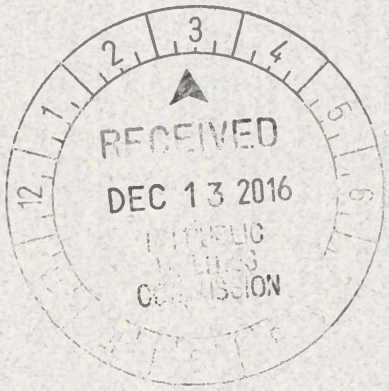
REC 16-297

Innovative Natural Resource Solutions LLC

Natural Resource Consulting Since 1994

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

www.inrsllc.com



December 9, 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 Class 1 Thermal Renewable Energy Certificates generated using renewable fuel at Memorial Hospital in Northern Conway, NH.

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.

REC 16-297 16-1215

ORIGINAL

RECEIVED DEC 13 2016

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

received 12-13-16

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
(814) 336-1284

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: GWA Research, LLC

Mailing Address: 7 Masa Morey Lane

Town/City: Lyme State: NH Zip Code: 03768

Primary Contact: Gary Phetteplace

Telephone: 603-795-4920 Cell:

Email Address: garyp@gwaresearch.com

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 # n/a

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 6.695 MMBtu/hour output each (Total Rated Output: 13.39 mmBtu/hr or 3.924 MW)

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
Boiler Combustion Controller	Hawk 4000	Cleaver-Brooks	n/a
Total System Accuracy (Percent)	96% (see attachments 3-1a, 3-1b, 3-2)		

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. [X]

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):

Manufacturer calibration frequencies were not available for the metering equipment, as frequency of calibration is normally something determined based on each application's characteristics and necessary accuracy level. The following calibration procedures are proposed for this application:

The accuracy of the HAWK 4000 Boiler Controller must be maintained by annual boiler tuning. Because the level sensor is a non-contact design, it has improved accuracy and drift characteristics compared to contact-type level sensors. A check of calibration must be performed for the level sensor at least once every 2 years using a delivery of a known volume of RFO. The tank levels before and after the known quantity is introduced to the tank should be recorded, when the boilers are not using any RFO, and the result will indicate whether the level sensor is within its accuracy requirements, for this application. If the level sensor fails the calibration check, it should be repaired or replaced.

REC Calculation Discount factor for meter accuracy (Enter 0 if no discount is required): 4 %

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 %

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: 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 _____ Date _____

Applicant's Printed Name Lee Torrens

Subscribed and sworn before me this _____ Day of _____ (month) in the year _____

County of _____ State of _____

_____

Notary Public/Justice of the Peace Seal

My Commission Expires _____

NH Professional Engineer Affidavit

AFFIDAVIT

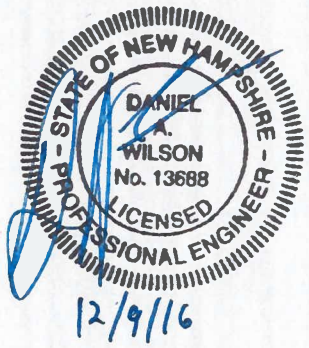
I, Daniel A. Wilson attest that this facility meets the requirements of the thermal REC eligibility requirements of Puc 2500, including the thermal metering and measurement methodologies and standards and REC calculation methodologies.

Professional Engineer's Signature _____ Date 12/9/16

Professional Engineer's Printed Name Daniel A. Wilson

NH Professional Engineer License Number 13688

PE Stamp



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 _____ Date 12.6.16

Applicant's Printed Name Lee Torrens

Subscribed and sworn before me this 6th Day of December (month) in the year 2016

County of Cumberland State of Maine

PAMELA HENNINGS
Notary Public
Maine
My Commission Expires Jun 12, 2021

_____
Notary Public/Justice of the Peace Seal

My Commission Expires June 12, 2012

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

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

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
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

Specification sheet

VEGAPULS 62

4 ... 20 mA/HART - four-wire

Radar sensor for continuous level measurement of liquids

Application area

The VEGAPULS 62 sensor can be used universally for continuous level measurement in liquids.
It is suitable for level measurement in storage containers, reactors and process vessels, even under difficult process conditions. With its various antenna versions and materials, VEGAPULS 62 is the optimal solution for almost all applications and processes. Its wide temperature and pressure range makes project planning simple.

