4.0 System component failure prevention

The routine monitoring of system components, preventive maintenance and record keeping is described as follows:

- Every day, the foreman or assistant foreman walks along the perimeter of the property (100 meters by 100 meters) to note deficiencies such as heavy equipment leaks, rainwater status in the cells, pumps, and integrity of the treatment cells. The fertilizer shelter (that also contains a few liters of motor oil) and the water treatment system are also inspected for any deficiencies.

- Heavy equipment maintenance (repairs, oil change, hydraulic hose integrity, etc.) is not done on the landfarm property. Heavy equipment is sent out to a local garage on a regular basis, based on usage and breakage.

- The foreman signs a weekly inspection log (broken down in 5 working days) confirming that the landfarm's operations and equipment are in good standing. In the contrary, the foreman writes on the log the nature of the deficiencies and the action taken to correct the situation. These logs are kept at NES head office in Iqaluit for review by governmental agencies.

5.0 System malfunction response action

Based on the landfarm's normal operation one can anticipate 4 types of malfunctioning events:

- Heavy equipment problems (fuel spills during re-fueling operations, hydraulic fluid hose rupture, motor oil leaks, vandalism, etc)
- Integrity of the treatment cells (geotechnical stability of the 1.5 meter high perimeter berm, water leaking out of the cells, and ripped geosynthetic liner)
- Fertilizer related problems (barrels tipped or pierced by forks of a fork lift, vandalism of the shelter, etc)
- Problems related to rainwater recirculation and the activated carbon water treatment system.

Heavy equipment malfunction response action

Proper maintenance is the best way of preventing spills. The daily routine inspection pays attention to leaks, hydraulic fluid hose integrity and overall status of equipment. In case of a spill, the rehabilitation would include spoiled soil removal and place them in the treatment cell, as described in section 5 of the spill contingency plan.

Integrity of the treatment cells

Daily inspections will note if berms are about to fail, if exposed geosynthetic liner is ripped or of leaks are observed. As a preventive mean, if any of these signs were noticed, NES staff would readily address them. If leaks or failed berms are noticed, they would be readily addressed using heavy equipment present on site.

Fertilizer potential problems

Fertilizers are applied 2-4 times per season. If the granular fertilizer is spilled during handling or application, the excess is removed and spoiled soil in placed in the treatment cell.

Rainwater recirculation and water treatment system

The pumping and water treatment system integrity is verified on a daily basis when in operation. Hose and valve integrity are verified and fixed / replaced when required. The foreman ensures that contaminated water follows the right pathway (complete water treatment by the activated carbon system) prior to returning into the environment. The foreman ensures that water samples are taken following the first treatment prior to discharging and that the activated carbon is recycled / replaced on a scheduled basis (one per season; water analyzed for Total Petroleum Hydrocarbons). These activities are recorded on the weekly check log described in section 4. In case of a spill, rehabilitation includes water pumping from the adjacent ditches back into a treatment cell. The operations manager (Mr. Carrière or someone specifically designated by him) is the only authorized NES staff to discharge treated water into the environment.

6.0 Response equipment

The response equipment located on site includes the following:

- Heavy equipment to address spoiled soil or failed berm (excavator, backhoe, loader, bulldozer)
- Pumps and activated carbon water treatment plant to address spilled contaminated water. A complete description of the water treatment system is found in the reference section
- Hydrophobic pads and booms to contain surface fuel or oil spills
- Fire extinguishers to address fires
- First aid kit to address workers injuries
- Hand tools (shovels, wheel barrels, etc) to address spills in difficult access areas

At this point, it is not anticipated that NES would require additional equipment for response action. Should it be the case, the situation would be documented and added into this contingency plan.

7.0 Response team

The response team to address failure events is the same as the one described in section 2 (response organization) of the spill contingency plan. The preventive and response staff is the same as NES counts a maximum of 5 employees at the landfarm. These individuals are trained and are conscious about spill rehabilitation and prevention.

