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Impermeable Cover Operation & Maintenance			Revision No.	2
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This document is provided by EFI USA, LLC. to serve as an outline and present suggested guideline for the operation and maintenance of an impermeable cover system. It is to be considered a working document, and as such, is subject to revision and resubmission at any time throughout the life of the impermeable cover system. Be advised that nonconformance to the following could result in negative consequences, not limited to: cover system failure, facility damage, voiding of warranty and personal harm. Please, carefully review the following for your consideration.

I. GENERAL COVER OPERATION GUIDELINES

1. The digester should be operated within the water level operating range specified. Lowering or raising the water level (and cover) below or above the specified low and high operating level may damage the cover system and void warranties. If it becomes necessary to lower or raise the water beyond normal levels, EFI (and/or your Consulting Engineer – if applicable) should be consulted first.
2. Water should be pumped off of the cover after every rain event. Localized ponding should be addressed using portable submersible pumps. The folds (if applicable) should not be pumped completely dry. Leave enough water to keep the fold open approximately one foot.
3. Whether the cover is designed to operate under slight negative pressure (-0.1" to -0.5" w/c is typical) or slight positive pressure (+0.1" to +0.4" w/c is typical), the cover should not be operated inflated to store biogas or any other reason. The cover membrane may rise off the surface of the water, but the cover weights should remain on the surface of the water. This will allow for some storage of biogas. If gas-handling equipment is non-operational due to malfunction or maintenance, the biogas should be allowed to vent into the atmosphere. If your cover is equipped with cover vents on the surface, the cover will automatically vent upon raising a predetermined level over the water surface. Otherwise manual venting is necessary. The ballast weights are not designed to overcome excessive positive gas pressure under the cover.
4. When accessing the cover, do not walk on the cover alone. Use the "buddy" system. Personal Floatation Devices (life jackets) and harnesses with lifelines are recommended. "Buddies" should stay within 25ft of each other.

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5. Check soles of shoes for dirt and debris before walking out onto the cover. Remove any rocks trapped in the treads. These can tear or puncture the cover.
6. No smoking on or near the cover, gas piping, or gas handling equipment. Biogas has the potential of being extremely explosive/flammable with the right gas-to-air mixture.

II. GENERAL GAS EQUIPMENT OPERATION GUIDELINES

1. Close the valve located in the gas line near the flare.
2. Verify the moisture separator (P-trap) valves are open and the moisture separator is filled with water.
3. Verify that the data panel power is turned on.
4. Verify the igniter is positioned and functioning properly through the access door on the side of the flare, being sure to close the access door when done.
5. Open the valve located in the gas line near the flare gradually to avoid the excess accumulation of gas in the combustion chamber.
WARNING: EXCESS ACUMULATION OF GAS MAY PRODUCE AN EXPLOSION!
6. Verify flow is registering on the flow meter.
7. After the flare is burning, wait approximately 5 minutes, and check the exhaust gases from the flare. If it is not burning clean adjust the number of burners and the setting of the air control ring on the bottom of the flare as required.
8. If the flare fails to light, check the flow registering on the flow meter. If the gas flow is low, cap one or two of the burners. Uncap the burners as the flow returns to normal. Ambient temperature digesters operating in northern climates will require this biannually (fall and spring).

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III. GENERAL RAINWATER PUMP OPERATION GUIDELINES

1. Inspect and clean submersible pumps periodically. Windblown debris caught in collected rainwater can accelerate wear on the pumps.
2. Keep power cords out of standing water on the cover as much as possible.
3. Inspect the condition of the insulation on the cords periodically.
4. Do not handle the pumps by the power cord.
5. Do not drag or drop portable submersible pumps on the cover. This can score or puncture the membrane, creating a weak point and possible failure.
6. Ensure pump discharge hoses are placed handled carefully to not damage the cover and prevent erosion at the discharge point.

IV. GENERAL SLUDGE REMOVAL GUIDELINES

1. The installed sludge draw-off pipes are designed to remove sludge across the entire floor of the digester. The frequency of removing sludge will have to be determined by the operator. Ideally the sludge should be applied to cropland at the agronomical rate required for the crop to be planted. The sludge should be sampled and tested to determine this. If this is not desired, then the sludge will have to be removed and disposed of periodically to prevent a significant reduction in treatment volume in the digester.
2. The installed pipes terminate at the berm of the digester. They are designed to have the suction hose of a high solids pump attached to them to remove the accumulated gravity-thickened sludge from the bottom of the digester. If the sludge has thickened to the point it is difficult to pump, the pumping system can be reversed. The suction of the pump would be placed in the storage lagoon or through a port in the digester cover in the supernatant (upper) zone. This low solids water would be pumped into the sludge draw-off pipe and used to fluidize the thickened sludge. The pumping system would then be reversed and the fluidized sludge could be withdrawn.

