BEST PRACTICES IN LEAK DETECTION AND REPAIR (LDAR) PROGRAMS

November 06, 2014

By: François Thibodeau, Eng.

PRESENTATION OVERVIEW

1. Essential Components of a LDAR Program
2. LDAR Best Practices
   a. A Good Start
   b. Chemical Compounds of Interest
   c. Potential Leak Sources
   d. Identifying Components
   e. Accepted Leak Detection Methodologies
   f. Repair and Follow-up Programs
   g. Reporting
   h. QA/QC
   i. Database and Software
   j. Audits
3. Discussion and questions

LDAR BEST PRACTICES

A GOOD START

A good LDAR program should start with a document specifying regulatory requirements and facility-specific procedures for component identification, monitoring, repairs and record keeping.

It should establish:

- The objectives of the program and how to measure its success
- The scope of the program
- The roles and responsibilities of personnel involved
- The training program for personnel involved
- The procedures for leak identification, tracking and repair
- The procedure for maintaining and updating the database

CHEMICAL COMPOUNDS OF INTEREST

The purpose of a LDAR program is to control and to reduce process fugitive emissions of pollutants to the atmosphere

- **Traditionally: VOCs, HAPs and more recently GHGs**
- **The same kind of program could be used to control and reduce fugitive emissions of any other substance, as long as there is a way of detecting leaks (ex: toxic, dangerous, valuable, etc.)**

POTENTIAL LEAK SOURCES (1 of 2)

LDAR programs usually include the following sources:

- Pump seals
- Compressor seals
- Agitator seals
- Valves
- Flanges
- Connectors
- Open-ended lines
- Pressure relief devices
- Sampling connections

POTENTIAL LEAK SOURCES (2 of 2)

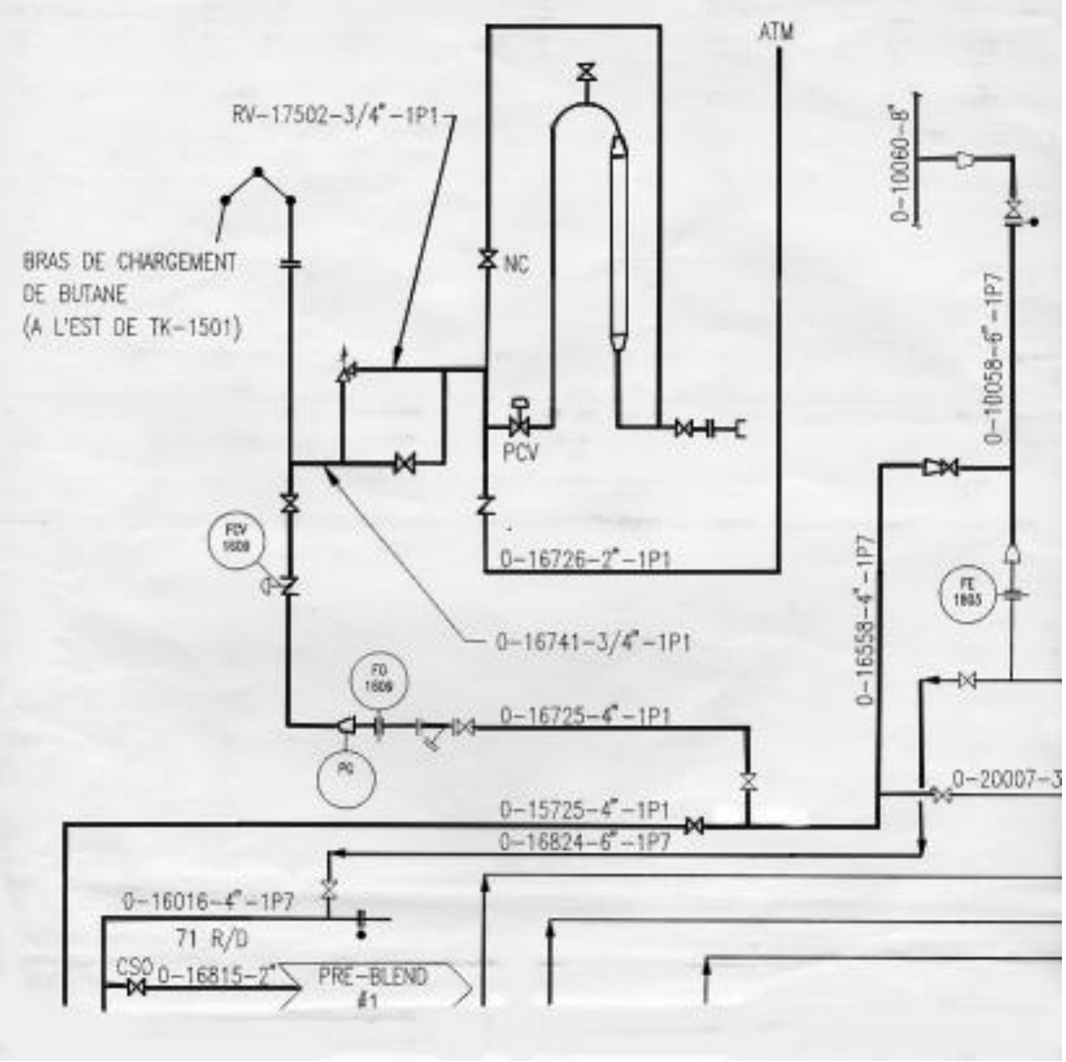
- Exemptions (CCME)
  - Stacks
  - Vents
  - Combustion systems
  - Storage tanks
  - Open storage piles
  - Ponds
  - Sludge drying beds
  - Cooling tower sumps
  - Wastewater separators

