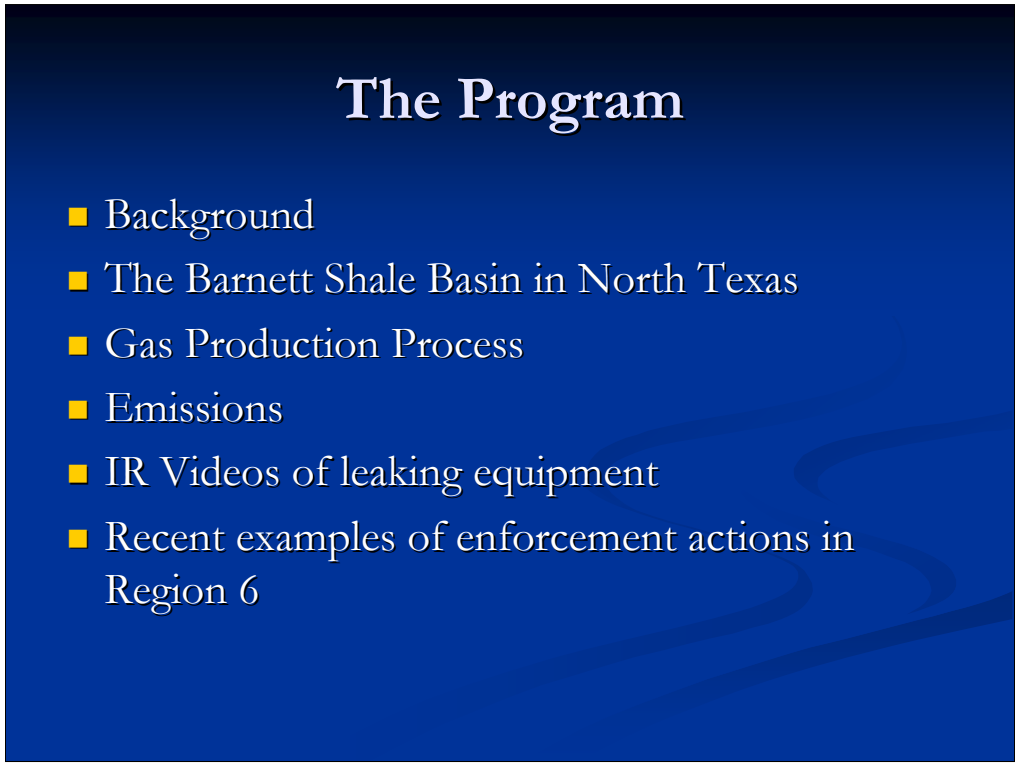
EPA-IR Videos Provide Instant Awareness

Presenter

Donald M. Smith

Air Enforcement Officer



My presentation will include the obligatory background discussion and will cover five areas:

The Barnett Shale Basin in North Texas,

some general information about the gas production process,

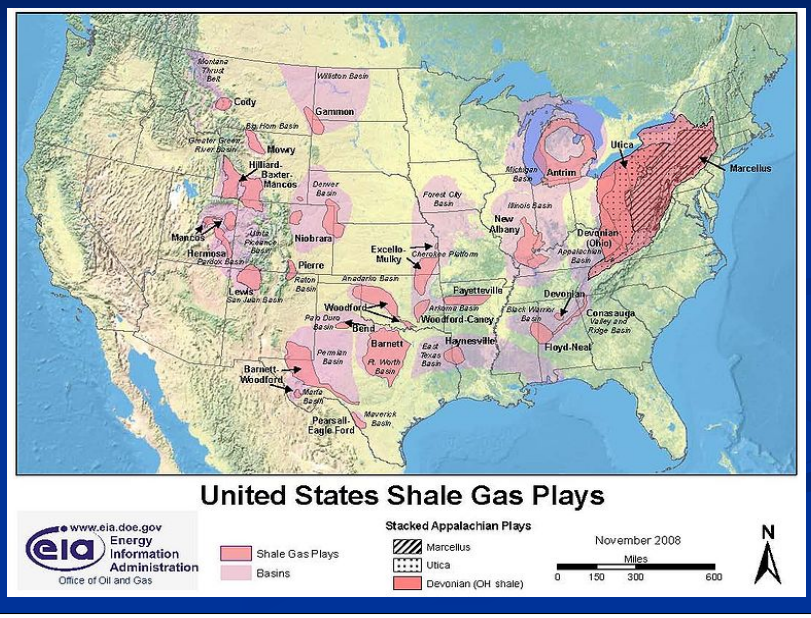
some discussion of our interests from an enforcement perspective.

