Rhode Island Renewable Energy Standard (RI RES)

Renewable Energy Resources Eligibility Form

CERTIFICATION FILING METHODOLOGY GUIDE

(Version 4 – December 2012)

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1. OVERVIEW AND PURPOSE OF THE GUIDE

This document provides guidance to assist program applicants to complete the Renewable Energy Resources Eligibility Form and associated Appendices for the Rhode Island Renewable Energy Standard (RI RES) Program. The RI RES rules and regulations promulgated by the RI PUC are the governing rules for participation and this guide serves only as a supplement, suggesting methods which might be helpful in responding to certain technical aspects of applications.

*** Applications completed and documented consistent with these guidelines stand a good chance of acceptance; however, use of the methodologies included in this document will not assure acceptance. ***

*** Note: Alternative methods may be acceptable. ***

This document will be updated from time to time to provide clarification and additional guidance on issues that may arise during actual application filings and reviews, as well as inclusion of alternative methods that may be also deemed acceptable.

Any questions on the material in this guide can be directed to RES.Filings@puc.ri.gov

2. BIOMASS PROJECTS

2.1 FOSSIL FUEL CO-FIRING – ELIGIBLE BIOMASS FUEL CALCULATION METHODOLOGY SUGGESTIONS

At the time of application for certification, Generation Units proposing to use an Eligible Biomass Fuel are required to submit a fuel source plan (RES Regulations – Section 6.9 (i)) [1] *In the case of co-firing with a fossil fuel, a description of how such co-firing will occur and how the relative amounts of Eligible Biomass Fuel and fossil fuel will be measured, and how the eligible portion of generation output will be calculated. Such calculations shall be based on the energy content of the proposed fuels used; (RES Regulations – Section 6.9 (i) (c))*

Two measurements are typically required to calculate the total heat input of solid biomass into the energy conversion system over time: 1) the mass flow of biomass and 2) the energy content per unit mass. Multiplying these data should provide an accurate way of calculating the total biomass portion of heat energy flows. For example:

*5 tons per hour of biomass * 12 million BTUs (MMBtu) per ton = 60 MMBtu per hour*

Given that this calculation is multiplicative, preserving measurement accuracy for the heating value and flow rate of the biomass is imperative. Additionally, the calculation above is shown on an hourly basis. These calculations can be conducted over a longer time period, but at a maximum, heat input accounting should typically be conducted on no less than a daily basis.

[1] As used in this document: State of Rhode Island and Providence Plantations Public Utilities Commission, "Rules and Regulations Governing the Implementation of a Renewable Energy Standard", July 25, 2007.

2.1.1 Biomass Mass Flow Measurements

Regardless of the type of system, tracking the mass flow (i.e., tons per hour) of biomass fuel into the boiler(s) is a critical component of accounting for the relative contribution of the renewable resource to the unit(s) output. Therefore, the biomass feed system should be designed to meter biomass fuel flows accurately. The options listed below offer approaches that are designed to provide accurate accounting, which will increase the likelihood of certification. Best options include:

1. The use of differential weighing devices such as loss-in-weight feeders or weigh hoppers properly equipped with devices to track changes in weight over time. These devices can provide an accurate and reliable means of measuring biomass fuel flow. If a single vessel-batch type system is employed, provisions should be made to maintain accurate flow measurements during refill periods. In addition, handling or fuel injection systems that employ less sophisticated weighing processes (truck scales or scoop scales) are sometimes used. In such cases, it is important that these systems are accompanied by detailed records of when each batch was weighed and introduced into the system for firing. In all cases, evidence from field calibration tests and/or manufacturer data for handling biomass materials such as those used on-site for fuel should be provided to demonstrate that a high degree of accuracy can be maintained throughout the duty cycle of the equipment. Projects employing these scales may need to provide recommended calibration and maintenance schedules and certify that the equipment has been installed by a qualified installer according to the manufacturer's specification, and that recommended calibration and maintenance schedules are being followed in accordance with the type of material being weighed. Thus, it is recommended to keep a file on the equipment in-house.
2. The use of belt scales (integrating weighing device) may also be acceptable provided that precautions are taken to ensure continued measurement accuracy. Belt scales make continuous measurements over an extended period of time and it may be difficult to detect measurement drift or the impact that material build-up is having on the readings. External forces such as wind, changes in belt tension and physical interference may introduce measurement errors. Projects employing these scales may need to provide certification that the equipment has been installed by a qualified installer according to the manufacturer's specification and that recommended calibration and maintenance schedules are being followed in accordance with the type of material being weighed. This could include, but may not be limited to, routine testing for "zero" weight. It is recommended to keep a file on the equipment in-house.

