NATURAL RESOURCES DEFENSE COUNCIL

April 28, 2017

Mr. Ryan Fogle
United States Environmental Protection Agency
ENERGY STAR Program
1200 Pennsylvania Ave NW
Washington, DC 20460

Subject: NRDC comments regarding ENERGY STAR UPS Draft Version 1.1 and Version 2.0 Specifications

Dear Mr. Fogle,

On behalf of the Natural Resources Defense Council (NRDC), and our more than 1.3 million members and online activists, we respectfully submit the following comments in regards to the ENERGY STAR Uninterruptible Power Supplies (UPS) Draft Version 1.1 and Version 2.0 specifications.

We appreciate the opportunity to provide input into the ENERGY STAR process and offer the following comments for EPA's consideration.

Summary

Our comments address the draft Version 2.0 specification and cover the following points:

1. We strongly support the ENERGY STAR program for UPS
2. We support EPA's approach of doing both a minor and a major revision of the UPS specification
3. We generally support the levels proposed by EPA, but seek clarification for VFD and VI UPSs rated more than 10,000 W
4. We urge EPA to include test-only requirements at **0%, 5% and 10% load points**, to collect data and enable potential efficiency requirements at these load points in future revisions.

Detailed Comments

1. **We strongly support the ENERGY STAR program for UPS**

The ENERGY STAR UPS specification has been a driving force in increasing the efficiency of UPS's in a voluntary, market-driven manner. Since the 1.0 specification, the market has evolved from a roughly 25% to a near 100% qualification rate, demonstrating the effectiveness of the specification at setting ambitious but achievable goals, that allow industry to design to and achieve over the normal design cycle of their products. With near complete market adoption today, it is time to reset the specification at the level that 25% of products on the market already achieve, and lift the remaining 75% of the market to the same level, helping reduce energy waste and saving customers money on their electricity bills.

2. **We support EPA's approach of doing both a minor and a major revision of the UPS specification**

NRDC supports EPA's proposal for two simultaneous revisions. The recent updates to the EPA test method and the near complete market adoption of version 1.0 performance levels, make these revisions necessary. NRDC supports EPA's approach to align with the EPA test procedure changes in a minor 1.1 revision that can go into effect rapidly, and to reset levels in a major revision that will take more time.

3. **We generally support the levels proposed by EPA, but seek clarification for VFD and VI UPSs rated more than 10,000 W**

The data on ENERGY STAR's UPS qualified-product list shows that EPA' s proposed levels are generally reasonable and achievable, and correspond roughly to the 25% most efficient products of the market across a broad range of product ratings and categories.

However, we seek clarification on why efficiency levels for VFD and VI products rated more than 10,000 watts are proposed to decrease from Version 1.1 to 2.0 as shown in NEEA's comments. While these products represent a very small fraction of the market, we are not aware of any data or rationale to justify a decrease in efficiency levels.

4. **We urge EPA to include 0%, 5% and 10% test points as "test and list" requirements. These load points are more representative of real-world use and will ultimately enable setting the right incentives for manufacturers to design for real-world energy savings.**

EPA proposes to have UPS tested at 25%, 50%, 75% and 100% load, consistently with the DOE test method, and that the average efficiency metric be a weighted average as shown in Table 1:

Table 1: Ac-output UPS Loading Assumptions for Calculating Average Efficiency

Rated Output Power, *P*, in watts (W)	Input Dependency Characteristic	Proportion of Time Spent at Specified Proportion of Reference Test Load, $t_{n\%}$			
		25%	50%	75%	100%
$P \leq 1500$ W	VFD	0.2	0.2	0.3	0.3
	VI or VFI	0	0.3	0.4	0.3
1500 W < $P \leq$ 10,000 W	VFD, VI, or VFI	0	0.3	0.4	0.3
$P >$ 10,000 W	VFD, VI, or VFI	0.25	0.5	0.25	0

This is problematic, particularly for VFDs whose main application is desktop computers, because none of the 4 load points are representative of modern desktop computer operation. Desktop computers typically spend much of their time and use most of their energy operating at loads of 10% or lower. At these low loading points, a UPS may deliver significantly lower efficiency that would not be captured under EPA's proposed approach.

