GOVERNMENT OF PUERTO RICO
PUBLIC SERVICE REGULATORY BOARD
PUERTO RICO ENERGY BUREAU

IN RE:
INTERCONNECTION REGULATIONS

CASE NO.: NEPR-MI-2019-0009

SUBJECT: Smart Inverter Default Utility Required Settings Profile – Comments of Tesla, Inc.

COMMENTS OF TESLA, INC.

Tesla, Inc. ("Tesla") respectfully submits the following comments to the Puerto Rico Public Service Regulatory Board ("Energy Bureau") regarding the implementation of specific smart inverter functions in accordance with IEEE 1547-2018 and UL 1741-SB. Tesla has significant experience in implementing smart inverter settings in other utility territories and is familiar with best practices associated with doing so. Smart inverter settings affect not only the inverter itself but also can have significant effects on the solar and storage systems of which they are a part. Therefore, Tesla has an interest in smart inverter settings not only as an inverter manufacturer, but also as a manufacturer of residential battery energy storage and solar systems. Tesla Powerwall residential battery energy storage systems comprise the vast majority of residential battery energy storage systems installed in Puerto Rico, with more than 116,000 Powerwalls installed in Puerto Rico.

We have significant concerns with the most recent draft smart inverter settings proposed by LUMA Energy, LLC and LUMA Energy ServCo (collectively, "LUMA") and also with any potential expedited implementation timeline that might be proposed for those settings.[1] Regarding our concerns, we offer the following three comments and associated recommendations.

1. An expedited implementation timeline could be untenable for OEMs. Instead, we recommend that the Energy Bureau should support a timeline that requires systems

[1] LUMA posted Technical Bulletin 2024-0001 Smart Inverter Settings Sheet on April 1, 2024. More recent draft revisions have been circulated via email in anticipation of a LUMA filing.

installed after a certain date to eventually implement the new smart inverter settings within a more reasonable timeframe.

2. The proposed Volt-Watt settings would threaten to significantly curtail customer solar generation and battery storage dispatch. Therefore, we recommend that the Volt-Watt setting should be deactivated until the Energy Bureau directs it to be turned on following a further stakeholder process.
3. The proposed Volt-Var settings would reduce the efficacy of residential solar and storage energy systems, causing such systems to provide customers and the grid with only a portion of their intended value. We recommend that the relevant Volt-Var triggering threshold should be increased to avoid this outcome.

Tesla acknowledges that conversations regarding smart inverter settings have been ongoing for several months, and we recognize the desire of LUMA and the Energy Bureau to finalize smart inverter settings to put in place requirements for residential solar and storage systems' inverters to provide certain autonomous grid support functions. However, we urge LUMA and the Energy Bureau to adopt the recommendations described in our comments in order to get this issue right. Getting this wrong could, in a worst-case scenario, significantly hamper the capabilities, contributions, value-proposition and daily functioning of residential solar and storage systems in Puerto Rico.

1. **An expedited implementation timeline could be untenable for OEMs. Instead, we recommend that the Energy Bureau should support a timeline that requires systems installed after a certain date to eventually implement the new smart inverter settings within a more reasonable timeframe.**

Rushing mandatory implementation of the new smart inverter settings on an expedited timeline after they are approved by the Energy Bureau risks suboptimal outcomes for the grid and for Puerto Rico's residential solar and battery storage system. In most utility territories in which new smart inverter settings are released, inverter manufacturers are provided at least 12 months to update and implement the settings. That typical implementation timeline is not arbitrary: instead, it recognizes that manufacturers must include the new settings as part of equipment firmware updates, and it provides sufficient time for manufacturers to lab test how unique smart inverter settings requirements will interact with their firmware updates. Failure to conduct this testing risks unintended consequences that could in fact make the grid *less* stable, in contrast to the intended

aim of the new settings. Forcing manufacturers to rush to update smart inverter settings within a short timeline, such as within a month, would force manufacturers to choose between foregoing testing, becoming out of compliance with the new requirement, or pausing equipment installation.

