Colorado Department of Public Health and Environment
Air Pollution Control Division

# Colorado Optical Gas Imaging Infrared Camera Inspection Program: Updated Assessment

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## Introduction

In 2013, the Colorado Air Pollution Control Division (APCD) undertook a two-year pilot project to utilize optical gas imaging (OGI) infrared (IR) cameras to identify and address sources of emissions at oil and gas (O&G) facilities. The project ran from July 2013 through June 2015 and allowed for the purchase of four (4) IR cameras for APCD, and the hiring of four (4) temporary full-time employees to perform the inspections using these cameras. By the close of the project on June 30, 2015, approximately 4,500 IR camera inspections were completed across Colorado. An assessment of this pilot project was published on July 11, 2016.[1] The original pilot project assessment report noted that the facility emissions issue rate had decreased over the course of the project and that the majority of emissions issues identified were tank emissions (see details below).

At the end of the pilot project, APCD was approved to retain the four temporary IR camera inspector positions permanently and continue with IR camera inspections as part of overall compliance monitoring activities for the O&G industry. The permanent IR camera inspection program commenced with inspection year 2016 (October 2015 – September 2016).

Since the incorporation of the IR camera inspection program into APCD's compliance monitoring activities, and through inspection year 2018 that ended in September 2018, an additional 5,696 IR camera inspections have been completed statewide. A total of 10,325 IR camera inspections have been completed overall through September 2018.

This updated assessment provides an overview of findings and results of the IR camera inspection program to date through the end of inspection year 2018.

[1] https://www.colorado.gov/pacific/sites/default/files/APCD_IRCameraProject_FinalAssessment.pdf

**Facility Emissions Issue Rate Analysis**

To facilitate program assessment, APCD defined the individual facility emissions issue rate as *the percentage of facilities inspected that had one or more emissions issues identified with the IR camera during an inspection*. Typical emissions issues include: storage tank emissions, leaks from components, pneumatic controller emissions (may or may not be indicative of improper controller operation) and emissions from unlit flares or combustors, among others. In the pilot project assessment this was referred to as the "Individual Facility Leak/Vent Rate".

The table below provides a summary of the individual facility emissions issue rates for each inspection year (October 1st through September 30th) since IR camera inspections began. This information includes all IR camera facility inspections completed statewide.

| Individual Facility Emissions Issue Rate by Inspection Year (October – September) | |
|---|---|
| **Inspection Year** | **Facility Emissions Issue Rate** |
| 2014* | 28% |
| 2015 | 17% |
| 2016 | 16% |
| 2017 | 12% |
| 2018 | 13% |

** Inspection Year 2014 includes findings from September 2013, which was the first month IR camera inspections began but is technically the final month of Inspection Year 2013.*

Not accounting for inspection year 2018, during which a nominal increase in the facility emissions rate was observed, the individual facility emissions issue rate has decreased each inspection year since IR camera inspections began.

Out of all IR camera inspections completed from September 2013 through September 2018, 89% (9,185) were completed in the Denver/North Front Range ozone non-attainment area (NAA) where the bulk of the oil and gas activity is located in the state. 8% (877) of the facility inspections were completed in the Piceance Basin of western Colorado (Garfield, Rio Blanco and Mesa counties), which is a major natural gas producing region, and the remaining 3% (263) were completed in all other counties or parts of the state where oil and gas activity is present. The table below provides a summary of the individual facility emissions issue rates for each of those areas and overall:

| Individual Facility Emissions Issue Rate by Area/Location in Colorado | | |
|---|---|---|
| **Area/Location** | **Total IR Inspections Completed** | **Facility Emissions Issue Rate** |
| Ozone NAA | 9,185 | 19% |
| Piceance Basin | 877 | 18% |
| All Other Parts of State | 263 | 5% |
| Statewide | 10,325 | 18% |

Viewing the data through a different lens, 74% (7,669) of all IR camera inspections completed from September 2013 through September 2018 were first-time IR camera inspections of facilities, while the remaining 26% (2,656) were re-inspections of facilities that had previously been inspected. The table below provides a summary of the individual facility emissions issue rates for facilities inspected only once with an IR camera (initial inspection) and facilities inspected more than once with an IR camera (repeat inspection(s)). For repeat inspections, the facility emissions issue rate is based on the findings only from inspections occurring after the first or initial inspection:

| Individual Facility Emissions Issue Rate by Inspection Occurrence | |
|---|---|
| **Inspection Occurrence** | **Facility Emissions Issue Rate** |
| Initial Inspection | 20% |
| Repeat Inspections | 14% |

The above results show that for facilities where repeat inspections have occurred there is a lower facility emissions issue rate for the repeat inspections than for facilities that have been inspected only once. This suggests better performance of facilities where there is an increased or recurring inspection presence by APCD. APCD will continue to selectively re-inspect facilities to further gauge performance while ensuring that any new facilities or ones never inspected before are also visited.

