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June 30, 2020

Mr. Jim Hughes
Colorado Oil and Gas Conservation Commission
1120 Lincoln Street, Suite 801
Denver, Colorado 80203

RE: 4M SFTC Expansion/Renovation Evaluation
June 2020

Dear Mr. Hughes:

LT Environmental, Inc. (LTE) is providing this evaluation of potential improvements for the 4M Outcrop Mitigation Project in La Plata County, Colorado, to the Colorado Oil and Gas Conservation Commission (COGCC). The South Fork Texas Creek (SFTC) mitigation system has proven to be an effective mitigation system for capture of methane gas and conversion of that gas to electrical energy. The mitigation system was originally installed to determine the feasibility of gas capture for beneficial use. In addition to supplying electricity to the local grid, positive benefits resulting from successful gas capture included improvement of the surrounding vegetation that was previously distressed to nonexistent and reduction in the amount of greenhouse gases that reach the atmosphere. The COGCC is now considering the next phase of operation for the system. LTE has evaluated two tiers of system improvements that will not only result in higher electrical generation and increased cost effectiveness but will prolong the life of the SFTC mitigation system. LTE has provided a third tier of system expansion that will increase overall system output and performance, thereby expanding the observed positive benefits to a larger platform.

LTE has not included the estimated annual O&M costs in this evaluation but can provide that information to the COGCC upon request. Since 2011, BP America Production Company (BP) has paid for the SFTC mitigation system operations and maintenance (O&M), but due to recent purchase of BP assets in La Plata County by IKAV, it is unclear how long the new owner will fund system operation.

BACKGROUND

The objective of the mitigation portion of the 4M Outcrop Mitigation Project was to demonstrate the technical viability of recovering gas and using gas at specific locations where methane seeps to the surface along the Fruitland Formation Outcrop. An additional goal is to protect the environment, which includes reducing carbon emissions and improving plant growth. To accomplish these objectives, LTE designed and installed vapor collection and barrier systems for methane collection at the SFTC site. The recovered methane is used to fuel a microturbine generator, which generates electricity to operate the collection system. The excess generated

power is returned to the local electrical grid for credit as a renewable energy resource. The initial design, installation, and startup of the SFTC mitigation system was completed in 2008 and 2009. During June 2010, the SFTC mitigation system was expanded to increase methane collection. A collection liner designed to direct vapors into the existing collection system was installed beneath the creek, and 32 diagonal well points were installed along the creek and piped into the existing manifold. Results and O&M activities are detailed in previous annual reports completed by LTE and submitted to the COGCC.

ELECTRICAL GENERATION

Operation of the system commenced on May 5, 2009, and so far, 324,975 kilowatt hours (kW-h) have been supplied to the electrical grid. The value of the electricity generated to date has been used to offset electrical usage and administrative fees for electrical service. The remainder of any cash disbursement is held by La Plata Energy Association as credit. The credit is reported in the annual reports submitted to the COGCC.

SYSTEM LIFE EXPECTANCY

When the SFTC mitigation system was installed, it was designed as a pilot project to prove the viability of the concept, and the equipment was anticipated to have a life expectancy between five to seven years. The system is currently in its 12th year of operation and the turbine has continued to operate with limited maintenance requirements. LTE believes the SFTC mitigation system, as currently configured, may be approaching the end of its life expectancy due to continued use and the deterioration of the system components over time.

SYSTEM DEFICIENCIES

Although the system is currently operating and fully functional, LTE has identified the following items as problematic for continued operation:

- Hydrogen sulfide and carbon dioxide intermixed with the gas stream create acidic conditions that corrode steel pipes, gaskets, and other pieces of equipment in the gas stream over time. The amount of hydrogen sulfide has increased, and efforts to isolate and reduce the hydrogen sulfide have been implemented. However, equipment corrosion and leaks introduce foreign particulates to the gas stream that cause periodic shutdown due to plugging of small diameter tubing and filters and degrades the equipment.
- The current configuration of the systems telemetry is out of date and no longer supported by the manufacturer. The system was designed to send out notification in the event of a compressor shut down; however, due to a programming issue, the compressor can shut down without distributing a notification, resulting in reduced operational time.
- There is currently no continuous logging or recording of the methane flow/concentration data. The data logging system has aged beyond the manufacturer support period.

