Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Energous Corporation	)	File No.: 1744-EX-ST-2017
	)	
Application for Special Temporary Authorization	)	

OPPOSITION TO APPLICATION FOR SPECIAL TEMPORARY AUTHORIZATION

EXECUTIVE SUMMARY

Pursuant to 47 CFR 5.95, I oppose and object to the application for Special Temporary Authorization ("STA") File No. 1744-EX-ST-2017 ("Application") submitted by Energous Corporation ("Applicant"). The proposed operation, as detailed in the Application, is a safety hazard. It also interferes with the communication of potentially hundreds of exhibitors and hundreds of thousands of attendees at the upcoming CES 2018, the largest consumer technology trade show in the United States. The purported goal of the STA – exhibiting and demonstrating wireless power transfer concepts – can be achieved by other means that are neither hazardous nor disruptive. The Application itself is deficient because it contains untrue, incorrect, or incomplete data. Finally, the Applicant has a long history of operating and demonstrating equipment that is not authorized and cannot be authorized, in violation of the Commission rules. I submit this opposition in my capacity as a duly registered attendee of CES 2018.

Page

ARGUMENT.....3

I. The Proposed Operation Is Hazardous to Humans.....3

II. The Proposed Operation Will Interfere With Communications in a High-Profile Venue That is Already Heavily Congested.....6

III. The Proposed Operation Is Not Necessary to Achieve the Stated Goal of the Special Temporary Authorization.....7

IV. The Application Is Deficient Because It Contains Statements and Data That Are Untrue, Incorrect, or Incomplete.....9

A. *Environmental Effect*.....10

B. *Frequencies of Operation*.....10

C. *Transmitter Power and Beamwidth*.....10

D. *Location*.....11

E. *Need for Special Temporary Authorization*.....11

F. *Equipment Authorization Status*.....12

V. The Applicant Has a History of Staging Hoax Demonstrations With Devices That Have Not Been and Cannot Be Authorized, in Violation of Commission Rules.....12

CONCLUSION.....14

ARGUMENT

I. The Proposed Operation Is Hazardous to Humans

Operating 30-watt transmitters several days in a row in crowded trade-show booths and suites, as proposed in the Application, will cause human exposure to levels of radiofrequency radiation in excess of the limit in 47 CFR 1.1310.

The maximum permissible exposure ("MPE") power density limit for general population, uncontrolled exposure is about 0.6 mW/cm2 in the 902-928 MHz ISM band. The proposed transmitter type in this band has ERP of 30 W, equivalent to EIRP of about 49 W, as stated in the Application's technical data section. Basic calculation shows that the MPE limit will be violated at distances less than 0.8 meters, or about 2.6 feet, from the transmitter in the main beam of the antenna.[1]

The main beam of the proposed transmitter type is very wide and is likely to cause hazardous exposure to a large part of the body, if not the whole body, of a person standing next to the receiver. For example, at a distance of 0.8 meters from the transmitter, the 30-degree half-power beamwidth stated in the Application translates into an arc with length of about 0.4 meters, or about 16 inches, which completely covers the 15-inch interscye length of a median 40-year-old American male.[2]

Particularly troubling, the Application does not specify how many of the proposed 13 transmitter units will be of this type and what will be their configuration/proximity, opening the possibility that power density levels reach levels that are 13x as high as those estimated above.

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1 Using the spherical-wave model to estimate power density in the far-field, or 1,000 x 49 W / (4 x Pi x 80 cm x 80 cm), results in 0.6 mW/cm2. The wavelength is about 0.33 m, so a distance of 0.80 m from the transmitter is in the far field, and therefore the calculation is valid.

2 Retrieved from https://msis.jsc.nasa.gov/sections/section03.htm on December 12, 2017

The proposed location, the "Convention Center Booths and Suites," is an extremely crowded venue during the requested period of operation, opening the possibility that hundreds of thousands of unsuspecting attendees and exhibitors will be exposed to the hazard. Based on my personal attendee experience, exhibitor personnel and often even attendees can spend hours, not just minutes, in the same location, in close proximity to an exhibited device of interest at distances much shorter than 0.8 meters from the device, and therefore will be subject to hazardous exposure levels from the proposed transmitter type.

