EMISSIONS AND TECHNOLOGY REVIEW OF SELECTED BIOMASS CONVERSION SYSTEMS

(REVISION 1)

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EXECUTIVE SUMMARY

Biomass fuels such as wood represent a resource with significant potential to provide clean energy, replacing fossils fuels with a carbon neutral, renewable energy source. However, in considering the use of biomass energy conversion technologies, it is important to examine the potential to produce harmful air pollution. There are a variety of biomass conversion technologies available, the predominant of which is conventional direct combustion, in which fuels are combusted directly in an oxygen rich environment.

Nexterra Systems Corporation develops, manufactures and delivers gasification systems that convert biomass fuels into syngas, which is then combusted to produce useable heat (in the form of hot water, hot oil, or steam), and in some cases, electricity. Due to the design of the Nexterra gasification system, it is expected that in-use emissions of Criteria Air Contaminants (CACs) should be lower than or – in the case of some pollutants – comparable to the best emissions level achieved by conventional direct combustion technologies. Nexterra contracted Levelton Consultants to compile and compare CAC emissions from Nexterra systems and comparable conventional direct combustions systems in Canada and the United States, as well as detailing regulatory emissions limits from various jurisdictions.

Emissions test data were collected for 4 Nexterra gasification facilities (Dockside, Kruger, Tolko, USC), 17 biomass direct combustion facilities, and 4 fossil fuel direct combustion facilities. Test data were available for Total Particulate Matter (TPM), Carbon Monoxide (CO), Nitrogen Oxides (NO_x), and Volatile Organic Compounds (VOC – US EPA Method 25A). There was insufficient test data available to perform a comparison of emissions of particulate matter smaller than 10 and 2.5 microns in diameter (PM_{10}, $PM_{2.5}$), and Total Hydrocarbons (THC).

Results obtained for CO and VOC indicate that Nexterra system emissions of these pollutants are significantly lower than direct combustion system emissions. Mean and median CO and VOC emissions were less than 3% and 2% respectively of the mean and median levels for direct combustion systems. These results are likely attributable to the design of the Nexterra gasification system, which separates gasification and combustion, allowing independent control of temperature and air addition. As such, formation of pollutants associated with incomplete combustion (i.e. CO and VOC) is expected to be low.

Results obtained for TPM and NO_x indicate that the best-performing combustion systems can produce emissions levels comparable to Nexterra systems. These results are not unexpected, given that TPM control is strongly dependant on the efficiency of secondary treatment devices, and NO_x levels are dependent on fuel nitrogen levels. However, it is important to note that Nexterra's systems exhibited characteristics that make them particularly amenable to good control of both TPM and NO_x. As expected based on Nexterra's gasifier design, the uncontrolled TPM levels from the Tolko facility were low, even relative to some direct combustion facilities with primary (multiclone) and secondary (Electrostatic Precipitator (ESP)) PM control. Further, test results for implementation of Selective Non-Catalytic Reduction (SCNR) NO_x control on two Nexterra facilities indicated very low emissions levels, comparable to Low NO_x natural gas systems, and lower than direct combustion systems with SNCR or Selective Catalytic Reduction (SCR).

Finally, a review of various North American emissions regulations relevant to biomass combustion revealed that the most stringent emissions limits are associated with the proposed US EPA (United States Environmental Protection Agency) NESHAP (National Emissions Standards for Hazardous Air Pollutants) Boiler MACT (Maximum Achievable Control Technology) rules for Major and Area Sources. Test results indicated that Nexterra systems would be able to meet MACT PM and CO limits for both Area and Major source rules. However, further study of the Major source rule HCl, mercury, and dioxin / furan limits is required.