In fact, Tesla is essentially unable to implement a bespoke smarter inverter setting update within a shortened timeline of only a month or so. That is because Tesla must align smart inverter setting updates for Powerwall with our regularly scheduled firmware updates, which occurs at predefined two-month intervals for our entire worldwide Powerwall fleet and other distributed energy resource (DER) applications. During those two-month cycles, Tesla takes numerous steps to ensure that firmware updates and accompanying setting updates are safe and have the intended effect. For smart inverter setting updates, that process includes:

1. Agreeing on all updates and settings by a predetermined date to ensure sufficient time for testing, validation, and rollout.
2. Creating the new smart inverter setting file.
3. Validating the new smart inverter settings file in the lab. Testing the settings against varying voltage, current and frequency parameters. Testing the settings under various predetermined scenarios that the system is certain to experience, such as full AC load. Working to solve any issues that arise due to various elements of the new firmware update.
4. After lab testing, ensuring that other Powerwall functions have not changes.
5. Attaching the smart inverter setting to the next scheduled firmware update, which will roll out in four phases: piloting of 100s of systems; Phase 1, where the update is pushed to thousands of systems; Phase 2, where the update is pushed to 5,000 systems; and Phase 3, where the update is pushed to the entire global fleet. The incremental scaling of the firmware update ensures no unintended consequences upon release. While the firmware rollout occurs across the entire fleet, a territory with a new smart inverter setting likely would comprise a disproportionate amount of the testing pool to ensure that the setting update is working as intended.

This testing process has been developed over the lifetime of the Powerwall and Tesla's other residential energy product to ensure that the performance of our systems meets customer expectations and to ensure the safety of our systems and our customers.

Tesla's next scheduled Powerwall and DER firmware update is set to be released on October 16, 2024, and our internal deadline for providing changes to be part of that planned update was in mid-August. While Tesla has reviewed LUMA's proposed smart inverter settings, these settings have yet to be finalized, making it difficult for us to include these smart inverter settings in the upcoming round of firmware testing, approval, and implementation. Additionally, if LUMA recommends an expedited deadline to implement smart inverter settings, it is very possible that the shortened deadline will not align with a preplanned firmware update, which will make compliance exceedingly difficult. If Tesla is unable to get LUMA's updates in the October firmware update, our next firmware update is on December 16, 2024 – which could be a more reasonable timeline to rollout the changes in Puerto Rico, if the smart inverter settings have been finalized and approved at that time.

However, we recognize that both LUMA and the Energy Bureau have an interest in ensuring that systems installed in the near future will be required to implement smart inverter settings to support the grid with autonomous functions. Therefore, we recommend that the Energy Bureau direct that all distributed solar and battery energy systems installed after a certain date must eventually implement the new smart inverter settings, but the actual smart inverter setting updates do not need to be implemented on those systems until the end of 2024 – or until a similarly appropriate timeline if approval of LUMA's proposed smart inverter settings is delayed. For example, the Energy Bureau could direct that any system installed on or after September 16, 2024, would be required to implement the new smart inverter settings by Jan. 1, 2025, while urging manufacturers to complete the work and implement the update as soon as possible. This middle-ground solution would ensure that systems being installed in the coming months would very soon adhere to the new smart inverter settings, but the Energy Bureau would avoid creating a requirement that could be onerous and produce suboptimal results.

Tesla is not seeking to delay implementation or provide excuses for future noncompliance. Instead, we're simply seeking to explain why expedited compliance would be exceedingly difficult and propose a solution that might work for all parties.

2. **The proposed Volt-Watt settings would threaten to significantly curtail customer solar generation and battery storage dispatch. Therefore, the Volt-Watt setting should be deactivated until the Energy Bureau directs it to be turned on following a further stakeholder process.**