The Applicant has taken no measures to reduce the safety hazard of its proposed operation. For example, there is no plan to construct a Faraday cage around the transmitter(s), or around the transmitter/receiver pair(s), or any other engineering solutions to reduce or eliminate the hazard, such as lowering the power density and changing the operating frequency and the antenna design to tighten the beam and limit the exposure to only parts of the body. There is no plan to establish and enforce a minimum separation distance. Nor is there a specific on/off schedule for the transmitter operation – operating for a brief period followed by a long pause – so that the average exposure stays below the limit in any 30-minute period, as specified in 47 CFR 1.1310.

The Applicant has failed to warn the trade show organizers about the safety hazard of its planned operation. To my knowledge, the Applicant has even failed to notify the other exhibitors that are to share its designated booth, 40140, on the 2nd floor of the Sands Expo Hall, which are AirFuel Alliance, Efficient Power Conversion, PowerSphyr Inc. and Salcomp PLC, according to the latest published show floor plan.

Exhibitors and attendees at neighboring booths in the immediate vicinity, such as Mercku, Airthings, Interlogix, Carrier Corporation, Bridgetek Pte Ltd., and Orbit B-hyve could be exposed to, but are and will be completely unaware of, the hazard, since they will be unable to read the proposed notice even if placed in a conspicuous location as described in the Application's Purpose of Operations section.

According to a recent press release[3], the Applicant's affiliate, Myant, will also be "featuring" the Applicant's "technology." Its assigned booth, 45343, and its neighboring booths are located on the same floor on the opposite side of Sands Expo Hall. In addition, according to the Applicant's public conference call[4] on November 11, 2017, the Applicant will have "a significant presence in the Dialog Semiconductor technology suite where [it] will be demonstrating the very latest [wireless power transfer] technology," and "a number of products [using the technology] from our partners will be announced and demoed in their perspective booths and suites at the show." While the general location of Dialog Semiconductor's CES 2018 suite is publicly known – outside the Sands Expo Hall and somewhere in the Venetian Hotel – the specific suite number or even floor is not and will not be until the morning of January 9, 2018, based on my previous experience. The demonstration booths of the other "partners" of the Applicant and their exhibit neighbors, if any, will not be publicly known at least until a press release is issued near the start of the show, with no practical way for non-affiliated parties to warn them about the radiation hazards of the proposed operation.

Note that supposed safety measures described in the Applicant's previous application for special temporary authorization, granted in June 2016 for the period June 8, 2016 – June 24, 2016, are patently ineffective. The purpose of that operation was also to demonstrate the Applicant's "wireless power transmission at a distance technology," but just to Commission staff at Commission headquarters. Specifically, the "Petition for Interpretation" in Exhibit B in that application[5] details elaborate but hypothetical "Sensor Systems" that are to "prevent RF exposure in excess of Commission requirements" to humans and pets in the vicinity of the transmitter(s) and receiver(s). However, those systems, as depicted there and if actually implemented, prevent any wireless power transfer, not just excess exposure, unless each of the receivers is levitating in the air far from any object, inanimate or living, and, therefore, the demonstration fails.[6]

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3 Retrieved from http://www.marketwired.com/press-release/myant-taps-energous-corporations-wattup-wireless-charging-solution-new-clothing-sensors-nasdaq-watt-2240085.htm on December 21, 2017

4 Transcript is available at https://content.equisolve.net/_7e0a893fc9360ead640b9d9e68400cb3/energous/db/189/1283/transcript/11-10-17_Energous_Transcript.pdf

5 File No.: 0823-EX-ST-2016; exhibit retrieved from https://apps.fcc.gov/els/GetAtt.html?id=177542&x=.

6 For a detailed analysis of the sensor systems, please consult the report titled "Energous: No Path To Regulatory Approval" at https://seekingalpha.com/article/4031990-energous-path-regulatory-approval

II. The Proposed Operation Will Interfere With Communications in a High-Profile Venue That is Already Heavily Congested

In a crowded indoors trade show venue, such as the proposed location, all communication options are heavily congested. Authorized but unlicensed wireless communication consumer devices, such as devices operating in the 915MHz or 5GHz bands, must accept interference, but there is implicit expectation by their manufacturers and users that those devices will operate on a level playing field under the rules in 47 CFR 2.803, 2.805, and 15.