8.0 Training exercises

Nunatta Environmental Services is an environmental contractor. Its main field of activities is summarized below:

- Landfarm operation
- Addressing fuel and other contaminant spills (on soil or on water)
- Asbestos and other waste management
- Project management for environmentally sensitive issues such as phase 1 and 2 investigations and terrain remediation.

NES staff is exposed to environmental situations on a daily basis and have addressed several minor and important spills in Iqaluit and elsewhere in Nunavut. The interventions range from addressing fuel spills in basements or in water bodies to designing a phenol contaminated water treatment plant. NES members are concerned about environmental issues and new employees receive constant training through discussions with more experienced workers. Formally, training and exercises offered to NES employees consists of the following:

For individuals without an environmental background, each new employee spends 2 complete days as observers with an established employee to learn and understand the types of intervention that NES specializes in. Each employee must read and understand the company's Health and Safety Plan and the Spill Contingency Plant.

'Tool box' type of briefing explaining various potential failure situations is offered seasonally on a weekly basis. During these sessions, the foreman explains how various equipment and

material failure occurs and how to address these situations (for NES's clients) and often recalls that failures do not only happen at Client's property but also on the landfarm area. Directives are given to the employees how to react if a failure was to occur within the property.

Specifically, a training exercise will be prepared on a seasonal basis. This training exercise will consist of the following 2 points:

- An old hydraulic hose that needs to be replaced on a piece of heavy equipment will intentionally be ruptured (directly on already contaminated soil present in the treatment cells) without the working staff being informed. Once the situation occurs, the oil spill source will be stopped (by stopping the equipment's engine, the spill will be contained, the hose will be inspected and replaced. This exercise will help workers be more conscious about old and about to fail hydraulic hoses.

- Fresh water will be pumped into a municipal ditch. The foreman (preparing the exercise) will inform all workers of the situation. The purpose of this exercise is to ensure that water returning to the ditches must be clean at all times. During the exercise, the source of the water being pumped will be identified and questions will be raised as to whether the source is clean or not. This will make all workers more conscious about pumping any liquids into the environment.

Mr. Alain Carrière is responsible for preparing mock failure events exercises, for documenting it and for keeping the General Contingency Plan updated. Mr. Carrière has been in charge of NES since NES's inception in 1999 and has been involved in Nunavut on a full time basis since the mid 1970's in earthwork and construction projects. He has been training and supporting local staff projects such as residential, commercial and industrial construction, heavy equipment operation, landfarm construction, emergency spill response, phase 1 and 2 investigations, environmental and geotechnical monitoring, asbestos removal. Mr. Carrière sat on the Board of Directors of the Workmen Compensation Board until June 2004. Safety and environmental issues are part of the everyday training offered to staff employed by Nunatta Environmental Services Inc.

References

The Material Safety Data Sheets are reported in attachment 2 of the spill contingency plan and also applies to the general contingency plan. The weekly inspection report sheet used to note any deficiencies related to the landfarm operations is shown below:

Tasks	Date	Observations
Inspect heavy equipment for leaks, etc.		
Inspect fertilizer storage shelter		
Verify cell berm and liner integrity		
Walk around property to detect leaks		
Verify pumps and activated carbon water treatment system		
Inspect groundwater monitoring wells		
Training provided?		Attach content and attendance
Fence inspection		

