



Colorado Optical Gas Imaging Infrared Camera Pilot Project: Final Assessment

July 11, 2016

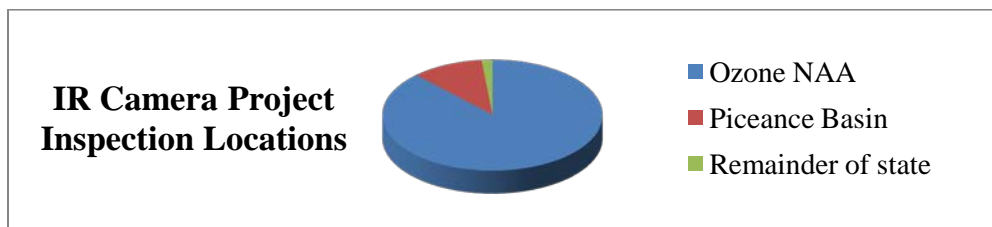
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Introduction

In 2013, the Colorado Air Pollution Control Division (APCD) undertook a two-year project to utilize optical gas imaging infrared (IR) cameras to identify and address sources of emission leaks and venting at oil and gas (O&G) well production facilities. The project ran from July 2013 through June 2015 with the goal to visit as many well production facilities in Colorado as possible (approximately 8,000 total locations) within that time period. The project allowed for the purchase of four IR cameras for APCD, and the hiring of four temporary full-time employees to perform the inspections using these cameras. By the close of the project on June 30, 2015, APCD staff completed 4,474 IR camera inspections (three-quarters at facilities with tank emission controls and one-quarter at facilities without tank emission controls) of individual well production facilities operated by 61 different companies in 20 counties and the major O&G producing basins in Colorado (Denver-Julesburg/DJ Basin and Piceance Basin). The map in Appendix A provides an overview of IR camera inspections completed statewide during the project.

Results & Findings of IR Camera Project

The first year (July 2013 – June 2014) of the IR Camera Project focused exclusively on the ozone non-attainment area (NAA) with nearly 2,800 inspections completed during that time. The second year (July 2014 – June 2015) of the project expanded efforts outside the NAA to the Piceance Basin, which includes Garfield, Rio Blanco and Mesa counties, as well as other parts of the state, including Cheyenne, Dolores, Jackson, Kiowa, Logan, Moffat, Montezuma, Morgan, Prowers and Routt counties. However, the bulk of facility inspections (88%) during the two-year monitoring period were completed in the NAA where the majority of controlled well production facilities are located in Colorado.



The table below summarizes quarterly inspection results from the start of inspections in September 2013 through the last month of inspections in June 2015. For the purposes of this project, emissions found to be coming from a thief hatch, pressure relief valve/device (PRV) or open vent line (manually operated blow-down vent) on a storage tank are referred to as venting; whereas, emissions found to be coming from any other source are referred to as a leak. The distinction between venting and leaking was further clarified during the Colorado Air Quality Control Commission’s (AQCC) February 2014 rulemaking (see “Impacts of IR Camera Project” and “Next Steps” sections below).

| APCD IR Camera Project Quarterly Inspection Results | | | | | |
|--|---------|--------------------------------|--|---|---|
| Year | Quarter | Number of Facility Inspections | Total Number of Leaks/Vents Found ¹ | Individual Facilities with at least One Leak/Vent Found | Individual Facility Leak/Vent Rate ² |
| 2013 | 3* | 261 | 133 | 109 | 42% |
| 2013 | 4 | 940 | 523 | 296 | 31% |
| 2014 | 1 | 872 | 267 | 230 | 26% |
| 2014 | 2 | 703 | 202 | 162 | 23% |
| 2014 | 3 | 395 | 155 | 106 | 27% |
| 2014 | 4 | 517 | 280 | 128 | 25% |
| 2015 | 1 | 424 | 95 | 62 | 15% |
| 2015 | 2 | 362 | 38 | 32 | 9% |
| Totals | | 4,474 | 1,693 | 1,125 | 25% |

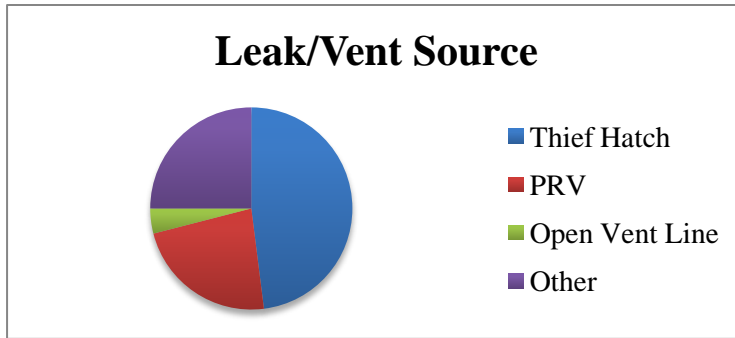
* Inspections only conducted in September 2013.