Your benefit

- Maintenance-free operation thanks to non-contact measuring principle
- High plant availability, because wear and maintenance free
- Exact measuring results independent of pressure, temperature, gas and steam

Function

Extremely short microwave pulses are emitted by the antenna system in the direction of the measured product, reflected by the product surface and received back again by the antenna system. The time from emission to reception of the signals is proportional to the level in the vessel. A special time stretching procedure allows reliable and precise measurement of the extremely short signal running times.

Technical data

Measuring range up to	35 m (114.8 ft)
Deviation	±2 mm
Process fitting	Thread from G1½; 1½ NPT; flanges from DN 40, 1½"
Process pressure	-1 ... +160 bar/-100 ... +16000 kPa (-14.5 ... +2320 psig)
Process temperature	-196 ... +450 °C (-321 ... +842 °F)
Ambient, storage and transport temperature	-40 ... +70 °C (-40 ... +158 °F)
Operating voltage	
– Version for low voltage	9.6 ... 48 V DC, 20 ... 42 V AC, 50/60 Hz
– Version for mains voltage	90 ... 253 V AC, 50/60 Hz
SIL qualification	Optionally up to SIL2

Materials

The wetted parts of the instrument are made of 316L, Alloy C22 (2.4602), Alloy 400 (2.4360), stainless steel precision casting (1.4848) or PTFE, PP, PEEK. The process seal is made of FKM, FFKM or graphite.
You will find a complete overview of the available materials and seals in the "*Configurator*" at www.vega.com and "*VEGA Tools*".

Housing versions

The housings are available as double chamber version in plastic, stainless steel or Aluminium. They are available in protection class IP 66/IP 67.

Electronics versions

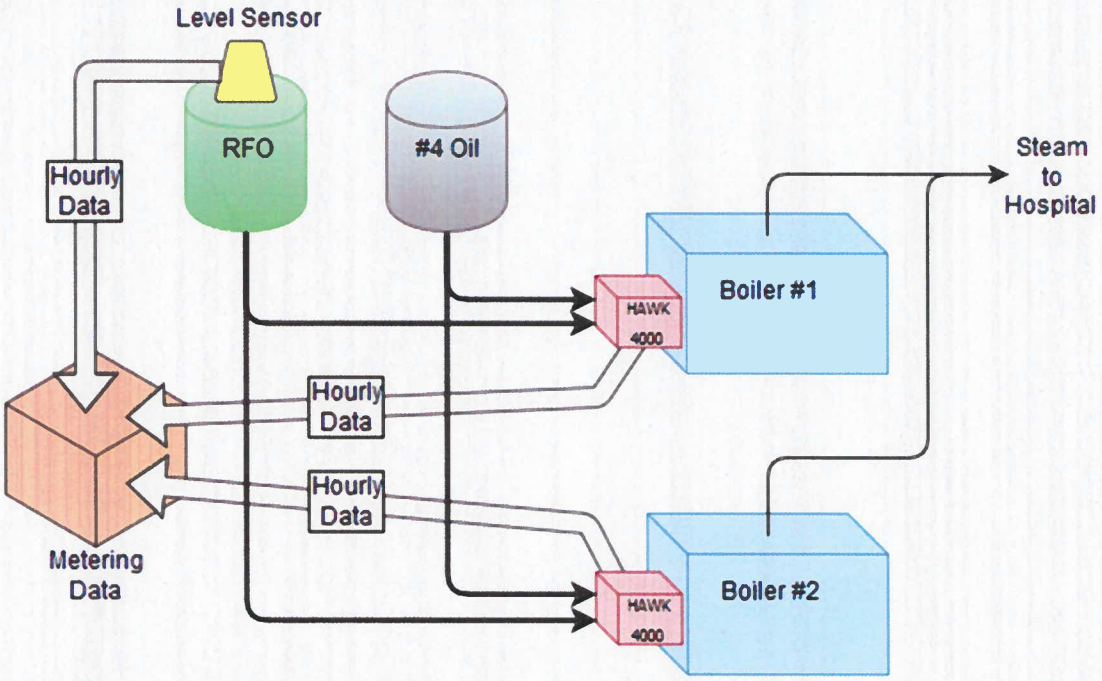
The instruments are available in different electronics versions.
Apart from 4 ... 20 mA/HART in two and four-wire version, there are also digital versions with Profibus PA, Foundation Fieldbus and Modbus protocols. Another HART version is available with integrated accumulator.