However, two of the three proposed transmitter types in the Application do not comply with existing rules as they far exceed their respective field strength limits and therefore will cause interference and unfairly worsen the congestion even further and block the respective communication channels in the vicinity of their operation, and possibly in the entire Sands Expo Hall, the Venetian Hotel, Hard Rock Hotel, and potentially other CES buildings and public spaces not yet announced publicly by the Applicant.

Specifically, the 30 W ERP continuous-wave device type operating in the 902-928 MHz band and the 1 W ERP continuous-wave device type operating in the 5,725-5,850 MHz band both fall under 47 CFR 15.249, which specifies a limit for field strength of fundamental emission of 50 mV/m at 3-meter distance from the transmitter. ERP of 30 W, equivalent to EIRP of about 49 W, at 3 meters translates into field strength of about 12,800 mV/m, or over 250x the limit[7]. A 1 W ERP, equivalent to about 1.6 W EIRP, at 3 meters translates into field strength of about 2,300 mV/m, or nearly 50x the limit.[8] Those excessive power levels are particularly unfair and offending to unsuspecting nearby users attempting to use their devices for communication, as the two proposed transmitter types do not even transmit any voice or data or communicate at all.

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7 Using the spherical-wave model to estimate field strength in the far-field, or 1,000 x SQRT (377 x 49 W / (4 x Pi x 3 m x 3 m)), results in 12,780 mV/m. The wavelength is about 0.33m, so a distance of 3m from the transmitter is in the far field, and therefore the calculation is valid.

8 Using the spherical-wave model to estimate field strength in the far-field, or 1,000 x SQRT (377 x 1.6 W / (4 x Pi x 3 m x 3 m)), results in 2,309 mV/m. The wavelength is about 0.05m, so a distance of 3 meters from the transmitter is in the far field, and therefore the calculation is valid.

The Application shows no specific attempt to establish, prior to commencing operation, plans and procedures for the quick identification and elimination of the interference the proposed operation may cause and to notify parties that might be affected by the proposed operation. Nor are there any planned coordination measures or precaution of any kind to alleviate the damaging interference caused by its transmitters, such as reducing the frequencies used or limiting transmission to a particular channel, or restricting the time of use and limiting the duration of the operation to only brief periods during the day on a publicized schedule and supplying that schedule to at least the CES organizers and neighboring booths, or employing other means to address potential interference concerns. The Applicant has not attempted any due diligence of the local operating environment to identify the interference risks, although providing adequate analysis would be difficult given that the various locations in the trade show venue are not under the Applicant's control and given that hundreds, maybe even thousand of devices, will be operating in the unlicensed bands on the show floor at the same time.

The unfair interference that the proposed operation will cause to devices heavily used by CES 2018 exhibitors and attendees is particularly ironic, given that Chairman Pai is scheduled attend the trade show and discuss allocation of additional unlicensed bands "to power consumers' growing demand for anytime/anywhere connectivity."[9] Commissioners Carr, Clyburn, O'Reilly and Rosenworcel will also join a roundtable discussion on hot policy topics, where congestion issues in the current unlicensed bands are bound to be raised.

III. The Proposed Operation Is Not Necessary to Achieve the Stated Goal of the Special Temporary Authorization

The purpose of the proposed operation, as stated in the Application, is demonstrating WPT, that is, wireless power transmission or transfer, concepts. However, accomplishing that objective does not require special temporary authorization or unauthorized equipment.

9 Retrieved from https://www.ces.tech/News/Press-Releases/CES-Press-Release.aspx?NodeID=a960d70e-1a64-44f6-be2e-502d4071a35d on December 21, 2017

Such ideas and techniques are not novel and can easily be demonstrated at a trade show with any regular commercial off-the-shelf authorized transmitter operating in the unlicensed spectrum and with one or more off-the-shelf RF meters that display power received over the air, or even with regular smartphones using the bars or the actual values of the received signal strength indicator. Simply put, every wireless transmission at radio frequencies is a power transmission – all electromagnetic waves carry or transfer power at a distance.

