REC 16-297

Innovative Natural Resource Solutions LLC

Natural Resource Consulting Since 1994

107 Elm Street, Suite 100G
Portland, ME 04101
207.772.5440

www.inrsllc.com

March 4, 2016

Ms. Deborah Howland
Executive Director
NH Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

Enclosed please find an original and two copies of Ensyn Fuel Inc.'s application for Thermal Renewable Energy Certificates generated using renewable fuel at Memorial Hospital in Northern Conway, NH.

This application proposes an alternative metering technology, previously discussed with staff and counsel.

If you have any questions, or require additional information, please do not hesitate to contact me.

Sincerely,

Eric Kingsley
kingsley@inrsllc.com
Mobile 207-233-9910

Enclosures

CC: Lee Torrens, Ensyn Fuels Inc.

State of New Hampshire
Public Utilities Commission
21 S. Fruit Street, Suite 10, Concord, NH 03301-2429

DRAFT

APPLICATION FORM FOR

RENEWABLE ENERGY SOURCE ELIGIBILITY FOR CLASS I THERMAL SOURCES WITH RENEWABLE THERMAL ENERGY CAPACITY GREATER THAN 150,000 BTU/HR

Pursuant to New Hampshire Administrative Code PUC 2500 Rules

- Please submit one (1) original and two (2) paper copies of the completed application and cover letter* to:

Debra A. Howland
Executive Director
New Hampshire Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

- Send an electronic version of the completed application and the cover letter electronically to executive.director@puc.nh.gov.

* The cover letter must include complete contact information and identify the renewable energy class for which the applicant seeks eligibility. Pursuant to PUC 2505.01, the Commission is required to render a decision on an application within 45 days of receiving a completed application.

If you have any questions please contact Barbara Bernstein at (603) 271-6011 or Barbara.Bernstein@puc.nh.gov.

Only facilities that began operation after January 1, 2013 are eligible.

Is this facility part of a Commission approved aggregation?

Yes X No ______

Aggregator's Company Name: WES Energy & Environment LLC

Aggregator Contact Information: Dan Wilson, dan@wesenergyandenvironment.com
(704) 256-7066

Contents

Attachment Labeling Instructions

Please label all attachments by Part and Question number to which they apply (e.g. Part 3-7). For electronic submission, name each attachment file using the Owner Name and Part and Question number (e.g. Pearson Part 3-7).

Part 1. General Application Information

Please provide the following information:

Applicant

Name: Ensyn Fuels Inc.

Mailing Address: One World Trade Center, Suite 8500

Town/City: New York State: NY Zip Code: 10007

Primary Contact: Lee Torrens

Telephone: (406) 490-9831 Cell: (406) 490-9831

Email Address: ltorrens@ensyn.com

Facility

Name: Memorial Hospital

Physical Address: 3073 White Mountain Highway

Town/City: North Conway State: NH Zip Code: 03860

If the facility does not have a physical address, the Latitude: ______ & Longitude ______

Installer

Name: Blake Equipment

Installer License Number: MBE1000400

Mailing Address: 7 Ingersol Drive, Unit 1

Town/City: Portland State: ME Zip Code: 04103

Primary Contact: Dan Burnell

Telephone: 800-308-2213 Cell: ______

Email Address: Dan.burnell@bghusa.com

If the equipment was installed by the facility owner, check here: ☐

Facility Operator

If the facility operator is different from the owner, please provide the following:

Name: Memorial Hospital

Facility Operator Telephone Number: 603-356-5461

Independent Monitor

Name: To be determined, based upon metering requirements

Mailing Address: ______

Town/City: ______ State: ______ Zip Code: ______

Primary Contact: ______

Telephone: ______ Cell: ______

Email Address: ______

NEPOOL/GIS Asset ID and Facility Code

In order to qualify your facility's thermal energy production for RECs, you must register with the NEPOOL – GIS. Contact information for the GIS administrator follows:

James Webb

Registry Administrator, APX Environmental Markets

224 Airport Parkway, Suite 600, San Jose, CA 95110

Office: 408.517.2174

jwebb@apx.com

Mr. Webb will assist you in obtaining a GIS facility code and an ISO-New England asset ID number.

GIS Facility Code # NON58396 Asset ID # NON58396

1. Has the facility been certified under another non-federal jurisdiction's renewable portfolio standards?

Yes [ ] No [X]

If you selected yes, *please provide proof of certification in the form of an attached document as Attachment 1-1.*

2. Attach any supplementary documentation that will help in classification of the facility as Attachment 1-9

Part 2. Technology Specific Data

All Technologies

Fuel type (solar, geothermal, or biomass): Biomass

Rated Thermal Capacity (Btu/hr): 2 units at 8.45 MMBtu/hour each

Date of initial operation using renewable fuels: Boiler 1 – July 2, 2014; Boiler 2 – May 6, 2015

Biomass

If a thermal biomass facility, provide proof of New Hampshire Department of Environmental Services approval that the facility meets the emissions requirements set forth in Puc 2500, as Attachment 2-1.

Solar Thermal

If a solar thermal facility, please provide the Solar Rating and Certification Corporation rating based on Mildly Cloudy C (kBtu/day): ____________________

Geothermal

If a geothermal facility, please provide the following:

The coefficient of performance (COP): ____________________

The energy efficiency ratio of the system: ____________________

Part 3. Metering and Measurement of Thermal Energy and REC Calculations

This section deals with the thermal metering system including methods for calculation and reporting useful thermal energy. **A copy of PUC 2506.04 of the RPS rules is included as Appendix A.**

Using the table below, identify the thermal metering system or custom components (e.g., heat meters, flow meters, pressure and temperature sensors) used to measure the useful thermal energy and enter the accuracy of measurement for the entire system:

System or Component	Product name	Product Manufacturer	Model No.
Tank level reader	Vegapuls 62 Radar Level Transmitter	Vega	PS62.UDBAE2HANXX
Total System Accuracy (Percent)	(please see attachment 3-1)		

Attach component specification sheets (Accuracy, Operating Ranges) as Attachment 3-1. [x]

Attach a simple schematic identifying the location of each sensor that is part of the metering system as Attachment 3-2. [ ]

Check the applicable standard for meter accuracy prescribed in Puc 2506.04 among the six choices below (compliance with Puc 2506.04 shall be certified by a professional engineer licensed by the state of New Hampshire and in good standing):

If the facility is a large thermal source using a liquid or air based system, check the method that applies:

A. Installation and use of heat meters capable of meeting the accuracy provisions of European Standard EN 1434 published by CEN, the European Committee for Standardization. The heat meter shall have the highest Class flow meter that will cover the design flow range at the point of measurement and a temperature sensor pair of Class 5K or lower. [ ]