- The manufacturer of the gas compressor is no longer in business, making it difficult to find replacement parts. It is common for seals and bearings to require replacement after 5 or more years of operation.
- The current building which houses the system is aging and needs maintenance to deal with rodent and water infiltration as well as handle ice-damming in the winter. Falling ice has the potential to damage the compressor controller and electrical control housing.
- The system has been operational at approximately one-half the capacity of the turbine, which appears to be due to limitations in the single-phase to three-phase power transfer equipment. The manufacturer of the existing phase converter system has indicated that the system was upgraded by the manufacturer two years following installation and is no longer supportable.
- It is estimated that about 8 to 10 thousand cubic feet per day (MCFD) of gas is being used the SFTC mitigation system. In a study completed in 2015, LTE estimated 1,285 MCFD of available methane seepage at SFTC is not being captured by the system. More recently during a wet year in 2019, the estimated flux observed during the standard annual survey for the entire area was approximately 10 percent of that measured in 2015. Therefore, roughly 128 MCFD potentially remained available for capture in 2019, sufficient to upgrade with additional generation capacity.

LTE recognizes that addressing all of the aforementioned deficiencies would be a costly one-time expenditure. As such, LTE has separated the costs into three different tiers, providing COGCC with options to consider improvements or upgrades to the system based on short-term necessity to long-term improvements (i.e. Tier 1 = short-term recommendations, Tier 2 – moderate-term recommendations, and Tier 3 = long-term recommendations).

TIER 1 RECOMMENDATION

In the Tier 1 (T1) recommendation, LTE suggests addressing the most pressing issues to maintain uninterrupted operation without increasing maintenance cost. In effect, T1 maintains the system as-is, but at an improved cost effectiveness. If the T1 recommendations are not implemented, the potential for parts failure remains high, the system's overall lifespan decreases, and costs to keep the system operational will continue to increase. The suggested upgrades are listed by LTE preference with the most pressing issues listed first.

Task 1 Replace the existing dryer tank

The existing dryer tank has a small crack in the line connected to the drain valve that was caused by the corrosive nature of the gas. LTE has been able to slow and contain the leak, but not eliminate it. Replacing the dryer tank will allow for better gas conditions (dryer gas) and increase the amount of recovered gas.

Task 2 Replace existing steel piping with stainless steel piping and fittings

As mentioned in the "System Deficiencies" section, the existing steel pipe at the Site is corroding, causing particulates to enter the gas stream and inefficient gathering of gas. By replacing existing steel piping from the gas compressor inlet downstream to the turbine with stainless steel piping, the corrosion will be reduced.

Task 3 Add new telemetry to monitor operational data remotely

With a modern telemetry system, the operation of the system could be remotely monitored for pending or existing problems. The existing telemetry will not send out notification if the turbine shuts down. By upgrading the telemetry system, certain problems could be predicted before they occur, this would limit the number of shutdowns, and reduce the number of site visits to maintain the system.

LTE is anticipating that the telemetry system can be upgraded without upgrading the existing support system. In the event that the existing phone line does not allow for the new telemetry system to function properly the building will have to be equipped with internet. Currently Century Link (phone services provider) does not have a Digital Subscriber Line (DSL) or fiber internet option for the site; however, satellite internet is available through ViaSat. The base business package for internet services is $90 per month. The one-time installation fee for setting up the internet would be approximately $300. These costs are not included in Table 1 but have been introduced here for reference.

Task 4 Add a new flow meter/data logger to track gas flow and concentration

Replacing the existing flow meter with one that has data logging capabilities would allow for direct comparison of gas flow and concentration data to the data collected by the on-site weather station. Not only would this allow for better understanding of how seasonal weather fluctuations are related to gas flow, it would also allow for the potential to track periods of lower gas use and predict when maintenance was required on the system prior to an issue causing system shutdown.

Task 5 Install ice dam protection on the existing roof

Installing heated wire on the north side of the roof could prevent the formation of any ice dams and protect electrical components on the north side of the building.

Task 6 Inspection and recommendations by a Capstone microturbine representative (Pumps and Services in Farmington, NM)

LTE replaces all expendable parts within the turbine that are feasibly possible for our technicians, but some parts (fuel injectors, igniters, etc.) can only be serviced by a Capstone-certified

technician. Servicing these parts at the proper intervals will help maintain the operation of the turbine and prolong its lifespan. Additionally, periodic software upgrades to the system can be installed by the manufacturer's representative at this time.

The total estimate cost to complete all of the above items is $28,000 plus the internet service fees. A cost estimate for completing these tasks is included as Table 1. Some degree of cost savings will be available if all of the measures are implemented.

TIER 2 RECOMENDATIONS

In the Tier 2 (T2) set of recommendations, LTE addresses issues that will allow the system to run at higher capacity, thereby increasing electrical generation and further reducing methane seepage in the area. These improvements are not pressing but are required if better performance is the overall objective. It is important to note that T1 upgrades should be implemented to improve the results of implementing the T2 recommendations.

