11 September 2014

Report of Fuel Spill Assessment and Corrective/Remediation Work

Reference: http://www.rothtanksales.com/_pdf/DWT-installation-manual.pdf

1. Background

DRDC Atlantic operates a science camp at Gascoyne Inlet, Devon Island, Nunavut. The main building at the camp, Fox Lodge, is a combined quarters, dining room and kitchen. The heating system for the building is a diesel fueled forced air furnace, supplied by a Roth DWT 1000L fuel tank.

The Gascoyne Inlet Camp is used twice per year; once in April, when requested, in support of the Canadian Armed Forces (CAF) Op Nunalivut, and in July and August for DRDC purposes. As a minimum, the camp has a maintenance visit every August. In 2014, the Gascoyne Inlet camp did support Op Nunalivut in April and Fox Lodge was operated during that period. Prior to the DRDC summer deployment a report from Nunavut Land Use Office stated that there was evidence of a minor fuel spill at Gascoyne Inlet Camp, at the Fox Lodge fuel tank.

2. Evaluation

As soon as was practicable after arrival at Resolute, a two person team was sent to Gascoyne Inlet Camp (GIC). Close inspection revealed that a small amount of fuel had been forced out through the fuel tank's filler tube when water had filled up the void between the inside fuel tank and the outside galvanized tank and frozen. Based upon the size of the ground stain and concentration of fuel in the stain, the amount of fuel spilled was less than nine liters (two imperial gallons) and perhaps as low as 4.5 Liters. Refer to the tanks diagrams within the reference. Discoloration of the gravel around the tank showed that the pressure of the water freezing between the two tanks had bowed the tank outward and inward creating pressure on the inside poly carbon tank. Due to the tank being overfilled (over 80% full) in April, a small amount of fuel was squeezed out through the fill tube and outer protrusion tubes which are capped. One of the capped openings on the inner tanks was loose and it is likely that fuel may have been forced out through the plastic threads. The fuel sat on the top of the tank (due to a one half inch manufactured lip around the top of the tank), and during the snow melt period, the fuel then floated on the melting snow and flowed down the side of the tank onto the ground surrounding the tank stand. A push on the outside of the tank forced water out of at least two openings created at the top of the tank from the pressure of the expanding freezing water during the freeze and melt cycles in May June and July as weather began to warm in the day and refreeze at night. As it was evident that the inside tank was undamaged and that there was no leak, the decision to leave the tank in place until a plan could be derived for removal of the tank and a remediation plan for the small amount of fuel in the ground around the tank.

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Review of the reference identified that this type of tank requires a roof (Ref pages 11 and 33) for outside installations to ensure that there is no buildup of snow or water on the top of the tank. There is no seal between the outer and inner tanks and water can seep into the outer tank easily. When this freezes in the winter, it can create enough pressure in the inner tank that, if the tank is full; it will force

fuel out through top openings in the inner tank. The tank was not provided with a roof when installed in 2011. The tank was not checked for water build up in the outer tank at any time.

3. Action: Tank

The entire team arrived at GIC on the 5th and 6th of August. As there was no immediate danger of rupture of the tank and the fuel overflow sight glass showed that the inner tank was still sound, the decision to use the tank for a period of time was made to bring down the level of fuel in the inner tank. This limited the risk of an extra amount of fuel spillage during the fuel transfer of the full tank to empty barrels brought by the team. On Aug, the fuel in the inner tank was transferred to three fuel barrels using an electric fuel pump and hose. The sight glass on the top of the outside tank was removed and water was hand pumped into a 45 gallon plastic barrel with fuel absorbent pads (water repellant) on the bottom. As the water filled up the pads floated on the surface and absorbed the small amount of fuel in the water. The water was then put through a filter designed by SEI industries to remove and further fuel and returned to the ground. An estimated 60 gallons (270 L) of water was pumped out of the outer tank. The tank was then lifted out and the residue of the fuel in the inner tank was poured into a plastic pan and poured through a funnel into one of the three barrels removed earlier. The last bit of water in the outer tank was poured into another pan filled with fuel absorbing pads and returned to the ground through a berm filter. The fuel absorbent pads used were all disposed of by burning them in our INAC approved on stage burner unit. The empty tank was put into the camp berm to vent until next year when it will be disposed of.

A temporary fuel tank for the furnace was set up in a berm using a 45 gallon drum and stand. It was tied in place and the berm was lined with fuel absorbent pads weighted down with sandbags. It was left in place for use in April during OP Nunalivut in the upcoming spring.