B. Installation and use of meters that do not comply with European Standard EN 1434, provided that the manufacturers' guaranteed accuracy of the meters is ±5.0% or better, [ ]

C. Use of an alternative metering method approved pursuant to Puc 2506.06. [ ]

If the facility is a large thermal source using a steam-based system, check the method that applies:

D. Installation and use of meters with accuracy of ±3.0% or better. [ ]

E. Installation and use of meters with system accuracy that do not meet D but are ±5% or better. [ ]

F. Use of an alternative metering method approved pursuant to Puc 2506.06. [X*]

* Alternative metering method pending, see attachment 3-3, 3-4 and 3-5

Please summarize the manufacturer's recommended methods and frequency for metering system calibration and provide reference for source document (e.g. owners/operators manual):

[ ]

REC Calculation Discount factor for meter accuracy (Enter 0 if no discount is required): 0 %

If the meters used to measure useful thermal energy comply with the accuracy of the European Standard EN 1434 for liquid systems or use of meters with accuracy of ±3.0% or better for steam systems enter zero, for all other systems enter the sum total of the manufacturer's guaranteed accuracy of the meters used or the accuracy of the alternative method approved pursuant to Puc 2506.06.

REC Calculation Discount factor for operating energy and thermal energy losses: *2.0* %

Check the method used for determining the operating energy and thermal loss factor among the choices below:

Default Factor [*X*]

- For sources using solar thermal technology, the discount factor shall be 3.0% of the useful thermal energy produced;

- For sources using geothermal technology, the discount factor shall be 3.6% of the useful thermal energy produced;
- For sources using thermal biomass renewable energy technology, the discount factor shall be 2.0% of the useful thermal energy produced.

Actual Metering ☐

- Include a simple schematic identifying the operating energy and thermal energy losses and placement of the meters.

Interim Alternative Metering Method

Until such time as the Puc 2500 rule is finalized applicants may utilize an alternative method as described in the draft rule 2505.02(e)(2):

> *In lieu of the information required by Puc 2505.02 (d) (11) through (13), a thermal source may submit a detailed explanation of the methodology used to measure and calculate thermal energy and an attestation by a professional engineer that is licensed in New Hampshire and in good standing that the methodology for measuring useful thermal energy and calculating certificates is sound.*

Please see attachments:

3 – 3: Need for Alternative Metering
3 – 4: Summary of Project, Fuel Characteristics, Boiler Efficiency
3 – 5: Proposed Calculation of Thermal Renewable Energy Certificates

Part 4. Affidavits

Owners Affidavit

The following affidavit must be completed by the owner attesting to the accuracy of the contents of the application pursuant to PUC 2505.02 (b) (14).

AFFIDAVIT

I, Lee Torrens have reviewed the contents of this application and attest that it is accurate and is signed under the pains and penalties of perjury.

Applicant's Signature	2.20.16	Date			
Applicant's Printed Name	Lee Torrens		Ralph Lee Torrens		
Subscribed and sworn before me this	20th	Day of	February	(month) in the year	2016
County of	Litchfield		Litchfield		
	Connecticut	State of			

Notary Public/Justice of the Peace Seal

TIFFANY A. HUSSEY
NOTARY PUBLIC
MY COMMISSION EXPIRES 7/31/2017

My Commission Expires

NH Professional Engineer Affidavit

AFFIDAVIT

I, __________ attest that this facility meets the requirements of the thermal REC eligibility requirements of Puc 2500, including the thermal metering and measurement methodologies and standards and REC calculation methodologies.

Professional Engineer's Signature __________ Date __________

Professional Engineer's Printed Name __________

NH Professional Engineer License Number __________

PE Stamp

Application Checklist				
Application Section		Item Description	Attachment Required	Check box
Part 1-1	x	Applicant Information		☐
Part 1-2	x	Facility Location Information		☐
Part 1-3	x	Installer Contact Information		☐
Part 1-4	x	Equipment Seller Information		☐
Part 1-5		Facility Monitor Information		☐
Part 1-6		Regulatory Approvals for REC Requirements	Yes	☐
Part 1-7		Other REC Certifications		☐
Part 1-8		Facility Output Information		☐
Part 1-9		Facility Operator Information		☐
Part 1-10		Additional Facility Classification Information		☐
Part 1-11		Attestation that Building Codes are Met		☐
Part 2-1		Rated Thermal Capacity		☐
Part 2-2a		Thermal Biomass Facility, 3-99 MMBTu/hour Output		☐
Part 2-2b		Thermal Biomass Facility, 100+ MMBTu/hour Output		☐
Part 2-3		Solar Thermal Facility Solar Rating and Certification Corporation Rating		☐
Part 2-4a		Geothermal Facility Coefficient of Performance		☐
Part 2-4b		Geothermal Facility Energy Efficiency Ratio		☐
Part 3-1		Equipment and Meter Description		☐
Part 3-2		Recommended Methods for Meter Calibration		☐
Part 3-3		Attestation that Meters meet PUC 2506 Requirements		☐
Part 3-4		Guaranteed Accuracy of Meters		☐
Part 3-5a		Small Thermal Source- Calculating Useful Thermal Out		☐
Part 3-5b		Large Thermal Source- Calculating Useful Thermal Out		☐
Part 3-6		Meter Accuracy Discount Factor		☐
Part 3-7a		PUC 2506 Operating Energy and Thermal Loss Discount Factor		☐
Part 3-7b		Determining Operating Energy and Thermal Loss Discount Factor		☐
Part 4-1		Owner Affidavit		☐
Part 4-2		Professional Engineer Affidavit		☐

Appendix A. Excerpt from Puc 2500 – Certain Thermal Metering Provisions

For complete rules and requirements related to the RPS and REC eligibility, please refer to Puc 2500.

Puc 2506.04 Metering of Sources that Produce Useful Thermal Energy

(a) Sources producing useful thermal energy shall comply with this part in metering production of useful thermal energy.

(b) Sources shall retain an independent monitor to verify the useful thermal energy produced.

(c) Sources shall take data readings for the measurement of useful thermal energy at least every hour. The useful thermal energy produced shall be totaled for each 24 hour period, each monthly period, and each quarter.

(d) Sources shall install meters to measure thermal energy output in compliance with the manufacturer's recommendations and as noted in this part.

