Residential Fuel Oil Distribution Systems

An analysis of risk and loss prevention initiative

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Residential Fuel Oil Distribution Systems
An analysis of risk and loss prevention initiatives

1.0 Purpose and Scope of Work

Although the fuel oil storage tank has been the focus of loss prevention initiatives in the past, it is but one component in the fuel distribution system and fuel releases are not solely attributable to the storage tank. It is therefore important to examine the entire fuel oil distribution system including fuel lines, filters, valves, connections etc.

Inspection of the fuel oil distribution systems based on the risk to the environment is important to insurers, homeowners and regulators for different reasons. To the property insurance carrier the scope is loss prevention and reduction in claims. To the homeowner, is the conservation of the environment, retention of property value and undisrupted enjoyment of the home. To regulators, minimizing and eliminating releases which impact the environment and are a health safety hazards.

The purpose of this study is to provide useful information about residential fuel oil storage tanks, current code requirements and a critical assessment of underwriting practices. The current CAN/CSA-B139 standard has been used as reference as has Spectius’ experience with large scale underwriting residential fuel oil storage tank projects. The Canadian Oil Heat Association, R.S. Consulting, Datanet Engineering, Boston Environmental and a number of Canadian scientific studies relating to fuel oil tank failure have been consulted.

1.1 Background

When domestic fuel oil spills happen, the results can be disastrous for the homeowner and for the environment. Spills from indoor fuel oil tanks can cause extensive damage to the home and its contents and the presence of harmful vapours can make the home unliveable for a considerable period of time. Spills from outdoor fuel oil tanks often result in the contamination of soil and groundwater and can enter sewer systems. Fuel oil fumes can infiltrate homes through the sewer system, basement floor or foundation walls. The cost of clean-up can vary from tens of thousand dollars to more than the value of the property and groundwater can be rendered unusable for 20 years or more. Even when affected properties have been properly cleaned up and restored it must be disclosed in the real-estate Agreement of Purchase and Sale. The result is often a significant decrease in the property values because of perception of “damaged goods”.
2.0 Nature of the Problem

Traditionally, the domestic fuel oil tank has been a single wall metallic tank which can be purchased for under $400. Total installation including piping and fittings can average $1,800. In Canada, domestic fuel oil tanks must be manufactured, tested and certified in compliance with a Standards Council of Canada approved testing agency, such as the Underwriters Laboratories of Canada. The traditional domestic fuel oil tank has not changed significantly for more than 50 years other than reducing the gauge (10 or 12 to 14). The tanks are constructed from hot-rolled carbon steel with no interior pre-treatment for corrosion resistance or removal of mill-scale. After construction, the exteriors of the tanks undergo preliminary corrosion-resistance treatment, which usually consists of removal of mill-scale with a phosphate wash and application of a primer. Most residential tanks have a 900 litre (200 gallons) or 1140 litre (250 gallon) capacity and are connected to the furnace by copper tubing with an in-line fuel filter. The tanks are normally installed either in the basement of the home or outside the home.

Variations on the metallic tank, such as stainless steel tanks and the incorporation of polyethylene linings into metal tanks, have also been introduced to the market over the years but also at a substantially higher cost. For those who can afford a more expensive tank, solutions to the corrosion problem already exist. The reality is that most people (in Canada) are unable or unwilling to accept a dramatically increased price for the purchase of a domestic fuel oil tank keeping in mind that most European governments have banned single steel wall tanks for domestic fuel oil storage since the early 1970s. Unfortunately, the Canadian regulations and marketplace has not reacted as quickly.
2.1 Distribution System Failure

It is important to note that the tank is but one component in the fuel distribution system and that fuel releases are not only attributable to the storage tank, but also other components which include fuel lines, filters, valves, connections as well as human error during the filling process. Rupture of fuel lines caused by the impact of weather, such as falling ice or snow, is also a common cause of sudden catastrophic leaks.

Other less prevalent causes include manufacturing defects, installation errors, vandalism and toppling of tanks because of unstable bases or impact from vehicles or weather.

The tank is but one component in determining the integrity of the fuel distribution system. Corrosion induced failure of single wall steel tanks accounts for only 45% of the releases and 29% are attributed to fuel lines failure.
2.2 Corrosion of single wall steel fuel oil tanks

Corrosion is a precursor to fuel oil storage tank failure. Exterior surface corrosion is common in many installations. Corrosion induced failure is the most common cause of leaking fuel oil tanks. Most domestic oil tank failures are a result of corrosion from the inside of the tank rather than the outside of the tank. A corrosive sludge can develop at the inside bottom of oil tanks by the condensation and accumulation of atmospheric moisture. With the exception of the “underbelly” of the tank, upper interior surfaces of the tanks are often largely in reasonably good condition, exhibiting light surface corrosion or being corrosion free.