Regardless of the individual technology employed, it will be important that projects demonstrate accurate measurement of the as-fired fuel flow rates. Plant operators employing batch technologies that rely on infrequent mass measurements upstream of the fuel injection system, should demonstrate that they know how much fuel was introduced into the boiler across a discrete time frame. For example, if a fuel conversion rate is based on fuel withdrawals from a day bin which is being filled on an as-needed basis over a 16-hour period, the project should employ additional system monitoring and operation protocols that will allow independent verification of the following:

1. All of the fuel delivered to the day bin was consumed; and
2. When biomass fuel conversion started and when it was completed (via an auditable record either through boiler plant controls or signed data log).

Ultimately, the mass flow measurement data should be recorded and converted into a fuel firing rate, such as tons/hour. Note that projects providing fuel injection measurements on a near-real-time basis are preferred, but daily accounting of total biomass fuel consumed may be considered acceptable provided the proper tracking protocols are in place. In cases where day bins may not be completely emptied in a 24-hour period, visual or non-instrument based measurements of fuel delivery rates will not be acceptable. It will be incumbent on plant operators to manage fuel processing in a manner that allows quantitative analysis of fuel flow rates over accurate time frames.

2.1.2 Biomass Fuel Energy Content

Accounting for the biomass fuel's heating value (i.e., MMBtu per ton) is an equally critical component to measuring fuel heat input. Although some real-time heating value measurement systems are entering the market, they are costly and have a limited track record. Commonly, fuel heating values are determined via laboratory analysis of batch samples.

It is also important to recognize that fuel moisture content is the single most likely indicator of a biomass fuel's energy content. This fact is easily illustrated by comparing the "bone dry" and "as-received" heating values of different biomass fuels (Exhibit 1).

Exhibit 1 Heating Value Comparison

Fuel Type	As Received Moisture (Weight %)	As Received Higher Heating Value (Btu/lb)	Bone Dry Higher Heating Value (Btu/lb)
Green Wood	50.0%	4,390	8,780
Willow	10.2%	7,478	8,330
Bark	50.0%	4,185	8,370
Refuse-Derived Fuel (RDF)	20.0%	6,450	8,063
Switchgrass	7.9%	7,370	8,000
Sawdust	52.6%	4,150	8,760

Note that despite the very different nature of the fuels above, the "bone dry" heating values are far less disparate than the differences in the "as received" heating values at the varying moisture levels. In fact, the heating value variance is directly proportional to the moisture in the fuel, so a 50% decrease in moisture content will increase a fuel's heating value by 50%. The effect is similar for ash content, however, non-RDF sources of biomass (especially woody resources) tend to be relatively low in ash, and variations in heating value due to ash content tend to be less dramatic.

Given this data, the following methodologies are offered for establishing baseline heating values using complete fuel analyses and more frequent sampling and testing for fuel moisture content verification and use in ongoing heat input calculations. On-site batch sampling may be required where fuel sources and characteristics are variable.

2.1.3 Fuel Supplier/Type Baseline Chemical Analysis

Establishing a baseline fuel composition is important for several reasons. First, since project eligibility is dependent both on the combination of fuel resource and conversion technology, the chemical analyses provide documentation of fuel eligibility. Second, both proximate and ultimate fuel analyses provide heating value information, a critical parameter in calculating the total energy contribution of the renewable resource.