(e) Large thermal sources using a liquid or air based system shall measure the useful thermal energy produced using one of the following methods:

> (1) Installation and use of heat meters with an accuracy that complies with European Standard EN 1434 published by CEN, the European Committee for Standardization, and that complies with paragraph (k), (l) or (m). The heat meter shall have the highest Class flow meter that will cover the design flow range at the point of measurement and a temperature sensor pair of Class 5K or lower. Compliance shall be certified by a professional engineer licensed by the state of New Hampshire and in good standing;
>
> (2) Installation and use of meters that do not comply with subparagraph (e) (1), provided that the manufacturers' guaranteed accuracy of the meters is ±5.0% or better, and provided that a professional engineer licensed by the state of New Hampshire and in good standing certifies that the meters were installed and operate according to the manufacturers' specifications and in accordance with paragraph (k), (l) or (m); or
>
> (3) Use of an alternative metering method approved pursuant to Puc 2506.06, provided that the accuracy of any such method is ±5.0% or better, and provided that a professional engineer licensed by the state of New Hampshire and in good standing certifies that the source implemented the alternative method as approved by the commission and certifies that the alternative method achieves the stated accuracy of ±5.0% or better.

(f) Large thermal sources using a steam-based system shall measure the useful thermal energy produced using one of the following methods:

> (1) Installation and use of meters with accuracy of ±3.0% or better, which compliance shall be certified by a professional engineer licensed by the state of New Hampshire and in good standing and in accordance with paragraph (m);

(2) Installation and use of meters that do not comply with the accuracy of subparagraph (f)(1), provided that the manufacturer's guaranteed accuracy of the meters is ±5.0% or better, and provided that a professional engineer licensed by the state of New Hampshire and in good standing certifies that the meters were installed and operate according to the manufacturer's specifications and in accordance with paragraph (m); or

(3) Use of an alternative metering method approved pursuant to this section, provided that the accuracy of any such method is ±5.0% or better, and provided that a professional engineer licensed by the state of New Hampshire and in good standing certifies that the source implemented the alternative method as approved by the commission and certifies that the alternative method achieves the stated accuracy of ±5.0% or better.

(g) Small thermal sources shall measure useful thermal energy produced using one of the following methods:

(1) For any small thermal sources, the methods described in paragraphs (e) or (f);

(2) For small thermal sources using solar thermal technologies, the method described in paragraph (h);

(3) For small thermal sources using geothermal technologies, the method described in paragraph (i); or

(4) For small thermal sources using thermal biomass technologies, the method described in paragraph (j).

(h) Calculation of useful thermal energy produced by small thermal sources using solar technologies.

(1) "Q" means thermal energy generated, stated in Btu's.

(2) "R" means the Solar Rating and Certification Corporation (SRCC) OG100 rating on Mildly Cloudy C Conditions, stated in thousands of Btu's per day.

(3) "L" means the orientation and shading losses calculated based on solar models such as Solar Pathfinder, T-sol, Solmetric, or another model approved by the Commission, converted from a percentage to the equivalent number less than 1.

(4) "t" means the total operating run time of the circulating pump as metered, stated in hours.

(5) "h" means 11 hours per day to convert the SRCC OG100 rating to an hourly basis (conversion factor).

(6) To calculate Q, the useful thermal energy produced by small thermal sources using solar technologies, the source shall compute the product of R, t and the result of 1 minus L, and divide the result by the product of h and 1,000, as in the formula below:

$$Q = [R * t * (1 - L)] / (h * 1{,}000)$$

(i) Calculation of useful thermal energy produced by small thermal sources using geothermal technologies.

(1) “Q” means thermal energy generated, stated in Btu’s.

(2) “HC” means the Air Conditioning, Heating and Refrigeration Institute (AHRI) certified heating capacity at part load, stated in Btu’s per hour.

(3) “COP” means the AHRI Certified Coefficient of Performance.

(4) “t” means total operating run time of the pump when the entering water temperature is greater than the leaving water temperature, stated in hours.

(5) Small thermal sources using geothermal technologies may calculate Q, the useful thermal energy produced, by multiplying HC by the difference between COP and 1, multiplying the result by t, and dividing the result by COP, as in the formula below:

$$Q = [HC * (COP - 1) * t] / COP$$

(j) Calculation of useful thermal energy produced by small thermal sources using thermal biomass renewable energy technologies.

(1) “Q” means the thermal energy generated, stated in Btu’s.

(2) “D” means the default pellet density, which shall be 0.0231 pounds per cubic inch.

(3) “R” means the auger revolutions per hour.

(4) “V” means auger feed volume, stated in cubic inches per auger revolution. Small thermal sources shall assume that V equals one of the following:

a. 5 cubic inches per revolution for augers with a 2” inside diameter;

b. 20 cubic inches per revolution for augers with a 3” inside diameter;

c. 50 cubic inches per revolution for augers with a 4” inside diameter;

d. 95 cubic inches per revolution for augers with a 5” inside diameter; or

e. 150 cubic inches per revolution for augers with a 6” inside diameter.

(5) “EC” means the default energy content of pellet fuel, which shall be 7870 Btu per pound.

(6) “ASE” means the default thermal efficiency expressed as a percentage based on the manufacturer’s warranty of average seasonal thermal efficiency, or based on a default thermal efficiency of 65%.

(7) “t” means the total auger run time in hours as metered.

(8) The estimated amount of fuel burned (the product of D, R, V and t) shall be verified by the fuel purchase records and fuel inventory.

(9) Small thermal sources using thermal biomass renewable energy technologies with wood pellets as the fuel source may calculate Q, the useful thermal energy produced, by computing the product of D, R, V, EC, ASE and t, as in the formula below:

$$Q = (D * R * V * EC * ASE * t)$$

(k) Thermal sources using solar thermal technologies.

(1) "Q_g" means the heat generated in the collector loop, stated in Btu's.

(2) "dm/dt" means the mass flow of the collector working fluid measured near the inlet to the solar storage tank, stated in pounds per hour.

(3) "c_p" means the specific heat of the collector fluid, stated in Btu's per pound (mass), degrees Fahrenheit (BTU/lbm-°F).

(4) "Ti" means the collector loop inlet temperature measured near the outlet of the solar storage tank, stated in degrees Fahrenheit.

(5) "To" means the collector loop outlet temperature measured near the inlet to the solar storage tank, stated in degrees Fahrenheit.

(6) "t" means the frequency at which data readings are recorded, stated in hours.

(7) Meter sensors shall be installed on the collector loop as close to the water storage tank as practical and in accordance with the meter manufacturer's guidance.

(8) Thermal sources using solar thermal technologies shall calculate Q, the useful thermal energy produced, by calculating the product of dm/dt, $c_{p,}$ the difference between To and Ti, and t, as stated in the formula below:

$$Q_g = (dm/dt)*c_p *(To - Ti) * t$$

(l) Thermal sources using geothermal technologies.

(1) "Q_g" means heat generated in the ground loop, stated in BTU's.

(2) "dm/dt" means mass flow measured near the outlet of the ground loop, stated in pounds per hour.

(3) "c_p" means specific heat of the working fluid, stated in BTU/lbm-°F.

