# 2008 API AST Conference

## An Evaluation of Alternative Methods for Internal Floating Roof Seal Inspection for In-Service Tanks

**Presented By:**
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Tank Industry Consultants, Inc.

# Floating Roof Seal Inspection:

## Introduction

- PRCI* Project
- Internal FR Inspection Presents Challenges
  - How to safely access roof and seals?
  - How to measure seal gaps?
- Update on Seal Inspection Technologies

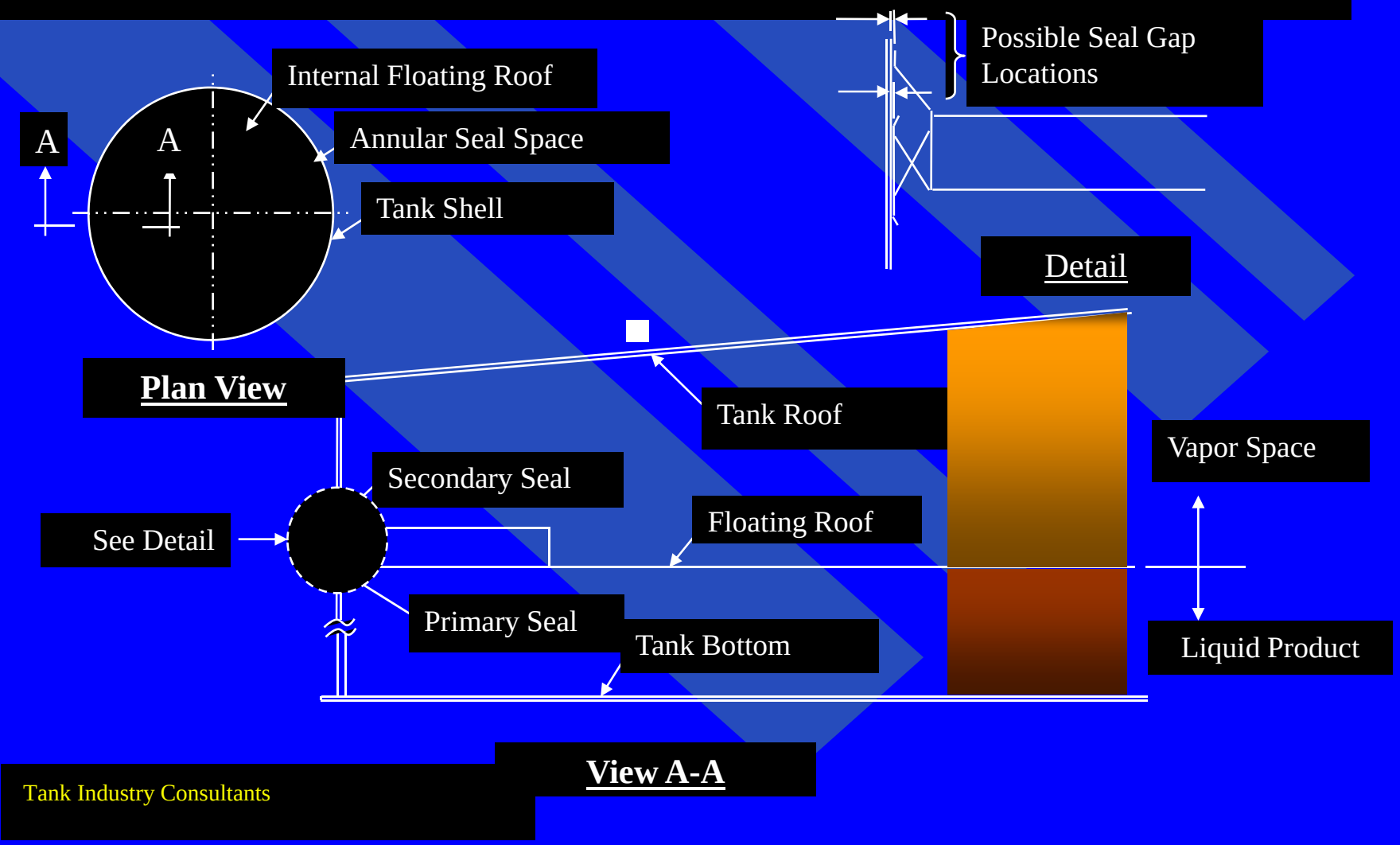
*(Pipeline Research Council International)

