

# Emissions Reductions from Capture of Waste Heat at the Garvin Compressor Station

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|                          |                                                                                                                                     |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b>     | <i>Emissions Reductions from Capture of Waste Heat at the Garvin Compressor Station</i>                                             |
| <b>Version</b>           | <i>1</i>                                                                                                                            |
| <b>Date of Issue</b>     | 16 March 2012                                                                                                                       |
| <b>Project ID</b>        | 702                                                                                                                                 |
| <b>Monitoring Period</b> | 01 January 2010 – 31 December 2011                                                                                                  |
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## Table of Contents

|                                                     |         |
|-----------------------------------------------------|---------|
| Project Details                                     | Page 3  |
| Implementation Status                               | Page 6  |
| Data and Parameters                                 | Page 7  |
| Quantification of Emissions Reductions and Removals | Page 18 |
| Additional Information                              | Page 18 |

## 1 PROJECT DETAILS

### 1.1 Summary Description of Project

This project activity uses waste heat from the exhaust generated by a natural gas compressor station to produce zero emissions electricity. Verified Carbon Units (VCUs) are generated through the displacement of existing resources on the grid.

In the absence of this project, the waste heat generated at the compressor stations would dissipate into the atmosphere. With the implementation of this project, a major portion of the waste heat is recovered and used to produce an average of 5.5 MWs of electricity each year. The heat recovery generating station – referred to as a recovered energy generation (REG) unit – is located at compressor station #12 near Garvin, MN along the Northern Border Pipeline. The recovered heat energy heats a thermal oil, which is then transferred and used to vaporize a fluid that expands to drive the turbine, which in turn drive a generator. The facility delivers electricity to Western Area Power Administration (WAPA) – Upper Great Plains East (UGPE) Integrated System (IS). This power control area is part of the Midwest Reliability Organization (MRO) NERC region.

Basin Electric Power Cooperative (BEPC) developed this project on a voluntary basis in anticipation of potential GHG and renewable legislation. This project was not required to meet any state renewable portfolio requirements. In addition, the monetization of the green attributes from this project was part of the justification of the economics of the project to BEPC as they have more cost effective alternatives to obtain energy from grid connected resources, absent the value of the green attributes.

### 1.2 Sectoral Scope and Project Type

As a grid-connected, zero emissions waste heat recovery project at a compressor station, the project activity is principally categorized under Sectoral Scope 4: Manufacturing industries. This project is not a grouped project.

### 1.3 Project Proponent

The project co-proponents are Ormat Technologies's subsidiary Ormat Recovered Energy Generation II (OREG II), and Basin Electric Power Cooperative (BEPC).

BEPC is a wholesale electric generation and transmission cooperative based in North Dakota that provides electricity to 2.8 million customers across 135 rural distribution companies in 9 states (Montana, Minnesota, Iowa, South Dakota, North Dakota, Colorado, New Mexico, Nebraska, and Wyoming). BEPC has entered a power purchase agreement (PPA) with the owner and operator

of the recovered energy generation (REG) units, Ormat Technologies, through Ormat's subsidiary OREG II (used hence forth to refer to the owner / operator of the waste heat facility).

OREG II built the waste heat project and oversees facility operations. BEPC built the interconnection infrastructure and owns and operates the meter which measures the amount of energy that is provided to the grid by the Garvin site.

Currently, BEPC buys energy generated from a total of eight waste heat recovery units along the Northern Border Pipeline (NBP), which travels in a south-easterly direction across Montana, North Dakota, South Dakota and Iowa as it carries natural gas from Canada to the Chicago area.

Contact information for BEPC and OREG II is:

Dave Raatz, Manager of Marketing & Power Supply Planning, BEPC  
1717 East Interstate Avenue  
Bismarck, North Dakota 58503-0564  
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701-557-5392

Jason Doerr, Sr. Marketing Engineer, Marketing & Power Supply Planning Division, BEPC  
1717 East Interstate Avenue  
Bismarck, North Dakota 58503-0564  
[jdoerr@bepc.com](mailto:jdoerr@bepc.com)  
701-557-5388

Kip Waddell  
Project Developer, OREG II  
[kip.waddell@comcast.net](mailto:kip.waddell@comcast.net)  
517-668-2081

## 1.4 Other Entities Involved in the Project

Element Markets, LLC is a renewable energy development and environmental credit marketing company based in Houston, Texas. Element Markets has rights to the emissions reductions from this project for the project's crediting period, is undertaking the validation of this project, and will manage future verifications for the project site.