To illustrate, consider a hypothetical desktop computer that complies with the California Energy Commission's December 2016 computer efficiency standards, which will go into effect in 2019 (tier 1) and 2021 (tier2), when the Version 2.0 specification will be in effect (at least for 2019).

A mainstream desktop computer with a 70 kWh typical energy consumption (TEC) as defined by the ENERGY STAR test procedure (50 kWh base allowance and 20 kWh of various adders), could draw around 16 watts in short idle mode, 12 watts in long idle mode, 2 watts in sleep mode, and 1 watt in off mode.

Such a desktop computer would typically have a power supply unit (PSU) with a maximum power rating in the 300 watt range, and the user may select a 400 watt (700 VA) UPS to provide margin for the monitor and computer accessories (the difference between 70 kWh and 300 W is due to the fact that TEC represents mostly idle load, while PSU power rating corresponds to the maximum power demand of a computer, with some margin to allow for expandability such as adding a graphics card).

When combined with the duty cycle measured by the University of California Irvine 2014 monitoring study,[1] and estimating power draws, weightings, and power factor for active mode, this gives the operating load points shown in Table 2. Active Low represents web browsing, office productivity software use, and media streaming, Active High represents gaming and other processing intensive tasks.

[1] http://www.energy.ca.gov/2014publications/CEC-500-2014-092/CEC-500-2014-092.pdf

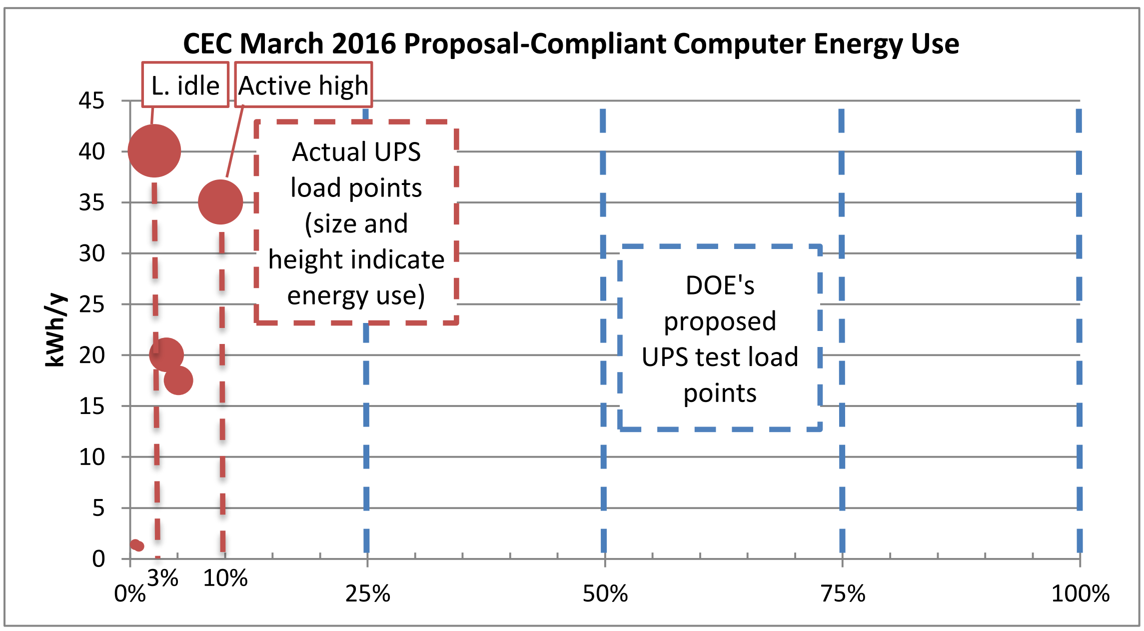
Table 2: UPS operating load points for hypothetical CEC-compliant desktop computer