Then I want to show you some examples of what may be seen with the FLIR Camera, including some representative examples of leaking equipment.

Finally I will share some recent examples of enforcement actions Region 6 has taken in this sector using this and other tools.

- Public awareness has increased as oil and gas wells are being drilled in urban and suburban areas.
- Public complaints have increased dramatically.
- EPA and State agencies are responding to the public with more inspections and enforcement activities.

United States Gas Fields

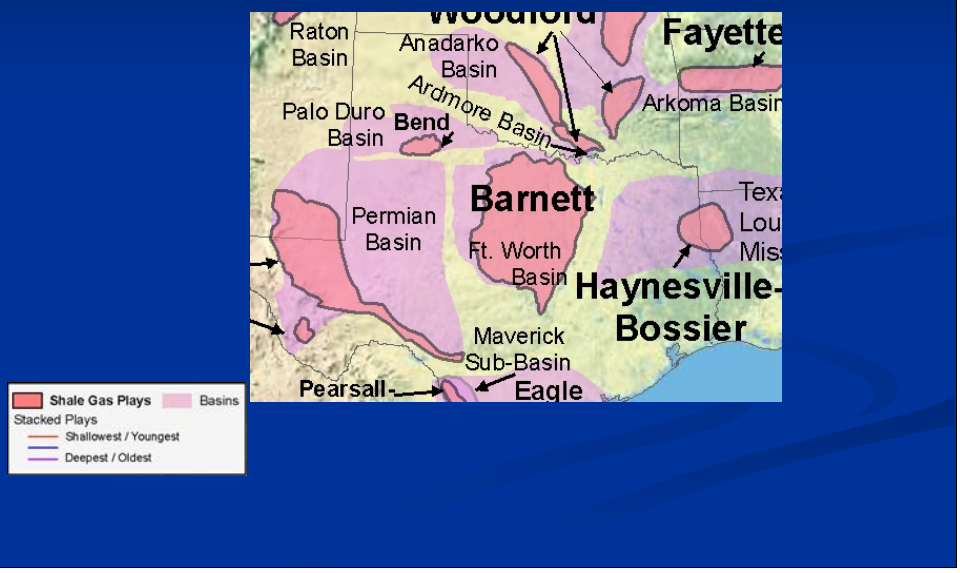


North Texas is a both a leading indicator and a leader of production in shale gas development.

This map shoes major gas development basins in the U.S.

The Barnett Shale is currently leading the country in production and numbers of wells, but you may see the large area of the Marcellus Shale in the northeastern US.

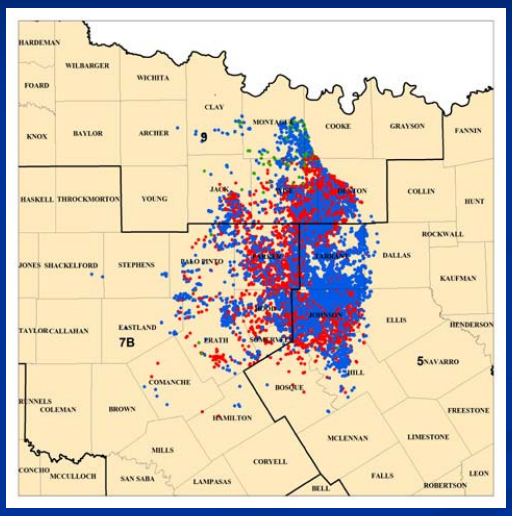
Closeup of Barnett Shale Area



The Barnett Shale encompasses approximately 17 counties in North Texas and lies on the western side of the DFW metropolitan area.

Counties in this area include urban and suburban populations, and some are included in the DFW Ozone non-attainment area.

Drilling in the Barnett Shale



Dallas and Tarrant county are near the center.

Red drilled gas wells;

Blue gas wells permitted but either not yet drilled or not yet reported to RRC;

Green are oil wells

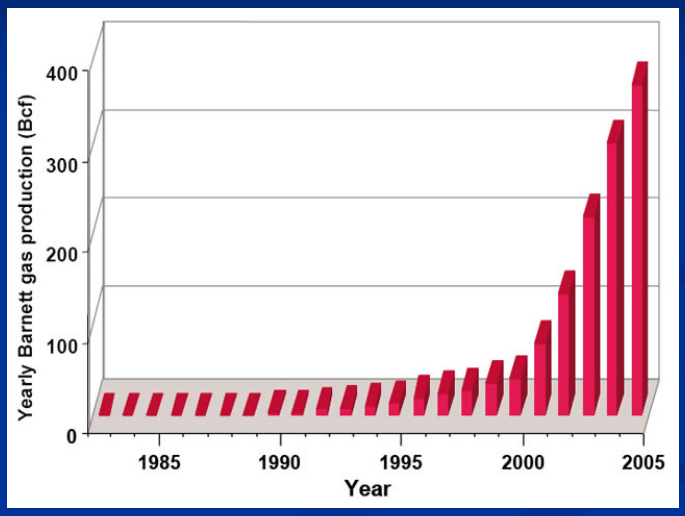
Extent of Operations in the Barnett Shale

