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IN THE UNITED STATES DISTRICT COURT FOR THE
DISTRICT OF UTAH, CENTRAL DIVISION

UNITED STATES OF AMERICA,

Plaintiff,

vs.

RAPOWER-3, LLC, INTERNATIONAL
AUTOMATED SYSTEMS, INC., LTB1,
LLC, R. GREGORY SHEPARD, and
NELDON JOHNSON,

Defendants.

Civil No. 2:15-cv-00828 DN

**DECLARATION OF
DR. THOMAS MANCINI**

Chief Judge David Nuffer
Magistrate Judge Evelyn J. Furse

I, Dr. Thomas Mancini, declare as follows:

1. I am over the age of 18 and competent to testify about the facts set forth in this
declaration

2. I am a consultant in the field of applied solar energy, specifically in the area of solar thermal power generation. For more than 35 years at Sandia National Laboratories and most recently as a private consultant, my technical efforts have focused on helping the solar industry develop cost-competitive, commercial solar thermal systems.

3. The United States retained me to provide opinion testimony on various topics involving concentrated solar energy. My opinions are identified in my report¹ and I elaborated on them when I testified at trial.²

4. I make this declaration in support of the United States' opposition to the defendants' Motion to Amend/Correct the Court's ruling.³

5. I have reviewed the defendants' Motion to Amend/Correct the Court's ruling, and the documents filed in support: (1) "Confirmation of Electrical Power Production;"⁴ (2) "Sterling Engine Power Production Data;"⁵ and (3) "Exhibit Resume of John Kraczek."⁶

6. I also reviewed the defendants' website at rapower3.com, including the page at "https://www.rapower3.com/copy-of-turbine," which includes limited information on their "Stirling Engine." A copy of this webpage is attached to this declaration as Pl. Ex. 923.⁷

¹ [ECF Doc. No. 253-1](#).

² ECF Doc. No. 372; Trial Tr. 39:5-218:21.

³ [ECF Doc. No. 451](#).

⁴ [ECF Doc. No. 451-1](#).

⁵ [ECF Doc. No. 451-2](#).

⁶ [ECF Doc. No. 451-3](#).

⁷ Pl. Ex. 923, attached, printout from RaPower-3 website, <https://www.rapower3.com/copy-of-turbine> (last accessed 9/24/2018).

Plaintiff's Exhibit 923 contains new information that was not on their website when I testified on April 2, 2018 or before that date.

7. According to the defendants, "the Johnson Fresnel lenses at issue in this case have been successfully used to generate independently measurable electricity" using a "Colorado" Sterling Engine built by Infinia.⁸

8. I am familiar with dish/Stirling⁹ engines and I discussed them in my report.¹⁰

9. In January and April of 2017, I visited the defendants' manufacturing and testing sites in Delta, Utah. Those visits were in connection with this case and for a related matter for which the IRS retained me. I extensively reviewed all documents the defendants produced to the United States in this case.

10. This is the first time I have seen any information suggesting that the defendants were using dish/Stirling engines in conjunction with their solar lenses to generate electricity. All previous information stated that they intended to use the Rankine cycle with their in-house-developed bladeless steam turbine to generate electricity, a fundamentally different process requiring different equipment than the dish/Stirling engine.¹¹

11. Based on the information provided by the defendants, they claim to have produced approximately 500 watts during two operational periods totaling 1 1/3 hour using a

⁸ [ECF Doc. No. 451](#), p. 2.

⁹ Defendants use the term "Sterling" throughout their motion and supporting materials. Since they reference a system that was built by Infinia, a company I was familiar with before their 2013 bankruptcy, and their website contains new information about "Stirling engines," Pl. Ex. 923, it appears that they are referring to the same dish/Stirling system that I described in my report. The correct spelling is "Stirling."

¹⁰ See Expert Report of Thomas R. Mancini, [ECF Doc. No. 253-1](#), p. 8.

¹¹ Expert Report of Thomas R. Mancini, [ECF Doc. No. 253-1](#), [ECF Doc. No. 253-1](#), p. 6, ¶ 25; Trial Tr. 58:12-59:4.

dish/Stirling engine generator on their solar dish. In order to fully evaluate the technical and commercial viability of this new solar energy system using the Stirling engine generator, I would need to perform a detailed analysis similar to the one I conducted for my July 2017 expert report¹².