Projects seeking to participate in the RES program should perform either an ultimate or proximate analysis on each type of fuel from each supplier sufficiently frequently to capture any variation in fuel sources. At minimum these analyses should be performed semi-annually. These analyses will form the basis for documenting each fuel's dry heating value. In addition, as noted elsewhere in this document, specific chemical analyses may be required to demonstrate that the fuel is either unaltered, or to identify potential contaminants of concern.

Any methodology that relies on infrequent and small samples extracted from large fuel flows assumes that the incoming material is relatively homogenous in chemical composition. When considering biomass fuel supplies, this is a valid assumption if the fuel is being sourced from a reliable broker/supplier with quality control measures and a contractual obligation to provide a relatively homogenous product of a particular type or blend. The Applicant should describe the frequency and sample size of the methodology, and the homogeneity of fuel supply, in justifying that Applicant's proposed methodology is reasonable and appropriate. In addition to the chemical fuel analyses, plant operators should keep fuel supply contracts and other documentation on hand to demonstrate that fuels being converted at the facility are consistent with the RES program eligibility requirements.

2.1.4 On-site Batch Sampling/Operations Protocol

Coupled with the more rigorous chemical property testing (outlined above) to determine each fuel's dry heating value, regular grab samples analyzed for moisture content provide a practical method for estimating the heating values of the biomass fuels on an as-fired basis. Moisture analysis (a key component of measuring heat input) can be accomplished with relatively low-cost, bench-scale equipment which is often part of the fuel laboratories located at larger power plants. Heating values for as-fired fuels can be calculated from the ultimate or proximate analysis as follows:

Equation 1

$HHV_{AS\text{-}FIRED} = HHV_{DRY} * (1\text{-}MCW_{AS\text{-}FIRED})$; *where*

HHV = Higher Heating Value

MCW = Moisture Content Wet Basis

Grab samples from the as-fired biomass fuel stream should ideally be taken on an hourly basis.[2] However, less frequent sampling may be possible depending on the delivery method of the fuels, storage/pile management, and diversity of supply. Introduction of "like-fuels" into the system in large batches may make less frequent sampling acceptable. However, projects employing less frequent sampling may be required to demonstrate handling protocols that ensure like-fuel aggregation and sufficient records to audit their handling methodology upon request. Applicants should include in their fuel source plan a description of their on-site batch sampling and operations protocols.

2.1.5 Calculation of Total Plant Heat Input

Another key variable in calculating the co-firing percentage is the plant's total heat input while co-firing. This Guide contemplates two methods of determining the plant's total heat input, both of which are consistent with industry practices. However, each method's

[2] Note that the grab samples do not have to be analyzed on a real-time basis, just collected, and tagged with the time and date. It is recommended that actual moisture analyses are calculate within 24 hours of collection and certainly before any material degradation. The results of the analysis will be used in downstream calculations accordingly.

applicability is determined by the availability of a continuous emissions monitoring system (CEMS).

a) Facilities with CEMS or CO2 Emissions Monitors

Most large power plants are required, as a condition of their operating permits, to install and maintain CEMS. The data from these systems are used to report key power plant emissions such as SO_2 and NO_X to regulatory agencies such as the EPA or state air quality organizations. However, these systems are also used to track the total heat input of fuel into the plant. This is useful in measuring the plant's overall efficiency (Plant Heat Rate) and allowing for emissions output to be converted into a rate (lb-pollutant/MMBtu.) Although these heat input calculations rely on fuel chemical characteristics, they depend on measurements of the plant's CO_2 emissions (not fuel flow rates) to determine how much fuel is being consumed. Since these systems are tied to plant environmental performance monitoring, they are also required to be regularly calibrated.

It is also possible that plants not otherwise required to maintain CEMS, could install a stack CO_2 emissions monitoring system. Provided that the system and its installation meet the requirements specified for CEMS, the information collected from this type of instrumentation could be used synonymously for the CEMS CO_2 data discussed below.

In addition to being used in single-fuel plants, the underlying EPA methodology also offers guidance on multi-fuel systems. While other methodologies may offer some advantages in calculation simplicity, they do not tie all of the regulatory and plant operational data elements together, and offer less precision in measuring renewable generation.