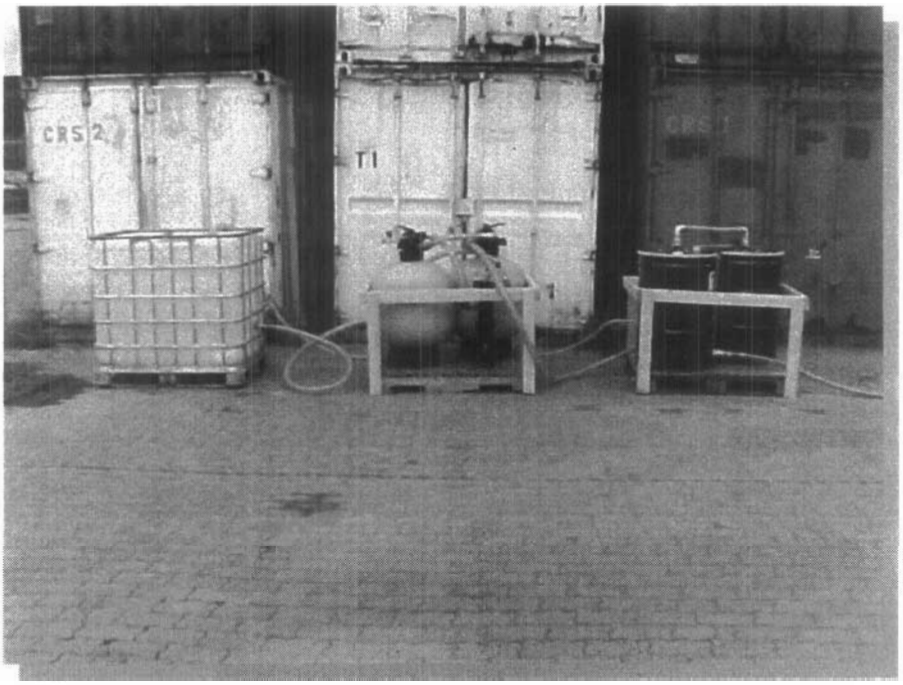

Photo 1 : Water treatment unit (Skids # 1 to # 3, from left to right)

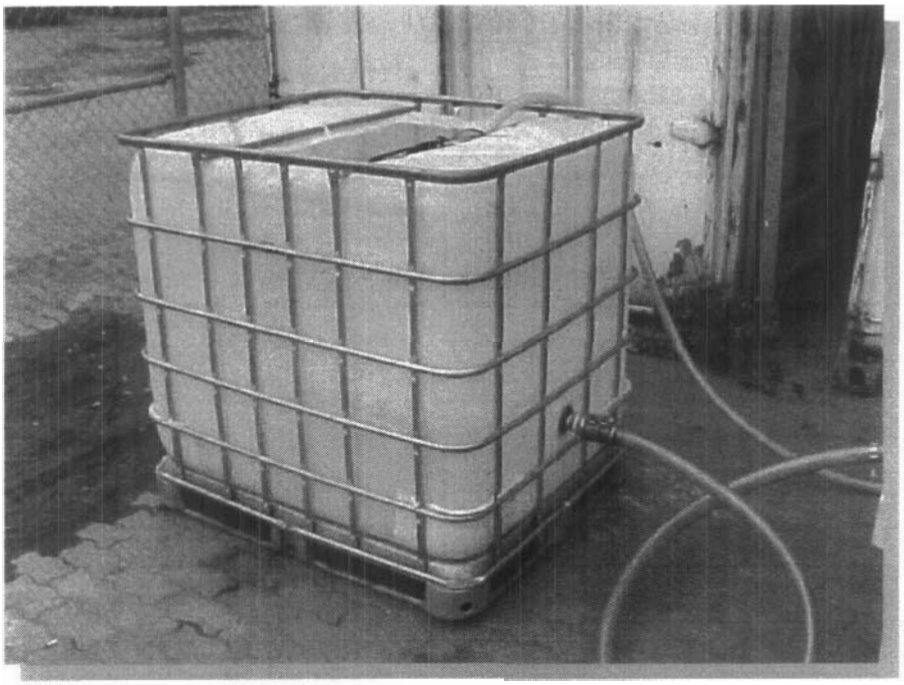

Photo 2 : Skid # 1 - Water outlet on side of tank and return hose (from pressure relief valve) placed through top of tank.