Mode	Real power (W)	Apparent Power (VA)	PF	PSU Load	UPS Load	Mode weighting	Annual energy use (kWh)	Annual energy use (%)
Active high	50	67	0.75	20%	10%	8%	35	**30%**
Active low	25	36	0.70	10%	5%	8%	18	**15%**
Short idle	15	27	0.56	6%	4%	15%	20	**17%**
Long idle	10	18	0.56	4%	3%	46%	40	**35%**
Sleep	2	6	0.31	1%	1%	7%	1	1%
Off	1	4	0.26	0%	1%	16%	1	1%
Total						**100%**	**115**	**100%**

Table 2 shows that **98% of the annual energy use of a modern CEC-compliant desktop computer takes place between 3 and 10% of UPS load**. This shows a large gap between the current test points and the real-world operating range for this type of application.

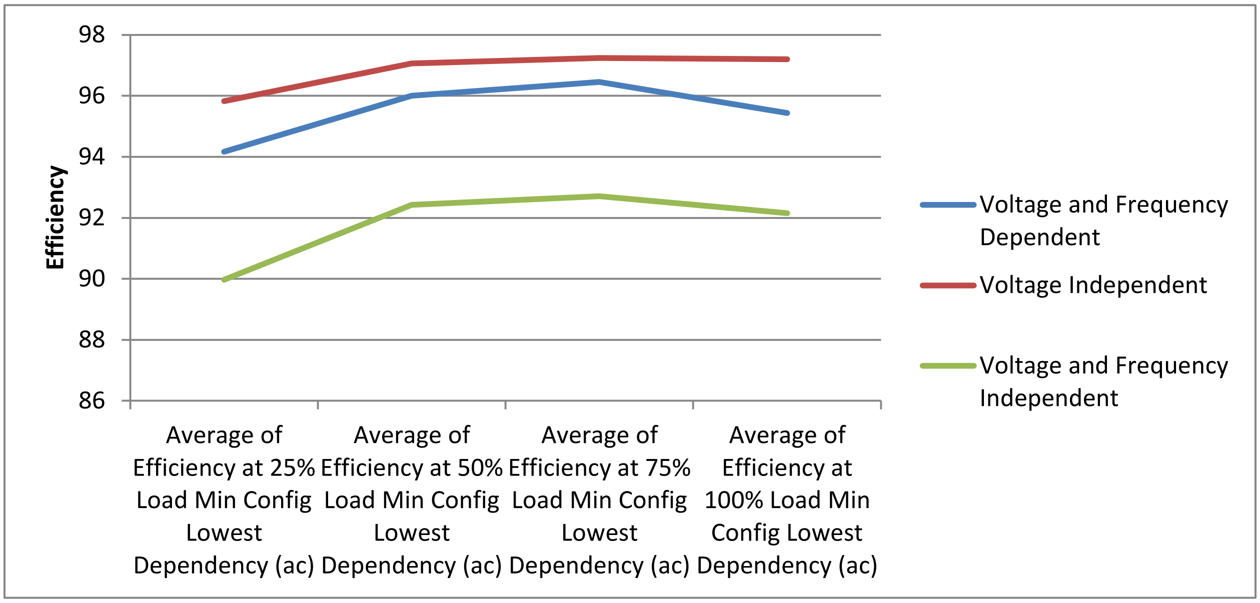
These results are plotted on Figure 1, and shows that the **proposed test points are not at all representative of the operating conditions of a CEC-compliant desktop computer.**

Figure 1: UPS operating load points for hypothetical CEC-compliant desktop computer



The ENERGY STAR data (despite not being available at loads lower than 25% given the current test procedure) suggests that UPS efficiency drops at lower load as shown in Figure 2.