Task 7 Replace the compressor

A new compressor would make the system more efficient and ultimately cost less to maintain. The manufacturer of the existing compressor is no longer in business which makes finding replacement parts difficult, and because of the age of the compressor, these parts fail more often. The size of the turbine is unique and comparative gas compressors are difficult to find; however, LTE has identified a local supplier with new and used compressors which exceed the turbine needs. These compressors could be utilized in the existing system and LTE could design the electrical controls to match the turbine needs. Upgrading wiring and system controls will also likely be required. The new compressor replacement estimate includes upgrading the pre-treatment and control components of the inlet gas in order to operate effectively. These costs have been included in this evaluation along with the compressor.

Task 8 Upgrade the phase converter and transformer

The SFTC mitigation system is not running at full capacity due to limitations in the three-phase to single-phase power transfer equipment. Maximizing electrical generation with the existing compressor will require replacing the phase converter and/or the transformer, which convert the electricity being generated by the turbine from three phases of 460 volts alternating current (VAC) to a single phase of 230 VAC. The phase converter works in the reverse during startup periods, converting the 230 VAC single phase grid power to 460 VAC three phase to start the gas compression and initiate turbine operation. The 230 VAC single phase power is compatible with the rural electrical grid. Once the phase converter is upgraded, LTE anticipates that the existing transformer will need to be upgraded as well in order to handle the increased electrical generation. Currently the continuous methane sensor on the compressor inlet is not functioning and replacement of this sensor is included with the phase converter upgrade to monitor the gas concentration with the system operating at a higher demand.

Task 9 Improve the efficiency of methane collection

In 2015 LTE evaluated gas seepage along the borders of the collection system and above the collection areas. The 2015 report indicated that a large volume of gas escapes above the collection system at the Site due to damages to the liner, possible damaged subsurface piping, and areas where the liner is not covering seepage areas. This gas is still available for capture at the site. LTE recommends repairing any damaged gathering lines and vapor barrier connections to decrease loss of this gas.

The total estimate cost to complete the above T2 items and items in T1 is $119,000. A cost estimate for completing these tasks in addition to the T1 options is included as Table 2.

TIER 3 RECOMENDATIONS

If the SFTC mitigation system were to effectively collect a larger percentage of the available gas and convert it into larger amounts of energy, it is plausible that the Carbon Tax Credit program could be utilized at this site. This would draw significant interest from operators who could fund the annual O&M costs. If the SFTC collection is deemed successful in supplying carbon tax credits, additional seep areas along the outcrop could be feasible to investigate adding a mitigation system similar to SFTC. SFTC serves as a catalyst to expanding the 4M project and ultimately reducing greenhouse gas emissions in the area at the benefit of generating electricity.

In the Tier 3 (T3) evaluation, LTE recommends expanding the system footprint within the SFTC site in order to collect more gas and turn this system into a state-of-the-art electrical generator. The T3 recommendations support significant advancement of the gas capture and electrical generation system. The following upgrades would be conducted in addition to the T1 and T2 options.

Task 10 Expand the footprint of existing collection areas

In the study completed by LTE in 2015, along with gas seeping from above the collection system it was also noted that a large volume of gas is escaping along the edges of the collection system. LTE estimates that roughly 8 to 10 MCFD of gas is being used by the existing system but approximately 1,285 MCFD of gas is escaping from the collection area. Theoretically, LTE could improve the collection system to capture a large percentage of this available which could equate to additional electrical generation. Not only would the expanded footprint of the collection system allow for more electrical generation, it would also reduce the greenhouse gas emission from the seep area and continue to improve the surrounding ecosystem.

It is possible with the expansion of the collections areas that more hydrogen sulfide could be introduced into the system. If this scenario arrives LTE will have to evaluate options for installing and hydrogen sulfide scavenger system in order to eliminate the hydrogen sulfide from the gas stream prior to compression.

Task 11 Perform a pilot test for gas availability

In order to better understand the available gas at the site, LTE recommends performing a pilot test once the expanded collection area is installed. The pilot test would be performed once by collecting all the subsurface gathering lines to a central manifold and applying a slight vacuum to the manifold. The gas concentrations and flow rates could be monitored to determine how much gas is being captured by the new collection system. Once the concentration and flow data are obtained, the total MCFD of gas that is being collected by the system could be calculated. The pilot test will allow for confirmation that there is enough gas being collected to support a second turbine, or a larger turbine.

Task 12 Install an additional 30kw Microturbine

Once additional gas is captured by the expanded system an additional turbine will need to be installed in order to convert a large amount of gas into electrical energy. Ideally, installing expanding the footprint of the existing collection areas would allow for the SFTC to double the amount of electrical generation. Once the pilot test is conducted, a second Capstone 30-kilowatt Micro-turbine could be installed and integrated into the system. There is likely sufficient gas availability to prove a larger turbine and if this option is pursued the availability of used equipment at the time of implementation should also be evaluated.

