



Tuesday, July 26, 2013

MEMO

**To:** Michael J. Harris, P.E. , Colorado Department of Public Health and Environment

**From:** Paul Quick, Jennifer Hale, Denver Zoological Foundation

**Subject:** Re: Questions on gasification unit

1) *Who is the manufacturer of the gasifier?*

Denver Zoo is working with chemical, mechanical, electrical, process, and controls engineers in the design of the gasifier. It will be constructed by Denver Zoo using Denver Zoo staff, engineers and consultants as needed.

2) *What modifications is the Zoo making to the gasifier?*

Per answer to question 1, because this is being built by our staff engineering team the term "modifications" is defined as any changes we need to make in order to assure operation of the system meets our design parameters.

3) *Are there any emission guarantees from the manufacturer?*

Again, because this system is being designed and built by Denver Zoo, it does not come with manufacturer guarantees. The source testing to be performed as part of the construction permit process will provide us with data on the gasifier. In areas where specific manufactured equipment from an outside entity, for example Denver Zoo is using SAS Engineering to design the flaring components of the system. SAS Engineering is under contract to provide guaranteed operational requirements are met as specified in the air permit. The revisions we are looking to request on the original APEN application will be revised and resubmitted to CDPHE by August 15. Their guarantee is conditional in that the information that Denver Zoo provided was accurate for the gas flowing into the flare (which is based upon chemical modeling combined with test data from the smaller scale gasifiers the zoo has tested).

Other equipment, such as the dryer, engine and micro turbine, because these specific pieces of equipment have been modified in order to meet our process, we do not have guarantees from the manufacturer and will need to verify the data from source testing as required in the construction permit.

4) *Are there similar systems currently in operation?*

The closest system to the one being developed for the zoo is a CPC downdraft gasifier, located in Dixon Ridge Farms, CA (50 KWe) The zoo's system is a 300kW.

Source: [http://www.energy.ca.gov/research/notices/2012-02-29\\_workshop/presentations/Biomass/Lester-Dixon\\_Ridge\\_Farms-Green%20Bio-Energy\\_For\\_Food\\_Processing.pdf](http://www.energy.ca.gov/research/notices/2012-02-29_workshop/presentations/Biomass/Lester-Dixon_Ridge_Farms-Green%20Bio-Energy_For_Food_Processing.pdf)

There are other vendors that produce similar gasifiers, however, many do not utilize our feedstock in their installations and operate in Europe/India. They include companies such

as (downdraft at Denver Zoo scale):

- Ankur – India
- Xylowatt – (NOTAR gasification) – Installations in Gedinne, Belgium and Tournai, Belgium
- Weiss – Viking gasifier – Installation in Hadsund, Denmark

Denver Zoo did a thorough evaluation of gasification suppliers in 2007 for 6 months and then again in 2010 for 4 months searching for vendors to supply an “off the shelf” gasifier. For reasons related to: distance, support, technology development, and scale most of these companies were not capable of delivering a product to meet our requirements. Denver Zoo then proceeded with constructing two small scale pilot systems (<10kW) in order to test the technology on our fuel stream.

*5) What is the proposed operating schedule for the gasifier?*

Denver Zoo anticipates that the gasifier will require maintenance and/or shutdown to evaluate performance once a week. The goal is to have more uptime, but initially we anticipate at least a few years of this operating schedule. Estimated hours for generator: 8784 hours/year, hours for gasifier: 7512 hours/year and hours for flare: 4000 hours/year

The flare is used for start-up and shutdown and will operate less once the gas clean-up and generator(s) are designed/installed/operating. Prior to this, Denver Zoo will be operating and collecting data for the design and installation of the gas clean-up portion.



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