Therefore, operating the proposed high-power 30 W and 1 W ERP unauthorized device types is not necessary for the stated experimental objective. That objective can be successfully accomplished with power levels that are practically an order of magnitude lower using the same or different frequencies or modulation. Operating the third device type, presumably a Bluetooth control transceiver module, would simply require posting a conspicuous notice, if not authorized, and no special temporary authorization is needed. Excessive power levels at a mobile station are particularly inappropriate in a venue, such as a trade show, that is not under the Applicant's control.

It is also my understanding that the two high-power transmitter types have no clear path to authorization under current Commission rules, given the particular combination of power, modulation, and operating frequencies, which renders their use for demonstration purposes counter-productive or moot, at best. On the other hand, other CES exhibitors have been and will be demonstrating wireless power transfer at a distance, not just concepts, using equipment that is authorized. Powercast (assigned booth 40268), for example, has an "RF Powering device," FCC ID YESTX91501, authorized since 2010 at 915 MHz with 2 W ERP and directional antenna gain of 6.8x, and has demoed it at CES and other trade shows in the past[10] while powering sensors, tree ornaments, smart cards, a keyboard and a mouse, etc.

However, even when using unsafe radiated power levels, power at a distance is not practical in the foreseeable future, because the typical receiver is still too power hungry. For example, the highest power density

10 One trade-show demonstration video, for example, is available at https://www.youtube.com/watch?v=z2R6z6zk0YY

at 3 feet from a 30 W ERP transmitter is just 0.47 mW/cm2.[11] That density results in just about 20 mW DC or less at a receiver with a half-wavelength, or 16 cm, dipole in the main transmission beam and with optimal orientation[12]. The most ubiquitous consumer communication devices, smart phones, typically require 1 W DC, or 50x that level, to even start charging, based on my experience.[13]

Finally, the number of proposed transmitter units – 13 – listed in the Application (2 x Demo1, 2 x Demo2, 4 x Demo3a, 2 x Demo3b, 2 x Demo4, and 1 x Demo5) are beyond the necessary for a trade show demonstration of wireless power transfer concepts. The Applicant's technology for "simultaneous power delivery to multiple devices" was supposedly "validated" in a lab by just one high-power transmitter and two receivers (which may contain low-power control transmitters), while the "mobility power delivery" added just two more receivers, according to the Applicant's own press release[14] and published results from the custom tests[15].

IV. The Application Is Deficient Because It Contains Statements and Data That Are Untrue, Incorrect, or Incomplete

To my knowledge and understanding, the Applicant has made several statements and provided data in the Application that are untrue, incorrect, or incomplete, and therefore the Application is deficient. The problematic entries relate to environmental effect, frequencies of operation, transmitter power and beamwidth, location, the need for special temporary authorization, and equipment authorization status.

11 Calculated as 1,000 x 49 W / (4 x Pi x 91.4 cm x 91.4 cm)
12 Effective aperture calculated as 142 cm2 or 0.13 x 33 cm x 33 cm, then DC power can be estimated as 20mW or 142 cm2 x 0.47 mW/cm2 x 30%, where 30% is a very generous factor that accounts for various efficiency conversion losses.
13 The charging indicator gets activated at significantly lower power levels, but the battery charge level does not increase
14 Retrieved from http://www.marketwired.com/press-release/underwriters-laboratories-ul-validates-performance-wattup-wire-free-charging-from-energous-nasdaq-watt-2071570.htm on December 21, 2017
15 Retrieved from http://s3.amazonaws.com/energous/FCC-Electromagnetic-Wireless-Power-Delivery-Test-Report.pdf on December 21, 2017. Note the intentionally misleading file name "FCC...Test Report" used by the Applicant

A. *Environmental Effect*

The Applicant has certified that the construction of the station would not be an action which is likely to have a significant environmental effect. However, since operating the proposed equipment would cause human exposure to levels of radiofrequency radiation in excess of the limits in 47 CFR 1.1310 in a crowded general population environment for a week, there will be a significant, albeit temporary, environmental effect.