Contact information for Element Markets:

|                            |                            |
|----------------------------|----------------------------|
| Gauri Potdar               | Ken Nelson                 |
| Senior Director            | Senior Vice President      |
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| Houston, TX 77096          | Houston, TX 77096          |
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| gp@elementmarkets.com      | knelson@elementmarkets.com |

## 1.5 Project Start Date

The date of first generation for the Garvin project is October 21, 2009.

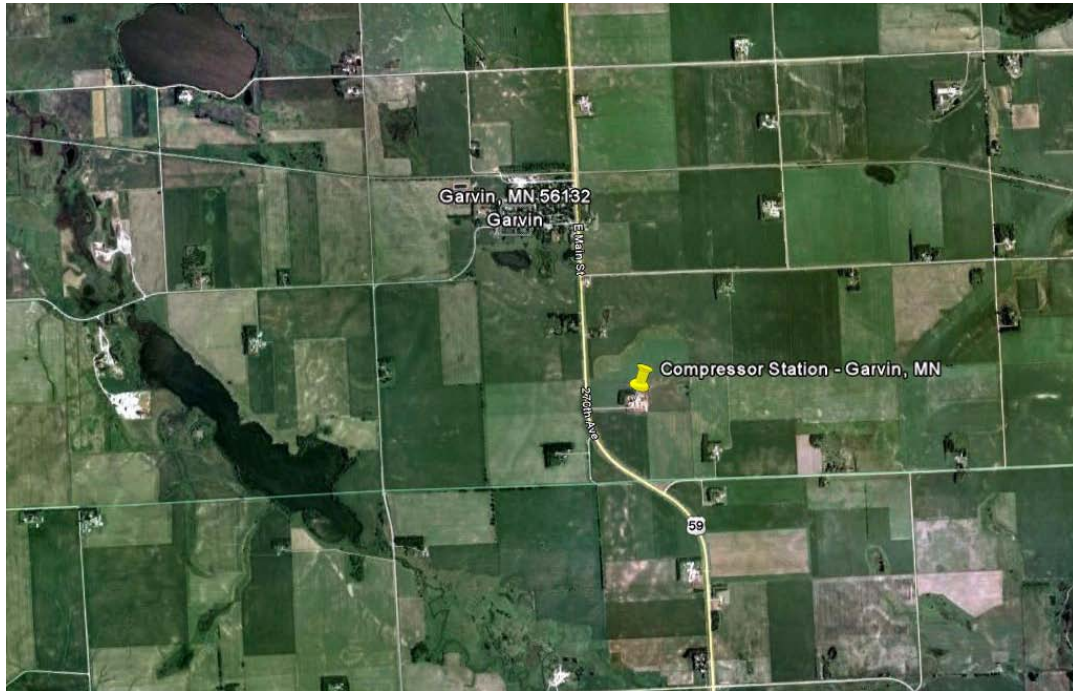
## 1.6 Project Crediting Period

The project crediting period for the projects will commence January 1, 2010, and conclude December 31, 2014, for a total of 5 years. This verification covers the periods from January 1, 2010 – December 31, 2010 and January 1, 2011 – December 31, 2011.

## 1.7 Project Location

The compressor station is located approximately one mile southeast of Garvin, MN in Lyon County.

Garvin, MN – Latitude: 44.2° Longitude: -95.8°



## 1.8 Title and Reference of Methodology

**Title:** AMS III.Q: Waste Energy Recovery (Gas / Heat / Pressure) projects

**Reference:** [http://cdm.unfccc.int/filestorage/R/W/8/RW84DSJ1MY7KQZBLECHV2603IFXTP5/EB60\\_repan22\\_%20AMS-III%20Q\\_ver04.pdf?t=ek58bHNwYmdifDB95nlUkZtbZMtBalZccVMF](http://cdm.unfccc.int/filestorage/R/W/8/RW84DSJ1MY7KQZBLECHV2603IFXTP5/EB60_repan22_%20AMS-III%20Q_ver04.pdf?t=ek58bHNwYmdifDB95nlUkZtbZMtBalZccVMF)

**Version:** Version 4.0

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

The Garvin waste heat project has been operating since October 21, 2009. The project experienced normal operations in 2010 and 2011. There were no disruptions to normal operations experienced at the compressor station.