# Floating Roof Seal Inspection:

## What is the Issue?

**How does one access the interior of an in-service internal floating roof tank in order to inspect the floating roof and identify and measure any gaps that may exist in the primary and/or secondary seal?**

# Floating Roof Seal Inspection:

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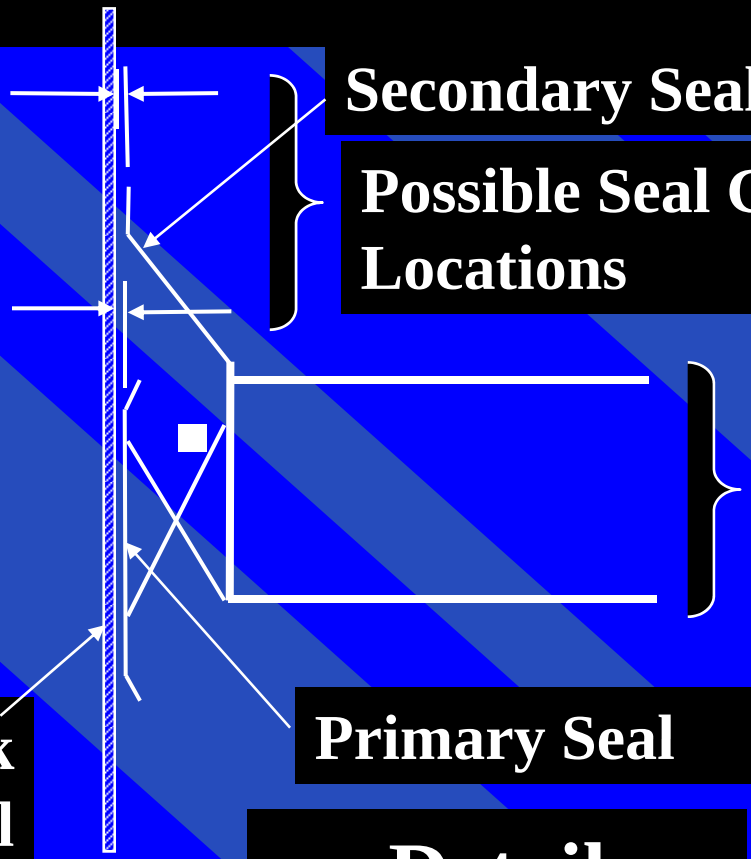
# Floating Roof Seal Inspection:

(Photo Courtesy of Matrix)




**Detail**

# Floating Roof Seal Inspection:

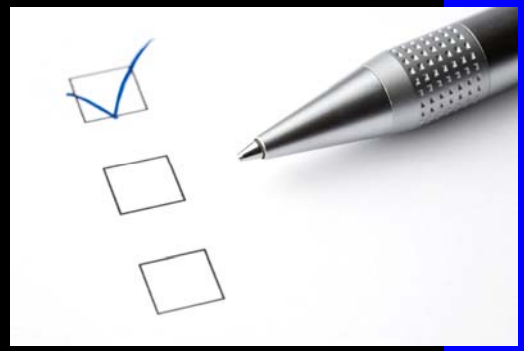
## Background

- What is the PRCI Project?
  - "Review current practices and methods to ensure seals operate correctly and that seal gap can be measured in service or as required".
  - "New techniques for remote or robotic inspection of the seal gaps, needed to assist integrity maintenance efforts and to reduce the exposure of human inspectors to operational hazards, will be investigated".

# Floating Roof Seal Inspection:

## Background

- Internet Search
  - 1200 + Sites reviewed
  - Gap Measurement, Remote Inspection, etc.
- Questionnaires to Identify Current Practices
  - PRCI Member Survey
  - API Tank Owner/Operator Survey
  - API Tank Inspector Survey