## Emissions Issues Overview and Analysis

As part of this assessment, APCD reviewed the type and number of specific emission issues identified during IR camera inspections. Generally, APCD has grouped emissions issues into three broad categories: tank emissions, component leaks and other emissions issues. These categories are defined to include the following types of emissions:

- Tank emissions are emissions observed from a thief hatch, pressure relief valve (PRV) or device, open vent line, or other access point on a hydrocarbon liquid storage tank.
- Component leaks are emissions observed from a component as defined in Colorado Regulation No. 7, Sections XII and XVII,[2] excluding tank emissions.
- Other emissions issues include pneumatic controller emissions, flare pilot flame off and fuel gas valve on (unlit flare/combustor emissions), and visible emissions (smoking) from equipment.

During the pilot project, component leaks were grouped with "other emissions issues". Beginning in inspection year 2016, component leaks were split out from "other emissions issues". Beginning in inspection year 2018, "other emissions issues" were defined to include the sources noted above. However, for purposes of this assessment, "other emissions issues" will still be identified and includes component leaks for inspection years 2014 and 2015.

The table below summarizes the type and number of emissions issues for each inspection year and the total of all years combined from inspection years 2014 through 2018:

| Emission Issue Types and Numbers of Observations | | | | |
|---|---|---|---|---|
| **Inspection Year** | **Number of Tank Emissions** | **Number of Component Leaks** | **Number of Other Emissions Issues** | **Total Emissions Issues** |
| 2014* | 942 | *(included in Other)* | 200 | 1,142 |
| 2015 | 335 | *(included in Other)* | 86 | 421 |
| 2016 | 334 | 33 | 53 | 420 |
| 2017 | 233 | 35 | 54 | 322 |
| 2018 | 223 | 68 | 52 | 343 |
| TOTAL | 2,067 | 136 | 445 | 2,648 |

**Inspection Year 2014 includes findings from September 2013, which was the first month IR camera inspections began but is technically the final month of Inspection Year 2013.*

[2] "Component" means each pump seal, flange, pressure relief device (including thief hatches or other openings on a controlled storage tank), connector, and valve that contains or contacts a process stream with hydrocarbons, except for components in process streams consisting of glycol, amine, produced water, or methanol.

Coinciding with the decrease in the Facility Emissions Issue Rate, APCD has observed a decline in total emissions issues observed each inspection year since IR camera inspections first began, with a nominal increase in inspection year 2018. Comparing inspection year 2014 to inspection year 2018, total emissions issues identified decreased by 70%.

Similar to the findings of the pilot project, tank emissions are the greatest number of emissions issues identified, accounting for 78% of total emissions issues. However, the number of tank emissions observed have also decreased each inspection year and by a greater rate than the decrease in total emissions issues with a 76% decline in tank emissions issues observed when comparing inspection year 2014 to inspection year 2018. The number of other emissions issues has also generally decreased, although observations of component leaks have gradually increased. Generally speaking, the total number of component leaks identified is low considering both the number of IR camera inspections completed and the relatively large number of components typically found at facilities overall.

**IR Camera Inspection Program Enhancements**

Beginning in inspection year 2018, APCD implemented a new web-based data system/application for tracking, recording and reporting of IR camera inspections. The system is accessible to approved internal (APCD) and external (companies/operators) users via secure login through an internet connection. The new system incorporated a number of improvements and efficiencies for both internal and external users compared to the prior database and recordkeeping approach utilized for IR camera inspections. Some of the enhancements include: providing a centralized location for inspection information, delivery and routing of emissions issue notifications and responses, and storage for IR camera videos. The new system also improves standardization of the processes associated with IR camera inspection findings and resolution. The system provides a feature for internal users to keep track of inspections, issue notifications and responses, and other pertinent information, and allows external users to do the same in regard to issues associated with inspections of their company's facilities. Overall, the new system has reduced time and errors around IR camera inspection data entry, issue notifications and company/operator responses, and allowed for more detailed and accurate data analyses of inspection results.

With the improvement to APCD's IR camera inspections data system, APCD intends to further leverage the large and growing data set in the system through more sophisticated analyses of inspection results to better inform targeting efforts for future inspections. These efforts could lead to more frequent inspections of facilities where

APCD is more likely to identify emissions issues, which would improve the effectiveness of the IR Camera Inspection Program.

## Conclusions

Colorado continues to see a decline in the rate of observations of emissions. These improvements in operator performance may be attributed, but not limited to APCD's increased inspection presence in the field, strategic enforcement efforts related to storage tanks emissions and enhanced company monitoring required through adoption of more stringent regulatory requirements in Regulation 7.