Some tanks exhibit a band of corrosion along the very bottom of the interior and is a characteristic signature of the presence of water and/or corrosive sludge. In many cases, there is severe corrosion and many corrosion pits within this band.

2.3 Microbial Influenced Corrosion (MIC)

The corrosive effects of microorganisms as well as their detection and remediation have been extensively studied during the 20th century. Microbial corrosion of a substance occurs at the interface between the biofilm and surface of the substance as a direct result of microbial activity. Microorganisms do not introduce a new corrosion mechanism but rather accelerate (influence) the chemical and electrochemical corrosion kinetics that results in Microbial Influenced corrosion (MIC).

Metal systems that store and distribute fuels are at risk for internal corrosion due to the corrosive nature of microbial wastes as well as chemical compounds present in the biofilm that damage or deplete the metal’s protective oxide layer making the metal surface vulnerable to corrosion.

MIC Corrosion on Heating Oil Tank

Microbiological Induced Corrosion (MIC) resulted in penetration of this Steel Heating Oil Storage Tank within 4 years. Most commonly the microbes are found to be Sulphate Reducing Bacteria (SRB) which generates a highly acidic environment within and under the colony. Source: Bushman & Associates, Inc.
2.4 Ultra-low-sulphur Fuel Oil (ULSFO)

A potential corrosion problem with ULSFO may seem paradoxical, given that hydrotreating No. 2 fuel oil tends to destroy organic acids that could, if present in high-enough amounts, cause corrosion in fuel delivery systems, as Chevron pointed out in its 1998 manual, "Diesel Fuels Technical Review."

"Ultra-low sulphur fuels can lose natural antioxidants that help prevent the fuel from forming gums and sludges. A fuel's antioxidation properties are particularly important in modern fuel systems, where the fuel is exposed to higher operating temperatures. Ultra-low sulphur fuels can also be more corrosive than conventional fuels, requiring corrosion-inhibiting additives." "...Hydrotreating to produce ULSD can certainly affect the fuel's lubricity, anti-corrosive, anti-oxidant and conductivity properties.\(^v\)

Fuel oil used for the heating of homes is slightly heavier than diesel fuel but shares similar properties and is considered a middle distillate as diesel is. Fuel oil for residential use produces approximately the same amount of BTUs as diesel and has a low volatility which makes it ideal for residential heating. In some colder regions, diesel fuel is used in residential heating systems as it performs better in cold environments.
3.0 Fuel Oil Usage Statistics

3.1 Households that Use Oil in Canada

The following table lists the approximate number of households in Canada by province where oil is used as the primary fuel for heating and or domestic hot water use.

<table>
<thead>
<tr>
<th>Province / Territory</th>
<th># Households heating with oil</th>
<th>% Households heating with oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>NF</td>
<td>55,210</td>
<td>28.0%</td>
</tr>
<tr>
<td>PE</td>
<td>36,132</td>
<td>68.0%</td>
</tr>
<tr>
<td>NS</td>
<td>207,262</td>
<td>55.0%</td>
</tr>
<tr>
<td>NB</td>
<td>50,313</td>
<td>17.0%</td>
</tr>
<tr>
<td>PQ</td>
<td>350,828</td>
<td>11.0%</td>
</tr>
<tr>
<td>ON</td>
<td>318,852</td>
<td>7.0%</td>
</tr>
<tr>
<td>MN</td>
<td>8,078</td>
<td>1.8%</td>
</tr>
<tr>
<td>SK</td>
<td>24,003</td>
<td>6.2%</td>
</tr>
<tr>
<td>AL</td>
<td>22,612</td>
<td>1.8%</td>
</tr>
<tr>
<td>BC</td>
<td>82,158</td>
<td>5.0%</td>
</tr>
<tr>
<td>YT</td>
<td>7,821</td>
<td>62.0%</td>
</tr>
<tr>
<td>NT</td>
<td>9,908</td>
<td>69.6%</td>
</tr>
<tr>
<td>NV</td>
<td>7,831</td>
<td>99.7%</td>
</tr>
<tr>
<td>CANADA</td>
<td>1,181,007</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

Source: Statistics Canada

3.2 Ratio of interior v. exterior tanks in Atlantic Canada

The approximate ratio of interior tanks to exterior tanks is 46:54

<table>
<thead>
<tr>
<th>Estimated number of interior tanks</th>
<th>Estimated number of exterior tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>187,531</td>
<td>220,145</td>
</tr>
</tbody>
</table>

3.3 Gauge of tank

Over 85% of the tanks manufactured in Canada in the last 25 years have been 14 gauge in part to decrease production costs. Therefore these represent the majority of the tanks installed and currently in service.

