Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
DEPARTMENT OF ENERGY RESOURCES

ALTERNATIVE ENERGY PORTFOLIO STANDARD (APS)

APS GUIDELINE
ON THE ELIGIBILITY AND METERING OF COMBINED HEAT & POWER PROJECTS
("APS Guideline for CHP")

June 14, 2011 Edition

Pursuant to the Alternative Energy Portfolio Standard Regulation in 225 CMR 16.00

This *Guideline* covers methods, criteria, and specifications that must be satisfied in order for a CHP project to qualify as an APS Alternative Generation Unit under the APS Regulation and in order for the output of such a Unit to qualify for APS Alternative Generation Attributes – as embodied in Alternative Energy Certificates ("AECs") issued by the NEPOOL GIS. The Certificate calculation methods in Section 1 of the *Guideline* apply immediately to all projects, including those already approved except to the extent that project Owners, Operators, or Authorized Representatives are otherwise informed in writing by the Department of Energy Resources (DOER).[1] The meter specifications in Section 2 of this edition of the *Guideline* are effective on the date of this edition for all APS applications received subsequent to that date, as well as to any future metering changes in CHP Units that are already qualified or for which applications have already been received by DOER as of that date. The list in Section 3 of documents that must be submitted with a Statement of Qualification Application (SQA) is effective for all SQAs that are currently under review or received on or after the date of this *Guideline*, unless and until superseded in a future revised *Guideline*.

[1] The Owners, Operators, and Authorized Representatives of CHP projects that are qualified and in operation as APS Alternative Generation Units before or during 2011 are being informed by DOER that they have the option of using either the Lower Heating Value (LHV) or the Higher Heating Value (HHV) of their Units' input fuels in calculating the quantities of APS Alternative Generation Attributes *for their **2011** production only*, After 2011, all Attribute/AEC calculations must use the Higher Heating Value only. This temporary exception is explained in the notices for those Units.

1. EXPLANATION, ASSUMPTIONS, & FORMULAS FOR CERTIFICATE CALCULATION

A Massachusetts APS-qualified CHP Unit should receive NEPOOL GIS certificates with APS Alternative Generation Attributes (termed Alternative Energy Certificates, abbreviated AECs) to the extent that the Unit is optimally-designed in relation to its electrical and thermal loads, uses excellent technology, and is well operated maintained and operated. The formulas by which the quantity of Attributes of the CHP Unit is determined calculate the amount by which the energy input to the CHP Unit to produce a given electrical and thermal output is less than the energy input that would be required if those same outputs came separately from the electrical grid and an on-site boiler.

The formulas, which are presented below for several different system circumstances, assume the following with regard to efficiency:

a) an overall efficiency of 33% for electrical energy delivered to the end-use from a central plant via the grid (both generation and transmission losses considered), and

b) an overall efficiency of 80% for thermal energy delivered to a stand-alone heating unit on site.

Because the NEPOOL GIS can mint certificates only in terms of MWh of electricity, all values in the formulas are converted to MWh, with 3,412 thousand Btu of Useful Thermal Energy of input fuel being equivalent to one MWh of electrical energy – expressed in the formulas below as 3.412 MMBtu/MWh.

Use Worksheet 3 of the *APS-SQA CHP Worksheets* to calculate projected AECs (there termed "Alternative Energy Credits"), and then enter the results in SQA Section III.2.B.d.

Calculation for a New CHP Unit:
The basic formula for determining the Alternative Generation Attributes (AECs) for a new CHP system is expressed in prose as follows:

(Electrical energy generated per calendar quarter in MWh**) /** 0.33

plus ([Useful Thermal Energy produced in the calendar quarter in MMBtu] **/** 3.412 MMBtu/MWh**) /** 0.8

minus (all fuel and any other incremental energy consumed in the calendar quarter in MMBtu **/** 3.412 MMBtu/MWh**)**

equals Alternative Generation Attributes (as AECs) in the calendar quarter in MWh.

Calculation for a CHP System that Incorporates Supplemental Firing of an HRSG:
The formula for determining the Alternative Generation Attributes (AECs) for a CHP system that is also *supplementally fired* and in which the useful thermal outputs from the CHP section and non-CHP section are commingled is expressed in prose as follows:

(Electrical energy generated per calendar quarter in MWh**) /** 0.33

plus ([Useful Thermal Energy produced in the calendar quarter in MMBtu] **/** 3.412 MMBtu/MWh**) /** 0.8

minus (all fuel including the fuel supply to any supplemental burner(s) and any other incremental energy consumed in the calendar quarter in MMBtu **/** 3.412 MMBtu/MWh**)**

equals Alternative Generation Attributes (as AECs) in the calendar quarter in MWh.