Due to the persistent overvoltage on Puerto Rico's grid, implementing the Volt-Watt setting as proposed will cause a portion of residential solar and battery energy storage systems to constantly curtail active power generation to a degree that would fully prevent the systems from injecting to the grid.[2] As proposed, the smart inverter settings would frequently take nearly full control of some customers' system to provide uncompensated grid support rather than allowing the system to serve the customer who purchased the DER. We support any call to temporarily deactivate the Volt-Watt feature under the proposed smart inverter settings for an extended period of time, as long as it is clear that LUMA cannot unilaterally decide to enable that function at a later date. Instead, we propose that LUMA continue to work with manufacturers and other stakeholders to find a reasonable Volt-Watt setting or associated solution. We also recommend that LUMA should not be permitted to activate the Volt-Watt setting until after such a stakeholder process produces a more reasonable setting, and only after the updated Volt-Watt setting receives direct approval from the Energy Bureau. Ultimately, we believe that a Volt-Watt triggering threshold needs to be increased above what has been recommended in LUMA's draft smart inverter settings in order to account for the grid's persistent overvoltage.

The Volt-Watt setting smart inverter feature defines certain default voltage thresholds, and when voltage on the grid reaches a certain threshold, the settings automatically direct interconnected smart inverters to curtail active power generation. On most U.S. grids, this feature would be triggered infrequently. However, on Puerto Rico's grid, it is common for Tesla systems to register voltages above the "106% VN" threshold listed for V1 in Table 2-7 of LUMA's proposed smart inverter settings. At that threshold, systems would be required to curtail generation, meaning that solar and battery energy storage systems would be unable to dispatch power, limiting their ability to provide power to the customer or to the grid. In addition to harming customers by

[2] Appendix A is a graph of the average daily grid voltage at the roughly 116,000 Tesla Powerwalls on Puerto Rico's grid. The graph shows how many systems experience average daily grid voltage at or above important triggering thresholds proposed by LUMA for Volt-Watt and Volt-Var functions. The graph reveals that a high percentage of customers would be negatively affected by LUMA's proposed Volt-Watt and Volt-Var function triggering thresholds, which as proposed would threaten to wholly or partially reduce the efficacy of customers' Powerwalls and associated solar systems.

reducing the efficacy of their systems and limiting their ability to export as part of net metering, limiting a system's generation also could limit its ability to export as part of LUMA's Customer Battery Energy Sharing (CBES) program.

According to voltage data collected from Tesla's roughly 116,000 Powerwalls in Puerto Rico, approximately 8 percent of Powerwalls experience an average daily voltage at or above the proposed 1.06% VN threshold. That means if the 106% VN threshold for Volt-Watt implemented, roughly 1-in-12 new Powerwalls would be fully prevented from dispatching their solar or storage systems under average grid conditions. An additional 27 percent of new systems would experience some degree of regular curtailment, with some of those customers experiencing such curtailment 40 percent, 30 percent, or 20 percent of the time, depending on the average voltage at their location. In Appendix A to this filing, Tesla has provided a graph showing the average grid voltage at the location of our roughly 116,000 Powerwalls and how that compares to the proposed 1.06% VN Volt-Watt triggering threshold and the proposed 1.02% VN Volt-Var triggering threshold.

Enphase similarly identified the Volt-Watt issue as a problem in its July 15, 2024, comments to the Energy Bureau. In those comments, Enphase stated that, "The Volt-Watt smart inverter function can significantly curtail customer solar generation when the distribution grid experiences high voltages, leading to commensurate negative financial impacts to the customer. LUMA has not publicly disclosed how it expects to resolve persistent high voltage excursions on its distribution network that routinely curtail energy generation from a customer's solar system."[3]

One way to solve for this issue could be to raise the triggering threshold (V1 in Table 2-7) to a higher number, such as 109% VN, to adjust for the overvoltage on Puerto Rico's grid. However, for now Tesla supports recommendations to entirely deactivate the Volt-Watt setting until LUMA and stakeholders can agree on a reasonable setting.