- There are over 12,100 wells drilled in the Barnett Shale area.
- An additional 3,500 locations for wells have been approved by the Railroad Commission of Texas.
- There are over 1,300 gas compressor stations in the Barnett Shale area.

New numbers: 15,000 wells

5,000 locations

Annual Production in the Barnett Shale 1982-2005



These pictures show how the lives of North Texans have become entwined in Energy Extraction.

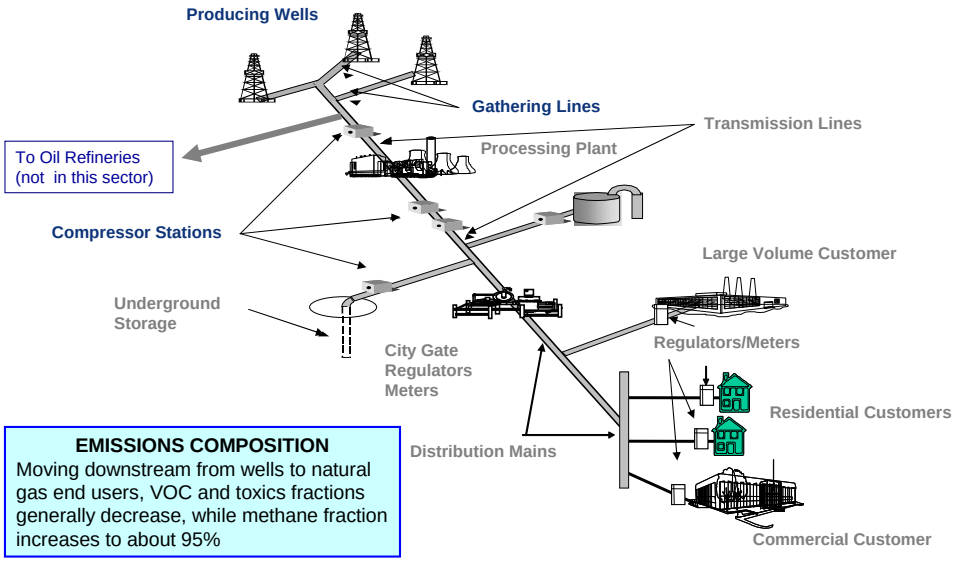
Why is the Barnett Shale so important?

- Enforcement responses in Region 6 and Region 8 (Denver) where there is a long history of energy extraction will likely influence the enforcement for this sector in other regions.

Overview of Production Process

- Gas well
- Field gathering
- Compressor stations
- Gas Plants
  - Treatment Processes
- Sales transmission

Oil and Natural Gas Operations



EMISSIONS COMPOSITION
Moving downstream from wells to natural gas end users, VOC and toxics fractions generally decrease, while methane fraction increases to about 95%

Source: American Gas Association and EPA Natural Gas STAR Program

This slide shows the typical process starting with the well and following the process through treatment and on to the consumer.

The portion after gathering in the field and before transfer to the sales pipelines is sometimes referred to as “midstream”.

Note that the emissions associated with the process change from complex mixtures including liquid fractions (such as propane) and other Volatile Organic Compounds further upstream to mostly methane by the time the product gets to the sales pipeline.

This is also a good place to discuss the treatment steps. Liquid natural gas, Water, Carbon dioxide and Hydrogen sulfide are among the most common substances that must be removed before the gas is ready for transmission through the pipeline to consumers.

What does this sector emit?