B. *Frequencies of Operation*

The proposed frequencies of operation of the two high-power transmitters types do not match the Applicant's public statements. The Application lists 902-928 MHz and 5,725-5,850 MHz, respectively, while the latest answers to frequently asked questions posted on the Applicant's website[16] state that the Applicant's "technology" uses the 5,850-5,875 MHz band for the "transmission of power." Moreover, the Applicant has repeatedly stated in the past that all its receivers will be compatible with all its current or future near-field, mid-field and far-field transmitters[17], implying operation in a tight band around 5,862 MHz, the frequency used by the two of its near-field transmitter reference designs that are already authorized, with FCC IDs 2ADNG-MT100 and 2ADNG-NF130.

C. *Transmitter Power and Beamwidth*

The Applicant has failed to disclose the RF power at the transmitter terminals in the Output Power field and has entered "N/A" instead. Also, the ERP values for both proposed high-power transmitter types, 30 W and 1 W, are suspect because they are entered as round numbers. The 30-degree value for the half-power beamwidth must be incorrect, as it exactly matches the value listed in the Applicant's previous application for special temporary authorization[18]. Such half-power beamwidth translates into dipole gain of least 3x under reasonable approximations[19], yet the derived dipole gain in the previous application was only 2.7x (calculated as

16 Archived on December 19, 2017 at http://web.archive.org/web/20171219052548/http://energous.com/technology/faqs/
17 For example, see https://www.benzinga.com/top-stories/16/11/8687756/exclusive-energous-ceo-talks-dialog-semi-deal-other-prospects
18 File No.: 0823-EX-ST-2016
19 Retrieved from http://www.phys.hawaii.edu/~anita/new/papers/militaryHandbook/antennas.pdf on December 21, 2017

55.6 W / 20.4 W). The Applicant has provided no explanation or exhibit about the orientation of the antenna(s) in the horizontal and vertical planes, or whether the half-power beamwidth value applies to all three proposed transmitter types or just some of them.

D. *Location*

The description of the area of operation of the proposed mobile antenna(s) is incomplete, making detection or notification of a deviation from the technical requirements of the station authorization more diffucult. The location coordinates point to somewhere within the Sands Expo Hall, but the description does not mention the exact floor or the exact booth number(s) of the proposed operation. The entered radius of 1 kilometer does cover the Venetian Hotel, but does not reach Hard Rock Hotel.

The published trade show map shows that the booths assigned to the Applicant and its affiliate Myant are on the 2nd floor of the Sands Expo Hall. The proposed operation will also occur at Dialog Semiconductor's hospitality suite in Venetian Hotel, with line-of-sight distance of less than 1 kilometer from the entered location coordinates, but the specific suite number or floor number is not yet publicly known. The location of the demonstration booths or suites of the other affiliates of the Applicant, if any, will not be publicly known at least until a press release is issued near the start of the show.

In past years, the Applicant has also staged demonstrations at a private suite in Hard Rock Hotel during the CES trade show. The line-of-sight distance from Sands Expo Hall to Hard Rock Hotel exceeds 1 kilometer.

E. *Need for Special Temporary Authorization*

The Applicant has failed to explain why special temporary authorization is necessary, given numerous public statements since 2014 that it has "a clear path to regulatory approval" and that Commission authorization for its "at-a-distance power transmitters" is imminent. Most recently, the CEO of the Applicant was quoted in an

article published[20] nine days after the Application's Certification was signed: "We believe we'll have [Commission approval for a wireless power transfer transmitter with a range of about three feet] before the end of this year," that is, well before January 6, 2018, the proposed start of operation.

F. *Equipment Authorization Status*

The Application's Explanation section states incorrectly that the proposed equipment is "non-type accepted." Equipment is no longer "non-type accepted" - it is simply not authorized.

V. The Applicant Has a History of Staging Hoax Demonstrations With Devices That Have Not Been and Cannot Be Authorized, in Violation of Commission Rules

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On January 5, 2017 at CES 2017 I witnessed an employee of the Applicant performing live demonstrations of a "mini" or "near-field" wireless charging transmitter to CES attendees at the Venetian Hotel suite assigned to the Applicant's affiliate Dialog Semiconductor. The transmitter was an unauthorized modification of reference design NF130 that was subsequently authorized with FCC ID 2ADNG-NF130. Unlike the reference design, this device transmitted at all times, regardless whether an authorized receiver was placed on it or not. It was powering the LED of a small receiver that did not contain a Bluetooth transceiver at about an inch from the transmitter antenna, well beyond the authorized 2-millimeter distance. It could also power two or more receivers simultaneously, unlike the authorized device.