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V. PROCEDURES FOR EXTREME WEATHER EVENTS

1. **HIGH WIND EVENTS**: The cover system can become vulnerable to damage during high wind events. The cover system will withstand wind gusts up to 90mph. If prolonged high winds are expected, especially winds over 90mph, it is recommended to flood the cover with water. Flooding the cover will provide additional ballast to protect the cover against wind damage. The cover will also be more prone to damage from flying debris in high wind conditions. (NOTE: EFI cannot guarantee that flooding will prevent damage due to winds.) Upon cessation of the wind event, pump off any accumulated water. A “MONTHLY” inspection of the cover should be done after the water has been pumped off. (see “Maintenance Checklist & Frequency”). EFI should be contacted for any repairs required.
2. **HEAVY RAIN EVENTS**: Observation of the cover and operation of the installed pumps is required. In heavy rain events the installed submersible pumps may not keep up with rainfall. Localized ponding can also occur. Additional portable submersible pumps may be required to keep up with rainwater removal. A “MONTHLY” inspection of the cover should be done after the water has been pumped off (see “Maintenance Checklist & Frequency”). EFI should be contacted for any repairs required.
3. **POWER OUTAGES**: On cover systems where the biogas is removed by means of a blower, a power outage can result in the cover inflating and being damaged by high winds. When a severe weather event is forecast, which may result in a power outage, the blower should be shut off and the blower bypass and emergency vent opened. The gas should be allowed to vent off to prevent inflation of the cover. This should be done in addition to flooding the cover with water to ballast it.
4. **ICE & SNOW**: The main concern with ice and snow accumulation is ensuring gas pathways are maintained to the draw off point(s). Covers with the grid weight system help channel snow/ice melt to appropriate sump location(s) for pumping. Foam flotation logs help ensure a void between lagoon contents and the cover to allow for gas flow to the perimeter and draw off point(s). Snow drift and ice jams may be expected in certain circumstances, however it is not recommended to access the cover in these circumstances to remove them. Lagoon content temperatures will help facilitate melt. Ensure pumps for water removal are operable from the shore/bank.

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VI. OTHER

1. **LEAKS & REPAIRS:** Watch the remaining water in the folds and along ballast weights, and observe submersible pump operation. If water level in the folds does not lower during pumping, appears to re-fill after pumping, or if pumped rainwater is dirty or contains digester contents, there is a leak in the cover system. EFI should be contacted immediately to isolate the leak(s) and to perform repairs. If a small hole is noticed in a “dry” area (any point on the perimeter above the water level), the cover may be temporarily patched using duct tape or HDPE tape until EFI can make repairs. Temporary patches should be checked daily and replaced if necessary until EFI arrives.
2. **PONDING & GAS BUBBLES:** If ponding and gas bubbles are occurring consistently in the same location(s), contact EFI or your Consulting Engineer, (if applicable), for troubleshooting.
3. **MOWING:** Caution should be exercised when mowing grass near the cover. Mower blades and flying debris can damage the membrane near the trench and gas-header. Gas leaks can also be ignited. If it is necessary to mow near the cover, direct the clippings away from the cover, or use a bagger.

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Digester Safety Precautions

COVER

1. The crew must have several portable fire extinguishers with them. These must be easily accessible near the work area.
2. If a generator is required for work near the cover, gas piping, or the gas handling equipment, it should be placed upwind of the work area as far as possible. Leaking fluids can damage the cover membrane and cause failure of the cover. Sparks can also ignite leaking biogas.
3. If the system has an installed blower system it may be utilized to pull gas from under the cover. The flare must not be burning or a flashback can occur. The blower will pull outside air through the damaged areas and prevent gas from under the cover escaping into the work area.
4. If a blower system is not installed a temporary vent can be installed. This is a section of pipe installed on the gas draw-off connection in the cover. It should be at least 10 feet long and installed vertically to allow the gas to dissipate. It can be taped to the draw-off and held upright with ropes tied to sandbags. This will create a chimney effect and pull gas from under the cover.
5. The cover should be temporarily patched using duct tape or HDPE tape until EFI can make repairs. Temporary patches should be checked daily and replaced if necessary until EFI arrives.

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6. When the cover is pulled in place it should be held tightly against the liner with sandbags or other means. This will minimize the amount of gas escaping into the work area.
7. Plan the direction of the work so that you can work from the upwind direction whenever possible. Keep any portable electric equipment as far away and upwind of the open edge of the cover as possible.
8. If it is not possible to work from upwind of the opening a portable fan can be utilized to keep the gas away from the equipment.
9. Be aware that as the length of the open edge of the cover decreases the gas concentration will increase.
10. Do not walk on the cover alone. Use the “buddy” system. PFD’s (Personal Floatation Device) and harness and lifelines are recommended. “Buddy” should stay within 25ft.
11. Check soles of shoes for dirt and debris before walking out onto the cover. Remove rocks trapped in the treads. This can tear or puncture the cover.