3.4 Age of tanks

An analysis of completed projects reveals the median age of fuel oil tanks to be 9 years, 8 months. (Just under 10 years)
4.0 Fuel Release Statistics

Out of approximately 1,181,000 homes with oil tanks, the insurance industry derives approximately $1.2 billion in premium. Based on extensive inspection data, approximately 625,933 installations are non-compliant with CAN/CSA B139 and approximately 72,277 tanks fail ultrasound testing. Based on an average of $65,000 per clean-up, the potential exposure on failed tanks could amount to over $4.5 billion.

4.1 Insurance Statistics

Out of approximately 1,181,000 homes with oil tanks, the insurance industry derives approximately $1.2 billion in premium. Based on extensive inspection data, approximately 625,933 installations are non-compliant with CAN/CSA B139 and approximately 72,277 tanks fail ultrasound testing. Based on an average of $65,000 per clean-up, the potential exposure on failed tanks could amount to over $4.5 billion.
5.0 Factors considered in traditional underwriting practice

5.1 Age of tank

Unfortunately, there is no published data identifying older tanks as the sole contributing factor to fuel releases nor is there direct correlation between older tanks and releases. However, the age of the entire fuel delivery system and regulations in effect at time of installation can be a contributing factor in releases.

Furthermore, older tanks were often installed in the basement of the home which has since been finished as living space. Tanks must be cut apart to be removed and the new tank installed outdoors exposing it to additional environmental factors that can cause failure of the system. *(Refer to section 5.3)*

5.2 Gauge of tank

In the US the minimum acceptable thickness for a single wall steel tank manufactured under UL-80 guidelines is 12 gauge. (2.5mm) In Canada the minimum acceptable thickness for a single wall steel tank manufactured under ULC-S602 is 14 gauge (2.0mm) or 25% thinner than its US counterpart.

Given the difference in thickness, it is believed that 12 gauge tanks last longer than 14 gauge tanks. In theory, this would be true if both tanks were subject to the exact same rate of degradation. However, the rates of degradation vary significantly from one installation to another and a 12 gauge tank could be subject to factors such as Microbial Influenced Corrosion (MIC) that would cause it to fail more rapidly than a 14 gauge tank that is not subject to MIC.

5.3 Interior v. Exterior Tank Installations

<table>
<thead>
<tr>
<th>Exterior Tank Installation</th>
<th>Interior Tank Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left unprotected from the elements the exterior tanks will deteriorate at a faster rate.</td>
<td>Remain in better condition on average depending on ambient conditions and humidity level of the basement.</td>
</tr>
<tr>
<td>Occurrence of condensation and accumulation of atmospheric moisture has been noted in partially filled fuel oil storage tanks in periods of the year (spring / fall) where greater fluctuation in temperatures (day / night) are recorded. Moisture in tanks is known to be a contributing factor in tank failure.</td>
<td>More constant temperature throughout the year and protection from being heated by sunlight minimizes condensation in the interior of the tank.</td>
</tr>
<tr>
<td>Rupture of fuel lines caused by the impact of weather, such as falling ice or snow is also a common cause of sudden catastrophic releases.</td>
<td>Fuel lines are protected from the elements however may be subject to other factors such as mechanical damage or corrosion as a result of being buried in the concrete flooring.</td>
</tr>
</tbody>
</table>
In light of the above, one can only conclude that interior installations are preferred over exterior installation.

In recent years the marketplace has seen an increase of exterior tank installation due to ease of installations and customer preference for finished basements, whereas the preferred location was the basement in preceding years.

It should also be understood that regional architecture also dictates where fuel oil tanks can be installed. (I.e. Older homes in certain regions did not have a full basement which would allow for installation.)

It is therefore important to remember that as exposures change in time and in region so should the approach to underwriting and loss prevention methodologies.

5.4 Fuel oil storage tank questionnaires for homeowners

Some insurers have relied on fuel oil storage tank questionnaires completed by the insured as a method of risk assessment. However, statistics show that the completion rate of questionnaires is very low and seldom properly completed due to lack of knowledge or ability in identifying components and or deficiencies.

Therefore, the information submitted can be incomplete, erroneous and lead to false conclusions on the part of the underwriter.

5.5 Visual inspections

Traditional inspections were solely based on exterior visual observations. While this method sufficed in determining installation deficiencies, it was not adequate in assessing the integrity of the tank and could not help determine when it had failed or was about to fail catastrophically. Insurance claims have continued to escalate despite the increase in visual tank inspections.

Furthermore, some inspections focused on the fuel oil storage tank and little or no attention was paid to the entire fuel distribution system. As fuel oil releases focused on the tank alone, it was often believed that there was no requirement for a thorough assessment of the entire distribution system. However, claims history involving other components than the storage tank indicates the contrary. 29% of the releases were a result of fuel oil line failure which may not have been subject of an exterior inspection.
6.0 Possible Methods of Managing Residential Fuel Oil Tank Risks

**Eliminating the risk** - This is, in theory, the simplest way to manage the risk associated with fuel oil storage tank. Coverage is simply not offered or removed.