### 2.2 Deviations from the Monitoring Plan

There are no deviations from the monitoring plan defined in the project description document.

### 2.3 Grouped Project

This project is not a grouped project.

### 3 DATA AND PARAMETERS

#### 3.1 Data and Parameters Available at Validation

Monitoring consists of:

- o Metering the net amount of electrical energy produced – this is provided by a revenue grade meter (a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837) owned by East River Electric Cooperative, which owns and calibrates the meter per the interconnection Agreement. The meter is tested every year, normally during the last quarter of the calendar year. This meter does not lend itself to be easily field calibrated, so it has been East River's practice that if the meter is found to be out of calibration they will simply replace the meter. This meter was last tested on 12/17/2010 and 11/1/2011, and found to be operating within acceptable parameters.
- o The data is acquired on a continuous basis, and is aggregated at hourly intervals. WAPA is a federal agency that serves as the control area operator for the Upper Great Plains East system. WAPA reads the meters on a monthly basis as the qualified reporting entity for BEPC and reports the information to the Midwest Renewable Energy Tracking System (MRETS). The data is reporting to MRETS for reporting purposes only. All renewable energy generation reported to MRETS will be retired so that VCUs can be issued.
- o Data Acquisition – continuous metering
- o Data Recording (Aggregation) Frequency – while the metering is continuous, the data is aggregated in HOURLY increments so BEPC has an 8760 shape of the MWhs generated every year. This information is provided in MV90 data.
- o Data Monitoring – MV90 data, generated on an hourly basis, is used to measure the amount of power generated and placed on the grid. All bills are processed on the readings of the MV90 data.
- o Metering the amount of waste gas or the amount of energy contained in the waste heat
  - o We do not monitor the gross amount of energy contained in the waste heat. Since emissions reductions are calculated based on net energy delivered to grid, and an ex-ante gross generation adjustment factor is used, the gross value is not pertinent to the calculations performed.
  - o Please note that certain other parameters defined in the methodology, namely temperature, pressure as well as the amount of waste heat, will not be monitored since they are not pertinent to calculating the emissions reductions.

|                        |           |
|------------------------|-----------|
| Data Unit / Parameter: | $f_{WCM}$ |
| Data unit:             | Ratio     |

|                 |                                                                                                                                        |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Description:    | Fraction of total electricity generated by the project activity using only waste energy (as opposed to waste energy and fossil fuels). |
| Source of data: | Default Factors                                                                                                                        |
| Value applied:  | 1                                                                                                                                      |
| Purpose of Data | This factor is a default amount. Since the electricity generation is purely from the generation of waste energy, this fraction is 1.   |
| Any comment:    | N/A                                                                                                                                    |

|                        |                                                                                                                                                                                                                                                                                     |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | EF <sub>elec,i,j,y</sub>                                                                                                                                                                                                                                                            |
| Data unit:             | Metric tons / MWhr                                                                                                                                                                                                                                                                  |
| Description:           | The CO <sub>2</sub> emissions factor for the grid i displaced due to the project activity, during the year y in metric tons CO <sub>2</sub> /MWh, as calculated by the combined operating margin (CM), which is a weighted average of the Simple Operating Margin and Build Margin. |
| Source of data:        | Calculated based on tool for calculating emissions intensity of the grid; Sources include EIA 923/860 databases, EIA fuel emissions factors                                                                                                                                         |
| Value applied:         | 0.8422                                                                                                                                                                                                                                                                              |
| Purpose of Data        | Used to calculate the metric tons displaced when 1 MWhr of renewable power is placed on the grid                                                                                                                                                                                    |
| Any comment:           | The ex-ante option is chosen                                                                                                                                                                                                                                                        |