Approvals

The instruments are suitable for use in hazardous areas and are approved e.g. according to ATEX and IEC. The instruments also have various ship approvals such as e.g. GL, LRS or ABS.
You can find detailed information at www.vega.com/downloads and "*Approvals*".

Attachment 3-2

Location of sensors (further discussion is Attachment 3-3)



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.

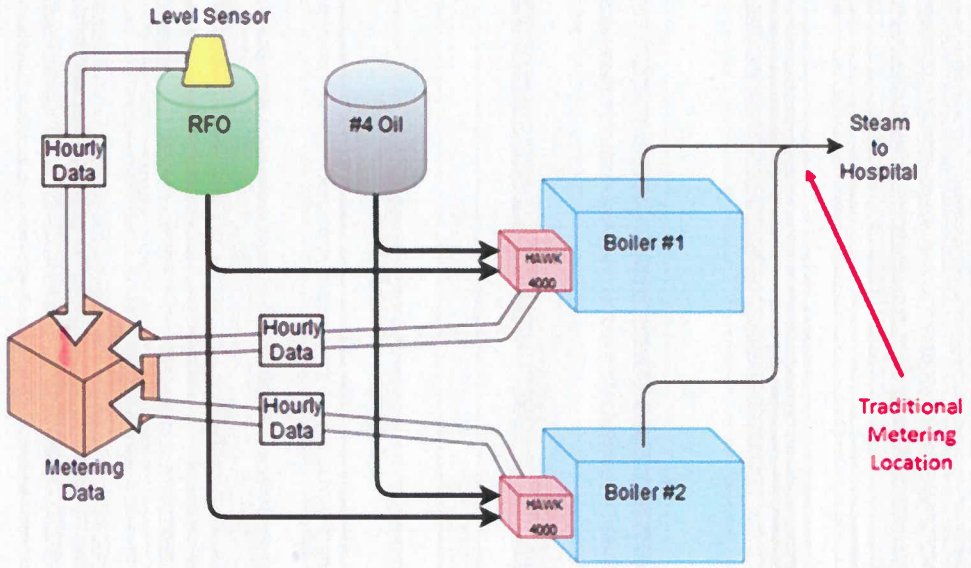
Memorial Hospital currently uses RFO as the only fuel, but there may be times – planned and unplanned – when No.4 oil is required as a fuel. These may include an unexpected problem with RFO at a boiler or in the tank that holds it, a supply disruption, or simply testing to ensure that the backup system functions properly, as is prudent for stable operation of a hospital. 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 schematic below shows how this location differs from the location where a traditional steam meter would be located.