However, the market impact in many geographical regions would be significant. For example, 38% of the homes in Atlantic Canada rely on fuel oil to heat their homes or supply the domestic hot water heater. This would preclude any insurer who subscribes to this type of risk management to effectively write business in this class. Not to mention the potential national impact on their corporate image and the impact on other lines of business such as auto and commercial. Unfortunately, from a business model perspective, the risk of not offering coverage to property owners with fuel oil storage tank outweighs the risk of providing coverage.

**Limiting coverage** - Removing coverage from the basic All-risk policy and then endorsing coverage with lower limits and more restrictive definitions will essentially reduce exposure. I.e. Most US insurers do not cover first party damage to the property unless the policy responds to third party damage. In other words, it is to a homeowner’s advantage if the release migrates to the neighbouring property.

In theory, this approach has merit; however, one has to consider the impact of restricting coverage.

Restricting coverage for those who already have “broader” wording and limits will have a significant impact to the insurer’s business. The rate of retention will undoubtedly suffer greatly and as in ‘limiting coverage’ will have a series of cascading impacts in the marketplace.

**Impact on mortgages** - In Canada, all prudent lending institutions required a homeowner to carry insurance coverage. I.e. in the event of fire, the lender(s) would be assured that their financial interest would be covered.

If a release should occur on the mortgaged property, what would the impact be on the lender? The home would undoubtedly depreciate in value despite the best restoration efforts. The lending institutions would have no other alternative than to amend the current terms of the mortgage upon renewal.

If a release should occur, and the coverage is limited to $100,000 when we know that the potential cost of clean-up could be as high as $1,000,000 who will be responsible for the difference? In this event, the release could effectively cause the homeowner to declare bankruptcy and simply walk away from the property, leaving the lending institution and or government to deal with the clean-up costs.

The significant financial impact to homeowners and lending institutions of restricting coverage may be, in the pseudo-classic sense, transferring the risk, but would undoubtedly upset the current mortgage requirements. It is for this reason that some provinces are contemplating mandatory insurance coverage on property with fuel oil systems.

**Reducing or managing the risk** - Risk management of fuel oil storage tanks is the only truly viable strategy for insurers who want to reduce the frequency and severity of claims associated with fuel oil releases while maintaining market share. Risk management initiatives are therefore the focus of the remainder of this study.
7.0 **Risk-based Inspections (RBI)**

To properly analyse the significance of fuel oil releases, one must consider the interaction of loss frequency and loss severity.

7.1 **Terminology**

In order to understand the Risk-based Inspection (RBI) process, there must be understanding of the terminology.

**Periodic Inspection (PI)** – A visual inspection conducted by the homeowner to assess the general conditions as best as possible.

**Visual Inspection (VI)** – A documented visual inspection conducted by a qualified inspector to determine code compliance and report on the obvious and apparent condition of the AST.

**Ultrasonic Testing and Inspection (UTI)** – A documented inspection conducted by a certified ultrasound technician / inspector to determine code compliance and condition of the AST to establish its suitability for continued service. This includes all the requirements of a Visual Inspection (VI) inspection as well as ultrasonic testing (UT) of the tank to determine retirement thickness.

7.2 **Risk-based Inspections (RBI)**

By assessing fuel oil distribution systems based on relative risk, a loss prevention program can optimize results. Traditionally, RBI programs use a “risk ranking matrix” that includes the two essential elements of risk; probability and consequence. In our case, probability relates to the uncertainty associated with a release. Consequence relates to the possibility that an unwanted event can occur. (i.e. groundwater contamination or spill to nearby body of water; as well as the extent of the unwanted event)
7.3 **Risk Ranking Matrix**

As outlined in the table below (*Prouty approach*), equipment (such as a tank) is ranked based on the probability of its failure along the x-axis and the consequence of the failure along the y-axis.

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Probability of failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not probable</td>
</tr>
<tr>
<td>Low</td>
<td>A</td>
</tr>
<tr>
<td>Minor</td>
<td>B</td>
</tr>
<tr>
<td>Average</td>
<td>C</td>
</tr>
<tr>
<td>Major</td>
<td>D</td>
</tr>
</tbody>
</table>

**Scenario 1**

- 12 gauge steel tank with double bottom
- Professionally installed 1 year ago
- Interior tank
- Complies with CAN/CSA B139-09
- Automatic fuel delivery
- Annual service contract
- Lowest ultrasonic test reading: 0.118

**Probability of failure = Not probable**

**Exposure = Low**

**Risk Factor = A**

**Scenario 2**

- 14 gauge single wall steel tank
- Installed 12 years ago
- Exterior tank
- Non compliance with CAN/CSA B139-09
- Purchases fuel as needed. Tank not full during summer months
- No service contract
- Lowest ultrasonic test reading: 0.070 (fail threshold)

**Probability of failure = Very probable**

**Exposure = Major**

**Risk Factor = F**

7.4 **Qualifying Probability of Failure**

Factors that affect the Probability of Failure.