|                        |                                                                                                                                             |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | EF <sub>grid,OMsimple,y</sub>                                                                                                               |
| Data unit:             | Metric tons / MWh                                                                                                                           |
| Description:           | Simple Operating Margin CO <sub>2</sub> emissions factor in year y                                                                          |
| Source of data:        | Calculated based on tool for calculating emissions intensity of the grid; Sources include EIA 923/860 databases, EIA fuel emissions factors |
| Value applied:         | 0.98542                                                                                                                                     |
| Purpose of Data        | Used to determine the simple operating margin. The combined intensity is a weighted average of                                              |

|              |                                                  |
|--------------|--------------------------------------------------|
|              | the simple operating margin and the build margin |
| Any comment: | The ex-ante option is chosen                     |

|                        |                                                                                                                                   |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | EG <sub>m, y</sub>                                                                                                                |
| Data unit:             | MWh                                                                                                                               |
| Description:           | Net quantity of electricity generated by power unit m in year y (m includes all power units except low cost must run power units) |
| Source of data:        | EIA 923/860 databases                                                                                                             |
| Value applied:         | Varies by unit                                                                                                                    |
| Purpose of Data:       | Used to calculate the simple operating margin                                                                                     |
| Any comment:           | N/A                                                                                                                               |

|                        |                                                             |
|------------------------|-------------------------------------------------------------|
| Data Unit / Parameter: | For simple operating margin - EF <sub>EL, m, y</sub>        |
| Data unit:             | Metric tons / MWh                                           |
| Description:           | CO2 emissions factor of power unit m in year y (tCO2 / MWh) |
| Source of data:        | EIA 923/860 databases                                       |
| Value applied:         | Varies by unit                                              |
| Purpose of Data        | Used to calculate the simple operating margin               |
| Any comment:           | N/A                                                         |

|                        |                                                                                                                                                                    |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | FC <sub>i, m, y</sub> and NCV <sub>i, y</sub>                                                                                                                      |
| Data unit:             | MMBtus                                                                                                                                                             |
| Description:           | Amount of fossil fuel type i consumed by power unit m in year y (mass or unit volume) and the Net Calorific value (energy content) of fossil fuel type i in year y |
| Source of data:        | EIA 923/860 databases and EIA Fuel Emissions Factors                                                                                                               |
| Value applied:         | Varies by unit                                                                                                                                                     |
| Purpose of Data        | Used to calculate the simple operating margin                                                                                                                      |
| Any comment:           | N/A                                                                                                                                                                |

|                        |                                                                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | EF <sub>CO<sub>2</sub>,i,y</sub>                                                                                                                        |
| Data unit:             | Kg CO <sub>2</sub> e/MMBtu                                                                                                                              |
| Description:           | CO <sub>2</sub> emissions factor of fossil fuel type i in year y                                                                                        |
| Source of data:        | EIA 923/860 databases and EIA Fuel Emissions Factors                                                                                                    |
| Value applied:         | Varies by fuel type                                                                                                                                     |
| Purpose of Data        | EIA fuel emissions factors are default values that have been used to prepare GHG inventories. These values are used to calculate the operating margins. |
| Any comment:           | N/A                                                                                                                                                     |

|                        |                                                                                                                                                       |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | EF <sub>grid,BM,y</sub>                                                                                                                               |
| Data unit:             | Metric Tons / MWh                                                                                                                                     |
| Description:           | CO <sub>2</sub> emissions factor of fossil fuel type i in year y                                                                                      |
| Source of data:        | Calculated using Option A2 for simple OM, but including all units as defined in the methodology. EIA 923/860 databases and EIA Fuel Emissions Factors |
| Value applied:         | 0.4126                                                                                                                                                |
| Purpose of Data        | This factor is the build margin. The combined margin is a weighted average of the build and operating margin.                                         |
| Any comment:           | N/A                                                                                                                                                   |