(4) "t" means the frequency at which data readings are recorded, stated in hours.

(5) "Ti" means ground loop inlet temperature measured at the inlet to the ground loop, stated in degrees Fahrenheit.

(6) “To” means ground loop outlet temperature measured at the outlet from the ground loop, stated in degrees Fahrenheit.

(7) Bleed points, supplemental boilers and cooling towers shall be excluded from the calculation.

(8) Meter sensors shall be installed on the ground loop as close to the ground loop inlet and outlet as practical and in accordance with the manufacturer’s recommendation.

(9) Thermal sources using geothermal technologies shall calculate Q, the useful thermal energy produced, by calculating the product of dm/dt, c_p, the difference between To and Ti, and t, as stated in the formula below:

$$Q_g = (dm/dt) * c_p * (To - Ti) * t$$

(m) Thermal sources using thermal biomass renewable energy technologies.

(1) “Q_g” means the thermal energy generated from biomass, stated in Btu.

(2) “dm_{out}/dt” means mass flow metered upstream of distribution and downstream of parasitic loads, stated in pounds per hour.

(3) “h_{out}” means the specific enthalpy at the metering point determined by temperature data and, for superheated steam, by pressure data, stated in Btu’s per pound.

(4) “dm_{in}/dt” means mass flow of water into the feedwater or condensate pumps, stated in pounds per hour.

(5) “h_{in}” means the specific enthalpy at the metering point which will be a function of the enthalpy of incoming condensate and make-up water prior to the first condensate or feedwater pumps, stated in Btu’s per pound.

(6) “t” means the frequency at which data readings are recorded, stated in hours.

(7) All metering systems shall measure boiler feedwater flow, pressure and temperature as close to the first feedwater pump inlet as possible, thereby excluding the deaerator.

(8) Metering for systems that produce hot water shall include sensors for temperature and hot water mass flow placed as close as possible to the boiler hot water distribution header inlet.

(9) Metering for systems that produce steam shall include sensors for temperature, pressure and steam flow placed as close as possible to the steam distribution header inlet and thereby prior to distribution to process loads.

(10) For saturated steam systems, pressure and temperature shall be measured to verify the absence of superheat at the measurement point.

(11) For superheated systems, both pressure and temperature measurements shall be required.

(12) Regardless of phase, the enthalpy under the measured conditions shall either be calculated using International Association for the Properties of Water and Steam (IAPWS) Industrial Formulation 1997 (IF97) formulas or taken from IAPWS or derivative steam tables.

(13) Thermal sources using thermal biomass renewable energy technologies shall calculate Q, the useful thermal energy produced, by calculating the product of dm_{out}/dt, (h_{out}), and t, and subtract from that number the product of dm_{in}/dt, h_{in} and t, as stated in the formula below:

$$Q_g = [dm_{out}/dt *(h_{out}) * t]-[dm_{in}/dt *(h_{in}) * t]$$

Puc 2506.05 Calculation of Certificates for Production of Useful Thermal Energy

(a) Sources producing useful thermal energy, the independent monitor or the designated representative shall report to GIS the useful thermal energy produced and the amount of RECs calculated pursuant to this part, as verified by the source's independent monitor.

(b) Useful thermal energy shall be expressed and reported in megawatt-hours where each 3,412,000 Btu's of useful thermal energy is equivalent to one megawatt-hour.

(c) Small thermal sources shall receive certificates based on the useful thermal energy produced as metered pursuant to Puc 2506.04(e) or (f) and discounted, as applicable, by the discount for meter accuracy pursuant to paragraph (e) or as calculated pursuant to Puc 2506.04(h), (i), or (j).

(d) Large thermal sources shall receive certificates based on the useful thermal energy calculated pursuant to Puc 2506.04(e) or (f), discounted by the sum of the percentage discount for meter accuracy pursuant to paragraph (e) and the percentage discount for operating energy and thermal storage losses, or parasitic load, pursuant to paragraph (f).

(e) The discount factor for meter accuracy referenced in paragraphs (c) and (d) shall be one of the following:

(1) If the meters used to measure useful thermal energy output comply with the accuracy of the European Standard EN 1434 as provided in Puc 2506.04(e)(1) or the accuracy pursuant to Puc 2506.04(f)(1), there shall be no meter accuracy discount; or

(2) If the meters used to measure useful thermal energy output do not comply with the accuracy of the European Standard EN 1434 as provided in Puc 2506.04(e)(1) or the accuracy pursuant to Puc 2506.04(f)(1), the applicable meter discount shall be the manufacturer's guaranteed accuracy of the meters used or the accuracy of the alternative method approved pursuant to Puc 2506.06.

(f) The discount factor for large thermal sources for parasitic load referenced in paragraph (d) shall be one of the following:

(1) For sources using solar thermal technology, the discount factor shall be 3.0% of the useful thermal energy produced as measured pursuant to Puc 2506.04;

(2) For sources using geothermal technology, the discount factor shall be 3.6% of the useful thermal energy produced as measured pursuant to Puc 2506.04;

(3) For sources using thermal biomass renewable energy technology, the discount factor shall be 2.0% of the useful thermal energy produced as measured pursuant to Puc 2506.04; or

(4) The discount factor shall be the source's actual metering of the parasitic load.

Puc 2506.06 Request for Alternative Method for Measuring Thermal Energy

(a) A source shall not use an alternative metering method until that alternative method is approved by the commission.

(b) A source seeking approval of an alternative method shall submit an application to the commission that includes the following information:

(1) The name, mailing address, daytime telephone number, and e-mail address of the person requesting approval for the alternative method;

(2) The name and location of the source at which the alternative method will be implemented;

(3) A description of the metering method otherwise required by these rules and the reasons it cannot be used with the applicant's facility;

(4) A description of the proposed alternative method;

(5) Technical data and information demonstrating that the accuracy of the method otherwise required by these rules will be substantially achieved by the proposed alternative method (such data and information may include third party data such as product test results from independent test laboratories, performance data based on nationally recognized product test/certification programs, published resource data for use in calculations, and examples of the use of the method by other organizations for similar purposes); and

(6) Certification by a professional engineer licensed by the state of New Hampshire and in good standing of the meter accuracy rate that will be achieved by the alternative metering method and that the proposed alternative method is technologically sound.

(a) Electricity generation in megawatt-hours and useful thermal energy expressed in megawatt-hours shall be measured and verified in accordance with ISO-NE and GIS operating rules and this Part.
(c) The commission shall approve an alternative metering method that satisfies the requirements of paragraph (b).