¹ This data represents the total number of individual leaks/vents found across all facilities inspected.

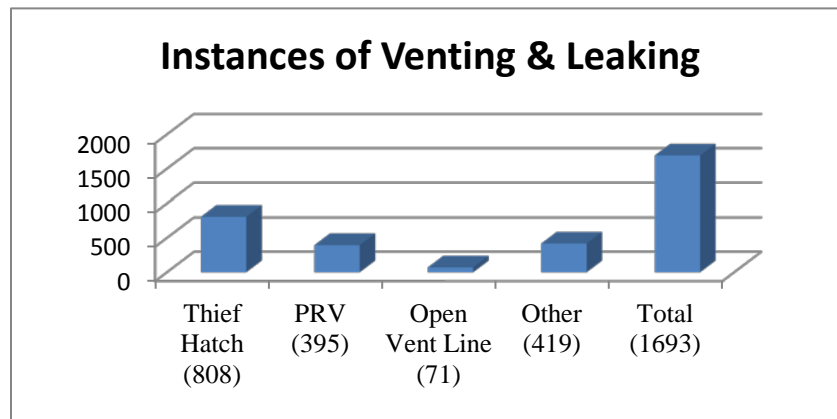
² Percentage of facilities inspected found to have at least one leak or vent.

There was a reduction in the individual facility leak/vent rate from the first quarter to the last quarter of inspections. After decreasing during the first four quarters of the project, the leak/vent rate increased slightly in quarters 3 and 4 of 2014, probably owing to the fact that inspections were being completed in new areas beyond the NAA during this time, such as the Piceance Basin and the rest of the state. However, by the last 2 quarters of the project, the individual facility leak/vent rate decreased again.

Of the total number of leaks and venting identified three-quarters were from the thief hatch, PRV or open vent line on controlled hydrocarbon liquid storage tanks. Overall, nearly half of all leaks and venting found during the project were from the thief hatch and nearly a quarter were from the PRV, indicating storage tanks as a primary source of emissions at well production facilities.



The chart below shows the number of instances of venting found from the thief hatch, PRV and open vent line on tanks, as well as “other” leaks (for example, from separator, vapor line, knockout tank, wellhead, etc.), and total number of instances of venting and leaking:



To ensure speedy repair, well production facility owners/operators were almost always notified within one business day of a leak or vent found and were often notified the same day a leak or vent was found. Most repairs were completed within 1 – 2 weeks after notification, and many within several days after notification. For thief hatches and PRVs, the most common reported repairs were to disassemble and/or clean the equipment, replace either parts or all of the equipment, or adjust the equipment.

Impacts of IR Camera Project

The most direct impact of the project, though not fully quantifiable, is the immediate reduction or minimization of emissions to the atmosphere from well production facilities through timely notification and repair of identified sources of leaks and venting. Additionally, there was a decrease in the facility leak/vent rate from 42% at the start of the project to 9% at the end, which appears to indicate greater attention or focus being given by O&G operators to prevent and address these sources of emissions. The project was also useful in helping identify atypical or previously unknown issues, such as cracked tanks, flare fuel gas line leaks (underground