Mechanics for calculating total plant heat input using plant stack CO_2 emissions rely substantially on a key variable known as a fuel factor or F-Factor for short. There are different values for the F-Factor, but it is primarily dependent on a fuel's carbon content and the way in which CO_2 emissions are being measured at the plant. Assuming the plant CEMS provides CO_2 stack flow data in standard cubic feet (scf) per hour, the F-factor is determined by either: (1) multiplying the percent carbon in the fuel by 321,000 and dividing by the gross calorific value of the fuel or (2) using the tabulated values set by EPA for the fuel types. To calculate the total heat input of fuel into the boiler over a given time period, the total measured CO_2 flow in the stack is divided by the F-Factor (F_c) with units of scf-CO_2 per MMBtu of fuel input.

Equation 2

Total Heat Input (MMBtu/hr) = *Total Measured CO_2 flow (scf/h)/ F_c (scf/MMBtu)*

Note that the time frame used in Equation 2 is based on hourly flow rates. Longer periods are acceptable provided that the guidelines for calculating the composite F-Factor for multi-fuel firing are consistent with the selected time frame. Projects calculating heat input on an hourly rate are preferred, but daily rates will be acceptable if all other data tracking required to support the calculation on this basis are accurate on a daily basis[3].

Tabulated F_c values for bituminous coal and wood are 1,810 and 1,840 scf per MMBtu, respectively.[4,5] Therefore, a co-firing application with 90% bituminous coal and 10% wood has a composite F_c value of 1,813 scf per MMBtu (see Equation 4 below). The proposed

[3] The results of heat input calculations will be aggregated and used in monthly reporting.

[4] Procedures for Preparing Emission Factor Documents, Environmental Protection Agency, Table I. F Factors for Various Fuels, November, 1997.

[5] The f-factor varies depending on chemical composition and is very different for some types of materials

method of calculating total heat input during co-firing uses a composite value for F_c based on daily coal and biomass usage. The composite F_c will then be used to determine the total heat input using stack CO_2 flow data. If an hourly co-firing rate (heat basis) is desired, then it can be calculated using hourly biomass heat input data (collected from fuel sampling and mass flow rate data) divided by the total boiler heat input as calculated from the composite F_c-based calculation. Equations for the process are illustrated below.

Equation 3

Coal % Heat In = (Coal HHV * Coal Flow (lb/day)) / (Coal HHV * Coal Flow (lb/day) + Biomass HHV * Biomass Flow (lb/day))

Where; HHV = Higher Heating Value (Btu/lb)

Equation 4

$F_{c,}$ Composite = Coal % Heat In * $F_{c,\ coal}$ + Biomass % Heat In * $F_{c,\ biomass}$

After determining these values, the total boiler heat input can be calculated using Equation 2.

b) Facilities without CEMS or CO2 Emission Monitors

The primary issue of universal application of the method described above is that plant CEMS are not required on older (installed prior to EPA's Acid Rain program) fossil fuel-fired boilers under 25 MW. As it would represent an unreasonable burden to impose the installation of such equipment (these systems can be expensive to install and maintain), an alternate heat input apportionment method is offered for facilities not otherwise required to have a CEMS. Although not as precise or rigorous[6], the use of fuel receipts and regular chemical composition data offers a verifiable and analytical measurement technique for determining the total boiler heat input.

Plants not equipped with CEMS or CO_2 emissions monitoring equipment should demonstrate an alternate method of measuring total heat input that accurately accounts for the combined fuel heat contribution of the biomass and fossil fuels. One option is to combine the biomass mass flow and heating value data with similar information collected for the fossil fuels used. In other words, regular fuel sampling of the fossil fuel portion combined with mass flow measurements across discrete time frames will provide a consistent and practical means of measuring total heat input.

