UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MEMORANDUM

To: Docket EPA-HQ-OAR-2015-0199

From: U.S. Environmental Protection Agency, Office of Air and Radiation

Date: August 2015

Subject: Gas Shift Emission Rate Credit (GS-ERC) Technical Support Document (TSD)

INTRODUCTION

This memorandum and appended spreadsheet (GS-ERC Calculations.xlsx) provide the calculations that EPA used in determining the calculations for Gas-Shift Emission Rate Credits (GS-ERCs). Building Block 2 (BB2) of the Best System of Emission Reduction (BSER) determination in the Clean Power Plan EGs describes shifting generation from fossils steam units to NGCC units because NGCC units generate electricity at a less carbon intensive rate. BB2 describes NGCC units generating at 75 percent of the unit's annual operating capacity. This level of generation, for most NGCC units, would represent an increase in annual generation from a 2012 baseline and for every hour of electricity generated by an NGCC unit beyond its 2012 baseline (i.e., incremental generation), there is a corresponding emission reduction in the power system.[1] The EPA is proposing to reflect the emission reductions of BB2 by crediting all NGCC generation on a pro rata basis that reflects expected incremental NGCC generation to 75 percent capacity. This means that for every hour that an NGCC unit generates electricity, it will also generate a partial credit associated with the generation shift from fossil steam to NGCC units. All affected NGCC generation will be credited, with ERCs, by a factor that represents the described emission reductions from incremental generation; ERCs credited in this are proposed to be designated as Gas Shift ERCs (GS-ERCs). Most specifically the spreadsheet shows the proposed determination of the least stringent regional Incremental Generation Factor (IGF) and values that all facilities subject to the a rate-based federal plan would use under the proposal. The IGF is one of three factors proposed to be used to calculate GS-ERC generation for a given NGCC unit and is the only factor in the calculation that is not unit specific. The IGF would be determined by

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[1] It is assumed that any increase in NGCC generation above 2012 levels is displacing fossil fuel-fired steam EGU generation.

the EPA as shown in the spreadsheet. The IGF and the other two factors (GS-ERC Emission Factor and NGCC Generation) are used through the following expression to calculate the amount of GS-ERCs that a facility generates:

GS-ERCs = NGCC Generation * Incremental Generation Factor * GS-ERC Emission Factor

The data in this spreadsheet is the same data that was used to determine the subcategorized standards for NGCC units and steam generating units.

The EPA is proposing that the IGF used for each compliance period be based on which region, on average, produces GS-ERCs at the highest rate (i.e., GS-ERCs generated per MWh). To do that the EPA calculated the anticipated average GS-ERC Emission Factor (column X) and multiplied it by the IGF (column Y) which gives the average GS-ERC Generation Rate for the region for the given year as shown in column Z. Note that although an average GS-ERC Emission Factor is used in determining the least stringent IGF, for compliance calculations determining the quantity of GS-ERCs that an individual NGCC earns the GS-ERC Emission Factor is a unit level calculation. The region with the highest average GS-ERC Generation Rate (Column Z) averaged over the compliance period is proposed to be the least stringent region. Each region's average annual GS-ERC generation rate is calculated as shown in cells AD13:AI17. The least stringent average (i.e., maximum) of the GS-ERC Generation Rates for each compliance period is used as the determination to designate which region is "least stringent" and the IGF values to be used. The corresponding region's IGF values for the compliance period are averaged and shown in cells AD20:AI22. These values are the proposed IGF values to be used in calculating GS-ERC generation for a NGCC unit.

GS-ERC FACTORS

As described above, there are three factors that go into determining the generation of GS-ERCs by an NGCC unit. The first factor that determines GS-ERC generation is the IGF. The IGF is an EPA calculated value that varies from compliance period to compliance period, and is based on calculations involving the projections of NGCC generation growth and renewable energy replacement. These calculations are shown in the spreadsheet. This factor distributes the anticpated collective incremental NGCC generation, as described by Building Block 2 of the CPP's BSER determination, over all NGCC generation. The purpose of the IGF is to allow NGCC units to generate GS-ERCs for all MWh of generation. This factor distributes the anticipated incremental NGCC generation and the GS-ERCs associated with it over all NGCC generation.