(**NOTE:** *All fuel supplied to the supplemental burner(s) must be metered using an APS approved fuel meter.*)

Calculation for a CHP System with a Parasitic Load Exceeding 25 kW:

In the case where the projected or actual electrical load due to CHP auxiliary systems is greater than 25kW**,** the electric energy usage will be considered as parasitic (not useful). If the CHP APS kWh meter is located such that it is not reading the net power produced, the parasitic usage must be subtracted from the electrical energy in MWh as read from the main system meter. In the case where an auxiliary system or group of systems fed out of a single motor control center represents a concentrated parasitic load greater or equal to 60% of the combined nominal parasitic load, a separate APS approved kWh meter must be installed on the feeder circuit to the system or motor control center.

Two typical examples of auxiliary systems to which this would apply are (a) the fuel gas compressor(s) for a combustion gas turbine based CHP unit, and (b) boiler feed water pumps for a large CHP unit. For the case in which the projected or actual parasitic load exceeds 25kW but there is no concentrated load as defined above, the applicant should provide and document a value for the kW parasitic load per nominal full load run hour. In this case the parasitic load will be the value per full load run hour **times** the number of full load equivalent run hours per quarter. This where the number of full load equivalent run hours equals the MWh electrical output divided by the nameplate full load electrical generating capacity.

The AEC formula for the case of a CHP system with a parasitic load of over 25 kW while running at nominal full load is expressed in prose as follows:

(Gross electrical energy generated per calendar quarter in MWh **minus** the parasitic electrical energy per quarter in MWh**) /** 0.33

plus ([Useful Thermal Energy produced in the calendar quarter in MMBtu] **/** 3.412 MMBtu/MWh**) /** 0.8

minus (all fuel and any other incremental energy consumed in the calendar quarter in MMBtu **/** 3.412 MMBtu/MWh**)**

equals Alternative Energy Attributes (as AECs) in the calendar quarter in MWh

Calculation for Incremental CHP at a Pre-2008 Unit (expressed in prose):

(Incremental Electrical Energy[2] generated per calendar quarter in MWh**) /** 0.33

plus ([Incremental Useful Thermal Energy[3] produced in the calendar quarter in MMBtu] **/** 3.412 MMBtu/MWh**) /** 0.8

minus (all Incremental Fuel[4] & any other incremental energy consumed in the calendar quarter in MMBtu **/** 3.412 MMBtu/MWh**)**

equals Alternative Energy Attributes (as AECs) in the calendar quarter in MWh.

[2] "Incremental Electrical Energy" is defined in 225 CMR 16.02 as the electrical energy generated by a CHP Unit that is either greater than (expressed as a positive amount) or less than (expressed as a negative amount) the electrical energy generated by the CHP Unit prior to the addition of new electric generation nameplate capacity, Useful Thermal Energy, or Incremental Useful Thermal Energy.

[3] "Incremental Useful Thermal Energy" is defined in 225 CMR 16.02 as the Useful Thermal Energy produced by a CHP Unit that is distinct in its final distribution, beneficial measure, and metering from Useful Thermal Energy previously produced by the CHP Unit, but only to the extent that the Incremental Useful Thermal Energy does not reduce the Useful Thermal Energy previously produced.

[4] "Incremental Fuel" is defined in 225 CMR 16.02 as the amount of additional fuel used by a CHP Generation Unit which is attributable to the production of Incremental Useful Thermal Energy or Incremental Electrical Energy.

2. APPROVED CHP SYSTEM METERS FOR ACP

GENERAL NOTES:

1) All meters required by the APS must meet and conform to all applicable Laws, Ordinances, Codes, Regulations and Standards.
2) All meters required by the APS must be of Revenue Grade quality and reliability.
3) It is preferred, but not required, that APS meters have the capability to generate and transmit a signal for remote reading.
4) Metering standards for additional fuels (such as landfill methane, other biogas, and solid biomass), additional meter types, and other revisions of the metering standards, as appropriate, will be included in future editions of the *Guideline*.

FUEL METERS

Natural Gas				
Meter Type	**Minimum Accuracy**		**Minimum Frequency of Calibration**	**Other**
	Flow rate Range			
All Meters, including Diaphragm & Rotary	2% Max DF ≤ Flow ≤ 100% Max DF Where Max DF is Maximum Design Flow Rate	± 2%	Annual	*See Notes.*

Natural Gas Meter Notes:

1) All Diaphragm meters must conform to the current ANSI B109 2 standard.
2) All Rotary meters must conform to the current ANSI B109 3 standard.
3) All volumetric measurements must be adjusted to Standard Cubic Feet (SCF) (i.e. corrected for temperature and pressure). Meter models that are pressure and temperature compensated will satisfy this requirement. Meters with settable pressure compensation may be used if installed downstsream of a pressure regulator. The applicant may propose an alternate method for converting the metered flow to units of Standard Cubic Feet.
4) For each Quarter in which the AECs are reported to the GIS, the average Higher Heating Value (HHV) in BTU/SCF must be obtained from the natural gas supplier and made available to the independent meter reader.
5) A gas meter furnished and installed as a part of a dedicated gas supply line to the CHP system by the applicable gas utility, will be accepted as an approved natural gas fuel meter.