Attachment 2-1: New Hampshire Department of Environmental Services approval that the facility meets the emissions requirements set forth in PUC 2500

NHDES

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

November 2, 2015

Debra A. Howland
Executive Director and Secretary
New Hampshire Public Utilities Commission
21 South Fruit Street, Suite 10
Concord, NH 03301-2429

Re: Recommended Certification as a Class I Thermal Renewable Energy Source
Memorial Hospital
North Conway, NH

Dear Ms. Howland:

The New Hampshire Department of Environmental Services (DES) was contacted by Eric Kingsley of Innovative Natural Resource Solutions on behalf of Memorial Hospital requesting certification of the wood-fired boilers located at Memorial Hospital as a Class I thermal renewable energy source. DES recommends that the Public Utilities Commission (PUC) grant conditional approval to Memorial Hospital as a Class I thermal renewable energy source eligible to generate renewable energy certificates (RECs). A summary of the facility description, DES's review of particulate and NOx emission rates and monitoring requirements, and a recommendation for approval are presented below.

Facility Description

Facility Name:	Memorial Hospital
Facility Location:	3073 White Mountain Highway North Conway, NH 03860
Gross Nameplate Capacity:	2 Cleaver Brooks boilers; 8.45 MMBtu/hr each
State Permit to Operate:	SP-0046
Issue Date:	March 19, 2014
Primary Fuel:	Renewable Fuel Oil (RFO), a liquid biomass fuel derived from wood products

Particulate Matter (PM) Emissions

By definition, *"Thermal biomass renewable energy technologies"*, requires units rated between 3 and 30 MMBtu/hr gross heat input to meet a particulate matter (PM) emission rate limit of 0.10 pounds/million British thermal units (lb/MMBtu). Permit SP-0046 issued by DES contains boiler operation requirements (see Table 3). In addition to the permit requirements, DES herein establishes the following quarterly reporting requirements in order to demonstrate continued REC eligibility by Memorial Hospital:

1. Certification that RFO was the primary fuel combusted in the boilers and that no #4 light residual petroleum fuel oil was combusted, and report the actual thermal output based upon the amount of RFO combusted;
2. Certification that the timing of the soot-blow system was a two-second cycle every 90 minutes, resulting in 16 2-second soot blow cycles, for a total of 32 seconds of soot blowing, per 24-hour period; and
3. Because testing was conducted at less than 90% of rated capacity, report the hours of operation and the calculated maximum quarterly thermal output, in addition to the actual thermal output.
   a. Tests were conducted at 87.2% of boiler #1 capacity and 81.7% of boiler #2 capacity.
   b. Alternative maximum rated thermal capacity = 0.872 x 8.45 MMBtu/hr + 0.817 x 8.45 MMBtu/hr = 14.27 MMBtu/hr.
   c. Calculated maximum quarterly thermal output = quarterly hours of operation x Alternative maximum rated thermal capacity.
4. Certification that the reported actual thermal output is less than or equal to the calculated maximum quarterly thermal output. RECs shall be calculated based on the lower of the reported actual thermal output or the calculated maximum quarterly thermal output.

Emission Rate Confirmation

A PM emission test has been performed for Memorial Hospital, and the test results have been reported in writing to DES. The emission test was performed for PM in accordance with the pre-test protocol reviewed by DES. The results of the emission test indicate the actual PM emission rate in lb/MMBtu meets the required 0.10 lb/MMBtu.

Nitrogen Oxides (NOx) Emissions

By definition, *"Thermal biomass renewable energy technologies"*, requires units rated less than 100 MMBtu/hr gross heat input to meet best management practices (BMP) as established by DES for control of nitrogen oxides (NOx) emissions. DES herein establishes BMP as conducting boiler tune-ups annually and conducting combustion efficiency testing initially and annually demonstrating results equal to or greater than 99%.

BMP Confirmation

Memorial Hospital measured actual carbon monoxide (CO) and carbon dioxide (CO_2) concentrations in the exhaust gas using a hand-held portable analyzer (or alternative method approved by DES) to determine combustion efficiency using the following equation:

$CE(\%) = 100 \times CO_2 / (CO_2 + CO)$

Where:

CE = combustion efficiency

CO_2 = % by volume of carbon dioxide in the flue gas, and

CO = % by volume of carbon monoxide in the flue gas.

The results of the initial test indicate that the combustion efficiency meets the required 99%. DES anticipates that Memorial Hospital will be able to meet ongoing BMP annually.

Conclusion and Recommendation for Approval

DES believes that Memorial Hospital currently meets, and annually will meet, the requirements to be certified as a Class I - New Biomass thermal renewable energy source. DES recommends that the PUC certify Memorial Hospital as a Class I thermal renewable energy source eligible to generate thermal renewable energy certificates beginning the fourth calendar quarter 2015 (October 1, 2015), because Memorial Hospital has demonstrated that the following conditions have been met:

1) Memorial Hospital emits PM at an average rate less than or equal to 0.10 lb/MMBtu; and
2) Memorial Hospital currently maintains CE equal to or greater than 99%.

If you have any questions, please contact me at joseph.fontaine@des.nh.gov or (603) 271-6794.

Sincerely

Joseph T. Fontaine

Joseph T. Fontaine
Technical Programs Manager
Air Resources Division

Attachment 2-2

Renewable Fuel Oil

Memorial Hospital is currently using Renewable Fuel Oil (RFO) to fire their boilers. As described on Ensyn's website[1], RFO is a liquid fuel manufactured through the process of fast pyrolysis using residual woody feedstocks. Feedstocks are primarily sawmill residues such as sawdust, bark, and wood chips. All of these are qualify as "biomass fuel "under both NH PUC 2502.03 and NH RSA 362-F:2.

There is no construction and demolition debris used as feedstock for RFO.

New Hampshire PUC rules define biomass as:

> PUC 2502.03 "Biomass fuels" means "biomass fuels" as defined in RSA 362-F:2, II, namely "plant derived fuel including clean and untreated wood such as brush, stumps, lumber ends and trimmings, wood pallets, bark, wood chips or pellets, shavings, sawdust and slash, agricultural crops, biogas, *or liquid biofuels*, but shall exclude any materials derived in whole or in part from construction and demolition debris."

Using this definition, the Renewable Fuel Oil (RFO) fuel used at Memorial Hospital clearly qualifies as "biomass fuel".

RFO contains 76,000 BTU per gallon. An analysis of RFO (as delivered to Memorial Hospital) follows.

