Ground Energy Support LLC
9 Madbury Rd Suite 402
Durham NH 03824
(603) 867-9762
www.groundenergy.com

REC 15-483

November 11, 2015

Debra Howland
Executive Director
State of New Hampshire
Public Utilities Commission
21 S. Fruit St, Suite 10
Concord, NH 03301-2429

NHPUC 13NOV15PM1:45

Dear Ms. Howland:

Please find enclosed the application for the geothermal heat pump system at581 Trudeau Rd, Bethlehem NH to become registered as a Class-I Thermal generating facility pursuant to Puc 2500.

The contact information for the owner is:

Kevin Roy
North Country Environmental Services
PO Box 9
Bethlehem NH 03574
kevin.roy@casella.com

NCES will be using Revolution Energy Aggregation LLC as the Aggregator. NCES also seeks approval of using Ground Energy Support (GES) as the Independent Monitor even though she is also using metering equipment sold by GES, as approved for Rolling Dog Farm in DE 14-237.

As per the instructions, I have enclosed the originals and two copies and will forward electronic versions to yourself and Ms. Bernstein. Please let me know if you have any questions or need any additional information.

Respectfully,

J. Matthew Davis, Ph.D.
Vice President, CTO

Cc: Kevin Roy

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

200,000 BTU/HR OR LESS

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: Revolution Energy Aggregation
Aggregator Contact Information: Mike Behrmann

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: NORTH COUNTRY ENVIRONMENTAL SERVICES

Mailing Address: PO BOX 9

Town/City: Bethlehem State: NH Zip Code: 03574

Primary Contact: Kevin Roy

Telephone: (603) 869-3366 Cell: (603) 361-6477

Email Address: Kevin.roy@casella.com

Facility

Name: NORTH COUNTRY ENVIRONMENTAL SERVICES

Physical Address: 581 TRUDEAU ROAD

Town/City: Bethlehem State: NH Zip Code: 03574

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

Installer

Name: APPALACHIAN GREEN BUILDERS

Installer License Number, if applicable: N/A

Mailing Address: 63 LEHAN RD

Town/City: Bethlehem State: NH Zip Code: 03574

Primary Contact: Peter Duguay

Telephone: (603) 728-8166 Cell: _____

Email Address: peter@nhlovesgeothermal.com

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

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

Facility Operator Name: _____

Facility Operator Telephone Number: _____

Independent Monitor

Name: GROUND ENERGY SUPPORT LLC

Mailing Address: 9 MADBURY RD SUITE 402

Town/City: DURHAM State: NH Zip Code: 03824

Primary Contact: Matt Davis

Telephone: (603) 867-9762 Cell:

Email Address: mdavis@groundenergysupport.com

NEPOOL/GIS Asset ID and Facility Code

In order to qualify your facility's electrical 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 # NON56691 Asset ID #

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 1-8.***
*Attach any supplementary documentation that will help in classification of the facility as **Attachment 1-9.***

Part 2. Technology Specific Data

All Technologies

Renewable energy source: **Solar** ☐ **Geothermal** ☒ **Biomass** ☐

Rated Thermal Capacity :

Btu/hr 93,000 MW equivalent 0.0273

Please show your calculation here: 93,000 / 3,412,000

Date of initial operation using renewable source: February 14, 2014

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

This section covers 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 of this application.** Applicants for small thermal systems may choose to meter the thermal energy generated (Part 3A) or use a simplified approach employing run time meters (Part 3B) coupled with calculations to estimate energy production based on operating time.

Indicate method used and complete corresponding section of the application:

Select one	Attachment Number	Description
☐	3A (see page 5 – 6)	Metering with a Heat Meter pursuant to 2506.04(g)(1)
☐	3B-Solar (see page 7)	Runtime metering of solar thermal pursuant to 2506.04(h)
☒	3B-Geothermal (see page 7)	Runtime metering of geothermal pursuant to 2506.04(i)
☐	3B-Biomass (see page 8)	Runtime metering of biomass pursuant to 2506.04(j)

Only complete the section of the application that corresponds with the attachment number checked above.