- Components in vacuum service
- Components in heavy liquid service
- Components that are of “leakless” design
- Inaccessible components
- Valves smaller than ¾ inch
- Valves that are not externally activated (i.e. check valves)

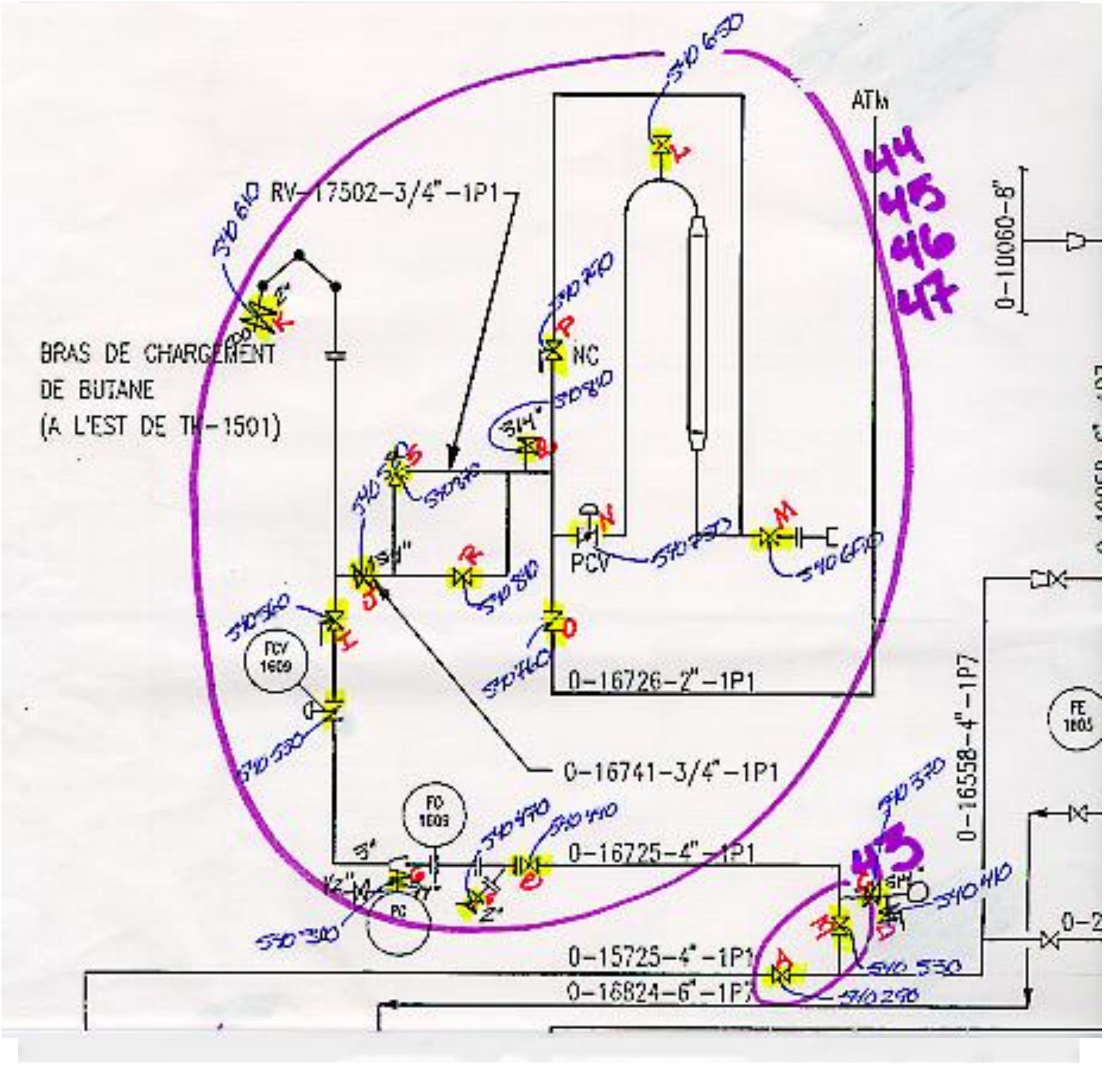
IDENTIFYING COMPONENTS (1 of 5)

- **Unique ID number for each component**
- **Verify with process diagrams and data**

IDENTIFYING COMPONENTS (2 of 5)



IDENTIFYING COMPONENTS (3 of 5)