The IGF is calculated by taking the number of MWh beyond the 2012 baseline needed for the corresponding region to reach the BSER level of NGCC generation capacity and dividing it by the NGCC BSER regional capacity for that compliance period, which produces the factor. Or in other words, it is taking the complement of the regional 2012 NGCC baseline generation (MWh) divided by NGCC BSER regional capacity for the

compliance period (MWh). The NGCC BSER regional capacity is the level of generation that the BSER assumes a region can reach for that year. This NGCC BSER regional capacity also accounts for both the growth of NGCC generation in each compliance period, reaching the 75% capacity factor in 2030, and for the replacement of fossil fuel generation via Building Block 3. The IGF can be summarized by the following expression:

$$\text{Incremental Generation Factor} = 1 - \frac{\text{Regional 2012 NGCC Baseline}}{\text{NGCC BSER Regional Capacity}}$$

The IGF is a factor that the EPA calculates and determines as described above and shown in the spreadsheet. The value of the IGF is transparently provided by the EPA.. The number of GS-ERCs generated is also dependent on the other two factors described below, which are unit specific. The IGF is proposed to be calculated for every compliance period based on the least stringent region's IGF, which is based on increased utilization of RE and its replacement of fossil fuel fired generation (i.e., based on Building Block 3 of the CPP EGs). For the calculation of this factor the EPA is proposing to use the least stringent region for each compliance period and applying it for all GS-ERC calculations subject to the federal plan. The EPA is requesting comment on an alternative approach that IGFs are calculated and applied at a regional level; this may better align with the relative emission reduction value of incremental NGCC generation than a nationalized "least stringent" approach. The EPA also requests comment on whether the "least stringent" region should be based on the least stringent IGF values or the least stringent regional average GS-ERC generation rate (column Z), as proposed.

The result of the IGF for each compliance period is shown in the cell block AD25:AI27. The interim goal IGF (cell AH27) is not being incorporated into the proposed federal plan, but is shown for consistency with the CPP Emission Guidelines.

The second factor is the GS-ERC Emission Factor. The purpose of this factor is to measure the degree that an NGCC unit is emitting at a rate less than the average fossil steam unit. This measure reflects the shift in generation from fossil steam to NGCC units and quantifies the avoided emissions through this shift. For purposes of calculating an IGF, the spreadsheet uses an anticipated average GS-ERC Emission Factor. When the EPA calculates the number of GS-ERCs a NGCC generates, the GS-ERC Emission Factor will be unit-specific, by incorporating its own emission rate, as described below (note that the NGCC Generation term will also be unit specific).

For the IGF calculations, the anticipated average GS-ERC Emission Factor for each region and each year are calculated (column X). These values are used in the proposed calculation and determination of the least stringent region and the IGF value. The anticipated average GS-ERC Emission Factor is calculated by taking the least stringent

fossil steam rate[2] standard among the regions (maximum value for the year in column V) and using it against that specific region's historical average emission rate (column I) to calculate the anticipated average GS-ERC emission factor (column X). The GS-ERC Emission Factor is expressed by taking the complement of the ratio of the NGCC standard to the fossil-steam standard. It can be summarized by the following expression:

$$\text{GS-ERC Emission Factor } = 1 - \frac{\text{NGCC emission rate}}{\text{Steam Standard}}$$

The EPA is using the least stringent steam rate standard because that is the value that has been used in the the goal setting calculations. The EPA is using the average NGCC emission rate of the region in which a given NGCC unit is located to determine the GS-ERC Emission Factor for the IGF determination. This average GS-ERC emission factor is being used solely for the determination of calculating the IGF value described above.

The calculation of a GS-ERC Emission Factor is unit specific. The NGCC unit takes the complement of its emission rate divided by the steam standard (note: this proposed treatment of GS-ERCs is solely intended for use in the subcategorized two-rate system where fossil steam units and NGCC units have different emission standards). An example of this is illustrated below.