For example, calculation of the total heat input to a boiler over an 8-hour period would be based on feeder weight totalizer readings, sample HHV data for the coal plus the same data for the biomass heat input. However, it will be incumbent on plant operators to demonstrate that their fossil fuel sampling and mass flow measurement protocols are accurate enough to provide a high degree of certainty that the total heat input to the boiler is being calculated. Projects without CEMS employing this methodology are strongly encourage to use steam condition and production information coupled with recent boiler efficiency data[7] to cross check results and ensure that total heat input calculations are reliable.

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[6] Biomass cofiring, particularly at high heat input levels, does have a small but measurable impact on boiler efficiency which is not captured if calculations rely on existing boiler efficiency data.

[7] There are several methods of measuring boiler efficiency data. However, this reference does not imply calculated values based on estimates of heat loss taken from original boiler commissioning data. If the heat loss method is

Equation 5

Total Heat Input = Coal HHV * Coal (lb/ (8-hours)) + Biomass HHV * Biomass (lb/ (8-hours))

Sample Solid Fuel Cofiring-CEMS Calculation

Boiler 1, with a current net output of 435 MW, consumes 200 tons/hr of bituminous coal and is interested in co-firing 10 tons/hr of clean wood waste. The coal and wood waste have HHV of 12,500 Btu/lb and 6,500 Btu/lb, respectively. The CO_2 stack gas flow at full load is 9,050,000 scf per hour during both co-firing and coal only operation. The calculations below show the potential renewable power generated over an 8 hour period.

%Coal Heat Input = (12,500 Btu/lb*400,000 lb/hr / (12,500 Btu/lb * 400,000 lb/hr + 6500 Btu/lb * 20,000 lb/hr)
= 0.975 or 97.5% (Daily Average)

$F_{c,}$ Composite = 0.975 * 1810 + 0.025 * 1840
= 1811 scf CO_2 / MMBtu

Total Heat Input (MMBtu/hr) = 9,050,000 / 1811
= 4,997 MMBtu/hr

Co-fire % biomass = (6500 Btu/lb * 20,000 lb/hr) / (10^6 Btu/MMBtu * 4,997 MMBtu/hr)
= 2.6%

Renewable Generation = 2.6% * 435 MW * 8 hrs
= 90.4 MWh

2.2 BIOMASS FUELS SUPPLY QUALITY ASSURANCE

[the fuel source plan shall specify:] A description of what measures the applicant will take to ensure that only Eligible Biomass Fuels are used, examples of which may include: standard operating protocols or procedures that will be implemented at the Generation Unit, contracts with fuel suppliers, testing or sampling regimes; (RES Regulations – Section 6.9 (i) (d))

Record keeping and reporting requirements are substantially impacted by the types of fuels that are fired at the certified facility. The RI RES requires that certified generation facilities ONLY fire ELIGIBLE fuels. These projects may be required to track the use of eligible fuels and track qualified energy production.

2.2.1 Generation solely from RPS eligible biomass resources

For standalone boiler/generator combinations where only eligible fuels are being used to generate power, monthly records of fuel deliveries should verify the quantities and

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employed, operators should provide recent supporting data provided by third-party measurements of boiler performance.

composition of the fuel. Since all of the facility's electric generation is derived from eligible fuels, the entire net output of the plant is qualified under the RPS. No apportionment of qualified/unqualified production is required. If biomass fuels are co-fired with fossil fuels, see provisions for co-firing.

Key data and record keeping provisions include:

- For each supplier and source combination, an ultimate fuel composition analysis should be on file. This test should be performed at least semi-annually.
- It is suggested that each fuel delivery is recorded to include the supplier name and address, the fuel source, description of the composition and physical characteristics and a statement of visual inspection to determine the integrity of the fuel.
- A record of the amount of fuel (mass basis) for each fuel delivery.
- Random sampling of deliveries may also be a part of the quality control regime, at least weekly for each supplier. Three fuel samples taken from the core of each third of the shipment is recommended. These samples can be mixed and used to generate a single mixed sample for testing. Weekly random samples may be stored in air tight containers and marked to match the delivery record. It should be clear to suppliers that the facility will be selecting representative samples each month for testing and that the PUC may request a third party to select and test samples from the monthly sample pool at any time during the contract.