- Fabrication of fuel oil tank
- Date of installation
- Installer
- Code compliance of system
- Exposure and location of tank
- Current condition of system
- Maintenance
  - Single family dwellings
  - Rental dwellings
- Regular inspections
- Operation of equipment
  - Fuel delivery options
### 7.5 Qualifying Consequence of Failure

#### Capacity of tank
The greater the volume the more severe the impact. As most of the tanks are 200 to 250 gallons, the difference is not a significant factor unless tanks are interconnected for a higher capacity.

#### Location of contamination on property

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Above ground</strong></td>
<td>Releases from ASTs tend to have a lesser impact than USTs. However, the industry does not underwrite UST as a matter of practice, therefore this is not a significant factor.</td>
</tr>
<tr>
<td><strong>Below ground</strong></td>
<td>Releases from ASTs tend to have a lesser impact than USTs. However, the industry does not underwrite UST as a matter of practice, therefore this is not a significant factor.</td>
</tr>
</tbody>
</table>

#### Gradient of the property
Low gradient = low spread. Steep gradient = greater spread

#### Near infrastructure

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sanitary sewers</strong></td>
<td>Oils and grease are removed at the sewage treatment plant as part of the primary settlement.</td>
</tr>
<tr>
<td><strong>Water lines</strong></td>
<td>In older civic areas, water lines are not always “water tight” due to aging and settling factors. As such releases can migrate into potable water systems.</td>
</tr>
<tr>
<td><strong>Water supply wells</strong></td>
<td>Water supply well located within 50’ and downgradient of the release location are at greatest risk. The further the well and the higher the slope, the lesser the chance of contamination of groundwater by the release.</td>
</tr>
<tr>
<td><strong>Catch basins</strong></td>
<td>Help to control runoff and prevent the contamination of local watersheds. Impact of oil contamination has not been extensively studied; however one can assume that the release would be more localized.</td>
</tr>
<tr>
<td><strong>Storm sewers</strong></td>
<td>Are connected to oil / water separators designed to remove trash, debris, some amount of sediment, oil and grease from storm water runoff. The impact with be minimal.</td>
</tr>
<tr>
<td><strong>Near ditches</strong></td>
<td>Are designed to control excess water storm water by directing it to specific location(s) where the water can percolate into the soil. The impact is significant as a ditch would spread the release over a larger area.</td>
</tr>
</tbody>
</table>

#### Near surface water

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Watercourses</strong></td>
<td>Major impact to aquatic life and recreational areas such as beaches.</td>
</tr>
<tr>
<td><strong>Wetlands</strong></td>
<td>Major impact to flora and fauna.</td>
</tr>
<tr>
<td><strong>Sand flats</strong></td>
<td>Major impact. Extremely permeable. The release would follow gravity until it reaches a denser geological material. (bedrock) The impact would possibly be more localized, but the cost of the clean-up could be much greater.</td>
</tr>
<tr>
<td><strong>Farm drain tiles</strong></td>
<td>Major impact to agriculture and livestock which impacts the food chain and could affect human health.</td>
</tr>
<tr>
<td><strong>Navigable waters</strong></td>
<td>Major impact to aquatic life and recreational areas such as beaches.</td>
</tr>
<tr>
<td><strong>Beaches / recreation areas</strong></td>
<td>Major impact. Health hazard. Closure of the beach.</td>
</tr>
<tr>
<td><strong>Near foundation</strong></td>
<td>The foundation system could act as a transfer medium allowing a release to penetrate further into the soil as well as damage to the foundation and footings. (concrete is a permeable material)</td>
</tr>
</tbody>
</table>
7.6 Environment and Topography

As previously defined, the environment that exists around the fuel distribution system as well as the topography as it relates to installations has a direct impact on the cost of mitigation.

Fuel releases can accumulate in soils, be carried away in storm runoff or contaminate soil and drinking water supplies. Petroleum products are composed of volatile organic compounds (VOCs). Any oil spill can pose a serious threat to human health and the environment, requires remediation that extends beyond boundaries of the property, and results in substantial cleanup costs. Even a small spill can have a serious impact. A single pint of oil released into the water can cover one acre of water surface area and can seriously damage an aquatic habitat. A spill of only one gallon of oil can contaminate a million gallons of water. It may take years for an ecosystem to recover from the damage caused by an oil spill. The location of the installation must be considered in relation to drinking water wells, streams, ponds and ditches (perennial or intermittent), storm or sanitary sewers, wetlands, mudflats, sand flats, farm drain tiles, or other navigable waters. Factors such as the distance to drinking water wells and surface water, volume of material stored, worse case weather conditions, drainage patterns, land contours, and soil conditions must also be taken into account.