[1] http://www.ensyn.com/technology/overview/ and http://www.ensyn.com/technology/feedstocks/

ENSYN

1 Innovation Drive
Renfrew, Ontario
Canada, K7V 0B5
1-613-433-9508

Customer: Memorial Hospital
3073 White Mountain Highway
North Conway, NH
3860

Delivery Instructions: None

Certificate of Analysis		
Product Name:		Shipping Date: 08-Feb-16
Product Code: 7100-203-100		Customer PO #:
Reference Number:		BOL #: 2677
Parameter	**Test Method**	**Result**
Water Content, wt% as is	ASTM E203	22.3%
Viscosity @ 40°C, cSt	ASTM D445	50.1
Solids Content, wt% as is	ASTM D7579	0.08%
Ash Content, wt% as is	EN 055	0.11%
Density @ 20°C, kg/dm^3	EN 064	1.19
HHV (as is), cal/g	ASTM D240	4324
HHV (as is), MJ/kg	ASTM D240	18.1
HHV (as is), BTU/lb	ASTM D240	7783
Quantity Shipped: 5900 Gallons		

This product conforms to specifications:	Yes
Technician Signature:	PS
Name:	Paula Sevigny
Date:	27-Jan-16

Attachment 3-1

http://www.vega-americas.com/en/radar_PULS62.htm

VEGA

4170 Rosslyn Drive Cincinnati, OH 45209 USA
1.800 FOR LEVEL (367.5383) americas@vega.com

MODERNIZING MEASUREMENT TECHNOLOGY

PRODUCTS

Company | Products | Industries | Downloads | Services | Contact Us

HOME > PRODUCTS > LEVEL > RADAR > VEGAPULS 62

Level

Radar

- VEGAPULS WL 61
- VEGAPULS 61
- VEGAPULS 62
- VEGAPULS 63
- VEGAPULS 65
- VEGAPULS 66
- VEGAPULS 67
- VEGAPULS 68
- VEGAPULS 69

Guided Wave Radar

Ultrasonic

Capacitive

MLI/Bridle

Additional Product Categories:

- Switching
- Pressure
- Radiation-Based Measurement
- Integration Solutions
- System Components
- plics Technology
- SPEED Delivery

VEGAPULS 62

The VEGAPULS 62 is a high-frequency radar gauge for the measurement in storage tanks or process vessels under difficult process conditions.

It utilizes a small stainless steel horn to produce a focused microwave beam to the product's surface and accurately measure level in various applications.

Features

26 GHz high-frequency radar

Loop-powered

316L or Hastelloy C wetted parts

Adjustment with PLICSCOM, HART handheld or PC

Key Specifications

-328° to 842°F (-200° to 450°C) operating temperature

-14.5 to 2320 psi (-1 to 160 bar) operating pressure

+/- 2 mm accuracy

246 ft (75 m) measuring range

SIL2 Qualified

» Principles of Operation

As shown above, the Vegaplus 6.2 gauge used is accurate to +/- 2mm (0.002 meters). Given that the tank is 25 feet (7.82 meters) in height, this provides a measurement accuracy of 0.026%, as shown below.

		Feet	Meters
Top of tank		25.66	7.821
Bottom of Tank		0.66	0.201
Tank Height	*(top - bottom)*	25	7.620
Accuracy of gauge	*(Attachment 3-2)*		0.002
Percent Accuracy	*(accuracy / height)*		0.026%

Attachment 3-3 Need for Alternative Metering

Metering for Thermal Renewable Energy Certificates

The physical set-up for RFO at Memorial Hospital necessitates an Alternative Method for Measuring Thermal Energy. Memorial Hospital has two Cleaver-Brooks boilers, which are capable of burning RFO or No. 4 oil. The presence of – and the ability to use – No. 4 oil allows Memorial Hospital the redundancy and back-up that hospitals need to ensure continued operations in the event of a technical problem, a supply disruption, or other unexpected circumstances to use oil to fire the boilers.

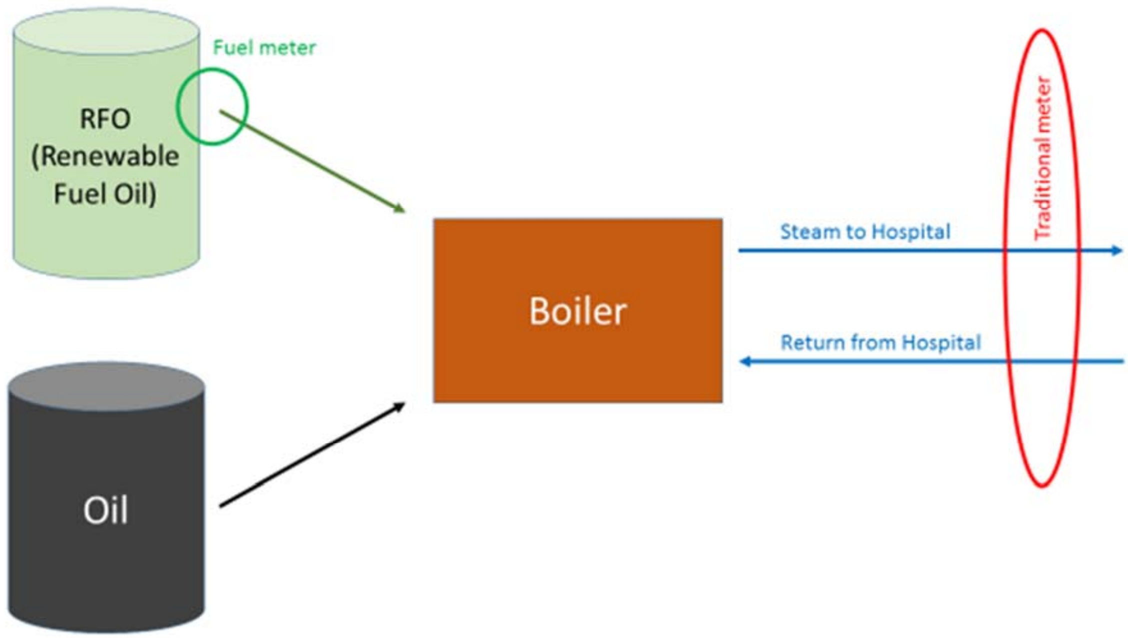
Memorial Hospital currently uses RFO as the only fuel, but there may be times – planned and unplanned – when No.4 oil is required as a fuel. These may include an unexpected problem in with the RFO at the boiler or in the tank that holds it, a supply disruption, or simply testing to ensure that the backup system functions properly. Importantly, it is not possible for the boilers to be co-fired (using both RFO and No. 4 oil simultaneously).

It is obvious to Ensyn and Memorial Hospital that heat generated using No. 4 oil is not and should not be eligible for T-RECs. However, a traditional heat meter, as described in NH PUC 2506.04(f) measures the heat after it has left the boiler. Obviously, in the layout that is present at Memorial Hospital, a traditional meter would measure the heat coming from the boiler and would be unable to distinguish between T-REC eligible thermal energy generated using RFO and non-T-REC eligible thermal energy generated utilizing No. 4 oil.