FLARE

1. Shut valve on gas line and turn off the igniter before inspecting or servicing the flare.
2. Ensure the access door on the side of the flare is closed before lighting the flare.

GAS EQUIPMENT

7. Biogas has the potential of being extremely explosive/flammable with the right gas-to-air mixture.
8. Check water level in the P-traps. Low water level could allow gas to vent off through them.
9. Check ground wire from the battery and the equipment stand is connected to the ground rod.

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10. Check igniter wires are in place and connections are tight.

RAINWATER PUMPS

1. When using portable submersible pumps on the cover, do not drag or drop them on the membrane. This will score or puncture the membrane thus creating a weak point for failure. Pumps should be picked up and set down gently when moving to another location on the cover.
2. Before servicing pumps ensure the power is turned off and the power source is locked and tagged.

GENERAL

1. No smoking on or near the cover, gas piping, or gas handling equipment. Biogas has the potential of being extremely explosive/flammable with the right gas-to-air mixture.
2. Fire extinguishers should be mounted near the digester cover. Personnel performing “hot work” on or near the cover, gas piping, or gas handling equipment should also have a fire extinguisher readily available.
3. Caution should be exercised when mowing grass near the cover. Mower blades and flying debris can damage the membrane near the trench and gas-header. Gas leaks can also be potentially ignited. If it is necessary to mow near the cover, direct the clippings away from the cover, or use a bagger
4. A maintenance and repair log should be kept. Log should include a sketch of the cover showing locations and dates of repairs.
 - b. Fire extinguishers should be mounted near the digester cover. Personnel performing “hot work” on or near the cover, gas piping, or gas handling equipment should also have a fire extinguisher readily available.
 - c. If a generator is required for work near the cover, gas piping, or the gas handling equipment it should be placed upwind of the work area as far as

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possible. Leaking fluids can damage the cover membrane and cause failure of the cover. Sparks can also ignite leaking biogas.

Maintenance Checklist and Frequency

DAILY:

- Observe cover system. An inspection trip around the perimeter should be done.
- Remove any debris from cover.
- Note amount of water along ballast weights. Pump as necessary.
- Check pump discharge hose placement. Is any erosion evident?
- Excessive water ponding can block gas migration and cause bubbles.
- Check for holes, tears, or leaks in the cover or gas piping, contact EFI for repairs.
- Check that the moisture separators (P-traps) are full of water and overflowing.
- Flare burning properly (Adjust burner & air ring if necessary)
- Igniter working properly
- Meter registering normal flow. Cover not inflated.
- Gate to gas equipment enclosure is closed and locked.
- Warning signs are in place
- Covers / caps on pump out ports, sample ports, etc. are in place

MONTHLY:

- Follow guidelines noted for DAILY inspection
- Observe cover system by walking out onto the cover for a general inspection.
- Look for broken ballast weights and/or straps.
- Remove any debris trapped near the weights. This will accelerate cover wear. (Closer inspection of center fold weights can be accomplished by lowering the digester level to low operating level).
- Check pump sump, remove any debris, clean pump strainer
- Check oil level in pumps. Milky oil color indicates seal failure.

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- Check condition of power cables to pumps
- Contact EFI for any required repairs.
- Check igniter wiring connections are tight and not corroded.
- Check solar panel voltage output and battery voltage.
- Check battery/equipment stand ground wire connected to ground rod.
- Download the data from the data logger using the installed serial port cable or download it from the internet.

QUARTERLY:

- Follow guidelines for DAILY and MONTHLY inspection.
- Check seams and previous patches for integrity.
- Contact EFI for repairs if required.
- Check the flare burners. Clean if required.
- Verify the flare burners are level. If the flame is hitting the outer wall it will cause premature wear of the refractory material.
- Change oil in pumps (See page 18 of the pump manual)
- Verify that the refractory material is in its right position (attached to the combustion chamber in the internal part). It should not be hanging because it could cause trouble with the exit of the combustion gases.
- Check amount of sludge accumulated. Schedule removal if required.

ANNUALLY:

- Follow guidelines for DAILY, MONTHLY, and QUARTERLY inspections.
- EFI should also be contacted to schedule a professional inspection, and maintenance/repair of the cover system as necessary.
- If there is an accumulation of soot on the outside of the combustion chamber of the flare it should be cleaned. The flare must be turned off and allowed to cool. The cleaning can be done by brushing the surface using soap and water.

4. RECORDS:

- a. A maintenance and repair log should be kept. Log should include a sketch of the cover showing locations and dates of repairs. In lieu of a “sketch” an additional printout of the As-Built Cover Plan can be used to denote repairs and dates.

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- b. Downloaded data records. (See Section titled “Download DMCS Data via Web Server” for downloading procedure)

Cover Daily Inspection Log

[illegible]