STATE OF VERMONT
PUBLIC UTILITY COMMISSION

Petition of Chelsea Solar LLC, pursuant to 30 V.S.A. § 248, for a certificate of public good authorizing the installation and operation of the "*Chelsea Solar Project*," a 2.0 MW solar electric generation facility located off Willow Road in Bennington, Vermont	)	Docket No. 17-5024-PET

PREFILED DIRECT TESTIMONY OF RYAN HAAC ON BEHALF OF PETITIONER

November 27, 2017

EXHIBITS

Exhibit CS-RH-1	Resume of T. Ryan Haac
Exhibit CS-RH-2	Project Noise Analysis
Exhibit CS-RH-3	Highway Noise Analysis

Q1. Please state your name, occupation, and business address.

A1. My name is T. Ryan Haac. I am an Analyst at Resource System Group ("RSG"). My business address is 55 Railroad Row, White River Junction, Vermont 05001.

Q2. Please describe your educational background and work experience.

A2. I completed a B.S. in Mechanical Engineering at Virginia Tech in 2008 and was awarded an M.S. from the same institution in 2010, specializing in Acoustics. Out of college, I worked as an analyst and Project Engineer for AVEC, Inc in Blacksburg, VA, designing specialized acoustic sensors, performing experiments, and processing acoustical data. During this time, I also trained and worked as a solar energy installation contractor for Baseline Solar Solutions in Blacksburg, VA, becoming a NABCEP Certified Solar PV Installation Professional. I remained employed by both firms until moving to Vermont in 2015 to work for RSG. At RSG, I have been involved in a wide variety of projects for public and private clients, ranging from studies of the acoustic properties in a room to assessments of community noise through physical sound level monitoring and sound propagation modeling. A copy of my resume is included as ***Exhibit CS-RH-1***.

Q3. Have you previously testified before the Public Utility Commission or in other judicial or administrative proceedings?

A3. I have no prior experience testifying in the Vermont regulatory system but have contributed work to a number of projects that have been before the PUC.

Q4. What is the purpose of your testimony?

A4. My testimony introduces an assessment of potential sound levels generated by the proposed Chelsea Solar Project (the "Project"), and it summarizes the conclusions of that assessment. My testimony also applies the conclusions of the assessment to the sound/aesthetics component of 30 V.S.A. § 248(b)(5).

Q5. What work have you performed with respect to the Project?

A5. I reviewed available documentation regarding features and conditions of the Project site as well as the proposed design details for the Project. I visited the Project site twice in the Spring of 2017 to evaluate site conditions and deploy sound monitoring equipment to gather background sound level data. I used widely accepted sound propagation modeling techniques to analyze the potential noise emissions from the operation of Project equipment. I prepared a report that details the results of my analysis; that report is included as ***Exhibit CS-RH-2***.

Q6. Please summarize the results of the Project noise analysis.

A6. The noise producing equipment associated with the Project includes a pair of 1-MW central inverters and a 2000 kVA transformer. Maximum sound levels from the Project would occur during periods of maximum power generation. Sound levels reported by manufacturers correspond to full-load conditions and thus, these conditions are modeled in this analysis. The project transformer will produce noise when energized and connected to the grid; the inverters only produce noise during the day when the PV array is producing power, resulting in diurnal operating conditions. The highest daytime sound emissions modeled at a residence (133 Russet Road) was

28 dBA during maximum production. Likewise, the highest sound level predicted at a residential property line during periods of maximum power production was 32 dBA. The corresponding modeled nighttime sound levels were 10 dBA at the residence at 14 dBA at the property line. The analysis did not consider any potential attenuation provided by the solar arrays.

Q7. Will the Project result in an undue adverse effect on noise? (30 V.S.A. § 248(b)(5))

A7. No. Sound levels outside of the project parcel were modeled to be at least 10 dB below any applicable standard. Thus, the project as designed will not create an undue adverse impact on aesthetics with regard to noise.

Q8. The analysis you performed assumed central inverters would be used for the Project. How would the sound levels compare using string inverters?

A8. Using the specifications of a string inverter model suggested by the Petitioner (Huawei SUN2000-40KTL), which uses natural convection for cooling and therefore does not have cooling fans, I tested a simple "worst-case" string inverter scenario with fifty inverters. Terrain and foliage were not included in the simple model scenario. For this modeling exercise, all fifty inverters were placed at a single point (i.e., nearest panel edge to a property line) and a receiver was placed at a point representing the closest property line location, which was 40 meters in this case. The overall sound levels of the string inverters at the aforementioned receiver were about 17 dBA under typical operation and 24 dBA for maximum output. The sound levels at the corresponding receiver for the central inverter scenario studied in my corresponding report (***Exhibit CS-RH-2***) were just under 32 dBA at maximum output, so the specified string inverter, or a similar fan-less unit, would

be quieter. My report (***Exhibit CS-RH-2***) provides an in-depth evaluation of the central inverter scenario, which is the louder of the two scenarios (central inverter vs. string inverters), and it concludes that the central inverter scenario does not result in an unduly adverse effect regarding Project-generated noise. A string inverter scenario would be even quieter, so the string inverter scenario obviously also does not result in an unduly adverse effect regarding Project-generated noise.

Q9. Have you analyzed any other scenarios involving noise and sound near the Project site?

A9. Yes. I prepared an analysis of how sound generated by vehicles traveling through Route 7 interchange (to the south and west of the Project site) currently propagates across the Project site before reaching residential homes located to the north and east of the Project site. The analysis also describes how the vehicle noise would travel across the Project site after the Project is constructed. Note that the study did not consider any potential attenuation provided by the solar arrays, which could provide considerable attenuation to noise propagating perpendicular to the rows and near the ground. However, with no data to represent the effect the panels have on propagating sound, we assumed only mixed-soft ground and no obstructions in place of the array. A report that details the results of my analysis is included as ***Exhibit CS-RH-3***. The results show that the increase in sound levels generated by vehicles traveling through the Route 7 interchange would be less than 3 dB at all residences in the area. A 3 dB change in broadband sound levels is

just perceptible by most people and a 3 dB increase in sound levels is not considered substantial by the VTrans Noise Analysis and Abatement Policy.[1]

Q10. Does that conclude your testimony?

A10. Yes.

[1] VTrans, Noise Analysis and Abatement Policy, July 13, 2011.