Instead, Ensyn proposes a metering technique that will assure that T-RECs are assigned only to that portion of the thermal energy generated using RFO. The RFO tank has a highly accurate meter that measures the tank level to 2 millimeters, in order to ascertain the volume in the tank (currently used to make sure both Ensyn and Memorial Hospital are aware of fuel use and the need to re-supply). The only place that the RFO tank feeds is the boilers, there is no other use for RFO at Memorial Hospital.

Ensyn proposes to use this measurement to determine actual daily RFO fuel use, and then use a professionally-derived boiler efficiency to determine (for T-REC purposes) how much useful thermal energy was generated and provided to Memorial Hospital using RFO.

The highly simplified (single boiler) schematic below shows how this location differs from the location where a traditional steam meter would be located.



Ensyn is confident that this proposed metering method will allow T-RECs to be quantified for only that portion of thermal energy generation produced using RFO. This unique circumstance is exactly the sort of situation that the Alternative Method for Measuring Thermal Energy (NH PUC 2506.06) was designed for.

Attachment 3-4 – Summary of Project, Fuel Characteristics, Boiler Efficiency

Renewable Fuel Oil Measurements

Memorial Hospital, North Conway, NH

ENSYN fuels

Introduction

Ensyn Fuels is pleased to produce and distribute a 100% renewable fuel, made entirely from residual, FSC certified biomass. The fuel is called Renewable Fuel Oil (RFO) and it is produced via Ensyn's proprietary thermal fast pyrolysis technology called Rapid Thermal Processing (RTP®). Ensyn has been in business for over twenty years, producing renewable fuels and chemicals for a variety of industries. Ensyn is very proud to be part of the state's commitment to sustainable energy.

The use of RFO as a direct replacement for fossil fuel oil provides customers such as Memorial Hospital at North Conway, NH a means to meet all of their thermal heating needs sustainably. By installing an independent RFO handling system and converting the two package boiler burners to be dual fuel capable (i.e. they can run on either RFO or fossil fuel, but never both), the hospital has improved their energy security by adding inherent redundancy. The equipment retrofit did not involve changing the boilers themselves, the steam loop, feed water handling, etc.

The information below provides the facts about how RFO input to the two boilers is measured in support of Ensyn Fuel's application for consideration as a Class I Thermal Source with Renewable Energy Capacity Greater than 150,000 Btu/hr.

Fuel Metering

Shipments of Ensyn's Renewable Fuel Oil (RFO) are measured on a load by load basis. Each load is delivered via road tanker which carries approximately 6,000 gallons of fuel. The tanker truck crosses 3rd party certified truck scales before and after loading, giving a direct reading of the mass of fuel shipped.

Every shipment leaving Ensyn's Renewable Fuel Oil facility has a sample drawn for analysis. The density at 68 °F and higher heating value are determined using the appropriate ASTM certified methods, and this data is used in conjunction with the mass (determined by the certified scales, above) to calculate the total amount of energy input into the boilers at Memorial.

Memorial's purchase arrangement is based on pricing in dollars per million British thermal units ($/MMBtu).

All of the RFO received at Memorial Hospital is used in the boilers, therefore all of the energy in that fuel may be considered as the renewable thermal energy source.

Below is the data showing the RFO shipments to Memorial Hospital in 2015, along with their respective energy contents.

Renewable Fuel Oil

Commercial Metering - Memorial Hospital

Shipment Date	Bill of Lading No.	Certified Truck Scale Readings: Weight In	Weight Out	Net Weight	Analytical Data: Higher Heating Value ASTM D240		Density at 20°C (68°F) ASTM D4052		Calculated Figures: Volume	Energy
		lbs	lbs	lbs	Btu/lb	Btu/gal	g/ml	lb/gal	gal	MMBtu
2015-01-01	2445	35,760	97,940	62,180	7,595	75,426	1.19	9.9	6,261	472
2015-01-06	2446	36,380	97,360	60,980	7,632	77,067	1.21	10.1	6,039	465
2015-01-12	2448	35,800	97,180	61,380	8,309	82,517	1.19	9.9	6,181	510
2015-01-16	2449	35,900	92,720	56,820	7,290	72,397	1.19	9.9	5,721	414
2015-01-22	2452	35,600	95,540	59,940	7,464	74,748	1.20	10.0	5,985	447
2015-01-26	2455	35,680	95,440	59,760	7,338	73,486	1.20	10.0	5,967	439
2015-01-29	2458	36,140	95,360	59,220	7,330	73,406	1.20	10.0	5,913	434
2015-02-04	2462	37,380	95,180	57,800	7,782	76,634	1.18	9.8	5,869	450
2015-02-10	2464	36,880	87,360	50,480	7,478	74,888	1.20	10.0	5,041	377
2015-02-12	2466	36,220	95,740	59,520	7,355	73,657	1.20	10.0	5,943	438
2015-02-17	2473	36,000	94,080	58,080	7,639	75,226	1.18	9.8	5,898	444
2015-02-19	2475	37,140	89,600	52,460	7,575	75,228	1.19	9.9	5,282	397
2015-02-25	2481	35,740	96,860	61,120	7,524	74,721	1.19	9.9	6,154	460
2015-03-02	2483	35,500	93,520	58,020	7,407	73,559	1.19	9.9	5,842	430
2015-03-04	2486	35,500	94,800	59,300	7,706	76,528	1.19	9.9	5,971	457
2015-03-09	2490	35,600	95,180	59,580	7,749	76,956	1.19	9.9	5,999	462
2015-03-15	2494	35,880	95,440	59,560	7,733	76,151	1.18	9.8	6,048	461
2015-03-23	2500	35,680	96,840	61,160	7,975	79,200	1.19	9.9	6,158	488
2015-03-26	2503	35,740	97,160	61,420	7,737	76,836	1.19	9.9	6,185	475
2015-04-02	2508	35,700	96,260	60,560	7,769	77,802	1.20	10.0	6,047	470
2015-04-09	2514	35,740	91,960	56,220	7,868	78,137	1.19	9.9	5,661	442
2015-04-15	2520	35,680	96,220	60,540	7,632	75,794	1.19	9.9	6,096	462
2015-04-19	2521	35,640	90,500	54,860	7,787	77,983	1.20	10.0	5,478	427
2015-05-07	2536	35,680	94,240	58,560	7,715	77,262	1.20	10.0	5,848	452
2015-05-13	2540	35,560	97,020	61,460	7,503	75,765	1.21	10.1	6,086	461
2015-05-27	2549	35,660	95,260	59,600	7,826	77,067	1.18	9.8	6,052	466
2015-05-29	2550	35,940	95,740	59,800	7,788	76,693	1.18	9.8	6,073	466
2016-06-15	2566	35,740	95,080	59,340	7,563	74,477	1.18	9.8	6,026	449
2016-06-25	2575	35,700	97,180	61,480	7,415	73,639	1.19	9.9	6,191	456
2015-07-06	2579	35,680	90,520	54,840	8,210	81,534	1.19	9.9	5,522	450
2015-07-20	2589	35,720	94,880	59,160	7,205	71,553	1.19	9.9	5,957	426
2015-07-23	2590	35,600	95,600	60,000	7,139	70,302	1.18	9.8	6,093	428
2015-08-12	2602	35,660	96,400	60,740	7,228	71,178	1.18	9.8	6,168	439
2015-08-24	2616	35,640	95,200	59,560	7,761	77,075	1.19	9.9	5,997	462
2015-09-02	2620	35,560	95,580	60,020	7,692	76,389	1.19	9.9	6,044	462
2015-09-16	2630	35,660	95,400	59,740	7,647	74,666	1.17	9.8	6,118	457
2015-09-29	2637	35,620	95,240	59,620	7,934	78,131	1.18	9.8	6,054	473
2015-10-05	2641	35,660	96,660	61,000	7,821	77,671	1.19	9.9	6,142	477
2015-10-14	2642	35,640	95,720	60,080	7,714	75,320	1.17	9.8	6,153	463
2015-10-26	2643	35,640	95,660	60,020	7,676	75,590	1.18	9.8	6,095	461
2015-11-02	2644	35,580	95,640	60,060	7,756	77,025	1.19	9.9	6,048	466
2015-11-11	2645	35,660	95,980	60,320	7,664	75,472	1.18	9.8	6,125	462
2015-11-18	2646	35,580	95,100	59,520	7,779	76,604	1.18	9.8	6,044	463
2015-11-24	2647	35,620	97,060	61,440	7,763	76,447	1.18	9.8	6,239	477
2015-11-30	2648	35,540	97,460	61,920	7,801	77,472	1.19	9.9	6,235	483
2015-12-07	2653	35,840	95,960	60,120	7,710	76,568	1.19	9.9	6,054	464
2015-12-14	2658	35,860	95,560	59,700	7,723	77,342	1.20	10.0	5,961	461
2015-12-21	2666	35,880	97,660	61,780	7,723	76,697	1.19	9.9	6,221	477
2015-12-28	2669	35,740	94,780	59,040	7,629	73,854	1.16	9.7	6,099	450