In order to complete this task, the existing building footprint would need to be expanded in order to house the additional turbine. In addition to a larger building, all electrical components would need to be upgraded to accommodate the additional turbine and added electrical generation. The costs here assume that La Plata Energy Association will accept the additional power input and upgrade to the electrical service is not required.

The total estimate cost to complete the above items and items included in the T1 and T2 proposal is $338,000. Estimated costs for the individual tasks are listed in Table 3.

SUMMARY

The provided costs in this evaluation are estimated based on informal conversations with various subcontractors and manufacturers. If the COGCC would like to proceed with any of the above stated work, LTE can provide a more formal cost estimate and provide a proposal to implement these changes or assist the COGCC prepare the bid documents for subcontractor work.

LTE believes that the above stated T1 through T3 recommendations provide added value to the SFTC mitigation system and the 4M project as a whole. By making specified upgrades throughout, the cost effectiveness and efficiency of the system can be improved dramatically. Upgrading the system will also allow for the increased mitigation of methane seepage and, therefore, increased positive benefits that have potential to move the pilot project into a more permanent phase of operation. That new level of success opens the door to potential new resources and more

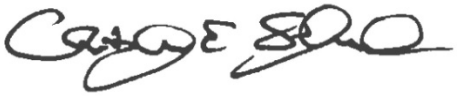
significant benefits. LTE believes that the continued operation of the SFTC system is vital, and by completing the above listed recommendations the system will continue to generate “green” energy, reduce greenhouse gas emissions, and improve the ecosystem surrounding SFTC. The lessons learned from operation of the SFTC mitigation system can be used to expand those documented benefits.

LTE appreciates the opportunity to provide these services to the COGCC and BP America. Please call us at (970) 385 1096 if you have any questions or comments regarding this report.

Sincerely,

LT ENVIRONMENTAL, INC.

Devin Hencmann
Project Geologist



Christopher E. Shephard, P.E.
Chief Engineer

Attachments
Table 1 Tier 1 Estimated Costs
Table 2 Tier 2 Estimated Costs
Table 3 Tier 3 Estimated Costs

TABLE 1
SFTC EXPANSION - TIER 1 ESTIMATED COSTS

SOUTH FORK TEXAS CREEK
LA PLATA COUNTY, COLORADO
COLORADO OIL AND GAS CONSERVATION COMISSION

Task 1 - Installation of dryer tank		
	TASK 1 ESTIMATED COSTS:	**$6,800.00**
Task 2 - Installation of new stainless steel piping		
	TASK 2 ESTIMATED COSTS:	**$6,200.00**
Task 3 - Installation of new telemetry system		
	TASK 3 ESTIMATED COSTS:	**$4,500.00**
Task 4 - Installation of new data logger		
	TASK 4 ESTIMATED COSTSL:	**$3,400.00**
Task 5 - Installation of ice dam protection		
	TASK 5 ESTIMATED COSTS:	**$1,000.00**
Task 6 - Turbine servicing		
	TASK 6 ESTIMATED COSTS:	**$5,000.00**
	SUBTOTAL	$26,900.00
	TAXES	$600.00
	SHIPPING	$500.00
	TOTAL ESTIMATED COST :	**$28,000.00**

TABLE 2
SFTC EXPANSION - TIER 2 ESTIMATED COSTS

SOUTH FORK TEXAS CREEK
LA PLATA COUNTY, COLORADO
COLORADO OIL AND GAS CONSERVATION COMISSION

Tier 1 Subtotal	**ESTIMATED COST :**	**$28,000.00**
Task 7 - Replace compressor		
	TASK 7 ESTIMATED COSTS:	**$41,500.00**
Task 8 - Upgrade phase converter and transformer		
	TASK 8 ESTIMATED COSTS:	**$33,000.00**
Task 9 - Repair collection system		
	TASK 9 ESTIMATED COSTS:	**$12,000.00**

SUBTOTAL	$114,500.00
TAXES	$2,500.00
SHIPPING	$2,000.00
TOTAL ESTIMATED COST :	**$119,000.00**

TABLE 3
SFTC EXPANSION - TIER 3 ESTIMATED COSTS

SOUTH FORK TEXAS CREEK
LA PLATA COUNTY, COLORADO
COLORADO OIL AND GAS CONSERVATION COMISSION

Tier 1&2 subtotal	**ESTIMATED COST :**	**$119,000.00**
Task 10 - Expand collection areas		
	TASK 10 ESTIMATED COSTS:	**$45,000.00**
Task 11 - Pilot test		
	TASK 11 ESTIMATED COSTS:	**$5,500.00**
Task 12 - Install additional 30kw turbine		
	TASK 12 ESTIMATED COSTS:	**$156,000.00**
	SUBTOTAL	$325,500.00
	TAXES	$7,000.00
	SHIPPING	$5,500.00
	TOTAL ESTIMATED COST :	**$338,000.00**