- VOC and Air Toxics (benzene and other organic HAP)
  - Equipment leaks
  - Storage tanks
  - Glycol dehydrators
  - Venting (pneumatics, well completions, workovers, etc.)
  - Misc sources (ponds, land farming, etc.)
- Other Criteria Pollutants (NOx, PM, and SO_2)
  - NOx emitted from engines, turbines, heaters
  - PM emitted from drilling rig engines
  - SO_2 emitted from sweetening (H_2S removal) process and from combustion of gases containing H_2S
- Greenhouse Gases
  - Methane (main component of natural gas) emitted from many of the same sources as VOC and toxics (leaks, storage tanks, venting)
  - In transmission and distribution segments, emissions are largely methane
  - CO_2 emitted from engines and heaters

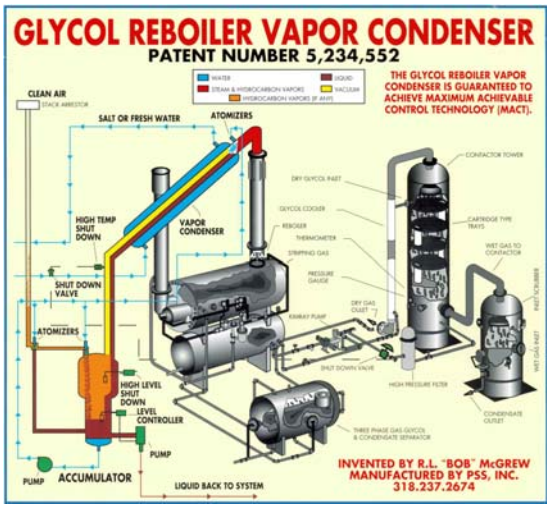
Compressor Engines

- Typically greater than 1,000 HP
- May use methane as fuel

These next two slides show some of the typical components we see at gas plant or compressor stations.

Here are two RICE (reciprocating internal combustion engines) driving multi-stage reciprocating compressors. We call this combination a compressor engine. These units are often large, in excess of 1,000 HP and may run on methane from the production gas stream.

Gas Treatment



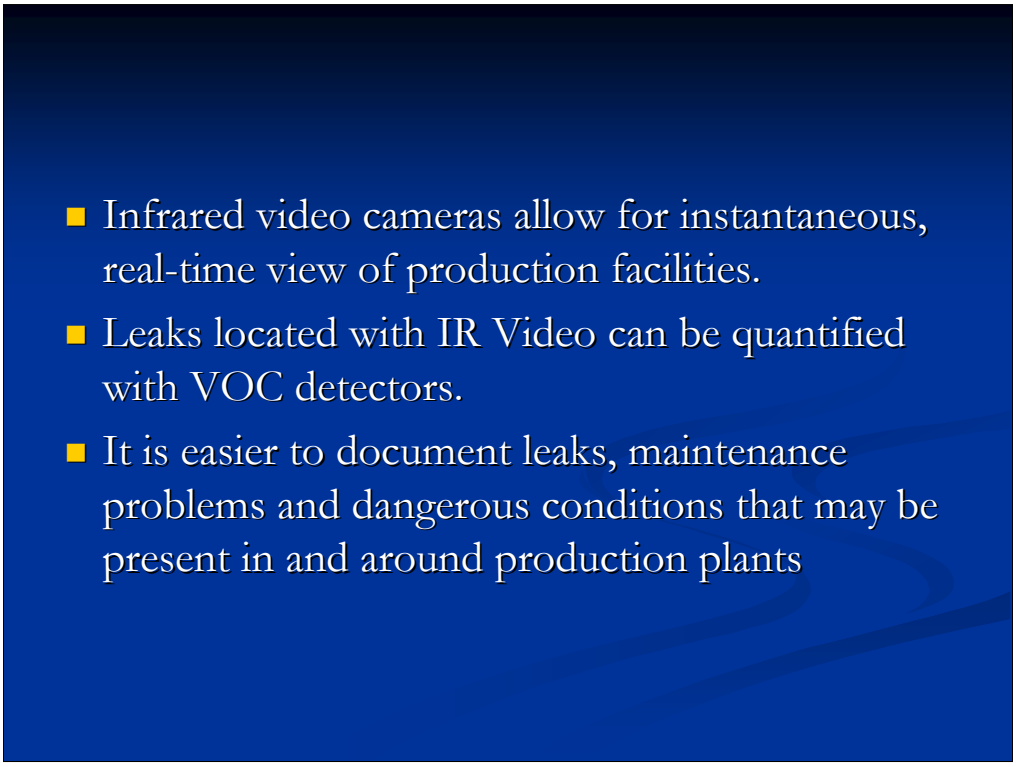
This is a cut-away view of a glycol dehydrator.

The principle of this type of dehydrator is that glycol is miscible with water. As Lean Glycol flows downward through the contactor tower (right) moisture laden gas (methane and ethane) flow counter to flow of glycol and water is very effectively removed.

The resulting Rich glycol, now moisture laden is pumped to the regenerator on the left side where a simple distillation occurs to regenerate the Glycol to lean state for re-use.

The system effectively dries the gas but often concentrates VOCs including Hazardous Air Pollutants such as BTEX in its emissions.