Ensyn and Wilson Engineering Services are 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 – Proposed Calculation of Thermal Renewable Energy Certificates

Wilson Engineering Services, PC
902 Market Street
Meadville, PA 16335
(814) 337-8223

11220 Elm Ln, Suite 200
Charlotte, NC 28277
(704) 900-1389

wES
Energy · Environment · Enterprise

Daniel A. Wilson, P.E.
11220 Elm Lane
Charlotte, NC 28277
(704) 900-1389

November 28, 2016

Mr. Geoff Hopkins, P.Eng.
Ensyn Technologies Inc.
2 Gurdwara Road, Suite 210
Ottawa, Ontario, Canada K2E 1A2

Dear Mr. Hopkins,

Ensyn Technologies has implemented metering of useful thermal energy on two boilers at North Conway Memorial Hospital which are able to fire on renewable fuel. Rather than metering steam sent to the building and condensate returned, as specified in PUC 2506.04(m), the metering method used monitors fuel consumption and combustion efficiency in order to calculate the delivered renewable thermal energy. I have evaluated this Alternative Metering Method and it is technologically sound. This metering method will achieve a meter accuracy rate of ±4% or better.

I have included a calculation methodology using the metering system in place, and a discussion of the calculation and metering accuracy, as required to be provided to the NH PUC as part of the Alternative Metering Method and Class I Thermal Eligibility applications.

Sincerely,

Daniel A. Wilson, P.E.
Wilson Engineering Services, Vice-President

Enclosures:

- Alternative Metering Method calculation memorandum

Wilson Engineering Services, PC
902 Market Street
Meadville, PA 16335
(814) 337-8223

11220 Elm Ln, Suite 200
Charlotte, NC 28277
(704) 900-1389

WES
Energy · Environment · Enterprise

MEMORANDUM

Date: November 23, 2016

To: Geoff Hopkins, Ensyn

From: Peter Oven, WES; Dan Wilson, WES

CC: Eric Kingsley, INRS

Re: North Conway Memorial Hospital Alternative Metering Method

1.0 INTRODUCTION

North Conway Memorial Hospital uses renewable fuel oil (RFO) as a heat source for their (2) 200 hp steam boilers. The boilers are also set up to use #4 fuel oil as a backup. This memorandum outlines the structure of an "alternative metering method" which allows Ensyn to realize Class I Thermal RECs without installation of a steam metering system.

2.0 DATA AND ASSUMPTIONS

Data must be collected to allow for calculation of useful delivered heat on an hourly basis pursuant to PUC 2506.04(c). The following data points must be logged each hour as an hourly average:

- Renewable fuel consumed
- Boiler #1 fuel type
- Boiler #1 fuel control valve position
- Boiler #1 efficiency
- Boiler #2 fuel type
- Boiler #2 fuel control valve position
- Boiler #2 efficiency

2.1 Renewable Fuel Consumed

RFO is stored in a single tank which has a height of 25'. As needed, the 2 boilers draw RFO from the tank. The combined RFO usage in gallons for the boilers shall be logged each hour. This value will be calculated based on tank level measurements using the Vegapuls 62 radar level sensor.

The level sensor has a maximum error of ±2mm (±0.079"). Based on the tank height of 25', this is an accuracy of ±0.026% of full scale.

2.2 Boiler Fuel Type

The controller for each boiler is able to record the type of fuel being combusted on a continuous basis. When a boiler is firing on RFO, the fuel type reported to the data logger is the value 100. When the boiler is not firing on RFO, either because it is firing on #4 oil, or because it is shut down, the fuel type reported to the data logger is 0. When averaged over an hour, the fuel type value is equal to the percent of time in that hour that the boiler fired on RFO. These values will be denoted by FT_1 and FT_2.

2.3 Boiler Fuel Control Valve Position

The average fuel control valve position shall be logged for each boiler. The control valves are able to continuously modulate the firing rate. These values will be denoted by FV_1 and FV_2.

2.4 Boiler Efficiency (stack loss only)

The average boiler efficiency based on stack loss only (EF_1, EF_2) of each boiler shall be logged each hour. These values will be supplied by the boiler control system.

2.5 Additional Parameters

The Btu value (HHV) of the RFO varies slightly due to manufacturing tolerances. The HHV used for the REC calculations should be calculated each quarter based on the delivery volumes and the HHV of each delivery. HHV will be calculated by **Equation 1**~~**Equation 1**~~, where HHV is measured in Btu/gal, and volume is measured in gallons. The term *m* is the number of truck deliveries in a quarter.