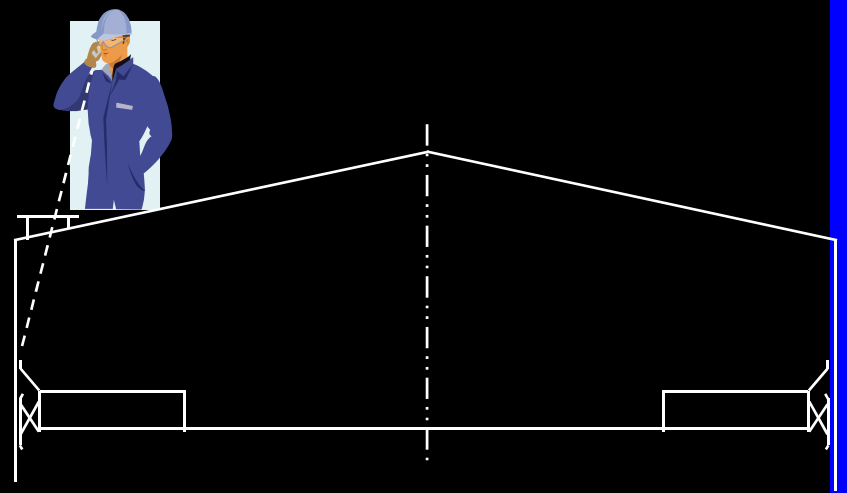


# Floating Roof Seal Inspection:

## Current Practice

- **Most Common Procedures are:**

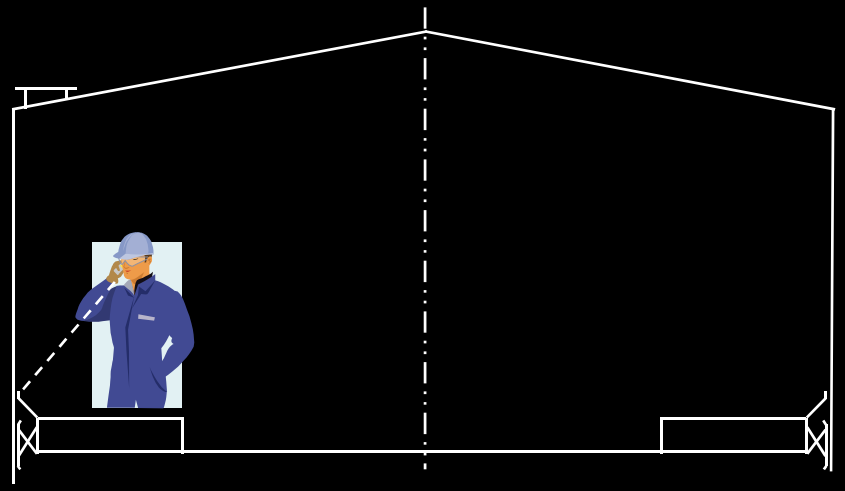
  **1) Visual inspection of the seal through roof openings from the top of the fixed roof. This method does not permit accurate quantitative measurement of the seal gaps, if any exist.**



# Floating Roof Seal Inspection:

## Current Practice

**2) Visual inspection and measurement of the primary and secondary (if present) seals by personnel from the top of the internal floating roof. The secondary seal is typically pulled back away from the shell to allow inspection of the primary seal.**



# Floating Roof Seal Inspection:

## Alternative Technologies

The following technologies were identified as potential candidates for remote/robotic seal gap measurement.

- **Remote Visual Inspection**
- **X-Ray Imaging Devices**
- **Laser-Based Scanning**
- **Hydrocarbon Sensors**

# Floating Roof Seal Inspection:

## Remote Visual Inspection

- Remote visual inspection technology for seal inspection in development since 1993, initially by ARD Environmental.
- BSI is only technology developed specifically for remote seal inspections.
- By 1996, technology was further developed to handle detection of gaps in primary and secondary seals.
  - Quik-Look™ camera for secondary seal, if present, inspection
- In late 1990's, InTank developed technology to measure seal gaps in both primary and secondary seals
  - Otis-G enabled view from bottom of tank