Action: Remediation of Gravel/Soil around Tank

The ground around the tank was hand shoveled into a Bobcat bucket. The area to be removed was determined by the ground stain present when the stand and tank were removed. Soil (gravel) removed was a minimum of 12 inches around the stain and down as deep as the frost line. This depth varied from 12 to 16 inches. The bucket was then poured onto a two inch galvanized stainless steel pan and left to evaporate. As we did not have a method of determining how much fuel was in the ground, the only method of determination was odor. There was no smell of fuel emanating from the soil removed and although it is not common practice, it was decided to attempt to light the ground in the pan. Numerous attempts revealed that if there was any fuel, the concentration of it was so small that it would not ignite. As the soil dried, it was apparent that there was no need to keep it in the pan and after two days we put the soil at a marked location to be tested next year. The hole was then filled with soil from an area we have been using for fill.

4. Findings:

a) The Roth fuel tank was suitable, by design, for use as an outside tank in the Arctic environment;
b) The Roth fuel tank was not properly installed because it was not provided with a tank cover as directed in the Roth manual
c) The Roth fuel tank is a double wall design to provide a safety capability in case of leaks in the inner fuel tank. The outer tank had filled with water since installation. The frozen water had

bulged the outer tank skin and compressed the inner tank. The upper seam of the tank had one small rupture, otherwise the inner and outer tanks were intact and without leaks.

d) The small seam rupture in the outer tank was not the source of the fuel spill.
e) In April, the Roth tank was filled beyond 80%. The water between the inner and outer tank walls was frozen and at maximum expansion. The inner tank was compressed, consequently the amount of fuel in the tank, after filling was not 100%.
f) During the spring/summer thaw, some small amount of fuel was forced out of the filler bowl and spilled onto the tank top. It mixed with water already accumulated on the tank top and flowed off the top.

4. Lessons Learned

a) There is a standard in the arctic communities that fuel tanks only be filled to 80% capacity to reduce risk of overfull tanks expanding, creating small fuel spills. This policy has been followed in the past at GIC, however there are no markings or warnings on the fuel tanks indicating this. The tanks were last filled during OP NUNALIVUT 14 by untrained personnel. Unfortunately, time did not allow for a final check of fuel levels in all of the tanks prior to departure from the camp in April 2014.

b) Remediation training should be provided for small spills. Personnel had just completed training previous to deployment but it was difficult to determine just how far to go with our cleanup due to the remoteness of the camp and the timeframe the spill occurred. Primary emphasis in training is normally on containment, not remediation.

5. Recommendations

a) Replace the tank with a standard double steel bottom tank which we use for the main generator(s). Ensure that the tank is placed in a filtered berm. We currently utilize this type of berm in our main camp berm next to the generator building.
b) If there is no requirement to replace the tank, a 205L drum could be stood on end with a tube attached through a JIC fitting in the main bung. The suction input line to the furnace would be attached to this fitting. This would require a temporary berm be set up each trip, but would greatly reduce the risk of having a fuel spill while the camp is unattended. The barrel would be disconnected and be placed in the camp berm .
c) Mark permanent fuel tanks with a warning to only fill to 80% capacity and clearly mark the capacity on the tank.
d) Use clearly labelled measuring sticks to dip tanks prior to departure and record the levels in the main camp log prior to departure.
e) Remediation training or guidance should be provided. As this can be costly, perhaps a reach-back capability could be established somehow.
f) Training personnel on how to perform soil and water samples would reduce the need to transport personnel to remote sites which is costly as well. Sample bottles/bags could be included in a field kit if required.

6. Conclusion

This was a small fuel spill which was easily evaluated and remediated. The primary cause proved to be the overfilling of the fuel tank. The lack of a tank cover and the filling of the outer tank with water were contributing factors only. A combination of further on-site training, standard arctic fuelling practices and markings/or labels on permanent fuel tanks will greatly reduce the risk of further occurrences. All permanent fuel tanks should be placed in a filtered berm and if possible, temporary fuel tanks should be placed in the main camp berm to further reduce the risk of spills while the camp is unattended.

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Enclosures: 2

- Photographs of fuel tank and spill site (report pages 5-8)
- Roth Tank advertisement (separate)

Roth tank showing bowing to outer skin

Diesel fuel is pink. Note very low quantity of fuel in water

Connections to Inner tank. Note lack of gaskets

Outer tank sight glass

Extent of spill impact with tank removed.

Draining last water out of the outer tank

Replacing gravel at spill site

Temporary fuel tank and berm