Weekly Random Samples should be held for a month. Samples that upon testing show a significant positive deviation from the filed composition analysis for metals or halide concentrations or any toxic elements may be grounds for evaluation of non-compliance with the RES eligibility rules.

Test Methods for Biomass Power Generation

The following test method is the widely accepted standard for fuel composition analysis. The use of alternatives may be approved, but approval should be sought in advance of using alternative methods in any report.

Measurement	Test Method	Frequency
Fuel Composition	ASTM Standard E870-82(1998)e1 Standard Test Methods for ANALYSIS of Wood Fuels	Once for each combination of Supplier and Source on a semiannual basis and weekly random sampling for quality control

2.3 BIOMASS FUEL ELIGIBILITY - SUBSTANTIATING THE USE OF CLEAN BIOMASS

Generation Units using wood sources other than those listed above may make application, as part of the required fuel source plan described in Section 6.9, for the Commission to approve a particular wood source as "clean wood." The burden will be on the applicant to demonstrate that the wood source is at least as clean as those listed in the legislation. Wood sources containing resins, glues, laminates, paints, preservatives, or other treatments that would combust or off-gas, or mixed with any other material that would burn, melt, or create other residue aside from wood ash, will not be approved as clean wood. (RES Regulations – Section 3.7)

Commission approval for use of biomass fuels other than those designated as eligible in the RES rules is required. One method for substantiating the eligibility of an unlisted source is a comparative composition analysis. The proposed biomass fuel may be compared to a recognized clean biomass standard. If the biomass source can be shown to not include any of the elements explicitly included in the regulations (e.g. containing resins, glues, laminates, paints, preservatives, or other treatments that would combust or off-gas, or mixed with any other material that would burn, melt, or create other residue aside from wood ash), then if the chemical composition is equivalent in terms of impurities then it may be certified as a clean biomass fuel. In this Guide we use the term "comparative composition analysis" to describe this process.

2.3.1 Comparative Composition Analysis

This is the most direct and widely applicable test for biomass eligibility. The facility may submit ultimate and proximate fuel analyses, plus a compound- and element-specific analysis of the proposed "clean wood" fuel. The standard for a clean wood fuel could be any one of the wood species commonly found in the Northeast. The comparison of the ultimate analysis plus elemental analysis for the proposed biomass fuel to the ultimate analysis and elemental analysis for the standard fuel would be the basis for a comparative analysis. Samples of the proposed biomass fuel, if containing any compound or element of concern exceeding the composition of the standard fuel for any compound or element of concern, would not be certified. The chemical species of most concern are the metals or halides and compounds containing them that have toxic properties by themselves or are common in toxic compound emissions from combustion for biomass. If the proposed biomass meets the criteria of comparable chemical composition then it may be certified for biomass facilities of all types.

2.4 INCREMENTAL BIOMASS POWER PROJECTS

For an Existing Renewable Energy Resource other than an Intermittent Resource, the incremental output in any Compliance Year over the Historical Generation Baseline, provided that such Existing Renewable Energy Resource using Eligible Renewable Energy Resources was certified by the Commission pursuant to Section 6 to have demonstrably completed capital investments after December 31, 1997 attributable to the efficiency improvements or additions of capacity that are sufficient to, were intended to, and can be demonstrated to increase annual electricity output in excess of ten percent (10%). The determination of incremental production for purposes of this paragraph shall not be based on any operational changes at such facility not directly associated with the efficiency improvements or additions of capacity; (RES Regulations – Section 3.23(v))

Historical Generation Baseline: means, for all Eligible Renewable Energy Resources including Intermittent Resources, the average annual electrical production from the Eligible Renewable Energy Resources, stated in megawatt-hours (MWh), for the three calendar years 1995 through 1997, or for the first 36 months after the Commercial Operation Date if that date is after December 31, 1994 (the "Baseline Period"); provided however, that the Historical Generation Baseline shall be measured regardless of whether or not the average annual electrical production during the Baseline Period meets the eligibility requirements of Section 5 of these regulations. (RES Regulations – Section 3.14)