12. Even absent a detailed analysis of the lens/dish Stirling system now proposed, my review of the defendants' submissions to the Court shows that the technical issues associated with the solar lenses, i.e., their alignment and tracking issues which I identified in my July 2017 report, have not been addressed.¹³ Plaintiff's Exhibit 923 shows that the defendants intend to suspend four dish Stirling engine generators beneath the four circular concentrators on each solar tower.¹⁴ The problem with this design is that there are major alignment and tracking issues to be overcome in order to keep all four dish/Stirling engine generators aligned with their respective solar concentrator on a single tower while tracking and the sun's position in the sky. Furthermore, even if the apparatus did track the sun, any amount of wind would cause the dish/Stirling engine generators to move out of the focused solar energy beams, thereby losing the sun's energy. This issue was a problem that I identified in my 2017 report for the receiver of the Rankine Cycle system and it is an even larger problem for any system using four Stirling engine generators on a single tracking structure.

¹² [ECF Doc. No. 253-1](#).

¹³ This has always been a problem with the defendants' solar lens assembly, which I discussed in my trial testimony. Trial Tr. 90:11-92:18; 126:23- 127:7; 144:15-22. There is no suggestion that the defendants have addressed this problem in their most recent iteration of the technology.

¹⁴ See Pl. Ex. 923, attached, printout from RaPower-3 website, <https://www.rapower3.com/copy-of-turbine> (last accessed 9/24/2018).

13. I am familiar with Infinia, the company that manufactured the dish/Stirling engine generators used by the defendants. For many years Infinia tried to make a dish/Stirling system comprising a single dish and a single Stirling engine generator to compete with conventional fossil fuels. The system they developed was simply too expensive and could not compete with fossil fuels. Infinia went bankrupt in 2013.

14. Even if the defendants could keep the four Stirling engine generators aligned with the four, focused solar energy beams, the new dish/Stirling System is not a viable system for producing electricity on a commercial scale. In the experiment reported by the defendants, only one of the four Stirling generator systems was operated, producing only 500 Watts of electrical power or 4 X 500 Watts if all four engine generators were in operation. They appear to have operated only one dish/Stirling engine generator solely to demonstrate so-called “measurable electricity.”¹⁵ Simply generating “measurable electricity” does not mean that a project will be commercially viable. This is a very small amount of electricity.

15. In fact, based on the reported analysis of Mr. Kraczek¹⁶, the Infinia Stirling engine generator is not matched to the optical characteristics of the RaPower3 concentrator. He states in his conclusion that “[s]electing a Sterling Engine sized for this application and tuning the engine - generator will likely improve performance.”¹⁷ In his analysis, Mr. Kraczek derated the solar lens performance by 50% and the Stirling engine generator performance from 28% to 6%.¹⁸ This

¹⁵ [ECF Doc. No. 451](#), p. 2.

¹⁶ [ECF Doc. No. 451-1](#).

¹⁷ [ECF Doc. No. 451-1](#), p. 12.

¹⁸ [ECF Doc. No. 451-1](#), p. 11.

indicates that the lens concentrator alignment and image size are far too large for the receiver, as I discussed in my earlier report. In fact, the actual predicted and measured performance of the dish/Stirling system using RaPower3 lenses are less than 2%. I made this calculation by dividing the predicted power generation (line 4.2 from page 11 of Mr. Kraczek's report, 537 Watts) by the solar energy incident on a circular lens which is calculated by multiplying of area of a lens (line 1.5 of Mr. Kraczek's report, 26.6 m²) by a standard solar input of 1000 Watts per m². I repeated the calculation for the reported power production of 500 Watts as well. These predicted and reported solar-to-electric conversion efficiencies are an order of magnitude less than a typical dish/Stirling system which are on the order of 25 to 30%.

16. As with the original Rankine Cycle system, the defendants have not provided any cost information for the Stirling engine generator system. However, based on my experience with dish Stirling systems and due to the lower solar-to-electric conversion efficiency of their system, I know that the unit cost of energy will be extremely high.¹⁹ This cost is even higher than Infinia experienced due to the fact that the RaPower3 dish Stirling system requires 4 engine generators per dish, assuming that they could even connect to the utility grid.

17. Based on my years of experience in the solar energy industry, knowledge of concentrated solar power and dish/Stirling systems, my opinions on the defendants' solar lens system utilizing a Stirling engine generator has not changed from the testimony I offered at trial

¹⁹ As I testified, there is no indication that the defendants can connect to the grid. Trial Tr. 108:12-111:15.

for the Rankine Cycle system.²⁰ The defendants' solar lens technology will never produce usable energy from the sun as a commercialized system that sells electrical power.

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 28, 2018, in Albuquerque, New Mexico.

A handwritten signature in black ink, appearing to read "Thomas Mancini", written in a cursive style.

DR. THOMAS MANCINI

²⁰ Trial Tr. 49:24-50:8.