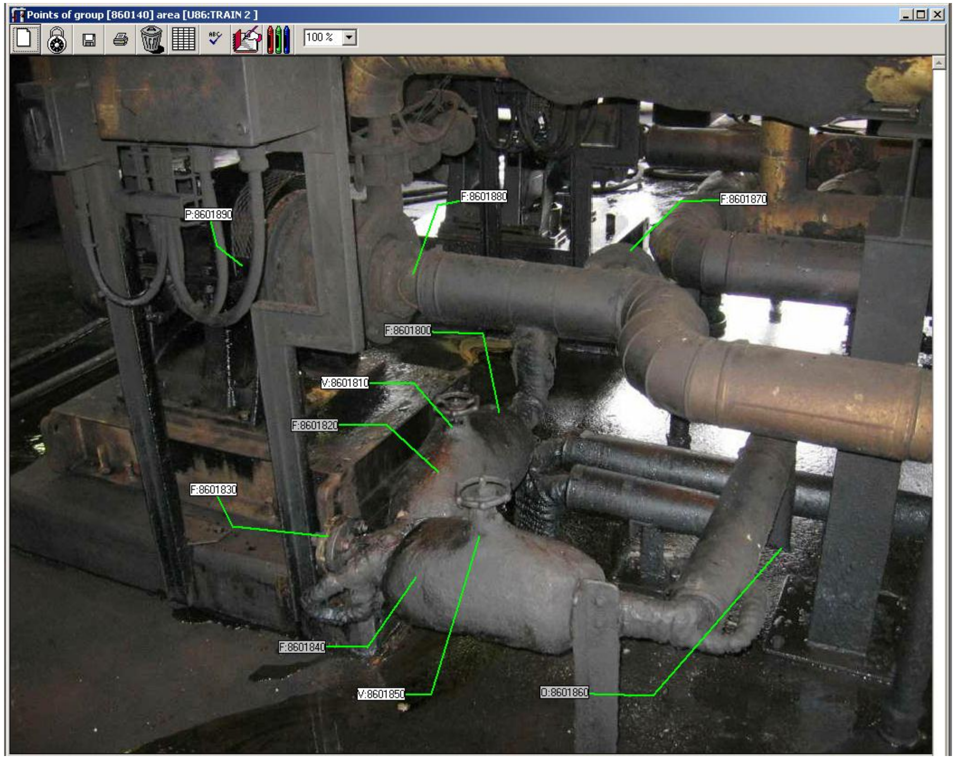


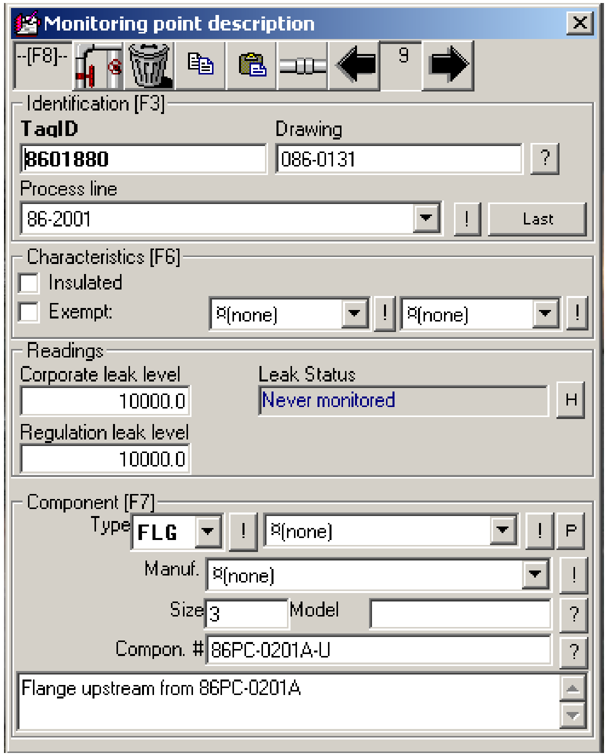
IDENTIFYING COMPONENTS (4 of 5)

- **Positively identify on site**
- **Record relevant information about each source**

IDENTIFYING COMPONENTS (5 of 5)

- **Database must be updated with new or modified equipment, or when it is taken out of service**
- **Periodic field audits should be performed**





ACCEPTED LEAK DETECTION METHODOLOGIES (1 of 5)

• U.S. EPA Method 21
(portable VOC analyzer)

• Alternate work practice
(IR Camera or others)

ACCEPTED LEAK DETECTION METHODOLOGIES (3 of 5)

EPA Method 21 Monitoring

- Response factors <10
- Calibration precision <10%
- Response time <30 sec
- Calibrations needed every monitoring day and periodic checks (logs)
- Calibration gases: at least zero air and span = leak definition
- Subtraction of background
- Monitor with probe at the surface
- Locate maximum value and monitor for 2x response time (response time is typically 3.5 sec)
- Trained technicians under management of competent supervisor
- Periodic audits

ACCEPTED LEAK DETECTION METHODOLOGIES (5 of 5)

Alternate Work Practice (IR Camera)

- Must be capable of imaging compounds that are regulated in the stream
- Must provide an image of the leak and the leak source
- Must meet a minimum detection sensitivity mass flow rate
- Conduct a daily check
- Keep records of detection sensitivity level used, analysis for determination of lowest mass fraction emission rate, daily checks and video record of leak survey
- Repair checks with the same detection technology
- At least one Method 21 monitoring per year
- Trained technicians under management of competent supervisor
- Periodic audits