|                        |                                                                                                                                                                              |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | For build margin - EF <sub>EL,m, y</sub>                                                                                                                                     |
| Data unit:             | Metric tons / MWh                                                                                                                                                            |
| Description:           | CO <sub>2</sub> emissions factor of power unit m in year y (tCO <sub>2</sub> / MWh)                                                                                          |
| Source of data:        | EIA 923/860 databases                                                                                                                                                        |
| Value applied:         | Varies by unit                                                                                                                                                               |
| Purpose of Data        | Used to calculate the build margin factor. Calculated using EIA 923 / EIA 860 databases and EIA Fuel emissions factors, based on Option A2 as described under the Simple OM. |
| Any comment:           | This factor uses the power generation efficiency                                                                                                                             |

|  |                                                                      |
|--|----------------------------------------------------------------------|
|  | factor and the CO2 emissions factor of fossil fuel type l in year y. |
|--|----------------------------------------------------------------------|

|                        |                                                                                                |
|------------------------|------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | For build margin - $n_{m,y}$                                                                   |
| Data unit:             | Percentage                                                                                     |
| Description:           | Average net energy conversion efficiency of power unit m in year y                             |
| Source of data:        | EIA 923/860 databases                                                                          |
| Value applied:         | Varies by unit, use default factors provided in methodology                                    |
| Purpose of Data        | Used to calculate the build margin factor. This is required by the Tool for the option chosen. |
| Any comment:           | N/A                                                                                            |

|                        |                                                                                                             |
|------------------------|-------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | $TDL_{j,y}$                                                                                                 |
| Data unit:             | Default Factor                                                                                              |
| Description:           | Average technical transmission and distribution losses for providing electricity to source j in year y      |
| Source of data:        | Tool to calculate baseline, project and/or leakage emissions                                                |
| Value applied:         | 20%                                                                                                         |
| Purpose of Data        | This is a default factor used to account for the line losses associated with consuming grid connected power |
| Any comment:           | N/A                                                                                                         |

|                        |                                                                                                                                                                                                                                          |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | $CF_{\text{historical, Garvin}}$                                                                                                                                                                                                         |
| Data unit:             | Percentage                                                                                                                                                                                                                               |
| Description:           | Ratio of mean daily horsepower hours generated over maximum theoretical horsepower hours feasible at the Garvin compressor station                                                                                                       |
| Source of data:        | Mean daily horsepower hours are based on BEPC's historical data collected over 32 months at the compressor station. Maximum theoretical horsepower hours is based on the conservative assumption that the Northern Border Pipeline has a |

|                 |                                                                                                                                                                                                                                                                                      |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 | 40,000 hp turbine in place at Garvin. This information is derived from the Gas Technology Institute's report about the BEPC and OREG waste heat projects.                                                                                                                            |
| Value applied:  | 0.674609                                                                                                                                                                                                                                                                             |
| Purpose of Data | This measure captures the historical capacity factor that measures how much energy was available at each compressor station. It is based on data which was used to assess the technical feasibility of the project at the Garvin Site. It is used to calculate the $f_{cap}$ factor. |
| Any comment:    | N/A                                                                                                                                                                                                                                                                                  |

|                        |                                                                                                                                                                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | Gross Adjustment Factor                                                                                                                                                                                                                                                              |
| Data unit:             | Percentage                                                                                                                                                                                                                                                                           |
| Description:           | Median of historical monthly data of percentage by which gross generation exceeds net generation at Compressor Station #12.                                                                                                                                                          |
| Source of data:        | OREG II readings at CS12 since its start date – historical data. OREG II data includes gross generation, net generation and parasitic load.                                                                                                                                          |
| Value applied:         | 12.75%                                                                                                                                                                                                                                                                               |
| Purpose of Data        | This measure captures the historical capacity factor that measures how much energy was available at each compressor station. It is based on data which was used to assess the technical feasibility of the project at the Garvin Site. It is used to calculate the $f_{cap}$ factor. |
| Any comment:           | N/A                                                                                                                                                                                                                                                                                  |