3A. Metering with a Heat Meter

Using the table below, identify the thermal metering system packaged 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.	Product Seller
N/A				
Total System Accuracy (Percent)		%		

*Attach component specification sheets (Accuracy, Operating Ranges) as **Attachment 3A-1.*** ☐

*Attach a simple schematic identifying the location of each sensor that is part of the metering system as **Attachment 3A-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 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 using a steam-based system, check the method that applies:		
A	Installation and use of meters with accuracy of ±3.0% or better.	☐
B	Installation and use of meters with system accuracy that do not meet 2.b.1) but are ±5% or better.	☐
C	Use of an alternative metering method approved pursuant to Puc 2506.06.	☐

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

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

3B-Solar *for Systems Using Solar Technologies*

This method for calculating useful thermal energy is based on the run time of the collector system's circulating pump. Please fill out the following information regarding the meter at your facility.

Product Name N/A

Product Manufacturer _____ Model Number _____

In order to calculate the useful energy produced by a solar thermal facility, please fill out the following information on variables determined one time for the calculations:

Variable	Definition	Value	Units
R	SRCC OG100 rating on Medium Radiation C Conditions		Thousands of Btu per day
L	Orientation and shading losses		Percentage as a decimal < 1
h	Conversion factor from SRCC OG100 to hourly basis	11	Hours per day

Please refer to Appendix A, Puc 2506.04 Metering of Sources that Produce Useful Thermal Energy subpart H to determine the useful thermal energy of your facility.

3B-Geothermal *for Systems Using Geothermal Thermal Technologies*

This method for calculating useful thermal energy is based on the run time of the system's ground loop pump. Please fill out the following information regarding the meter at your facility.

Product Name GxTracker

Product Manufacturer Ground Energy Support

Model Number GxT-Power

In order to calculate the useful energy produced by a geothermal thermal facility, please fill out the following information for each heat pump installed at facility:

AHRI Certified Heat Pump Performance Ratings

N	Manufacturer	Series/Model	Part Load		Full Load
			COP [-]	HC [MBtuH]	HC [MBtuH]
1	WaterFurnace	NDW120	3.4	55000	93000

Total system heating capacity (sum of Full Load HC): 93,000 Btu/hr

Please refer to Appendix A, Puc 2506.04 Metering of Sources that Produce Useful Thermal Energy Subpart I to determine the useful thermal energy of your facility.

3B-Biomass *for Systems Using Thermal Biomass Technologies*

This method for calculating useful thermal energy is based on the run time of the system's fuel auger. Please fill out the following information regarding the auger at your facility.

Product Name N/A

Product Manufacturer _____

Model Number _____

In order to calculate the useful energy produced by a solar thermal facility, please fill out the following information unless it is already given:				
Variable	**Definition**		**Value**	**Units**
D	Default pellet density		0.0231	Pounds
R	Auger revolutions			Per hour
V	Auger feed volume Assume 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			Cubic inches per auger revolution
EC	Default energy content of the fuel pellet		7870	Btu/lb
ASE	Default thermal efficiency (choose one):			Percentage converted to a decimal
	☐	*Based on the manufacturer's warranty*		
	☐	*Based on average seasonal thermal efficiency*		
	☐	*Based on default value of 65%*	0.65	
Please refer to Appendix A, Puc 2506.04 Metering of Sources that Produce Useful Thermal Energy Subpart J to determine the useful thermal energy of your facility.				

☐ If a thermal biomass facility, provide the New Hampshire Department of Environmental Services approval letter that the facility meets the provisions set forth in Puc 25005.02(d)15d as **Attachment 3-A**. (See the proposed best management practices that are consistent with the recommendations in the report entitled "Emission Controls for Small Wood-Fired Boilers" prepared for the US Forest Service, Western Forestry Leadership Coalition, by RSG, Inc., May 6, 2010 available at, http://www.wflccenter.org/news_pdf/361_pdf.pdf, as specified in Appendix B.