Potentially acidic CO2 or H2S are removed from the methane stream in a system somewhat parallel to dehydration that brings it in contact with an amine solution. At this stage of development, the Barnett Shale is relatively free of Hydrogen sulfide.



Now we are at a point where we will change our focus to the IR Video aspect of our presentation.

This technology is rapidly becoming a major factor for some facilities in the management of their emissions.

At least one of the gas plants we have visited recently introduced us to a technician whose new full-time job would include IR Videography at different facilities.

Industry Use of IR Video

- If what is leaking is the very product that is being sold, it is predictable producers in this sector are moving toward using the same technology to manage leaks.

Thermal Imaging

Infrared Camera

Process unit with 10,000
Components subject to monitoring

There are in essence two types of IR cameras for industrial applications. Mid Wave and Long Wave.

These are simply looking at different wavelengths of light. The longwave cameras are what most of the handheld temperature measurement cameras are today.

These are lower in cost because they do not have to be cryogenically cooled (i.e. a cooled system).

The GasFindIR has a thermoelectric cooler built in which is why it is called a cooled system.

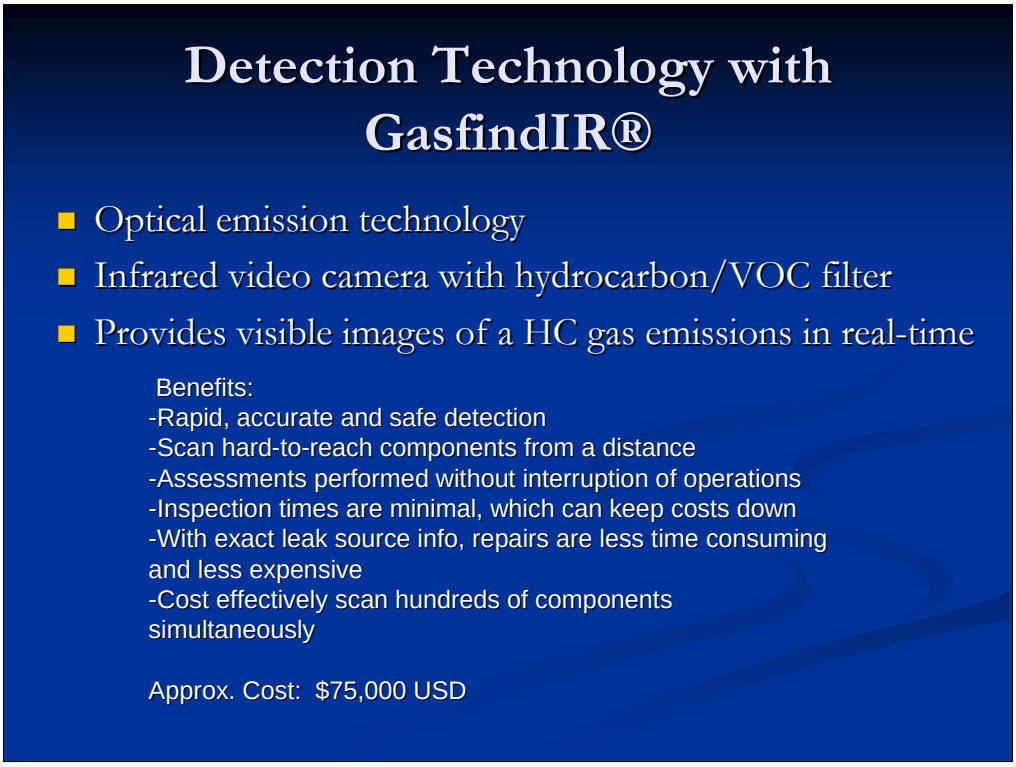
320x240 is the size of the array and InSb is the material that the detector is made of **Indium(III) Antimonide**.

The Cold Filter is what makes the GasFindIR so special. A Mid Wave camera operates from 3-5 microns. With the ~3.25um (3.25 micron) filter, the GasFindIR is tuned to "see" gases. It is tuned to "see" from 3.2-3.4um range which matches well to the portion of the spectrum in which the straight chain alkanes are found.

I might compare this to having special glasses that allow you to see a certain color. If you were wearing glasses that only allowed you to "see" the colors of blue, you would still be able to see everything that is not blue but they would be in black and white. But every little thing that has a small amount of blue in your vision is seen much more easily.

VOC Gas Emissions

- Methane
- Ethane
- Propane
- Butane
- Hexane
- Ethylene
- Propylene
- Benzene
- Toluene
- o-Xylene



The main drawback is, of course, the cost. However, economic studies have been undertaken that show a moderately aggressive program of leak detection can result in a cost recovery to the facility for the price of the camera.