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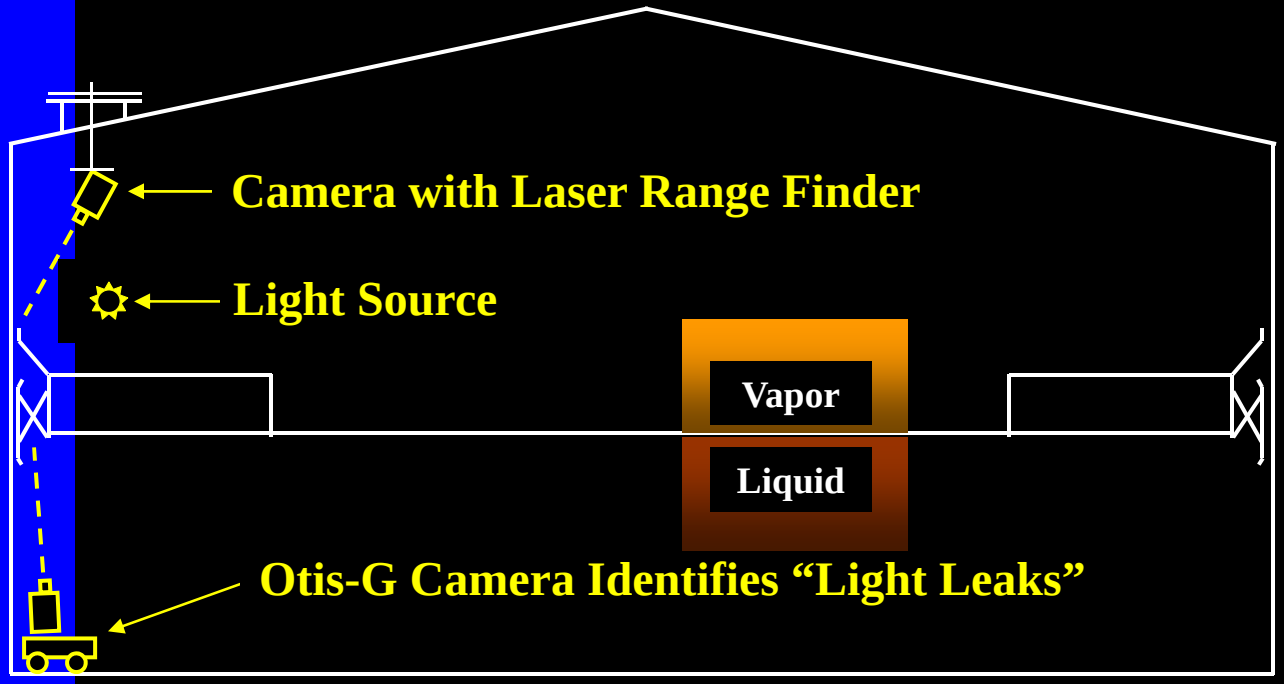
* ARD Environmental → InTank → Berkeley Springs Instruments (BSI)

# Floating Roof Seal Inspection:

# Remote Visual Inspection




Photos courtesy of Berkeley Springs Instruments

# Floating Roof Seal Inspection:

## Remote Visual Inspection

- Some current limitations:
  - Flash point ≥ 100°F
  - Approximate 40 ft range
- Regulatory endorsement of BSI technology received in 2003 from EPA.
- Technology is “on the shelf” and ready to be resurrected for use if industry is interested.

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## Alternative Technologies

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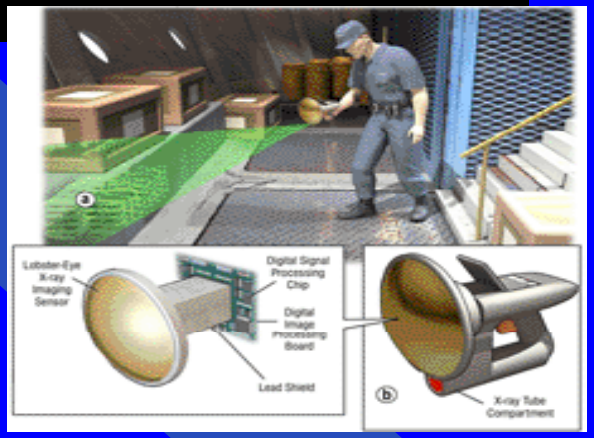
# Floating Roof Seal Inspection:

## X-Ray Imaging Devices

- Lobster Eye X-ray Imaging Device (LEXID™) is a technology that may be well-suited to seal gap detection and measurement.
- Syscor's presentation discusses in more detail how this technology could be applied to seal gap measurement.