The employee also demonstrated a larger "mid-field" reference design that supposedly powered a mouse and a keyboard placed a few inches from it. That device, with a "range up to 3 feet," was submitted for authorization early this year and is about to be authorized by the end of next week, according to numerous public statements by the Applicant.

20 Retrieved from https://www.cnet.com/news/2018-wireless-charging-bluetooth-mean-life-without-cables/ on December 21, 2017

No conspicuous notice or warning of any kind was posted at the demonstration, nor were attendees informed about the authorization status of the devices, in violation of Commission rules and CES exhibitor rules.

On that same day, the Applicant's affiliate PERI Inc.[21] performed live demonstrations on the show floor with an unauthorized version of an older "mini" reference design that was authorized in 2016 with FCC ID 2ADNG-MT100. Unlike the reference design, this device did not contain a magnetic reed switch, had a different antenna, and could power multiple receivers beyond the authorized 2-millimeter distance. Note that the CEO of the Applicant's affiliate insisted that the device was authorized and had been told so by the Applicant. The next day, that device was replaced with a different, tablet-shape, transmitter that appears to be yet another reference design of the Applicant but is yet to be authorized. Again, no conspicuous notices were posted.

One other affiliate of the Applicant, Chipolo, exhibited unauthorized Bluetooth trackers[22] and claimed that some of them could be "charged" by the Applicant's transmitters, but did not operate any such transmitters in its booth on the show floor and was referring attendees to the Applicant's private suite in Hard Rock Hotel for demonstrations. Later press accounts revealed that the Applicant was demonstrating there several unauthorized versions of the near-field devices already mentioned plus a mid-field and a far-field transmitter, none of which are currently authorized. The required conspicuous notices were not posted, based on the reviewed photo and video materials published in the media.

It is particularly troubling that the "stop buzzer" person listed in the Application has been employed by Applicant as a Director of Regulatory Operations since September 2016[23], yet he did not nothing to prevent the above violations of Commission rules concerning operating and marketing devices that are not yet authorized.

21 PERI is not on the list of exhibitor for the upcoming CES 2018
22 Some with a fake FCC ID 2AD85-M45S
23 According to his LinkedIn profile retrieve from https://www.linkedin.com/in/billy-manning-9075024/ on December 21, 2017

A review of photo and video materials published in the media reveal that similar demonstrations of devices that were unauthorized and cannot be authorized occurred in January 2016 and 2015 in the Applicant's suite at Hard Rock Hotel during the respective CES trade shows. At least one of the devices there appears to be a high-powered transmitter with a passive highly-directional antenna supposedly delivering over 0.6 mW DC to a receiver with a small patch antenna several feet from the transmitter. Again, no conspicuous notices are visible in the materials.

Similar demonstrations were also performed over the years at other trade shows, technology events, as well as sponsored marketing presentations to the media. At one recent demonstration[24] in May 2017, the Applicant even told the journalist that two of the unauthorized near-field transmitter devices, similar to the ones exhibited at CES 2017, were actually authorized[25].

To my knowledge, none of the actual devices ever demonstrated by the Applicant, either publicly or privately to affiliates, have been authorized or can be authorized under current Commission rules.

CONCLUSION

For all the foregoing reasons, the Application should be dismissed or denied. At the very least, the proposed operation should not be permitted to commence until it is substantially modified, so that all the issues raised in this opposition are resolved. Regardless whether the Application is granted or not, I urge the Commission to have field agents posted at the CES 2018 booths and suites assigned to the Applicant and its known affiliates, such as Dialog Semiconductor, Myant, Chipolo, and any other announced in a press release at the trade show, at all times during exhibit hours in order to monitor and verify the Applicant's compliance with the terms of the STA and Commission rules. I believe the Applicant's record of misleading the public and

24 See https://finance.yahoo.com/news/investigation-air-charging-hoax-174529315.html
25 Personal communication

disregard of rules covering marketing and operating equipment that has not yet been authorized justifies such extra effort.

Respectfully submitted,

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