Part 4. Statements

The following statements must be completed by the owner/application preparer and a NH Professional Engineer attesting to the accuracy of the contents of the application pursuant to PUC 2505.02 (b) (14). An electronic signature is permitted pursuant to RSA 294-E.

Owner/Preparer Statement

STATEMENT

1. I, Kevin Roy have reviewed the contents of this application and attest that it is accurate and is signed under the pains and penalties of perjury.
2. I, Kevin Roy attest that the system is installed and operating in compliance with applicable building codes.

Applicant's Signature /S/ [signature] Date 10/26/2015

Applicant's Printed Name Kevin A. Roy

If the applicant prepared the application leave the following blank

Preparer's Signature [signature] Date 11/2/15

Preparer's Printed Name J. Matthew Davis

Subscribed and sworn before me this 2nd Day of November (Month) in the year 2015

County of Strafford State of New Hampshire

Notary Public/Justice of the Peace Seal My Commission Expires: My Commission Expires January 25, 2017 (date.)

[signature]

NH Professional Engineer Affidavit

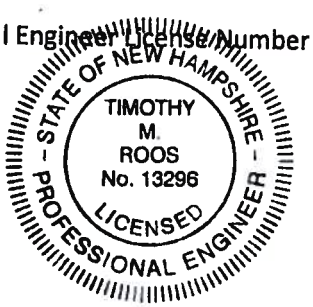
STATEMENT

I, Timothy M. Roos 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 [signature] Date 10/28/15

NH Professional Engineer License Number 13296

PE Stamp



NH Independent Monitor:

Name: Matt Davis

Facility Contact:

Name: Kevin Roy

Facility Location:

Street: 581 Trudeau Rd

City/Town: Bethlehem NH

Date: 9/12/14

County: ~~Coos~~ Grafton

Heat Pump System Specifications

Ground Loop Supply Line: Pressure Tank [Y/N] | Water Filter [Y/N] | Flow Center [Y/N]

Source Type (check one): ☐ Ground Water (GWHP) **or** ☑ Ground Loop (GLHP)

Non-Ground Sources: Do any of the heat pumps have a supply other than ground loop? [Y/N]

N	Manufacturer	Model Series-Capacity	Name plate Photo	COP	HC	EER	Full Load HC
				Part Load, GWHP or GLHP			
1	Water Furnace	NDW120	☑	3.40	55,000	21.1	93,000
2			☐				
3			☐				

Monitoring Equipment Inspection

Meter Manufacturer: Grand Energy Support Model: GXT-Power

HP	EWT Sensor	LWT Sensor	Runtime Sensor	Heating Cycle	✓
1	Type: OMP ID: *1628	Type: OMP ID: *BC28	Type: CT ID: *5B57E	Start: 2:05 End: 2:07	☑
2	Type: ID:	Type: ID:	Type: ID:	Start: End:	☐
3	Type: ID:	Type: ID:	Type: ID:	Start: End:	☐

Temp sensors: **OMP**=on metal pipe; **OPP**=on plastic pipe; **TW**=thermal well, **HP**= inside heat pump

Runtime sensors: **CS**= current switch; **CT** = current transducer; **FM** = Flowmeter.

✓ indicates heat pump cycle was correctly recorded by meter.

NH Thermal REC

Small Geothermal Inspection Report

Meter Readings:

☑ **ONLINE:** Connection type: ☐ Direct Ethernet ☐ Powerline Adapter ☑ Wireless

☐ **MANUAL:** Photograph meter display and note location of heating runtime [hrs]. ☐

Useful Thermal Energy:

Description of Use(s): Space Heating

Conditioned Space (Square Feet): approx 6000

Unusual circumstances, if any: Heating large quonset hut style mechanical shop w/ spray insulation

Total System Heating Capacity (sum of Full Load HC on previous page): ~~55,000~~ Btu/hr 93,000