In most regions the minimum distance from a fuel oil tank to a water well is 15 metres (48.75') and the minimum distance from fuel oil tank to Class 2 water source is 30.48 metres (100').

Class 2 water is defined as very clean fresh surface water resource used for consumption, which requires ordinary water treatment process before use.

One 250ml (1 cup) of fuel oil can contaminate enough water to fill an Olympic-size swimming pool. That's 2,452,947 litres or enough to provide water to over 3,700 people for one year.
7.7 Risk Analysis Process

Analysis of fuel distribution system

Data Collection

B-139 Compliance

Ultrasonic Test Results

Estimation of Probability of Failure (POF)

Estimation of Consequence of Failure (COF)

Risk Ranking Matrix

Risk = POF x COF
8.0 Degradation of Fuel Oil Delivery Systems

Many degradation mechanisms are time-dependent (e.g., general corrosion, settlement, etc.) In reality, the degradation rate may vary over time. Through systematic inspections, the average rates of degradation will become better defined.

Some degradation mechanisms are independent of time, and occur when there are specific conditions present. These conditions may not have been predicted in the original assessment. (I.e. microbial influenced corrosion or MIC)

8.1 Three most common reasons for single wall steel residential tank failure

1. “Single wall steel residential fuel oil storage tanks do not have a service life. All other aspects of a fuel system do have somewhat defined service lives, but not a tank. If a tank is installed in a manner that it will not be over-pressurized due to corrosion products or ice obstructing a minimum size vent diameter piping, then you just eliminated the number one cause of residential tank failures.

2. If the exterior of a tank is inspected on an annual basis and painted to control outside in corrosion, you just eliminated the second most frequent cause of a UL 80 failure (ULC S602).

3. If water is under control inside a tank by having a low point drain connected to the suction of a burner fuel pump, then you have eliminated the third most common reason for a residential tank failure.”

The American Petroleum Institute (API) completed a study comparing types of failures and ages of components. Tanks were split up into three groups: A) 1-15 years old, B) 16 to 30 years old and C) 30+ years of age.

The most likely tank to be leaking on the basis of age alone was a tank from Group A. The technical basis for this counter-intuitive result is that there are far more important parameters to consider when predicting tank failures. Also, the older tanks were installed correctly and were being maintained.

Errors in Logic can be quite expensive wherever they occur. In the case of an “Age rule”, there is no basis that any improvements in release control will be achieved. Further, the more often tanks are replaced, the more likely it is that the new tank will leak. Thus, the net effect of the “Age Rule” could be an increase in releases.
9.0 Spill Prevention, Containment and Countermeasure (SPCC)

Traditionally, fuel oil inspections were solely based on exterior observations of the tank. While this method may have been adequate in determining installation deficiencies, it was not adequate in assessing the integrity of the tank. Fuel oil releases have continued to escalate despite the increase in visual tank inspections.

In the United States the Environmental Protection Agency defines its SPCC Rule regarding the storage and handling of oils, both petroleum and non-petroleum under 40 CFR Part 112. In 112.8(c)(6) “…You must combine visual inspection with another testing technique such as hydrostatic testing, radiographic testing, ultrasonic testing, acoustic emissions testing, or another system of non-destructive shell testing. You must keep comparison records and you must also inspect the container’s supports and foundations. In addition, you must frequently inspect the outside of the container for signs of deterioration, discharges, or accumulation of oil inside diked areas…”
10.0 A New Loss Prevention Strategy for Fuel Oil Distribution Systems

A Loss Prevention Strategy must be multi-faceted in order to be considered effective. Outlined below are the various methods / roles which must be used in conjunction with one another in order to truly prevent losses from occurring.

10.1 The Consumer / Homeowner

The first line of defense in preventing pollution related losses lies with the education of the homeowner.

1. Historically, informational brochures have been used by insurers and various levels of government to help educate homeowners in regards to fuel oil storage tanks. However, these have not had the anticipated success for various reasons. A useful brochure needs to educate the homeowner in preventative maintenance of the fuel distribution system on an on-going basis. (i.e. homeowner’s checklist)

2. Proper maintenance of the fuel oil distribution system.
   - Inspecting of the fuel distribution system twice annually
   - Tuning up the oil burner to save money on oil heating

\[\text{CAN/CSA B139-09} \]
15.2.1: “The owner or operator of the oil-burning equipment shall ensure, at least once per year, that it is maintained in accordance with Clauses 15.2 to 15.5. Maintenance should also be in accordance with the manufacturer’s instructions.”

3. Periodic Inspection (PI) at 6 month intervals by the homeowner is integral to the loss prevention strategy.

4. Means of reminding, recording and reporting of the insured’s finding. (i.e. automatic e-mail notification)

Despite manufacturers’ warning that ‘Tank should be inspected and drained of any water accumulation annually’, this requirement is rarely, if ever met.
10.2 The Underwriting Process

1. Spills from domestic fuel oil storage systems are problematic and costly for insurers. Therefore properly underwriting the risk for the exposure is of utmost importance.