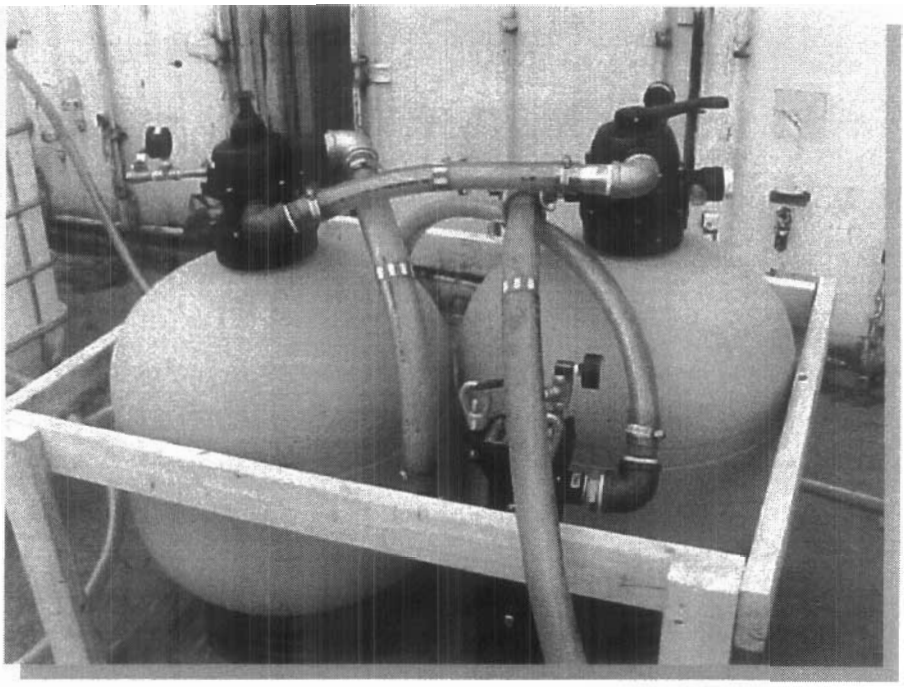

Photo 3 : Skid # 2 - Two Ultrasoption® filters and bag filter.

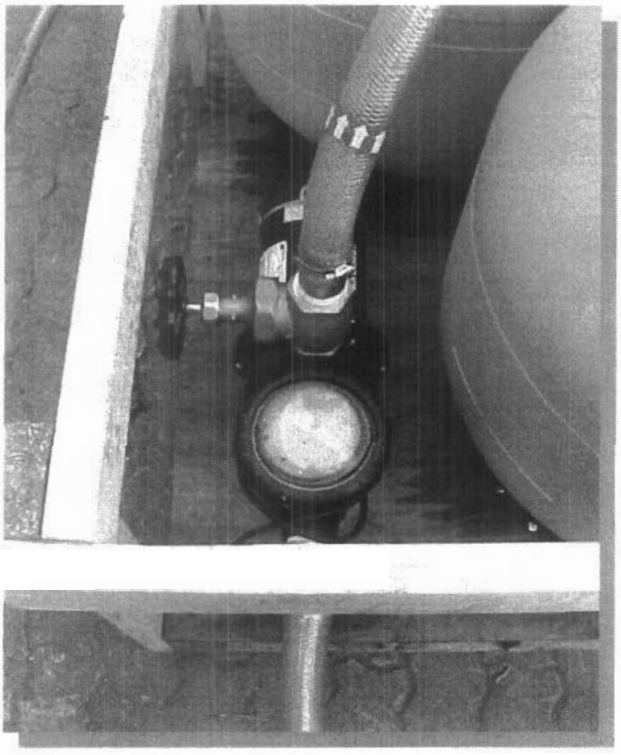

Photo 4 : Pump and globe valve.