Nameplate Photographs:

21 Landfill Lane
PO Box 348
Newport, VT 05855

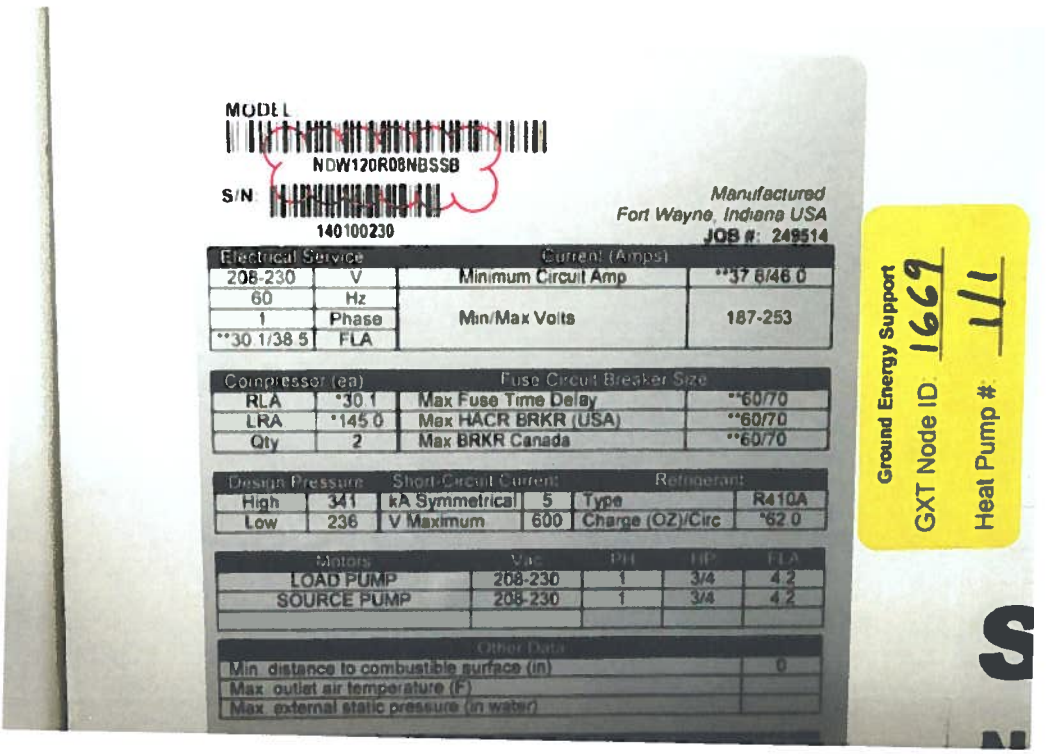
(802) 334-8300

(603) 361-6477
(802) 334-2476

casella.com

Kevin Roy
Division Manager

kevin.roy@casella.com



Independent Monitor Signature: [signature] Date: 9/12/14

AHRI CERTIFIED®
www.ahridirectory.org

This combination qualifies for a Federal Energy Efficiency Tax Credit when placed in service between Jan 1, 2006 and Dec 31, 2016 and used in GLHP or GWHP application point.

Certificate of Product Ratings

AHRI Certified Reference Number: 3841695 Date: 9/13/2014 †Status: Active

Product: Water/Brine to Water Heat Pump Packaged Unit
Model Number: NDW120*0

Manufacturer: WATERFURNACE INTERNATIONAL, INC.
Trade/Brand name: ENVISION NDW SERIES DUAL CAPACITY

Rated as follows in accordance with ANSI/AHRI/ASHRAE/ISO Standard 13256-2 for Water-to-Water and Brine-To-Water Heat Pumps and subject to verification of rating accuracy by AHRI-sponsored, independent, third party testing:

Indoor Fluid Flow Rate - Cooling: 28.0 / 28.0
Indoor Fluid Flow Rate - Heating: 28.0 / 28.0