Table 1-Memorial Hospital RFO Consumption 2015

Boiler Efficiency

Memorial Hospital has two Cleaver Brooks package boilers which supply the thermal energy, in the form of steam, needed to heat the facility. These boilers are equipped with the latest burner management system which controls firing rate based on desired steam header pressure. This system, called the "HAWK 4000", also has a provision for trim based on excess oxygen measured in the flue gas. Additionally, the temperature of the flue gas is monitored by the Hawk to determine efficiency. Efficiency is displayed on the HAWK's interface screen and is calculated based on the following loss calculations for non-condensing flue gas, provided courtesy of Cleaver Brooks:

Dry Gas Loss:

$$L_{D.G.} = \frac{100 \times \frac{\text{lbs.DryGas}}{\text{lb.Fuel}} \times \text{Cp} \times (\text{Tgas Out} - Tair)}{\text{BTU/lb.Fuel}}$$

Loss due to H2O from Combustion of Hydrogen:

$$L_{H+H2O.} = \frac{100 \times \frac{\text{lbsH}_2\text{O}}{\text{lb.Fuel}} \times (\text{hg@1PSIA \&Tg Out} - \text{hf@80°})}{\text{BTU/lb.Fuel}}$$

Loss due to Moisture in Air ~ Relative Humidity = 60%:

$$L_{Moist.} = \frac{100 \times \frac{\text{lbsH}_2\text{O(R.H.)}}{\text{lb.Fuel}} \times (\text{hg@1PSIA \&Tg Out} - \text{hg@80°})}{\text{BTU/lb.Fuel}}$$

By way of example, combining the above loss equations into a single equation based on the stack gas temperature and the percent of excess air, we have a total Stack Loss given by:

Stack Loss = (0.020875 + 0.000185 Ae) X + 5.481
Where Ae = % Excess Air, from the excess air meter
X = Tgas Out – Tair, from the thermocouples

Additionally, we have the losses due to radiation given by:

Radiation Loss:

$$\frac{100 \times 0.3}{\text{Firing Rate}}$$

Thus, efficiency can be calculated using the equation:

Efficiency = 100 – Stack Loss – Radiation Loss

The indicated efficiency as provided by the HAWK system ranges between 85.5% and 89.1%, with an average of 87.5%.

Emissions Testing

Emissions testing was conducted at Memorial Hospital to determine whether the boilers at Memorial Hospital at North Conway, NH, when firing on Renewable Fuel Oil, would meet the requirements to be certified as a Class I – New Biomass thermal renewable energy source. This testing was conducted by APCC, Ltd., of Brooksville, ME, and was witnessed by agents of the NH DES. All testing was conducted according to the appropriate EPA methods.

See Attachment 2-1

Conclusion

Based on the information provide herein and the associated application, we respectfully request the Public Utilities Commission of New Hampshire consider the use of Renewable Fuel Oil at Memorial Hospital certified as a Class I – New Biomass Thermal Renewable Energy Source.

We request that for the purposes of calculating the Renewable Energy Credits, the PUC consider the amount fuel energy input (in MMBtu) based on the current methodology, and the average boiler efficiency as provided by the manufacturer's burner management system of 87.5%.

We welcome any questions the PUC may have in its review of the submittals.

Attachment 3-5 – Proposed Calculation of Thermal Renewable Energy Certificates

As described above, Ensyn will be using actual RFO fuel use and boiler efficiency to determine the useful thermal energy provided to Memorial Hospital. With RFO averaging slightly over 76,000 BTU per gallon (75,921 BTU/gallon for the deliveries shown in Attachment 3-4), a boiler efficiency of 87.5 percent (again, Attachment 3-4), and the default factor for operating energy and thermal energy (Part 3), 65,170 BTUs of useful thermal energy are generated for each gallon of RFO fuel used.

Given that there are 3,412,625 BTUs in a Megawatt Hour, this means that one megawatt hour of useful thermal energy is produced each time 51.3 gallons of RFO are used.

BTU / gallon	76,000
Thermal Efficiency	87.5%
Operating Energy and Thermal Efficiency	**98.0%**
Useful Heat (BTU) / gallon	65,170
BTU / MWh	3,412,141
Gallons (RFO) / MWh	52.4

Ensyn requests a finding, based upon the information contained in this application, that allows one Thermal Renewable Energy Certificate to be awarded for each 52.4 gallons of RFO used at Memorial Hospital.