3. **The proposed Volt-Var settings would reduce the efficacy of residential solar and storage energy systems, causing such systems to provide customers and the grid with only a portion of their intended value. We recommend that the relevant Volt-Var triggering threshold should be increased to avoid this outcome.**

The proposed Volt-Var settings also will cause problems for customers due to the persistent overvoltage on Puerto Rico's grid, resulting in customer's solar and battery energy storage systems

[3] *See* Enphase Energy Inc. Comments on Default Smart Inverter Settings, at p. 2.

to underperform compared to nameplate capacity and customers' expectations. When high voltages on the grid trigger the Volt-Var feature, inverters direct customer systems to absorb reactive power. When systems absorb reactive power, it limits their current capability, which in turn reduces the potential for the inverter to dispatch at full nameplate capacity. Again, while this feature would be triggered relatively infrequently on most U.S. grids, Tesla's data from Powerwalls on Puerto Rico's grid shows that 55 percent of Powerwalls experience an average daily voltage higher than the proposed Volt-Var settings. That means that under the proposed settings, more than half of new systems would be triggered under average grid voltage to provide uncompensated grid services that would reduce system performance the majority of the time. Ultimately, it would result in customers being forced to accept a curtailed version of the energy system that they purchased.

In Table 2-6 of LUMA's proposed smart inverter settings, setting V3 determines the "dead band upper voltage limit," at which Volt-Var autonomous functions would be triggered on a customer's system. LUMA has set that threshold at only "102% VN." Roughly 55 percent of Tesla Powerwalls in Puerto Rico – or 64,000 Powerwalls – experience that level of voltage as their average daily grid conditions. An even greater number of systems experience this level of voltage on a semi-regular basis, meaning tens of thousands of systems would have their system capacity curtailed fairly regularly – whether that is 40 percent, 30 percent, 20 percent or 10 percent of the time.

When the Volt-Var function is triggered frequently on a customer's system, the DER and customer will experience harms. Frequent Volt-Watt and Volt-Var triggers could result in a customer's battery being asked to work much more frequently than it might otherwise, potentially reducing the system's lifespan. Additionally, when Volt-Var is activated, the customer would be able to use only a reduced portion of their system's capabilities. For example, a system with a triggered Volt-Var function would absorb reactive power, which would in turn limit the system's current capability – possibly from 48 amps to 40 amps. That reduction would in turn limit a Powerwall inverter from providing 11.5 kW (48 amps * 240 volts = 11,520 watts) to only 9.6 kW (40 amps * 240 volts = 9,600 watts). This would force thousands of customers – and eventually tens of thousands of customers as installs continue – to supply roughly 17% of their DER system capacity to provide uncompensated grid support the majority of the time.

One very simple fix to this issue would be to increase the "V3" triggering threshold in Table 2-6 to "105% VN." While this would still trigger the Volt-Var function not infrequently, it would be the difference between requiring that customer's provide uncompensated grid services *some* of the time rather than the *majority* of the time – or even *nearly all* of the time for some systems. We recommend that the Energy Bureau direct LUMA to increase the Volt-Var "V3" threshold accordingly.

4. Conclusion

We recognize that LUMA and the Energy Bureau have put effort into producing a set of smart inverter settings to have distributed energy systems improve power quality on Puerto Rico's grid. We support that aim. However, we want what is best for both Puerto Rico's grid and our customers, and the current set of proposed smart inverter setting and potential implementation timeline risk creating the opposite effect – a scenario in which the settings are not sufficiently tested before implementation and a scenario in which customer systems are harmed due to the requirements. We believe with a few small changes, LUMA's proposed settings could be fixed and be implemented in the very near future.

Thank you for the opportunity to provide comments. Please contact the undersigned if you have any questions.