Equation 1 – Fuel HHV

$$HHV = \frac{\sum_{i=1}^{m} TruckHHV_i * TruckVolume_i}{\sum_{i=1}^{m} TruckVolume_i}$$

2.6 Loss Factors

The radiation and convection losses (L_R) of the boilers will be incorporated into the thermal energy equation. For the purposes of this calculation, the radiation and convection loss of each boiler will be assumed to be a constant value of 26,780 Btu/hr. This value is taken from Table 1 of the Cleaver Brooks boiler efficiency guide, which shows that this loss is 0.4% of full load firing. Since there is no damper in the flue, a value of 40,000 Btu/hr is calculated as the loss through a hot standby boiler based on a calculation of natural draft for standard temperatures throughout the year.

The discount factor for accuracy referenced in PUC 2506.05(e)(2) shall be 4%. When used in the equation, this will be represented by D_A with a value of 0.96. This discount factor takes into account the accuracies of the level sensor, HHV analysis, and boiler controller efficiency calculation.

The discount factor for parasitic losses shall be the default of 2% as specified in PUC 2506.05(f)(3). When used in the equation, this will be represented by D_P with a value of 0.98.

The discount factor for blowdown will be 3%, which is assumed to be conservative. This will be represented by D_B with a value of 0.97.

3.0 CALCULATIONS

The boiler output shall be calculated as shown in Equation 2~~Equation 2~~ based on the sum of the renewable fuel oil consumption measured in gallons (RFO), the average higher heating value of the delivered RFO measured in Btu/gal (HHV, Equation 1~~Equation 1~~), the weighted average boiler efficiency (EFF), and various loss factors and adjustments. The term *n* is the number of hours in the reporting period in which at least one boiler fired on RFO.

Equation 2 – Boiler Plant Useful Renewable Heat Output

$$Q = \left(\sum_{t=1}^{n} RFO_t\right) * HHV * EFF * D_A * D_P * D_B - L_R$$

The term EFF shall be calculated according to Equation 3~~Equation 3~~. The fuel type and fuel control valve position of each boiler are used to calculate the proportionally blended efficiency of the boilers for each hour. The metered gallons of RFO for each hour are then used to calculate the overall weighted efficiency over the course of the quarter. The term *n* is the number of hours in the reporting period in which at least one boiler fired on RFO. Hours in which no RFO was used are skipped. Note that metered RFO is used in this equation, whereas the certified truck delivery volumes of RFO are used in Equation 1~~Equation 1~~.

Equation 3 – Boiler Plant Weighted Efficiency

$$EFF = \frac{\sum_{t=1}^{n}\left[RFO_t * \left(\frac{FT_{1t}*FV_{1t}*EF_{1t}+FT_{2t}*FV_{2t}*EF_{2t}}{FT_{1t}*FV_{1t}+FT_{2t}*FV_{2t}}\right)\right]}{\sum_{t=1}^{n} RFO_t}$$

The term L_R shall be calculated according to Equation 4~~Equation 4~~. The fuel type data point is used to determine when each boiler is not firing on RFO. When a boiler is not firing on RFO, it is assumed to be in standby. At this time there is no separate way of logging when a boiler is firing on #4 oil rather than RFO or standby. To be conservative, all time not spent firing on RFO is assumed to be standby time, and is thus assessed at 40,000 Btu/hr per boiler as explained previously. Additionally, all radiation losses are assessed against the RFO usage, even if at some point #4 oil was used to generate heat. The term *h* is the number of hours in the reporting period.

Equation 4 – Boiler Plant Radiation and Convection Losses

$$L_R = \sum_{t=1}^{h}\left[40{,}000 * \left\{\left(1 - \frac{FT_{1t}}{100}\right) + \left(1 - \frac{FT_{2t}}{100}\right)\right\} + 26{,}780 * 2\right]$$