Liquid Fuels				
Meter Type	**Flow rate**	**Accuracy**	**Minimum Frequency of Calibration**	**Other**
Positive Displacement	Full Range	± 1%	Annual	*See general and specific Notes.*

Liquid Fuel Meter Notes:

1) *The approved meter standard above applies* ***only*** *to the following ASTM fuels (with associated Higher Heating Values):* B-100 (120,714 BTU/gallon); M-100 (56,800 BTU/gallon); E-100 (76,100 BTU/gallon).
2) M-100 and E-100 are each eligible *only* if derived from biogenic, non-petrochemical based sources.
3) Blended and non ASTM Fuels: The approved meter standard above does not apply for these cases.

NOTE: ***The standard for blended and non-ASTM liquid fuels is RESERVED and will be issued in a future edition of the SQA and*** **Guideline.**

BioGas (Landfill Gas, Digester Gas)				
Meter Type	**Flow rate**	**Accuracy**	**Minimum Frequency of Calibration**	**Other**
RESERVED				

NOTE: ***The standard for BioGas Meters is RESERVED and will be issued in a future edition of the SQA and*** **Guideline.**

Solid Biomass
RESERVED

NOTE: ***The standard for Solid Biomass Meters is RESERVED and will be issued in a future edition of the SQA and*** **Guideline.**

THERMAL ENERGY METERS

Thermal Energy -- Steam Service					
Line Size	**Meter System**		**BTU Meter Field Accuracy**	**Minimum Frequency of Calibration**	**Notes**
	Flow Element and BTU Computer	**Temperature Element Installed in Thermowell**			
≥ 8"	*Flow Meter:* Orifice Plate with Differential Pressure Element and Transmitter. *BTU Computer:* Automated real-time computation and totalizer.	Only with superheat.	± 3%	Annual	If a significant fraction of flow occurs at velocities well below the nominal design flow rate, this flow meter type may undercount flow and BTU's. This can be addressed by installing a two meter manifold with a normal to high meter in parallel with a low flow meter.
< 8"	*Flow Element:* Vortex Shedding Tube. *BTU Computer:* Automated real-time computation and totalizer.	Only with superheat.	± 3%	Biannual	

Thermal Energy -- Hot Water					
CHP Output	**Meter System**		**BTU Meter Field Accuracy**	**Minimum Frequency of Calibration**	**Notes**
	Flow Meter and BTU Computer	**Temperature Measurement**			
> 10kW	In-line Ultrasonic Flow Tube (no strap-on) **or** Magmeter. *BTU Computer:* Automated real-time computation and totalizer.	Yes Must be installed in a Thermowell	± 3%	Biannual	Temperature elements installed in thermal wells.
≤ 10kW	In-line Ultrasonic Flow **or** strap-on **or** Magmeter. *BTU Computer:* Automated real-time computation and totalizer.	Yes	± 3%	Biannual	Temperature elements installed in thermal wells or securely mounted with excellent thermal contact and insulation on piping.

3. OTHER DOCUMENTS THAT MUST BE SUBMITTED WITH THE APPLICATION

a. Completed **CHP System Technical Information Data Sheets**
- DS#1: Genset(s) (prime mover and generator)
- DS#2: CHP Heat Recovery System(s)
- DS#3: APS Meters for CHP Systems
- DS#4: Generator and Electrical Distribution System(s)

b. Completed **CHP Worksheets**
- Worksheet 1, Thermal Loads Used as Basis of Design
- Worksheet 2, Total Electrical Usage for All Electrical Loads Served by the CHP System
- Worksheet 3, Projected Baseline CHP Average Annual System Performance
- Worksheet 4, Projected Net Carbon Dioxide Emissions Rate from CHP System

c. **System APS Meters:** Manufacturer's Specifications and Technical Data Sheets

d. **System Prime Mover, Generator, & Heat Recovery System**: Manufacturer's Specifications and Product Brochure(s)

e. **General Site Plan,** showing existing and proposed structures & utilities & property lines (only if the mechanical tie-in with the existing system occurs at more than one building)

f. **Equipment Arrangement Plan** (Mechanical & Electrical), including points of connection with existing equipment and/or distribution systems

g. **System Process Flow Diagram** for each major operating mode, including:
- Location of all APS required meters
- Major Equipment and Piping and Instruments
- All Thermal Dumping Sub-Systems
- Applicable Process Values, e.g., kW, temperature. pressure, enthalpy (Btu/lb), mass flow rate (lb/min or lb/hr) at inlets and outlets of all major equipment and at each main points of connection with existing systems

h. **One-line Electrical Distribution and Interconnection Diagram**

i. **System Controls**: Description, including a narrative of the sequence of controls for each of the system principal operating modes.