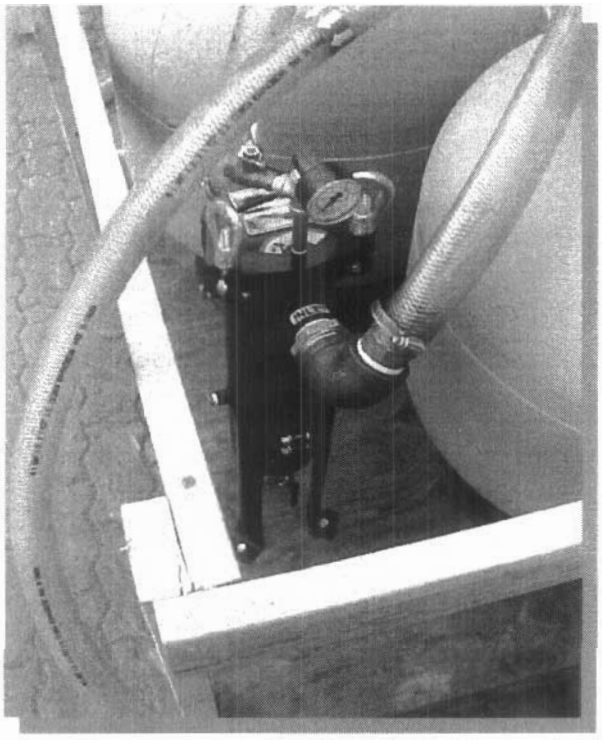

Photo 5 : Bag filter with pressure gage.

Photo 6 : Skid # 3 - Two Carbon filters.

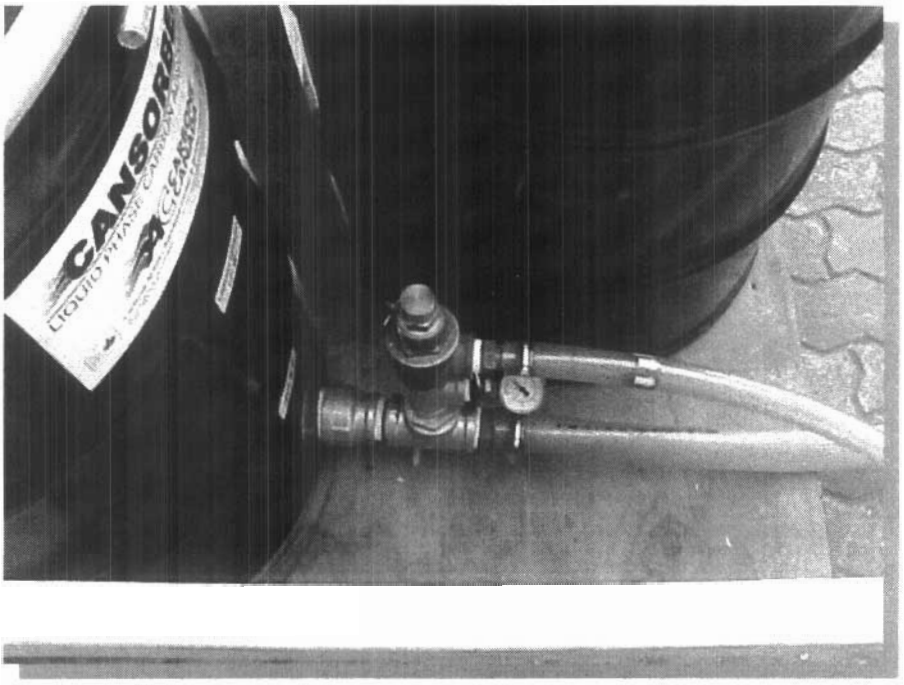

Photo 7 : Pressure relief valve and pressure gage at inlet of carbon filter # 1.

Mobile Water Treatment Unit – Set-up and Operating Instructions

The unit is made up of three skids containing the following equipment :

Skid	ID	Description	Function
#1	WWT-1	Plastic tank (1 000 Litres)	Water storage and settling
	FS-1	Float and level switch (piggy-back, 13 A)	Automatic start / shut-off of pump
#2	P-1	Centrifugal pump (Jacuzzi, 110 V)	Pumping water through system
	FAV-1	Globe valve (1.5" diameter)	Adjusting flow rate
	F-1	Bag filter (5 μm filter bags)	Removal of solids > 5 μm
	G-1	Pressure gage (0 – 60 psi)	Pressure reading, F-1 filter inlet
	F-2	Ultrasorption® filter #1	Removal of contaminants
	G-2	Pressure gage (0 – 30 psi)	Pressure reading, F-2 filter inlet
	F-3	Ultrasorption® filter #2	Removal of contaminants
	G-3	Pressure gage (0 – 30 psi)	Pressure reading, F-3 filter inlet
#3	PRV-1	Pressure relief valve (set at 10 psi)	Protect F-4 from pressure build-up
	G-4	Pressure gage (0 – 30 psi)	Pressure reading, F-4 filter inlet
	F-4	Carbon (GAC) filter #1	Removal of contaminants
	F-5	Carbon (GAC) filter #2	Removal of contaminants