## 3.2 Data and Parameters Monitored

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter:                                           | EG <sub>i,j,2010</sub><br>EG <sub>i,j,2011</sub>                                                                                                                                                                                                                                                                                                                                                   |
| Data unit:                                                       | MWh                                                                                                                                                                                                                                                                                                                                                                                                |
| Description:                                                     | The quantity of electricity supplied to the recipient (in this case the grid) by the generator that in the absence of project activity would have been sourced from i (MRO) grid in MWh in year y (2010 and 2011).                                                                                                                                                                                 |
| Source of data:                                                  | Project activity revenue meter at the Garvin substation - a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837 owned by East River Electric Cooperative.                                                                                                                                                                                                                |
| Description of measurement methods and procedures to be applied: | MV90 generation data is archived electronically. Electricity generation is measured continuously and recorded monthly.                                                                                                                                                                                                                                                                             |
| Frequency of monitoring/recording:                               | Monthly                                                                                                                                                                                                                                                                                                                                                                                            |
| Value applied:                                                   | EG <sub>i,j,2010</sub> - 37,766 MWh<br>EG <sub>i,j,2011</sub> - 43,285 MWh                                                                                                                                                                                                                                                                                                                         |
| Monitoring equipment:                                            | Project activity revenue meter at the Garvin substation - a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837 owned by East River Electric Cooperative. East River Electric Cooperative owns and calibrates the meter per the interconnection Agreement.                                                                                                               |
| QA/QC procedures to be applied:                                  | The meter is tested every year, normally during the last quarter of the calendar year. This meter does not lend itself to be easily field calibrated, so it has been East River's practice that if the meter is found to be out of calibration they will simply replace the meter. This meter was last tested on 12/17/2010 and 11/1/2011, and found to be operating within acceptable parameters. |
| Calculation method:                                              | Meter readings                                                                                                                                                                                                                                                                                                                                                                                     |
| Any comment:                                                     | N/A                                                                                                                                                                                                                                                                                                                                                                                                |

|                        |                                                                                  |
|------------------------|----------------------------------------------------------------------------------|
| Data Unit / Parameter: | CF <sub>actual, Garvin</sub> -for 2010<br>CF <sub>actual, Garvin</sub> -for 2011 |
|------------------------|----------------------------------------------------------------------------------|

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data unit:                                                       | Percentage                                                                                                                                                                                                                                                                                                                                                                                         |
| Description:                                                     | Sum of $EG_{i,j,y}$ each month * 1.1275 / (7.5 * 8760).                                                                                                                                                                                                                                                                                                                                            |
| Source of data:                                                  | Project activity revenue meter at the Garvin substation - a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837 owned by East River Electric Cooperative.                                                                                                                                                                                                                |
| Description of measurement methods and procedures to be applied: | MV90 generation data is archived electronically. Electricity generation is measured continuously and recorded monthly.                                                                                                                                                                                                                                                                             |
| Frequency of monitoring/recording:                               | An annual calculation will be made based on total electricity generated at the site                                                                                                                                                                                                                                                                                                                |
| Value applied:                                                   | $CF_{actual, Garvin}$ for 2010: 64.34%<br><br>$CF_{actual, Garvin}$ for 2011: 73.80%                                                                                                                                                                                                                                                                                                               |
| Monitoring equipment:                                            | Project activity revenue meter at the Garvin substation - a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837 owned by East River Electric Cooperative. East River Electric Cooperative owns and calibrates the meter per the interconnection Agreement.                                                                                                               |
| QA/QC procedures to be applied:                                  | The meter is tested every year, normally during the last quarter of the calendar year. This meter does not lend itself to be easily field calibrated, so it has been East River's practice that if the meter is found to be out of calibration they will simply replace the meter. This meter was last tested on 12/17/2010 and 11/1/2011, and found to be operating within acceptable parameters. |
| Calculation method:                                              | Meter readings and formula above                                                                                                                                                                                                                                                                                                                                                                   |
| Any comment:                                                     | N/A                                                                                                                                                                                                                                                                                                                                                                                                |