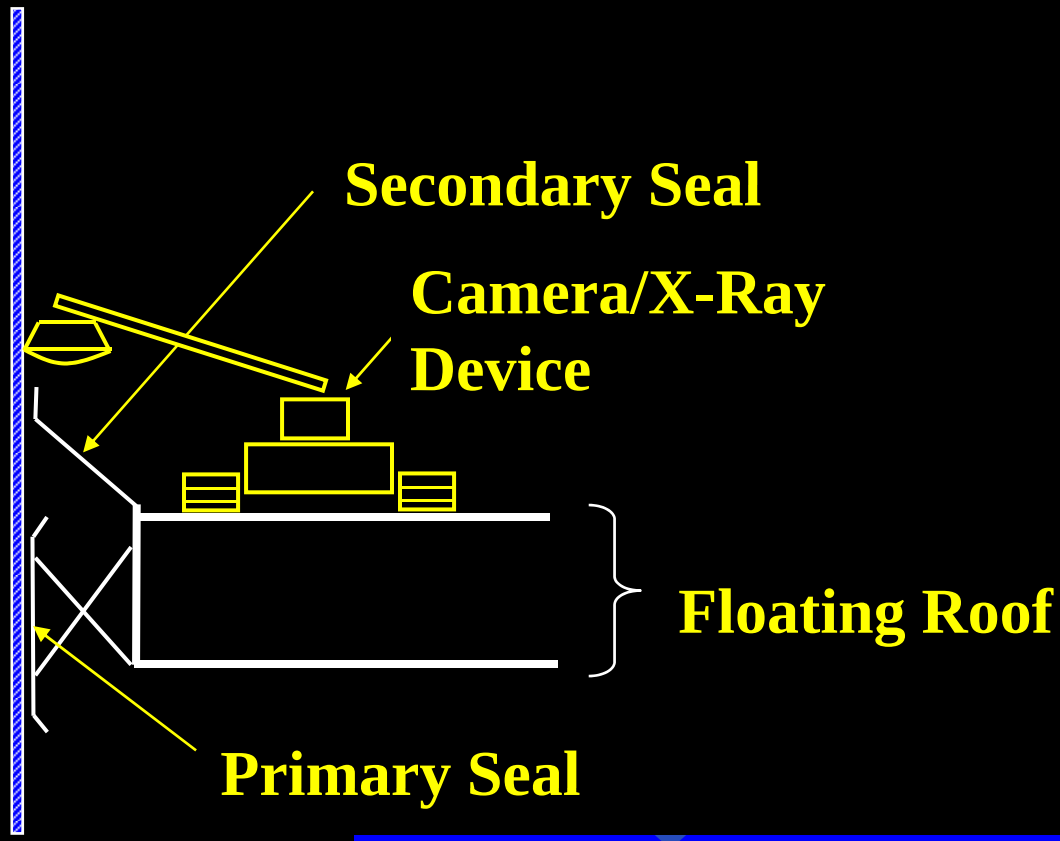




Photos courtesy of Physical Optics Corporation

# Floating Roof Seal Inspection:

# X-Ray Imaging Devices



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# Floating Roof Seal Inspection:

## Laser Based Scanning

- Not to be confused with laser components used in conjunction with other three technologies.
- May be feasible to adapt current laser scanning technology (EWI weld inspection, e.g) to seal gap measurement, but unlikely.
- Greatest obstacle is accessing the primary seal when a secondary seal is present.

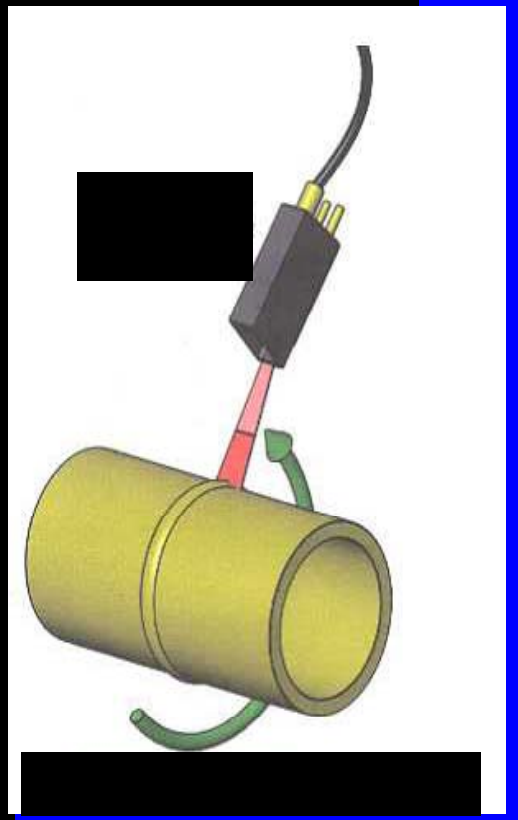

Illustration courtesy of Edison Welding Institute

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# Floating Roof Seal Inspection:

## Hydrocarbon Sensors

- Currently used for detecting and measuring emissions after they have exited the tank.
- Smart Leak Detection And Repair (LDAR)
- AIR Detection And Ranging (AIRDAR)
- DIfferential Absorption Light Detection and Ranging (DIAL)