Sincerely,

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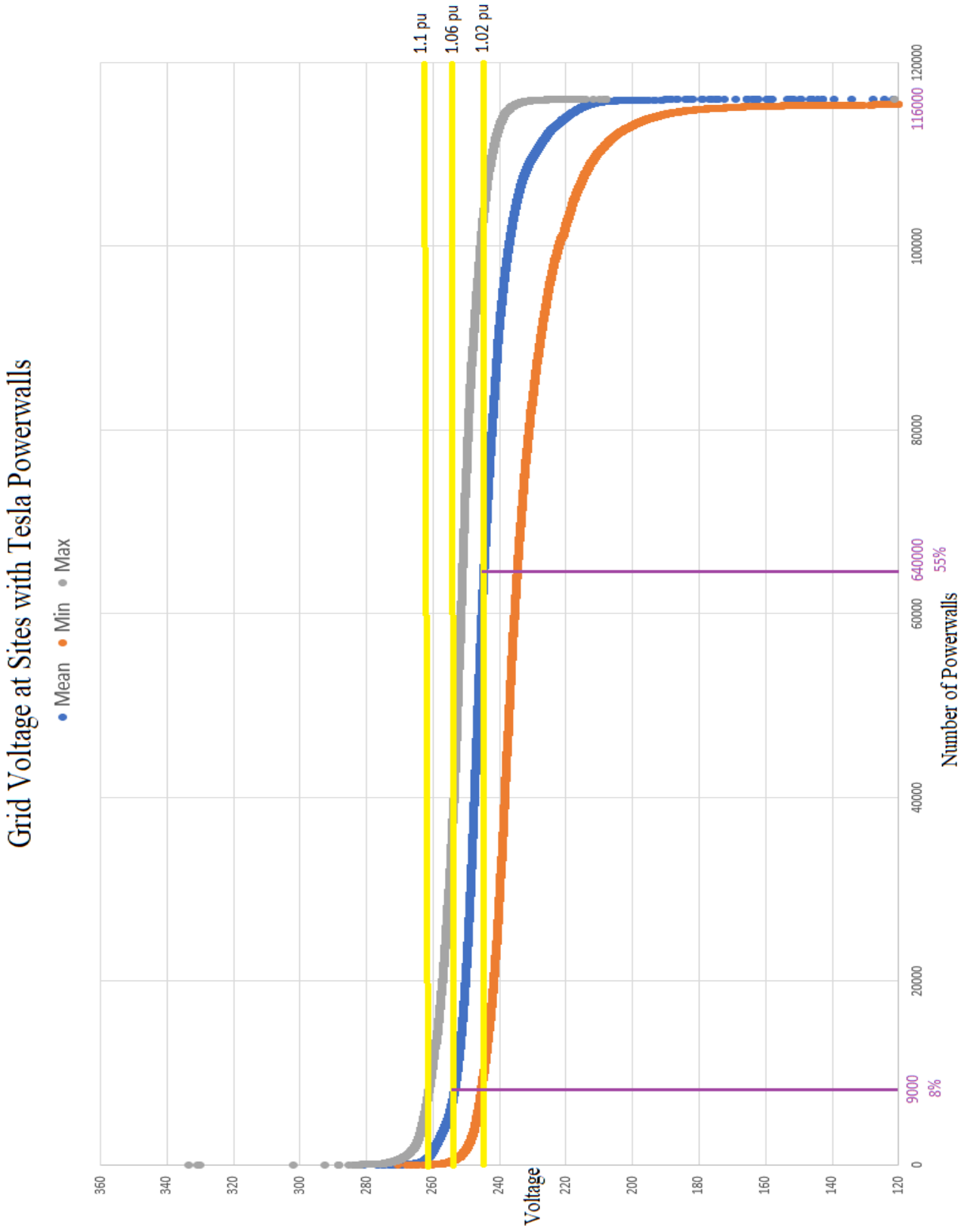
Appendix A


Grid Voltage at Sites with Tesla Powerwalls
Mean
Min
Max
1.1 pu
1.06 pu
1.02 pu
Voltage
Number of Powerwalls
360
340
320
300
280
260
240
220
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180
160
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120
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40000
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80000
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640000
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CERTIFICATE OF SERVICE

I certify that these comments were filed via electronic mail with the Energy Bureau to secretaria@jrsp.pr.gov and wcordero@jrsp.pr.gov. I certify that a copy of these comments was delivered by electronic mail to: Agustin.Irrizary@upr.edu, javrua@sesapr.org, hrivera@jrsp.pr.gov, contratistas@jrsp.pr.gov, aconer.pr@gmail.com, john.jordan@nationalpfg.com, lionel.santa@prepa.pr.gov, arivera@gmlex.net, mmonbouquette@enphaseenergy.com, mvalle@gmlex.net, laura.rozas@us.dlapiper.com, valeria.belvis@us.dlpiper.com, julian.angladapagan@us.dlapiper.com, cfl@mcvpr.com, and mgs@mcvpr.com

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