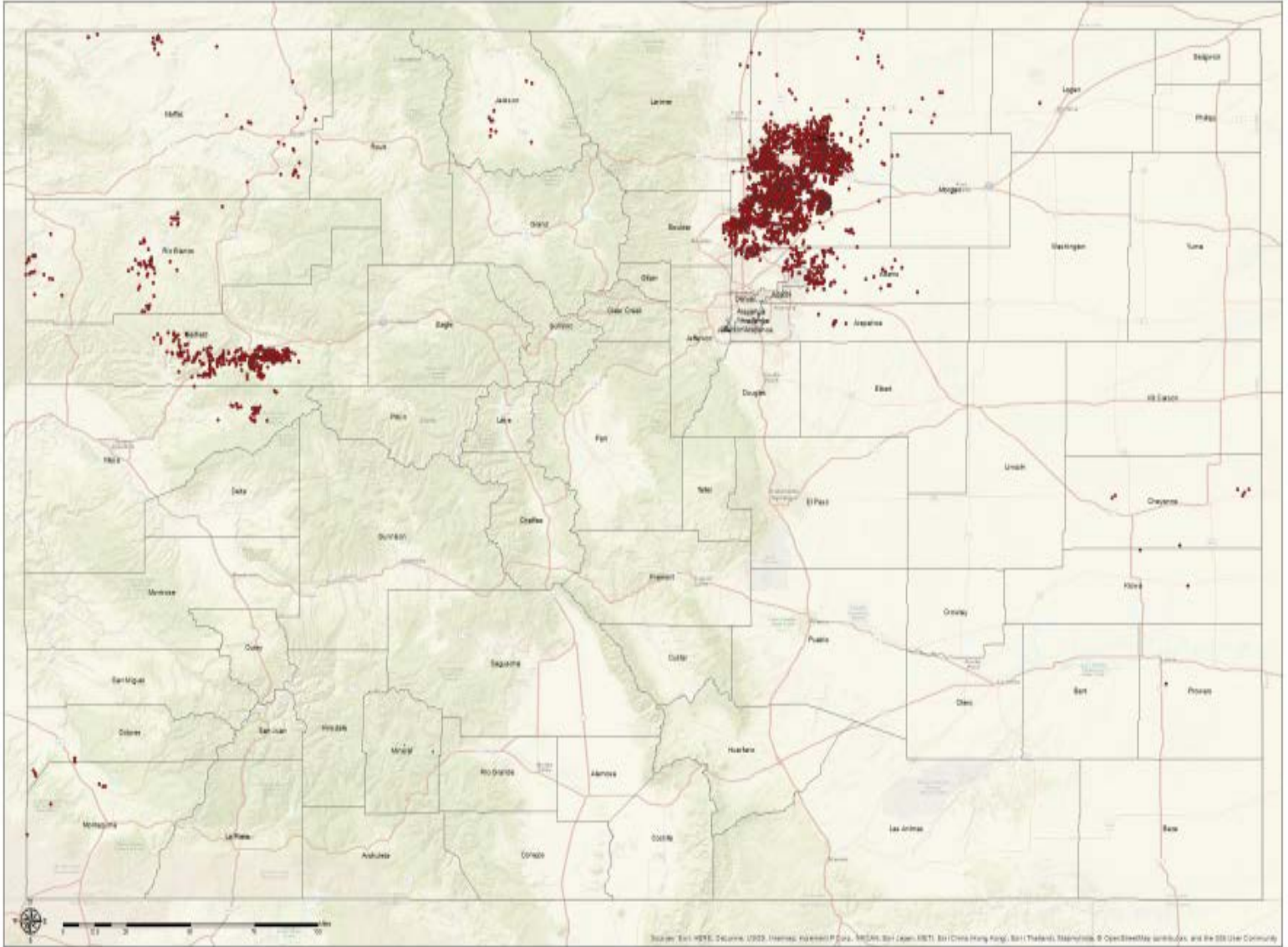
emanating to surface), separator pressure relief venting (indicative of separator unable to overcome high gathering line pressure), as well as malfunctioning equipment designed to vent (pneumatic devices). Finally, the project helped lay the groundwork for implementation of the Storage Tank Emission Management (STEM) and Leak Detection and Repair (LDAR) rules in Colorado AQCC Regulation No. 7 that were adopted in February 2014. Affected O&G operators/companies reported purchasing or increasing the use of IR cameras to find and prevent leaks/venting, transitioning to better materials or equipment (such as higher quality thief hatch seals/gaskets and PRVs), implementing best practices to help prevent leaks/venting, and focusing on tank system design and operations analysis. APCD was made aware of the impacts of the IR Camera project through communications with O&G companies and received positive feedback from outreach conducted to O&G operators during the project. Due to the success of the two-year IR Camera Pilot Project, it was approved by the state legislature in May 2015 to become a permanent part of O&G air quality compliance oversight activities within Colorado.

Next Steps

With approval as a permanent part of APCD compliance oversight activities, all O&G inspectors now perform IR Camera inspections as a regular part of their duties. Inspectors frequently use the IR camera to monitor for leaking and venting at well production facilities, but also use the technology at other O&G facility types. These include, but are not limited to, natural gas compressor stations, natural gas processing plants and water management facilities. The main focus is assessing compliance with the STEM and LDAR requirements in Regulation No. 7, Sections XVII.C.2 and F, and federal O&G rule requirements. The STEM provisions of Section XVII.C.2 require operators to meet a “no-venting” standard for controlled storage tanks, while the provisions of Section XVII.F require operators to monitor and repair component leaks. The cameras may also prove useful for monitoring and assessing other regulatory requirements such as well maintenance activities and well completion/flowback operations. APCD will also look for other innovative ways or opportunities the cameras may be used to help improve air quality and address citizen concerns. Additionally, an upgrade to the APCD IR camera database is currently being pursued to help improve data management and compliance oversight for the program.

Finally, APCD will continue to work with O&G operators to encourage proactive emission reduction efforts and to gain a better understanding of the underlying causes of venting and leaks, to ensure the implementation of effective, long-term solutions. APCD will also continue to utilize formal enforcement as warranted to achieve program goals and to further CDPHE’s mission of protecting public health and the environment.

APPENDIX A



IR Camera Pilot Project Statewide Inspection Locations

- + IR Inspection Locations
- Colorado Counties

Source Data:
 Site locations derived from Inventory Query generated on 02/09/2015.
 Background imagery made available from ArcGIS online accessed at time of map generation.
Author: Dida Osborne **Date Generated:** 4/27/2016

User Constraints:
 There are no restrictions and legal prerequisites for using this data set. The state of Colorado assumes no liability to the completeness, correctness, or fitness for use of this data set.