# Floating Roof Seal Inspection:

## Hydrocarbon Sensors

- Will not directly measure seal gaps
- Probably not suited for this purpose

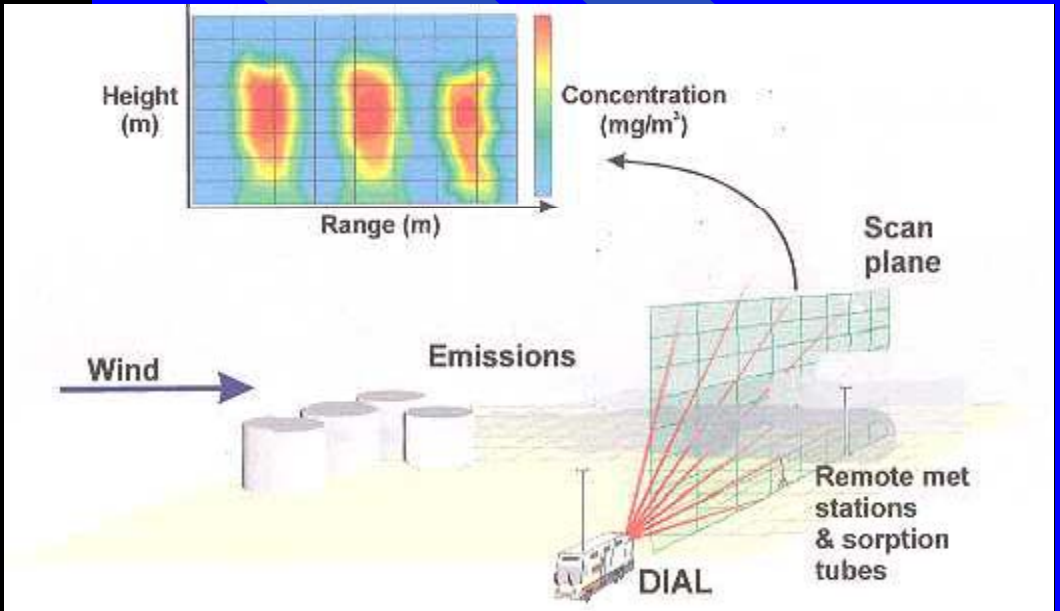


Figure 1: Schematic of DIAL System Measuring Emissions (figure courtesy of Spectrasyne Ltd., UK)

# Floating Roof Seal Inspection:

# Comparison of Technologies

| | Remotely Operated Camera | X-Ray Imaging Device | Laser-Based Scanning | Hydrocarbon Emission Sensors |
|---|---|---|---|---|
| Ability to identify gaps in both primary and secondary seal? | YES (1) | YES | NO | NO |
| Ability to measure gaps in both primary and secondary seal? | YES (1) | YES | NO | NO |
| Ability to safely operate in hydrocarbon vapor space above floating roof | YES | YES | YES | YES |
| Ability to operate immersed in liquid fuel environment? | YES (2) | N/A (3) | NO | NO |

(1) When used with laser accessory, light source above roof and immersion-service camera.
(2) OTIS-G is the only device capable of operating immersed in gasoline.
(3) Not applicable because immersion service is not required.

# Floating Roof Seal Inspection:

## What's Next?

- Industry must decide "what we want", i.e.:
  - Identify new technologies and/or advance emerging technologies to implement safer, potentially more cost-effective procedures for inspecting internal floating roof seals? . . . or
  - Continue to rely on current technology for these inspections?
  - Answer will depend on cost/benefit analysis and reliability of alternative technologies and regulatory requirements.

# Floating Roof Seal Inspection:

## What's Next?

- Some Recommendations for consideration:
  - Two technologies show promise and merit further study:
    - Remote Visual Inspection with Cameras
    - X-Ray Imaging
  - Seal gap measurement case to compare two technologies in terms of:
    - Costs, compared to each other and current practice
    - Relative advantages, disadvantages and limitations

# Floating Roof Seal Inspection:

## Summary

- This has been an overview of the PRCI study.
- More information is available from the speaker on the specific technologies.
- Anyone with additional knowledge is encouraged to share it with PRCI.
- Much work remains to develop the optimal path forward.

# Floating Roof Seal Inspection:

# Floating Roof Seal Inspection:

Thank you!

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