REPAIR AND FOLLOW-UP PROGRAMS

- Complete repairs as soon as practicable
- First attempt can easily repair over half of the leaks
- Check for success right away, but also after a few days
- Failed attempts ⇨ schedule for maintenance
- Keep records of all repair operations on each specific leak
- Analyze data to detect chronic leakers
- Consider replacing chronic leakers with “leakless” design components

REPORTING

- Typical reports : Leak reports, report of periodic or annual emissions, compliance reports
- Leak reports for the plant maintenance personnel
  - ID number, location, process fluid, repair history, etc.
- Annual emissions and compliance reports for the regulating authority
  - Emission calculation method used
  - Emissions detailed by component type, chemical species, process unit, etc.
  - Leak frequencies (by component and process unit)
  - Leaks found, repaired, and postponed
  - Results of internal audits and other QA/QC procedures

QUALITY ASSURANCE AND CONTROL (1 of 11)

- **Important to ensure that monitoring method and LDAR procedures are being followed in order to achieve emissions reduction**
- **Should include:**
  - **Internal and third-party audits**
  - **Written procedures for: source identification; monitoring; leak identification; repairs and follow-up; database updates; emission calculations.**
  - **Daily reviews/sign-off of monitoring data by LDAR supervisor**
  - **Process for evaluating chronic leakers**
  - **Recordkeeping**
  - **Training**

QUALITY ASSURANCE AND CONTROL (2 of 11)

- Internal audits
  - Review records, logs and database on a regular basis
  - Verify that all applicable process components are identified for monitoring
  - Verify that all leaks are being repaired within expected timeframes
  - Review calibration and monitoring
  - Review daily monitoring logs:
  - Trigger corrective measures as soon as possible
  - Frequency of internal audits has to be adjusted to the processes audited. Daily operations should be audited more often than monthly operations.

QUALITY ASSURANCE AND CONTROL (3 of 11)

- **Written procedure for source identification**
  - **Specify equipment and process parameters for inclusion in the LDAR program**
  - **Describe what documentation will be used (PFD, P&ID, etc.) and how sources will be identified**
  - **List responsibilities for implementation and verification**
  - **Identify exemptions**
  - **Specify which software is used**
  - **List information to be included for each source**

QUALITY ASSURANCE AND CONTROL (4 of 11)

- **Written procedure for monitoring**
  - **Monitoring equipment to be used**
  - **Training required**
  - **Calibration procedure**
  - **Monitoring procedure**
  - **Recordkeeping**
  - **Health and safety recommendations**
  - **Information on specific process units**
  - **Standardized forms for calibration, recordkeeping, etc.**

QUALITY ASSURANCE AND CONTROL (5 of 11)

- Written procedure for leak identification
  - Clearly define criteria to declare leaks
  - Instructions on how to identify leaks on site and in database
  - Good practice to apply a clearly visible leak tag

QUALITY ASSURANCE AND CONTROL (6 of 11)

- Written procedure for repairs and follow-up
  - Specify requirements regarding delay of repairs, acceptable repair methods, re-inspection procedure and recordkeeping
  - List steps of the repair process and establish responsibilities

QUALITY ASSURANCE AND CONTROL (7 of 11)

- **Written procedure for database updates**
  - **Establish responsibilities to keep the database updated with changes made in the plant**
  - **Create communication channels between plant departments to inform of changes**

QUALITY ASSURANCE AND CONTROL (8 of 11)

- **Daily reviews and sign-offs should check for:**
  - **Number of sources monitored per day per technician**
    - Method 21: should normally be between 300-600
  - **Time between readings**
    - Should never be below 10 seconds
    - On average in a day, should be between 30 and 60 seconds, or more
  - **Abnormal data patterns**
    - Bursts of readings
    - Severalhigh readings after a leak was found
    - Etc.
  - **Calibration data**
    - Calibration and verification times (beginning and end of day)
    - Calibration drift (<10%)
    - Calibration gases used
    - Etc.