Use of IR Camera in Oil and Natural Gas Industry

Areas of Concern:

- **Tank Hatches**
- **Valves**
- **Compressor Engines**

In this next section, we will show you a series of components that leak and examples of videos showing leaks.


FLIR
HI
MANUAL
WH
1/18/06 2:42:47PM

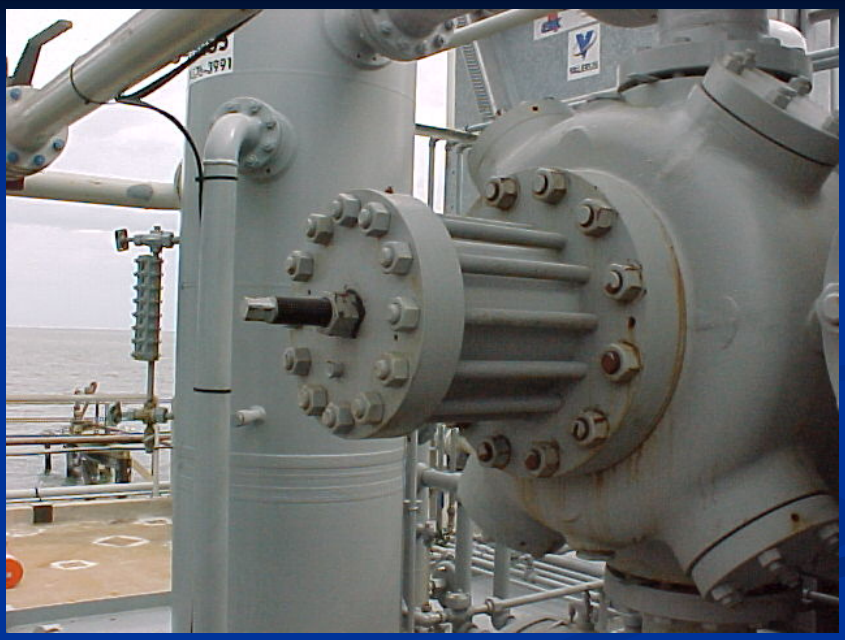
Two components are visible here: a thief hatch and a valve stack, possibly an Enardo Valve. Leaks from the Enardo valve may be permitted, but leaks from the closed hatch may be a problem if the gaskets are worn or the hatch is bent.

In this case it is not really possible at first to tell from this angle and direction exactly what is leaking; however, shortly into the video you will see a reverse in polarity (the camera allows this to help with viewing) and it turned out here that the hatch seals were leaking.

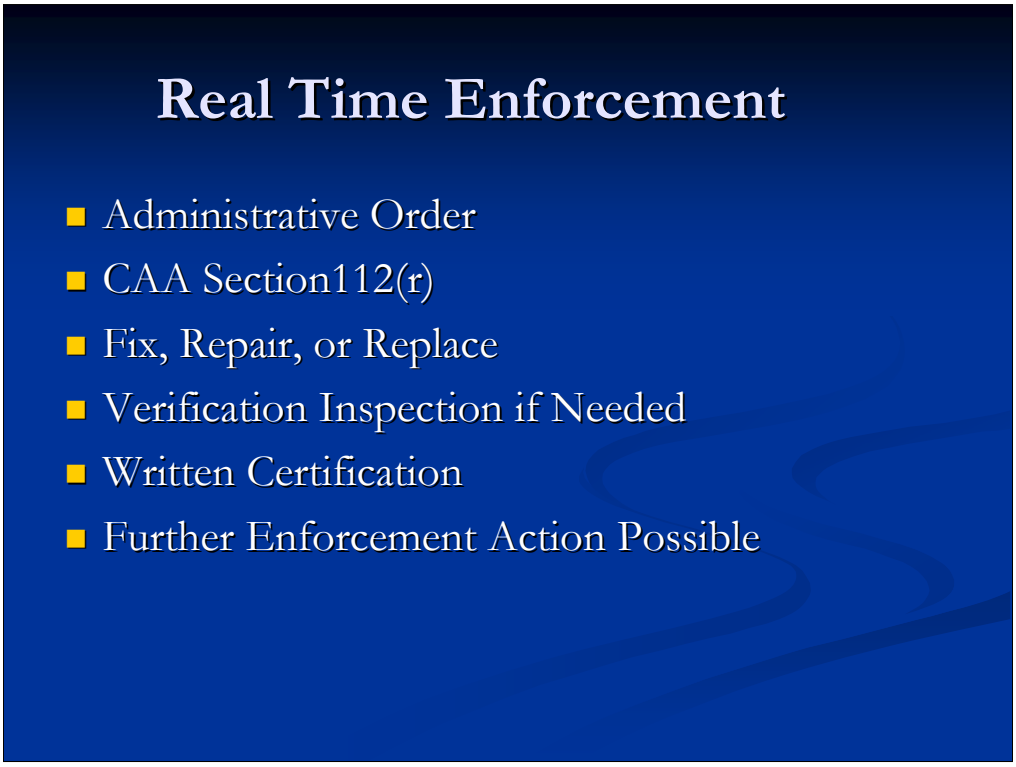
Another example of a hatch with worn out seals.