|                        |                                                                                                                                                                                                                                               |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter: | $f_{cap, Garvin, 2010}$<br><br>$f_{cap, Garvin, 2011}$                                                                                                                                                                                        |
| Data unit:             | Ratio                                                                                                                                                                                                                                         |
| Description:           | $f_{cap, Garvin} = \min \{1, 0.674609 / CF_{actual, Garvin, 2010}\}$<br><br>$f_{cap, Garvin} = \min \{1, 0.674609 / CF_{actual, Garvin, 2011}\}$                                                                                              |
| Source of data:        | $CF_{historical, Garvin}$ is calculated to be 0.674609 based on the average versus theoretical maximum daily horsepower hours at the compressor station. $CF_{actual, Garvin}$ will be based on the gross amount of electricity generated and |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                  | delivered to the grid in 2010 and 2011 respectively, which is calculated as the net amount of electricity delivered to the grid times the gross generation adjustment factor.                                                                                                                                                                                                                      |
| Description of measurement methods and procedures to be applied: | MV90 generation data is archived electronically. Electricity generation is measured continuously and recorded monthly.                                                                                                                                                                                                                                                                             |
| Frequency of monitoring/recording:                               | An annual calculation will be made based on total electricity generated at the site                                                                                                                                                                                                                                                                                                                |
| Value applied:                                                   | $f_{\text{cap, Garvin, 2010}} = 1$<br>$f_{\text{cap, Garvin, 2011}} = 0.9141$                                                                                                                                                                                                                                                                                                                      |
| Monitoring equipment:                                            | Project activity revenue meter at the Garvin substation - a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837 owned by East River Electric Cooperative. East River Electric Cooperative owns and calibrates the meter per the interconnection Agreement.                                                                                                               |
| QA/QC procedures to be applied:                                  | The meter is tested every year, normally during the last quarter of the calendar year. This meter does not lend itself to be easily field calibrated, so it has been East River's practice that if the meter is found to be out of calibration they will simply replace the meter. This meter was last tested on 12/17/2010 and 11/1/2011, and found to be operating within acceptable parameters. |
| Calculation method:                                              | Meter readings and formula above                                                                                                                                                                                                                                                                                                                                                                   |
| Any comment:                                                     | N/A                                                                                                                                                                                                                                                                                                                                                                                                |

|                                                                  |                                                                                                                                                                                                                                 |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter:                                           | $EC_{PJ,j,2010}$<br>$EC_{PJ,j,2011}$                                                                                                                                                                                            |
| Data unit:                                                       | MWh                                                                                                                                                                                                                             |
| Description:                                                     | Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr) for 2010 and 2011 respectively                                                                                              |
| Source of data:                                                  | Project activity revenue meters at the Garvin substation                                                                                                                                                                        |
| Description of measurement methods and procedures to be applied: | Station services consumption will be derived from billing statements provided monthly by Lyon Lincoln Cooperative in whose service territory this project is located, and to whose distribution lines the project interconnects |
| Frequency of                                                     | Monthly                                                                                                                                                                                                                         |

|                                 |                                                                           |
|---------------------------------|---------------------------------------------------------------------------|
| monitoring/recording:           |                                                                           |
| Value applied:                  | $EC_{PJ,j,2010} = 112.32$<br>$EC_{PJ,j,2011} = 54.94$                     |
| Monitoring equipment:           | Lyon Lincoln Invoices                                                     |
| QA/QC procedures to be applied: | Copies of Monthly Invoices submitted by Lyon Lincoln Electric Cooperative |
| Calculation method:             | Meter readings as detailed on the invoice                                 |
| Any comment:                    | N/A                                                                       |

|                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Unit / Parameter:                                           | $PE_{EC,y}$                                                                                                                                                                                                                                                                                                                                                                                                 |
| Data unit:                                                       | Metric Tons                                                                                                                                                                                                                                                                                                                                                                                                 |
| Description:                                                     | Project emissions from electricity consumption in year y (tCO <sub>2</sub> / yr)                                                                                                                                                                                                                                                                                                                            |
| Source of data:                                                  | Project activity revenue meters at the Garvin substation                                                                                                                                                                                                                                                                                                                                                    |
| Description of measurement methods and procedures to be applied: | <p>Station services consumption will be derived from billing statements provided monthly by Lyon Lincoln Cooperative in whose service territory this project is located, and to whose distribution lines the project interconnects</p> <p>After MWh consumed is obtained, the parameter will be calculated using the following formula:</p> $PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TD_{L,j,y})$ |
| Frequency of monitoring/recording:                               | Monthly                                                                                                                                                                                                                                                                                                                                                                                                     |
| Value applied:                                                   | $PE_{EC,2010} = 113.5$<br>$PE_{EC,2011} = 55.5$                                                                                                                                                                                                                                                                                                                                                             |
| Monitoring equipment:                                            | Lyon Lincoln Invoices                                                                                                                                                                                                                                                                                                                                                                                       |
| QA/QC procedures to be applied:                                  | Copies of Monthly Invoices submitted by Lyon Lincoln Electric Cooperative                                                                                                                                                                                                                                                                                                                                   |
| Calculation method:                                              | Meter readings as detailed on the invoice                                                                                                                                                                                                                                                                                                                                                                   |
| Any comment:                                                     | N/A                                                                                                                                                                                                                                                                                                                                                                                                         |

