

Waste Management System and Digester

A plug-flow digester and its associated 600KW electrical power generation system was built to use the waste from the cattle feeding operation. However, the cattle waste has not performed well in the digester, and therefore one of the primary goals of the new dairy is to generate a proven high quality feed stock for the digester. The dairy waste may still be augmented with cattle waste if needed, but the dairy waste water will be the primary manure supply to the digester. The layout of the bio-energy system at the cattle and dairy operation is shown in Figure 4 while a more detailed flow diagram of the bio-energy system is provided in Figure 7. The bio-energy system will handle daily inputs of the manure from the dairy. Any supplemental manure/bedding materials will be mixed in the receiving pit and brought to an appropriate moisture content (~10-12% solids) before being pumped into a 2.7 million gallon, spirally-mixed, plug-flow, and temperature-controlled methane digester. The digester is mostly underground so will not affect air through the barns and to be visually non-intrusive. The biogas generated in the digester will either be piped to two reciprocating engines connected to two 300 kw three phase electric generators or cleaned and delivered to a nearby natural gas pipeline. Waste energy from the engines or a boiler will be used to heat the digester to a constant 101 deg F for optimal gas production. The effluent from the digester will be pumped over two sloping screen separators to remove the larger solids. The effluent from the screen separators flows into a concrete solids settling tank (0.47 million gallons, 73'dia x 16'deep) to remove additional solids before overflowing into the existing plastic lined storage pond (1.7 million gallons, 120' x 230' x 18' with 3:1 side slopes, see Figure 4. Effluent from the irrigation storage pond will be pumped to center pivot irrigation systems on site or on the neighbor's farm that has partnered with Southern Cross Organics & Energy LLC for delivery to crops. The solids from the solids separators will be either directly applied at agronomic rates on non-sprayfield pivots or hauled off site or will be composted first onsite before being applied at agronomic rates on non-sprayfield pivots or hauled off site. The sludge solids from the settling pond will be spread on fields at agronomic rates. Approximately 40% of the phosphorus is removed in each of the solids separation steps. Less nitrogen (~20%) will be removed with the solids, so the majority will still be available for crop use through the effluent irrigation system.

The effluent irrigation will be delivered to the 17 pivots (~2195 acres) for use by the crops via a 6" diameter pipelines as shown in Figure 8. The 6" pipe size is sufficient to handle the 250 gpm produced by the floating effluent irrigation pump. Since this flow rate is insufficient to operate the center pivots, the effluent will only be delivered to a pivot that is being operated from a freshwater well. This means that the 250 gpm effluent will need to be delivered at a slightly higher pressure into the freshwater supply pipeline going to the pivot. The additional 250 gpm flow to the pivots means the capacity of the existing freshwater pumps have been reduced or the effluent be delivered to two or three operating pivots at the same time to prevent excessive pressures at the pivots. The floating pump has a pressure relief blowback to the pond to prevent excessive pressures. The mixing of the effluent and freshwater virtually eliminates any odors and provide optimal application uniformity.

In summary, the dairy flush water, cattle barn cleanout, and the land application process will be as follows: The excess dairy flush water will be pumped into the methane digester. If needed, some manure/bedding material from the cattle barns will be delivered to the reception pit at the east end of the manure digester where it will have water added before it is pumped into the methane digester. The effluent from the digester will be pumped over sloping screen solids separators before flowing into a large tank where additional solids will settle. Effluent from the settling tank will flow to a large irrigation storage pond from which the water will be pumped to