2. As part of the traditional habitational underwriting process, little attention was paid to the fuel oil distribution system beyond the “Age” of the tank. If this were the only contributing factor, releases from fuel oil storage tanks would have decreased proportionately with the replacement for new tanks. In fact, the reverse is true.

3. A minimum of 9 key areas of a fuel distribution system need to be addressed to qualify a risk for insurability. (I.e. location, age, installation, maintenance, etc…)

4. Mandatory ultrasonic testing and field inspection identifying deficiencies and corrective actions must be complied with in order to establish an acceptable baseline at year ‘0’

The purpose of Corrective Actions (CA) is to improve future performance and must be tailored to each situation. Factors to be considered include the type and importance of the standard that has not been met and the options that are available for reaching acceptable performance levels.

10.3 The Loss Prevention Cycle

1. Historically field inspections have been considered by many to play a small part in the underwriting process and were often viewed as a process that is costly in terms of external and internal resources and difficult to qualify the derived benefits.

2. However, true risk management aims to reduce the long-term overall cost of risk without precluding or otherwise interfering with the insurer goals or engaging in its normal activities.

3. Implementing Risk-based Inspections with Ranking Matrix achieves the risk management goal.

4. With a year ‘0’ baseline established by an initial inspection, the risk management process must be ongoing to continually re-evaluate changes in time or conditions. The fuel oil distribution system requires periodic maintenance similar to a vehicle requiring on-going servicing and tune-ups etc. Much like the “Clean-air Act” requires that a vehicle be inspected every two years in order to obtain license plate renewal, proof of an ultrasound inspection could be required prior to binding or renewing coverage.

5. Ultrasonic Testing and Inspection by a certified inspector is necessary to record and compare previously collected data and establish the rate of degradation and retirement thickness of the tank. However, should the rate of degradation or ultrasonic testing results be significant, the interval must be adjusted accordingly to reflect the specific conditions. (I.e. UT reveals a location thickness of 0.072” with the minimum acceptable thickness being 0.070”, that tank must be re-tested within the next 12 months.) Also, the role of the HVAC / Oil Burner Technician (OBT) has to be considered. As the oil industry is moving towards UT, the OBT would be well positioned to offer the service to the homeowner annually, who in turn could provide proof of insurability, by way of certificate, to their insurer.
11.0 Risk-based loss prevention cost analysis

Fuel oil releases have continued to escalate in Canada despite the effort put forth to date. The average cost of a fuel release clean-up has also increased dramatically over the years due to environmental requirements at both the federal and provincial levels. It is now common to expect an average of $65,000 in clean-up costs.

Out of approximately 1,181,000 homes with oil tanks, the insurance industry derives approximately $1.2 billion in premium. Based on a compendium of Statistics Canada, IBC, CMHC, COHA, Boston Environmental and Spectius historical data, approximately 625,933 installations are likely to be non-compliant with CAN/CSA B139 and approximately 72,277 tanks may fail ultrasonic testing. Based on an average of $65,000 per clean-up, the potential exposure on failed tanks could amount to $4.7 billion per year.

The cost of inspecting / testing all 1,181,000 tanks would be approximately $200,770,000. Given that the insurance industry’s current potential exposure is $4.7 billion, the return on expenditure could be approximately $4.5 billion.

12.0 Conclusion

Spills from domestic fuel oil storage systems have been a significant problem in Canada since the 1980s. Traditional loss prevention strategies have done little to curtail the problem in part because of the misunderstanding of the factors that affect releases, they rely solely on exterior visual observations and installations are only randomly selected for inspection.

The odds of preventing a release by inspecting the system that is about to fail at the right time without using the right tools are astronomical.

A systematic and comprehensive approach to loss prevention as described in section 10.0 of this document and the implementation of a 5 year testing / inspection cycle has the best potential to identify problematic systems and have them addressed before catastrophic failure occurs.

This methodology has been proven effective in the United States over 20 years and it is no longer acceptable to allow corrosion factors to progress to the point that a release occurs.
References


iv  Edward English, Technical Director, Fuel Quality Services, Inc., Oilheat 2009 Symposium, Montreal, Quebec.

v  Diesel Trends, Keith C. Corkwell, Regional Business Manager, The Lubrizol Corporation.

vi  John V. Cignatta, PhD, PE, President, Datanet Engineering, Inc.

vii Insurance Bureau of Canada, Domestic Oil Tank Spills - Information For Atlantic Canadians on Domestic Oil Spills
About Spectius Underwriting Solutions Ltd.