## 3.3 Description of the Monitoring Plan

The monitoring plan will include data monitoring, regular equipment maintenance and calibrations, and data management/archiving. Overall responsibility for the accurate measurement and archival of generation information is managed by BEPC. The parameters laid out in section 3.1 above will be monitored and the associated data will be aggregated and reported according to the following procedures.

- o Data Management and Archiving: Generation data is archived electronically. Electricity generation is measured continuously, aggregated hourly, and recorded monthly.
- o Metering Devices: Metering the net amount of electrical energy produced – this is provided by a revenue grade meter (a Nexus 1252-120-D-INP2 manufactured by Electro Industries, Serial No. 39827837) owned by East River Electric Cooperative, which owns and calibrates the meter per the interconnection Agreement. This meter generated MV90 data on an hourly basis. The MV90 data is the basis of all invoicing and is used to measure baseline emissions. Note that this meter is read by WAPA on a monthly basis and data is submitted to the MRETS registry, where the MWhrs are considered “renewable energy credits”. An MRETS report with monthly generation is provided. In order to avoid double counting of environmental attributes, all MWhrs generated in MRETS have been retired to avoid double counting.
- o Calibration Log: As outlined in the Interconnection Agreement, this meter is owned by East River Cooperative. The meter is tested every year, normally during the last quarter of the calendar year. This meter does not lend itself to be easily field calibrated, so it has been East River’s practice that if the meter is found to be out of calibration they will simply replace the meter. This meter was last tested on 12/17/2010 and 11/1/2011, and found to be operating within acceptable parameters.
- o Extraordinary Events: No extraordinary events or unscheduled outages took place this year.

Monitoring records will be retained for 7 years (two years past the project’s crediting period of 5 years)

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

### 4.1 Baseline Emissions

$$BE_{elec,2010} = f_{cap,2010} * f_{WCM} * EG_{i,j,2010} * EF_{Elec,i,j,2010}$$

$$BE_{elec,2010} = 1 * 1 * 37,766 * 0.8422 = 31,807$$

$$BE_{elec,2011} = f_{cap,2011} * f_{WCM} * EG_{i,j,2011} * EF_{Elec,i,j,2011}$$

$$BE_{elec,2011} = 1 * 0.9141 * 43,285 * 0.8422 = 33,322$$

## 4.2 Project Emissions

$$PE_{EC,2010} = EC_{PJ,j,2010} * EF_{EL,j,2010} * (1 + TDL_{j,2010})$$

$$PE_{EC,2010} = 112.32 * 0.8422 * (1+0.2) = 113.5 \text{ metric tons}$$

$$PE_{EC,2011} = EC_{PJ,j,2011} * EF_{EL,j,2011} * (1 + TDL_{j,2011})$$

$$PE_{EC,2010} = 54.94 * 0.8422 * (1+0.2) = 55.5 \text{ metric tons}$$

## 4.3 Leakage

No leakage is considered as the equipment being utilized in the project activity is not transferred from outside the boundary to the project activity. Ormat, the project developer, installed new, original equipment at this site to generate the emissions reductions, and has provided an attestation for the validation process to that effect. Hence, we do not consider leakage here.

## 4.4 Summary of GHG Emission Reductions and Removals

Total Emissions Reductions = Baseline Emissions – Project Emissions

Emissions Reductions (2010) = Baseline Emissions – Project Emissions = 31,807 – 113.5 = 31,693 metric tons

Emissions Reductions (2011) = Baseline Emissions – Project Emissions = 33,322 – 55.5 = 32,267 metric tons

## 5 ADDITIONAL INFORMATION

None.