At the time of application for certification, Generation Units proposing to use an Eligible Biomass Fuel are required to submit a fuel source plan, which shall specify:… (e) That the fuels stored at or brought to the Generation Unit will only be either Eligible Biomass Fuels or fossil fuels used for co-firing. Biomass Fuels not deemed eligible will not be allowed at the premises of certified Generation Units; (RES Regulations – Section 6.9 (i) (e))

Developers may consider options that will increase biomass power output at existing power plants. In some cases, these expansions may be as a result of retrofitting with new, more efficient technologies that will be accompanied by incremental gains in output (repowering). In others, the expansion may simply be a function of adding new processing equipment to increase biomass conversion rates. An example of the latter would be adding more equipment to increase a plant's biomass co-firing capacity.

Facilities seeking to increase biomass power generation by making upgrades or more fully utilizing existing biomass power generation capacity may use the following guideline in calculating the "new renewable generation component" of the output. The developer must also demonstrate that the incremental component represents a ten percent or greater increase in eligible biomass generation.

2.4.1 Method for Calculating Increased Generation

The increase in biomass power generation can be calculated on an energy basis with the baseline generation calculated using prior year energy production. For purposes of determining a baseline, production from both RI RES eligible and ineligible biomass fuels are included in the baseline calculation. In addition, a requirement that no ineligible fuels be consumed at the power plant once operating under the RI RES rules will apply to the total generation of the facility not just the incremental portion. Details for calculating the baseline generation, averaging period, and incremental generation are provided below. The basic equation is the following:

RI RES Program New Generation = Total Renewable Generation – Baseline Renewable Generation

The following definitions and conditions apply:

Averaging Period **–** the three calendar years 1995 through 1997, or for the first 36 months after the Commercial Operation Date if that date is after December 31, 1994 (the "Baseline Period")

Baseline Biomass Generation **–** the average annual electrical production from the Biomass Fuels, stated in megawatt-hours (MWh), during the averaging period; provided however, that the Baseline Generation shall be measured regardless of whether or not the average annual electrical production during the Baseline Period meets the eligibility requirements of Section 5 of the RI RES regulations.

Baseline Biomass Fuel Use **–** The amount (in tons) of biomass fuels used to generate power during the averaging period.

2.4.2 Baseline Analysis Report

RI RES program New generation (the incremental renewable generation above the baseline) will be calculated by subtracting the Baseline Biomass Generation from the plant's renewable generation output while participating in the RI RES program. A baseline will need to be calculated for all biomass facilities co-firing with ineligible fuels that are seeking RES eligibility for the incremental renewable generation amount.

Projects historically using ineligible fuels are required to switch to use of eligible biomass fuels only. Projects will be required to maintain and provide records sufficient to demonstrate that the facility is in compliance with this requirement, including an annual tally of the type and amounts of biomass fuels used supported by fuel delivery reports of the type recommended for quality assurance under Section 2.2 above.

3. HYDROPOWER PROJECTS

3.1 INCREMENTAL HYDROPOWER PRODUCTION

For an Existing Renewable Energy Resource that is an Intermittent Resource, provided that such Existing Renewable Energy Resource using Eligible Renewable Energy Resources was certified by the Commission pursuant to Section 6 to have demonstrably completed capital investments after December 31, 1997 attributable to the efficiency improvements or additions of capacity that are sufficient to, were intended to, and have demonstrated on a normalized basis to increase annual electricity output in excess of ten percent (10%), the incremental production in any Compliance Year shall be determined as a percentage of production in each month. Such percentage shall be equal to ***the percentage of average annual production at the Generation Unit following the improvements or additions of capacity that are attributable to the efficiency improvements or additions of capacity placed in service after December 31, 1997 as determined by the Commission using the information consistent with that used to determine the Historical Generation Baseline for such facility****. Such percentage shall be certified by the Commission. The determination of incremental production for purposes of this paragraph shall not be based on any operational changes at such facility not directly associated with the efficiency improvements or additions of capacity. In no event shall any production that would have existed during the Historical Generation Baseline period in the absence of the efficiency improvements or additions to capacity be considered incremental production for purposes of this paragraph. (RES Regulations – Section 3.23 (iv))*