Spectius Underwriting Solutions Ltd. is a provider of loss prevention inspection and loss prevention programs to the Canadian Property and Casualty industry and various government organizations. Over the last 35 years, we have worked closely with some of the country’s leading insurers to develop underwriting strategies, training and loss prevention initiatives to influence their underwriting results. Our long-standing relationship with the Canadian Oil Heat Association (COHA), Wood Energy Technology Transfer (WETT) and committee membership of both the CAN/CSA B-139 Installation Code for Oil burning appliances and B-365 Installation code for Wood burning appliances as well as past members of National Association of Corrosion Engineers (NACE) allows us to us to focus on the current loss prevention landscape while looking beyond the horizon.

About the authors

Vito L. De Simini – Previously a senior partner with Sentinel Underwriting Review Ltd., where he established a dedicated national High Value program, trained evaluation specialists, formulated training processes, manuals and first identified the need for a fuel oil inspection process. Vito instituted WETT (Wood Energy Technology Transfer) training to the inspection staff and worked closely with COHA (Canadian Oil Heat Association) to establish and introduce the fossil fuel inspection program to the insurance industry. Vito has also served on various CAN/CSA committees.

Marc R. Raymond – Has held various management and executive positions within Sentinel Underwriting Review Ltd., IAO-Sentinel and CGI-IBS. Marc has developed various course curricula and trained hundreds of insurance professionals in various aspects of loss prevention, building construction, evaluation methodologies, inspection processes and protocol, claims scoping and fire prevention at the IAO School.

Marc is an experienced Pollution Underwriter, Course of Construction Underwriter, Evaluation Specialist, and past board member of both WETT and AWETA. He served on two committees for the Canadian Standards Association (B-139, Fuel Storage Tanks and B-365, Solid Fuel Burning Appliances). He also was the first accredited FOSIL (Fuel Oil Storage Inspection Logistics) instructor through COHA (Canadian Oil Heat Association) and certified trainer for the Spectius-TankSure® Program. Marc is a member in good standing of the Insurance Institute of Canada, the Canadian Professional Sales Association, and is a former registered insurance broker.
Appendix A

Excerpts from Ultrasonic Thickness Testing for Compliance With AST Fuel Tank Inspection Requirements
John V. Cignatta, PhD, PE

There is much confusion about non-destructive testing as it relates to aboveground storage tank (AST) inspections.

Measuring wall loss of a tank is routinely accomplished around the world by technicians employing Ultrasound Testing (UT) technology. By the use of a short pulse of sound such as sonar, the time delay of the returning echo is captured to very precisely measure the thickness of the structure.

It should be appreciated that a single point thickness reading does not provide a very good depiction of the integrity of a fuel tank. Figure 1 is an elephant. Consider the man blind from birth reaching out and describing an elephant after touching it in just one spot. He will have in his mind vastly different concepts about an elephant if he touches first the tusk, the ear or the end of the tail.

From his very limited data gathering exercise (i.e. one touch), his concept of an elephant is far from complete. To provide the blind man with a better picture of the animal, he is permitted to walk along its side and touch it continuously four feet from the floor. This line of information will then give the man a far better (though still limited) concept on what is an elephant. If the blind man is then permitted to walk around the elephant and touch him on all sides, it will complete his picture of the animal.

There is a strong analogy of the blind man’s limited information on the elephant with evaluating fuel tanks. An A-scan is again the thickness of steel at a single point. This is comparable to the man being limited to a single touch of the giant beast. When the blind man walked down the side of the elephant, he was actually obtaining many points of information. In the same fashion, a string of UT readings down the side of the tank provides a two dimensional cross-sectional depiction of the tank along that line. This technique is called a B-scan.

Typical fuel tanks have the majority of their corrosive deterioration on their interiors limited to the lower several feet of their storage area. Some tanks like heated residual fuel oil tanks can have serious crown corrosion to their ceiling areas due to moisture condensation above submerged heaters.

CONCLUSION

It is no longer acceptable to allow interior corrosion problems on a fuel storage tank to progress to the point that a release occurs. In an attempt to control such failures, federal regulations (CAN/CSA-B139) mandate ongoing inspections but these regulations are seldom adhered to by industry members for numerous and various reasons. Unfortunately, the one critical component that has been missing in Canada as part of these inspections is wall loss measurements by using ultrasound for finding and correcting problems before yet another avoidable fuel release occurs.

John V. Cignatta, Ph.D., P.E. is the President of Datanet Engineering. He is the Senior Corrosion Engineer on staff with multiple accreditations and a wealth of knowledge relating to real world problems. John has provided expert witness testinomies in courtroom trials for insurance companies, private clients and government agencies. He manages and directs engineering assignments including fuel system, design, compliance, failure analysis, corrosion and environmental projects. John continues to write and teach the certified AST inspector course for the Steel Tank Institute and MDE UST Inspector courses. A few of his certifications include: NACE Corrosion Specialist, NACE Cathodic Protection Specialist, API 653 Inspector, and STI – AST Instructor.