements.
- » Use of pipeline wrap or steel sleeves during pipeline maintenance to reduce or eliminate pipeline blowdowns to atmosphere.
- » Emergency Shut Down (ESD) blowdown to flare.
- » Compressor Vent line alarms.
- » Replacement of reciprocating engines with newer more efficient reciprocating engines resulting in lower methane slip from combustion.
- » Implementation of valve maintenance best management practice under Methane Challenge program that includes unit isolation and blowdown valve maintenance.
- » Installation of rod packing vent capture systems.

DISTRIBUTION

- » Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- » Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/actuators with instrument air devices at gathering compressor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- » Cross compression for transmission/large pipes (major projects); piloting for distribution pipe.
- » Satellite methane leak detection pilot scaled to an entire state in 2023.
- » Creation of PAR (Pinpoint, Access & Repair) tool to ingest satellite data and advance leak remediation.
- » Gas cloud imaging technology regulator stations, compressor station & LNG plant (Pilot).
- » Leak surveys once every 3 years instead of 5 years combined with goal for find it & fix it process (Q4 2023) - zero leak inventory.

- » MSRP Replacement program for older metallic services under a 20-year program in one of the states with cost ~13 million a year.
- » Advanced Mobile Leak Detection Units deployed around distribution system to identify leaks for repair.
- » Capital based allocation largely based on leakage rate and type of pipe in the system.