UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
AIR, WASTE, AND TOXICS

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MEMORANDUM

SUBJECT: Procedure to Determine a Biomass Boiler's Fuel-Heat-Input-To-Steam-Output Ratio

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TO: Permit File

EPA Region 10 has developed the attached procedure for determining a biomass boiler's fuel-heat-input-to-steam-output ratio for use in estimating emissions based on steam production. Some permits issued by EPA Region 10 specifically direct sources to use this procedure; other sources responsible for estimating emissions from biomass boilers can also use this procedure.

EPA Region 10 regulates a number of wood products facilities in Indian Country across the Pacific Northwest. Nearly all of these facilities employ at least one biomass boiler. Facilities subject to the Title V operating permit program or FARR registration program are required to estimate emissions for various reasons (e.g. emission-based fees, compliance with limits, annual emission reports). Many of these sources have plant-wide emission limits for hazardous air pollutants and are required to calculate monthly emissions to demonstrate compliance.

Published emission factors for biomass boilers are often in terms of lb/MMBTU. Measurement of the heat input rate (MMBTU/hr) for use with such emission factors is difficult given the need for continuous measurement of the fuel feed rate and heat content. As an alternative, sources typically estimate the heat input rate using steam production, which is easier and more reliable to measure, and an assumed boiler efficiency. The attached procedure is intended to provide a more accurate conversion from measured steam production to boiler heat input for use with emission factors in units of lb/MMBTU.

This procedure underwent public notice and comment when the procedure was required in previously issued Title V permits. On those occasions, EPA Region 10 received no comments related to the procedure. Permitted sources will be directed to an EPA Region 10 web site for the most recent version of the procedure, much like a source test method. By posting it on the web, unpermitted sources will have access to the procedure as well.

Procedure to Determine a Biomass Boiler's Fuel-Heat-Input-To-Steam-Output Ratio

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Conduct at least three valid stack test runs; each at least 60 minutes in duration. Follow Steps 1 through 8 for each run. Calculate the arithmetic average value for fuel-heat-input-to-steam-output ratio considering the results of all valid runs.

1. Simultaneously Measure Stack Gas Volumetric Flow and Steam Generating Rate.
   - Measure average stack gas volumetric flow (dscfm) using EPA Reference Method 2
   - Measure average steam flow (mlbsteam/hr) using boiler monitoring equipment

2. Sample Fuel
   - Create composite sample (composed of three approximately 2-pound individual samples) using 63.7521(c); all individual samples shall be collected at a location that most accurately represents the fuel being burned; individual belt or screw feeder samples, described in 63.7521(c)(1)(ii), shall be collected such that one sample is representative of fuel combusted at the beginning of the run, one is representative of fuel combusted at the mid-point of the run, and one is representative of fuel combusted at the end of the run.

3. Homogenize Fuel Sample
   - Subdivide and homogenize composite sample using 63.7521(d) until sample passes 2 mm screen

4. Determine Fuel Moisture
   - Determine moisture content (%, wet basis) of composite sample using ASTM E871-82R06; time analysis such that sample used for moisture analysis represents moisture content of sample introduced to oxygen bomb;
   - For converting heat content or ultimate analysis % to dry basis, use the following:
     - (value, wet basis) / (1 - %moisture) = (value, dry basis)

5. Determine Fuel Heat Content (aka Gross Calorific Value or High Heat Value)
   - Determine gross calorific value (Btu/lb, wet basis) for composite sample using ASTM E711-87R04; convert GCV results to be on dry basis

6. Perform Ultimate Analysis (for composite sample)
   - Determine ash content (%, dry basis) using ASTM D1102-84R07
   - Determine C (%, wet basis) using ASTM E777-87R04; convert to dry basis
   - Determine H (%, wet basis) using ASTME777-87R04; convert to dry basis
   - Determine N (%, wet basis) using ASTM E778-87R04; convert to dry basis
   - Determine S (%, wet basis) using ASTM E775-87R04; convert to dry basis
   - Calculate O (%, dry basis) using ash, C, H, N and S results (%, dry basis) and ASTM E870-82R06

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7. Calculate Hogged Fuel F-Factor (for composite sample)
   - Calculate F-factor (dscf/mmBtu) using results from ultimate analysis (dry basis) and GCV (dry basis) using equation 19-13 in 40 CFR 60 App A, RM19

8. Calculate Conversion Factor
   - Determine fuel heat input rate (mmBtu/hr) using average stack flow rate and percent oxygen (dry) for the run and F-factor for composite sample:
     (dscf/min) ((20.9 - $\%O_2$)/20.9) x (60 min/hr) / (dscf/mmBtu) = (mmBtu/hr)
   - Determine input/output ratio (mmBtu/mlbsteam) by dividing the fuel heat input rate (mmBtu/hr) for composite by the steam flow rate (mlbsteam/hr) for the run