Photos 1 through 7, enclosed, present the water treatment unit and its components. Figure 1 presents a schematic of the system.

Set-up

The three unit skids should be placed on a flat surface in the following sequence : skid #1, skid #2, skid #3 (see Photo #1).

The unit can be stored and operated outside, however **the pump must be protected from the elements (*i.e.* rain and snow)**.

Link the settling tank outlet to the pump inlet with the hose supplied. Link the outlet of Ultrasorption® filter #2 to the inlet of GAC filter #1 with the hose supplied.

Prior to treatment, make sure the small ball-valves located on top of the Bag and Ultrasorption® filters are closed. These valves can be used to purge the filters of the trapped air once the treatment has started. Make sure as well that the filter drains are closed prior to starting the water treatment system.

Operating Instructions

Prior to shipment from Montreal, the unit was tested with clean water. The system was operated for a period of one hour, during which time a visual inspection was carried out to insure that all components were water-tight. The float switch, pump, and globe valve were checked for good working order. Pressure was built up in the system to test the pressure gages and relief valve.

Before starting the treatment of contaminated water on site, the unit should be tested again with clean water to insure that the system has not been affected by handling and transportation, especially in terms of water-tightness. Follow the instructions detailed below as if treating contaminated water. During the trial run determine the position of the valve required to obtain a treatment flow rate of approximately 5 to 10 Litres/min. Measuring the flow rate can be achieved by simply calculating the time required to fill up a container of known volume (*i.e.* 20 Litre pail). After successfully carrying out the trial run, the water treatment can begin.

The contaminated water should be pumped into the settling tank through the top opening of the tank. Make sure the pump valve is closed to prevent turbid water from entering the system filters.

Once the tank is full of raw water, let the suspended matter settle, for approximately 12 hours, until the water clears up. Before starting the treatment, open the pump valve at the position determined during the trial run. If the valve position was not determined, open the valve about half way and adjust the valve opening during treatment.

To start treating water, plug the piggy-back float to a power outlet and then plug the pump through the float jack. The pump will start carrying water through the system. The float will automatically shut the pump off when the water level reaches the low level. The pump and float combo should be unplugged prior to filling up the tank in order to prevent the pump from automatically starting to pump turbid water. The level of the float should be adjusted to prevent the pump from running dry and to prevent any floating oil film from being pumped through the system.

The pressure gages located on top of the filters will indicate if a filter is clogging up.

The outlet hose from the pressure relief valve should be placed through the top of the tank. If the relief valve opens, the partially treated water will return to the settling tank.

Water can be sampled before each of the three first filtration stages through the ball valves located on top of the filters. A sample from one of these valves will give an indication of the quality of the water before it enters the filter.

NOTE : Do not pump liquids other than water through the system.

Maintenance

When the bag filter gets clogged, change the bag. To do so, turn the pump off, close the valve, drain the filter through the bottom, and open the top. Remove the clogged bag and replace it by a new one.

The basket filter located on the pump should be checked and emptied regularly. To do so, turn the pump off, close the valve, and open the top. Remove the basket, empty its content and rinse if required before replacing it.

Drain the sediments from the bottom of the tank before the their level reaches the tank discharge, in order to prevent any sediments from being pumped through the system. The sediments can be drained out of the tank through the drain located on the side opposite from the tank discharge.

Before shutting the system down for the winter, all the components of the unit (*e.g.* filters, lines, pump, etc.) must be drained to remove all residual water and prevent damage due to freezing. All the valves and drains should remain open for the winter.