FLIR
HI
AUTO
HIST
BL
11/27/06 2.55.07PM
Low


FLIR
HI
AUTO
HIST
BL
9/18/07 1.13.57PM




FLIR
ME
AUTO
HIST
WH
2/12/08 1.48.48PM
LOW



The Goal is to stop the leak – stop the air pollution;

Real Time Enforcement is an Administrative Penalty.

If acted upon immediately, the only penalty is fixing the leak. It is resolved at the local level.

The traditional process includes lawyers, fines, referral to the Department of Justice.

Leaks found during an inspection can be fixed quickly and reduce emissions or danger of fire/explosion.

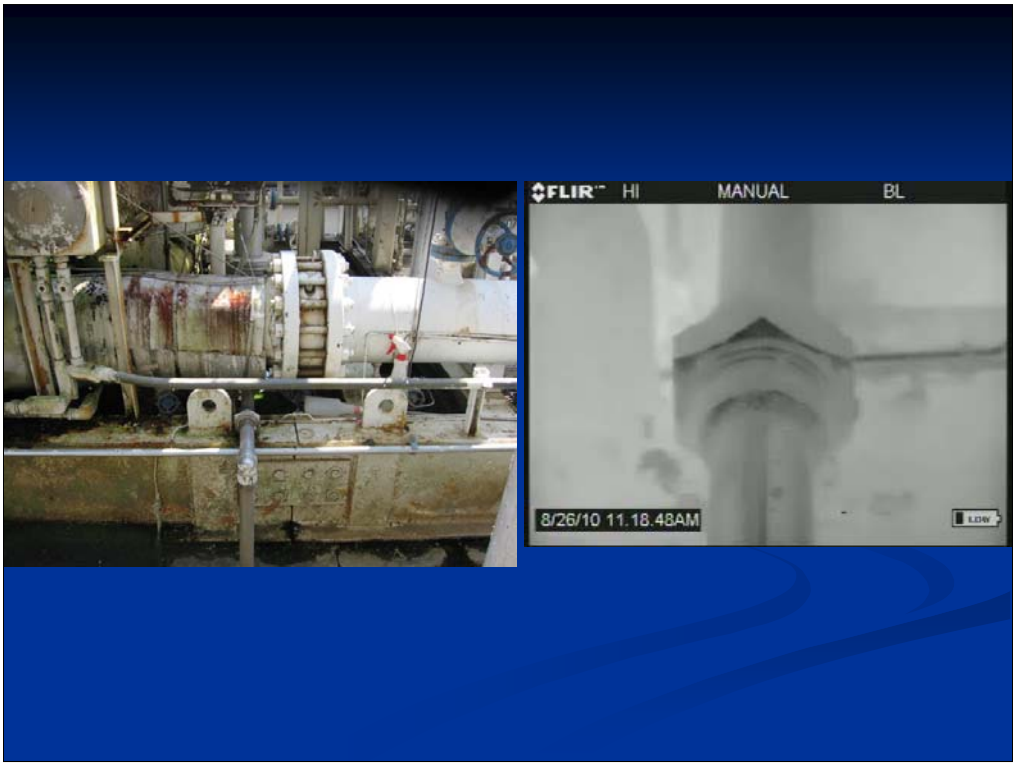
However, it should be noted that If there are serious enforcement issues beyond this, the door is still open to further action including traditional enforcement.

This series shows before and after shots of a leaking thief hatch from a waste tank. An AO was issued and the facility made timely repairs. In the next slide, the after shot, the entire hatch has been replaced but it is possible to tell from the back ground that it is the same tank. In this case the issue was maintenance.

