



Doosan Fuel Cell America, Inc.
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December 1, 2017

Ms. Samantha Meserve
Massachusetts Department of Energy Resources
100 Cambridge Street
Room 1020
Boston, MA 02114

Dear Ms. Meserve:

Doosan Fuel Cell America is a global leader in providing clean, continuous-duty, cost-competitive stationary fuel cell energy systems. Our PureCell[®] systems operate 24/7 with high efficiency and ultra-low emissions, allowing our customers to generate their own electricity and heat on-site while reducing their utility expenses and environmental emissions. With over 12 million fleet operating hours, PureCell[®] phosphoric acid fuel cell (PAFC) systems have demonstrated unparalleled durability and reliability.

Doosan Fuel Cell America was founded in 2014 on the strength of the people and technology developed at United Technologies over the past fifty years. We are building on the value of the organization and aspire to be the technology and market leader in the fuel cell industry. Our headquarters are in South Windsor, CT at the site of our world-class fuel cell R&D and manufacturing facilities where we currently employ 300 people with plans for expansion.

Doosan Corporation is a global company with 42,000 employees and worldwide revenue of more than \$20 billion. Our global businesses span a range of products and services in infrastructure support and power generation, including nuclear power, steam turbines, power plant boilers, water desalination, construction equipment, machine tools and engines for a variety of applications. Doosan's U.S. operations include Bobcat Company construction equipment and total over 3,000 employees and \$3 billion annually.

The State of Massachusetts is an emerging market for our energy systems, and fuel cells have the potential to contribute greatly to State's goals of reducing greenhouse gas emissions, reducing peak load, and improving the reliability of the electric utility system. Doosan fuel cells are currently supplying clean and secure power to a diverse set of customers in a variety of industries across the northeast and California such as hospitals, universities, industrial manufacturers, municipalities and high schools, supermarkets, residential buildings and waste water treatment facilities.



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Stationary fuel cell applications offer these customers a clean and efficient method of producing energy that provide resiliency, reliability and price stability, while reducing stress on the electric grid. A wider deployment for distributed generation (DG) will lead to clean, efficient electric generation and will alleviate the need for additional transmission facilities, when developed where the demand is needed.

Doosan also has significant experience in multi-MW fuel cell projects. Our PureCell[®] Model 400 system is highly scalable and can be used effectively to generate electricity from 460 kW up to 50 MW and more. Our largest operating site is 30 MW installed in Busan, South Korea in 2016. By operating with no combustion, fuel cells have negligible emissions of criteria air-pollutants such as NO_x, SO_x, CO, VOCs, and particulate matter.

Doosan appreciates the fact that the Massachusetts Legislature included fuel cells in the Alternative Portfolio Standard (APS) as an approved technology. We are also thankful to have been involved in the Department of Energy Resources stakeholder meetings over the past year in order to receive input from the fuel cell industry. Doosan also participated through the public hearing process as well as the written comment period. However, there are some issues that we feel still remain to be resolved.

Doosan agrees with the proposed eligibility requirement detailed in 225 C.M.R. 16.05(1)(a)(7)(b), Overall Efficiency. :, stating a "...Fuel Cell Generation Unit shall be more efficient than the current average for emitting locational marginal units as based on the heat rates for these units shown in the most recent ISO-NE Electric Generator Air Emissions Report available in the same year in which a Fuel Cell Generation Unit submits an SQA." Given the data from the 2015 ISO New England Electric Generator Air Emissions Report, the latest available, the efficiency this equates to is roughly 42% HHV or 47% LHV.

Given the different fuel cell technologies currently on the market this requirement can be met by some without any additional offset through the use of waste heat to increase system efficiency. Others may require some use of waste heat to achieve these levels.

The alternate eligibility requirement proposed in 225 C.M.R. 16.05(1)(a)(7)(b) of "...A Fuel Cell Generation Unit that generates both electricity and Useful Thermal Energy must have an overall efficiency of at least 55% ...," drastically increases the required system efficiency by 13% when any waste heat is utilized creating a major competitive advantage to the fuel cell technologies that can meet the "current average for emitting locational marginal units" without any waste heat use. These "electric only" fuel cell installations would be allowed to operate at 13% less efficiency. Alternately combined heat and power fuel cell installations would be limited to only customers' sites with significant thermal demand 24x7x365. While a combined heat and power fuel cell installation that does not meet the 55% efficiency but exceeds the 42% efficiency would not be eligible.



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Doosan would like the eligibility requirements to be consistent regardless of underlying technology and allow for combined heat and power fuel cell installations to qualify for the MA APS if they are "...more efficient than the current average for emitting locational marginal units as based on the heat rates for these units shown in the most recent ISO-NE Electric Generator Air Emissions Report available in the same year in which a Fuel Cell Generation Unit submits an SQA..." Doosan believes the legislative intent of adding fuel cells to be eligible within the APS was to increase the on-site production of clean electricity with negligible criteria air pollutant emissions in a fair and equitable manner.

It is our understanding that the 55% efficiency metric is an attempt to make the GHG emissions from a CHP Fuel Cell fall below the GHG from emitting locational marginal units as based on the heat rates for these units shown in the most recent ISO-NE Electric Generator Air Emissions Report per the following equation:

Net Fuel Savings = Net Fuel Cell Electricity /0.42 + Net MWH Useful Thermal Energy /0.8 - Fuel Cell Fuel Consumed

Given this calculation a CHP Fuel Cell installation at 55% total HHV efficiency and an electrical efficiency of 39% HHV would provide an 11% net source fuel savings and emit significantly less GHG than the GHG from emitting locational marginal units as based on the heat rates for these units shown in the most recent ISO-NE Electric Generator Air Emissions Report.

Specifically on the APS Guidelines, Doosan believes that because the efficiency metric is meant to limit GHG relative to grid generation resources the transmission line losses should be accounted for when calculating the Net Electricity Generated in section 3.C of the Guideline On Metering The Energy Output And Calculating The Alternative Energy Credits Generated By An Eligible Fuel Cell Generation Unit per the following example equation:

Net Elec= (Eg-Ep-Es) x (1+ transmission line loss percentage)

This will equate the electricity generated and consumed on-site to the electricity generated at the emitting locational marginal units where the efficiency metric is being measured.

Additionally, when calculating whether the system meets the Minimum Efficiency Standard per section 3.D the allowed measurement uncertainty of 0.5% of electricity per section 3.I, 6% of thermal use per section 3.G, and 4% of fuel consumption per section 3.H should be accounted for by allowing systems that fall within this band of uncertainty to qualify.

Doosan appreciates the opportunity to weigh in on these important guidelines and are available to discuss this with you at any time. We are also happy to provide any additional information as



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needed. Our company looks forward to working with all clean energy stakeholders committed to providing the Commonwealth of Massachusetts cleaner, cheaper and more reliable energy.

Respectfully submitted:

/s/ David Giordano

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