Cooling Air Flow Rate - Part Load: 28.0 / 28.0
Heating Air Flow Rate - Part Load: 28.0 / 28.0

	Full Load	Part Load
WLHP (Water-Loop Heat Pumps)		
Cooling Capacity(Btuh)	103000 / 103000	58000 / 58000
Cooling EER Rating(Btuh/watt)	14.00 / 14.00	15.50 / 15.50
Cooling Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00
Heating Capacity(Btuh)	142000 / 142000	76000 / 76000
Heating COP(watt/watt)	4.00 / 4.00	4.40 / 4.40
Heating Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00
GWHP (Ground-Water Heat Pumps)		
Cooling Capacity(Btuh)	123000 / 123000	65000 / 65000
Cooling EER Rating(Btuh/watt)	21.60 / 21.60	22.40 / 22.40
Cooling Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00
Heating Capacity(Btuh)	118000 / 118000	62500 / 62500
Heating COP(watt/watt)	3.30 / 3.30	3.70 / 3.70
Heating Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00
GLHP (Ground-Loop Heat Pumps)		
Cooling Capacity(Btuh)	114000 / 114000	63000 / 63000
Cooling EER Rating(Btuh/watt)	16.20 / 16.20	21.10 / 21.10
Cooling Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00
Heating Capacity(Btuh)	93000 / 93000	55000 / 55000
Heating COP(watt/watt)	3.00 / 3.00	3.40 / 3.40
Heating Fluid Flow Rate(gpm)	28.00 / 28.00	28.00 / 28.00

* Ratings followed by an asterisk (*) indicate a voluntary rerate of previously published data, unless accompanied with a WAS, which indicates an involuntary rerate.

AHRI AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

CERTIFICATE NO.: 130550869177237623

Geothermal Heat Pump Runtime Metering

Document applies to:
GxTracker-Basic
GxTracker-Power
GxTracker-PowerPlus

The GxTracker™ is an easy-to-install web-based monitoring system that displays ground source heat pump (GSHP) system operating data an online data portal.

Heat Pump runtimes are stored in separate heating- and cooling-runtime registers and can be used to compute Useful Thermal Energy produced in compliance with New Hampshire Public Utilities Commission (Proposed) Rule 2500.

System Components: Each GxTracker Monitoring System consists of three essential components to measure heating runtime:

- Ethernet gateway to transmit data to GES server
- On-pipe temperature sensor pair to measure entering and leaving water temperatures (EWT and LWT)
- Current or flow sensing device to detect heat pump activity

System Requirements:

- Always-on internet connection.*
- Exposed entering and leaving water pipes.
- Up to three geothermal heat pumps.

** Thermal energy produced when GxTracker is offline will not be reported and Thermal RECs are forfeited.*

Operating Algorithm:

1. Heat Pump data is posted to GES server once per minute using local internet connection.
2. Heat Pump On/Off status determined from electric input to compressor (current switch, current transducer, or watt meter) or inline flowmeter.
3. **If EWT > LWT,** time interval is registered as "HEATING"
   If EWT < LWT, time interval is registered as "COOLING"
4. **Thermal Energy Produced (*Q*)** is calculated daily using the AHRI Certified COP and Heating Capacity (*HC*) and the metered heating runtime (*t*). $$Q = \frac{HC \cdot (COP - 1) \cdot t}{COP}$$

Quality Assurance: AHRI Certified COP and Heating Capacity and the continuous heat pump operating data are stored in a centralized and secure database, insuring reliable calculation of runtimes and the corresponding thermal energy production. Raw data is backed-up daily to an offsite location and stored for at least 90 days, allowing for independent verification, if necessary.

Quality Control: For geothermal heat pumps that are providing building heating and cooling, GES develops a characteristic usage profile for each facility based on average outdoor air temperatures. GES staff are alerted to significant departures from the profile, enabling a check of meter operation and accuracy.

Runtime Accuracy: The nominal 1-minute sampling interval used by the GxTracker devices result in a typical daily runtime error of less than 0.5%.