QUALITY ASSURANCE AND CONTROL (9 of 11)

- Evaluation of chronic leakers
  - After several monitoring cycles, it becomes possible to detect specific components that tend to leak more often
  - Should take place at least once a year
  - Chronic leakers usually show that the equipment or seal or gasket used is not suitable for this particular application
  - Special action should be taken where possible to eliminate chronic leakers (more frequent monitoring, component replacement, use of alternate sealing technologies, etc.)

QUALITY ASSURANCE AND CONTROL (10 of 11)

- Recordkeeping
  - Procedures
  - Signed and dated reports of QA/QC activities
  - Daily calibration forms
  - Database of identified components, leaks found, repairs completed, etc.
  - List of chronic leakers and action taken
  - Audit reports and corrective actions
  - Annual report of fugitive emissions

QUALITY ASSURANCE AND CONTROL (11 of 11)

- Training
  - Important that all personnel involved have a sound understanding of all procedures
  - At a minimum, there should be an internal training program in place
  - To our knowledge, no training is currently available in Canada, at least on a regular basis. Specific training can be provided by some LDAR specialists on demand.
  - Training sessions are available from U.S. EPA and private companies.

DATABASE AND SOFTWARE

- **Considering the very large amount of data necessary to maintain a LDAR program, it is highly recommended to use a reliable LDAR software.**
- **Database will guarantee data integrity and collects all relevant information in the same place.**
- **Facilitates data analysis, recordkeeping, repairs and follow-up management, QA/QC, emission calculations and reporting.**

AUDITS (1 of 5)

- **Evaluation of LDAR programs can solely be done through review of reports only, but including on-site inspections is a much more reliable way to verify the overall quality of the program**
- **U.S. EPA's enforcement alert (October 1999): monitored 47,000 valves in 17 refineries. Results showed:**
  - **Leak rates significantly higher than reported (5.0% vs 1.3%)**
  - **Emissions significantly higher than reported (1.3 t/hr vs 0.5 t/hr)**
  - **Failure to follow monitoring method adequately**
  - **Estimated that monitoring at only 1 cm away from component instead of at the interface would result in missing 57% of leaks on valves !**

AUDITS (2 of 5)

Important factors that contribute to failure of detecting and permanently repairing leaks:

1. Not identifying all potential leak sources
2. Not monitoring components
3. Insufficient time spent detecting leaks
4. Incorrect positioning of probe
5. Failing to properly maintain and/or operate monitoring instrument
6. Incorrectly exempting components from monitoring
7. Unnecessarily postponing repairs
8. Inadequate repair follow-up

AUDITS (3 of 5)

Common shortcomings

- Personnel with insufficient LDAR training or knowledge
- Parts of the process omitted
- Insufficient documentation for exempted components
- Database not updated with recent plant modifications
- Incomplete calibration records
- Improper calibration gases (expired, incorrect concentration, wrong compound)
- Incorrect calibration procedure (warming period, beginning and end of day (minimum), drift calculation, etc.)

AUDITS (4 of 5)

Common shortcomings *(cont'd)*

- Too many components monitored in one day
- Incorrect probe positioning
- Insufficient time to detect leaks
- Not measuring the background
- Failing to monitor at the maximum leak location
- Not monitoring all potential leak interfaces

AUDITS (5 of 5)

Common shortcomings *(cont'd)*

- Leaks not reported in a timely manner for repairs
- No follow-up on repairs
- Incorrect verification of repairs
- No evaluation of chronic leakers
- Improper application of emission calculation techniques
- Inadequate or missing QA/QC procedures
- Insufficient recordkeeping

REFERENCE

François Thibodeau, Eng.

514-393-1000

francois.thibodeau@snclavalin.com

DISCUSSION AND QUESTIONS

Thank you!