Historical Generation Baseline: means, for all Eligible Renewable Energy Resources including Intermittent Resources, the average annual electrical production from the Eligible Renewable Energy Resources, stated in megawatt-hours (MWh), for the three calendar years 1995 through 1997, or for the first 36 months after the Commercial Operation Date if that date is after December 31, 1994 (the "Baseline Period"); provided however, that the Historical Generation Baseline shall be measured regardless of whether or not the average annual electrical production during the Baseline Period meets the eligibility requirements of Section 5 of these regulations. (RES Regulations – Section 3.14)

Two pathways are suggested for Applicants to certify incremental capacity improvements to their facility. In both cases, actual data collected after the upgrades/repowering work is preferred for certifying incremental capacity additions. However, for planned or recently completely upgrade work, interim certification may be offered using predictive performance data developed by a qualified third party engineer.

3.1.1 Certification

The Applicant will prepare a report that documents the specific upgrades/re-powering activities and associated investments that have been made to the referenced facility. Applicants are encouraged to have an independent engineer prepare or review the report and endorse the results. The report should also document:

1. Historical correlation of power production with the corresponding water flows as measured by USGS gauges or best available data sources for the Baseline Period prior to upgrades;
2. The post-upgrade/repowering correlation of production with the corresponding water flows as measured by USGS gauges or best available data sources; and

3. The expected average annual incremental production due specifically to the completed or proposed upgrades/re-powering investments, expressed as a percentage increase between (1) and (2). To be certified the increase must exceed 10%.

The latter measure is expected to be completed using flow distributions in an average year, where an average year means average annual flow conditions as determined as representative by the certifying engineer.

The Commission may at its sole discretion modify the certified incremental percentage based on actual performance on a forward-looking basis.

3.1.2 Interim Certification

Newly implemented or planned projects will not have the benefit of significant, post upgrade/repowering data to use in determining item 2 above. In this case, interim certification may be considered, good for a period of no more than one year, using modeled system performance in lieu of actual data. Note that interim certification is intended only to offer a fast track for new/planned facilities to participate in the RES.

The suggested approach for determining the baseline, the post-upgrade/repowering expected average annual production, and the percentage of such production attributable to the upgrade/repowering would entail the development of a mathematical model (flow correlation curve) to simulate monthly and annual energy production combined with the measurement of actual production and flows for the baseline period. The model would incorporate available stream flow data (USGS gauges or best available data sources), reservoir management requirements (determined by FERC license conditions), and the performance characteristics of the generating equipment (based on the manufacturer's guarantees or field testing) as parameters. The simulation model should be based on water-balance continuity (all inflows match outflows). Simulation results should be calibrated to actual electrical output over the historical periods that contain the most detailed and complete records (at least monthly flow data, with complete information on water utilization). Overall plant efficiency may be adjusted as needed to modify simulated production to match actual production. Once the model is fully calibrated, pre and post-upgrade simulations should be used to determine the percentage of electrical output attributable to the upgrade in an average year, where an average year means average annual flow conditions over a baseline period representative period including the three year Historical Baseline defined in the regulations (1995 through 1997 unless commercial operation started later). The engineer should determine if the defined Historical Baseline Period is representative of average annual water flows over a longer statistically significant period (ideally 20 years) and that power production during that period is also representative of the design output for the plant and not impacted by operational and maintenance changes that reduced output significantly.

In constructing the simulation model, any information on historical water utilization (i.e., minimum flow restrictions, bypass flows, and spillage) should be taken into account and the model should assume the operation of the facility conforms to the guide curves as laid out in the FERC license granted for such facility. Any FERC license constraints that will, in the future, change current reservoir management practices should be accounted for in the post-upgrade simulation. Note that applicants can propose an alternative approach to these calculations so long as the approach can predict the incremental production with comparable accuracy.

Verification of model predictions of annual average production in the post upgrade period will not be required for an advisory ruling or interim period certification, but final certification will require presentation of actual data as described above under "Certification."