The third factor in calculating an NGCC's generaton of GS-ERCs is the NGCC Generation. The NGCC Generation is the total net energy output generation of the affected NGCC unit during the year that GS-ERCs are being calculated. This factor is not incorporated into the spreadsheet and played no role in determining the IGF. The three factors combine to make the following equation:

$$\text{GS-ERCs} = \text{NGCC Generation * Incremental Generation Factor * GS-ERC Emission Factor}$$

The GS-ERC equation above gives the number of GS-ERCs that an NGCC will generate. The IGF and GS-ERC Emission Factor combine to make the GS-ERC generating rate for a given NGCC unit. This functions by the IGF prorating all incremental NGCC generation and the GS-ERC Emission Factor designating the proportion of the incremental NGCC generation that will generate ERCs. The GS-ERC generating rate multiplied by the total NGCC Generation gives the total GS-ERCs generated by the NGCC for the year. The GS-ERC generating rate, as described in relation to the IGF determination, is the proposed method for determining the least stringent region.

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[2] Note that in the attached spreadsheet for this document that the term "fossil steam" is used and is synonymous to the term "steam generating unit" used in the proposed federal plan and model rule preamble.

The calculation of GS-ERCs for an NGCC is independent of the calculation of ERCs generated or owed against the NGCC standard. It is possible that an NGCC will owe ERCs against its assigned emission standard for every MWh generated, but still be generating GS-ERCs. GS-ERCs may only be used to meet steam generation units' compliance obligations.

The EPA is using all values from a region for a particular year (with the exception of fossil steam rate) to calculate the factors that determine the least stringent region. Once all of the factors are calculated and used, the least stringent region is determined. This process identifies the least stringent region for purposes of calculating GS-ERCs. The EPA solicits comment on the determinations made in defining the least stringent region for a given year.

EXAMPLE

As an example that was used in the proposal preamble, an NGCC unit is connected to the grid and generates 1 million MWh of electric output for the first year of the final performance period (i.e., 2030). During this year it emits 850 million pounds of CO_2 giving it an emission rate of 850 lbs CO_2/MWh. The NGCC unit is subject to a Final Period emission rate limit of 771 lbs CO_2/MWh. Since the NGCC unit is always subject to its NGCC rate-based emission standard of 771 lbs/MWh and it is operating at a rate above that standard it will owe non-GS-ERCs for its own compliance. The ERCs owed are calculated by solving for the number of ERC MWh the NGCC unit will need to adjust its rate down to its emission rate limit. This is shown in the following equation:

$$850,000,000 \text{ lbs } CO_2 \, / \, [1,000,000 \text{ MWh} + \text{ERC MWh}] \; = \; 771 \text{ lbs } CO_2/\text{MWh}$$

When that equation is solved for the number of ERC MWh needed, the NGCC unit would need to acquire 102,465 ERCs to adjust its emission rate to its rate-based emission standard.

Additionally, the GS-ERC Emission Factor for this NGCC unit is calculated by using 850 lbs CO_2/MWh for the NGCC emission rate and 1,305 lbs CO_2/MWh for the SGU emission standard in the equation described above.[3]

$$\text{GS-ERC Emission Factor} \; = 1 - \frac{850 \text{ lbs/MWh}}{1,305 \text{ lbs/MWh}}$$

This calculation results in a GS-ERC Emission Factor of 0.35. The IGF is calculated by the EPA and is found in cell AI27 of the attached spreadsheet to be 0.26. By using the GS-

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[3] Note that in the example that was used in the proposal preamble, incorrect values for the NGCC emission rate (771 lbs/MWh was used instead of 850 lbs/MWh) and SGU standard (1,404 lbs/MWh was used instead of 1,305 lbs/MWh) were applied.

ERC Emission Factor and Incremental Generation Factor calculated above with the NGCC unit's generation for the year, the number of GS-ERCs for this NGCC unit can be calculated as follows:

$$0.35 * 0.26 * 1,000,000 = 91,000 \text{ GS-ERCs}$$

The calculation results in 91,000 GS-ERCs being generated. Because an NGCC unit cannot use the GS-ERCs it generates to meet its compliance obligations, this NGCC unit will both generate ERCs (91,000 GS-ERCs) and owe ERCs (102,464 non-GS-ERCs against the NGCC standard). This NGCC unit may sell (or otherwise transfer) or bank its GS-ERCs. If a GS-ERC is sold, those proceeds may, in turn, be used to acquire non-GS-ERCs to satisfy the NGCC unit's compliance obligations.