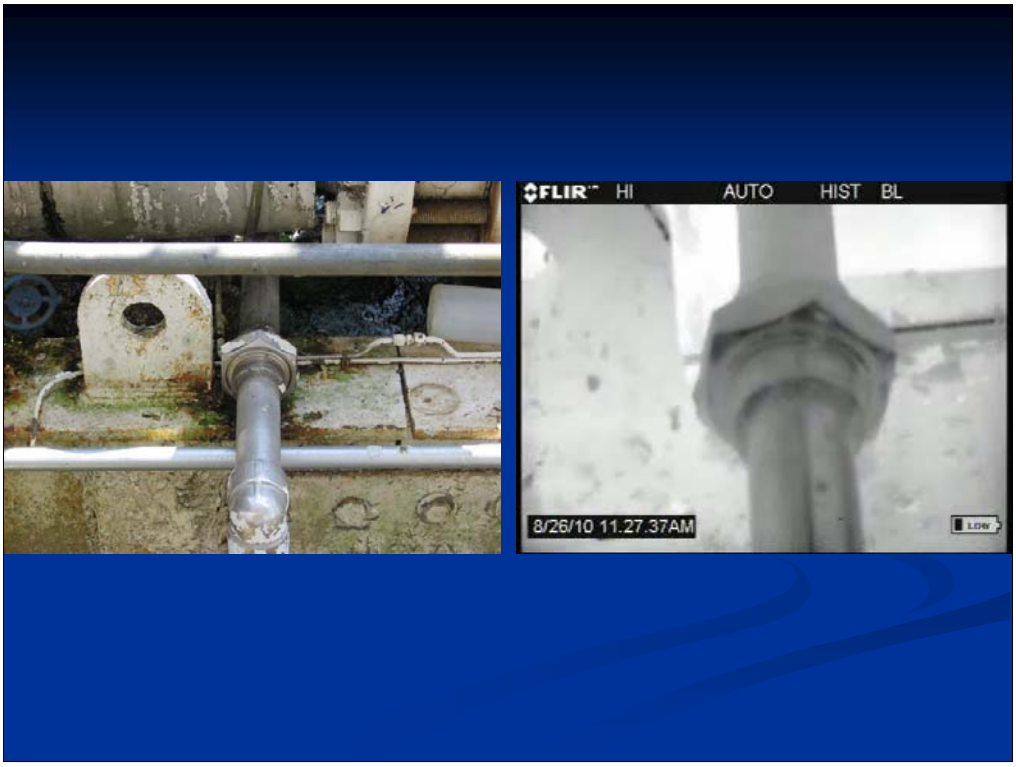
Tank hatch replaced. Although hatch is different background and tank surface can be seen to be the same tank.

This shows a gas compressor leaking methane from a packing vent. The facility's position was that it was the normal way they ran the compressor. The manufacturer disagreed and indicated that the compressor would run properly with the packing vent closed. An AO was issued and the facility complied and fixed the leak. The issue here was design and operation.

After repair.



Last example is of a Fix on the Spot. Leaking Union Joint. Photo taken at same time as the IR Video on the right.



Closeup of Union Joint, previously leaking, after repair. See IR Video to the right. Leak was fixed during inspection and confirmed. No Admin Order was issued.

Summary

- Because the Energy Extraction Sector has seen rapid growth in recent years, EPA is looking at the community level to see if the activities of this sector are negatively impacting human health and the environment.
- Using Infrared cameras, EPA is able to document leaks, maintenance problems and unintended emissions that may result in violations.
- EPA seeks to reduce emissions and limit exposure to the public.
- Toward that end, EPA is moving to increase its presence in this sector, seek cooperative compliance with operators of Energy Extraction facilities and explore new approaches to enforcement.

Sources of information:

U.S. EPA Natural Gas STAR Program

Roger Fernandez 202-343-9386 fernandez.roger@epa.gov

http://www.epa.gov/gasstar/

FLIR Systems

Craig R. O'Neill 866-837-3241 craig.oneill@flir.com

http://www.flirthermography.com/

Hy-Bon Engineering Company, Inc.

Larry S. Richards 432-697-2292

http://www.hy-bon.com

U.S. EPA Region 6 – ONG Coordinators

Tony Robledo 214-665-8182 robledo.tony@epa.gov

Don M. Smith 214-665-7270 smith.donald-m@epa.gov

The Natural Gas STAR Program is a flexible, voluntary partnership between EPA and the oil and natural gas industry. Through the Program, EPA works with companies that produce, process, and transmit and distribute natural gas to identify and promote the implementation of cost-effective technologies and practices to reduce emissions of methane, a potent greenhouse gas.

More Information Sources

- U.S. Energy Information Administration: http://www.eia.doe.gov
- Region 6 EPA Real Time Air Enforcement:
  - http://www.epa.gov/region6/6en/a/oil_and_gas.htm