Figure 2: ENERGY STAR QPL Efficiency Curves



Therefore, the test points and loading assumptions in EPA's draft 2.0 specification potentially significantly overestimate UPS efficiency in real-world operation, and incentivize manufacturers to invest in energy efficiency features that may not save energy in the real-world, while leaving low-load energy saving opportunities on the table.

We recognize that ENERGY STAR does not have the efficiency data at lower load points that is necessary to include those load points in the average efficiency formula. But ENERGY STAR should require the testing and reporting of efficiency at those load points for the following two reasons:

1. To collect data on the efficiency of UPSs at real-world load points and enable the inclusion of these load points in efficiency criteria in a future specification if appropriate;
2. To inform the market on the efficiency of UPSs in real-world operating conditions when used with desktop applications, including standby load (vampire power of the UPS when the desktop is switched off or in sleep mode), and UPS losses when desktops are in idle and low-intensity active mode.

Desktop computers are not the only application of UPSs, and other applications such as VOIP have different profiles. However, given the prevalence of this application, EPA should choose test points that capture typical operating conditions of the most common UPS applications, including desktop computers. We believe that testing UPS at 100% and perhaps even 75% load is not relevant for most applications because we expect users to select UPS with excess marginal capacities relative to the application, and are encouraged to do so by UPS vendors, as indicated in the California investor-owned utilities comments.

Stakeholders also claimed that users can right size UPS to minimize low-load operation. But the increasing dynamic range of computers (the ratio between max and min power) limits this:

Sizing for max power with some margin to minimize the risk of overheating will inevitably result in low-load operation for applications with a large dynamic range.

Standby losses: While off and sleep modes are only minor contributors to total energy consumption under the UCI study duty cycle (2% of TEC for 23% of the duty cycle), this doesn't account for cases where computers may remain unused in off or sleep mode for long periods of time, still plugged into the UPS. We therefore recommend the inclusion of one test point at 0% load to capture the standby losses of the UPS.

Proposed test points and weighting for VFD UPSs:

While ENERGY STAR testing requirements need to be compatible with DOE's test method, EPA can add test points to the DOE test procedure.

We suggest the following load points and weightings for VFD UPSs:

VFD UPS load point	**0%**	**5%**	**10%**	**25%**	**50%**
Weighting	0.1	0.3	0.3	0.15	0.15

Testing burden: Testing additional load points is virtually free for manufacturers: the cost of testing is driven mostly by product shipment and setup costs. Once the product is setup for testing, testing at 4 or 7 load points makes no meaningful difference.

We therefore believe this proposal has no real downside, and will only help inform the next revision of the specification with appropriate data. In the meantime, it will also help users understand the performance to expect from UPS's in real-world operating conditions, select products accordingly, and it will send manufacturers a signal that they need to start considering low-load efficiency in their designs, potentially yielding some savings even without including these load points in the average efficiency formula.

VI and VFI: We recommend a weighting of 0.25 at 25% load

The typical applications for VI and VFI UPSs are often data center equipment: servers, data storage and networking equipment. While the typical loading of a data center UPS is higher than that of a desktop computer UPS, data center servers have also been on a long-term trajectory of increasing dynamic range and decreasing idle load.

In addition, a recent study (Koomey, Taylor, April 2017)[2] shows that more than half of data center servers are still either idle or "comatose" (haven't been used in at least 6 months), meaning they spend the majority of their time operating at the bottom of their dynamic range. The same data also shows that virtualization is not eliminating this problem as 75% of virtual machines were found to be idle or comatose themselves.

The combination of decreasing idle power and the large number of idle or near-idle servers means that low-load still matters for VI and VFI UPSs. A weighting of 0 as proposed in Version

[2] http://anthesisgroup.com/wp-content/uploads/2017/03/Comatsoe-Servers-Redux-2017.pdf

2.0 would completely ignore UPS operation below 50%. This would be a big disconnect with how many UPSs still operate in data centers today and for the foreseeable future. We recommend a weighting of 0.25 at 25% load for VI and VFI UPSs.

Thank you for the opportunity to participate in this specification development process and for your consideration of our comments.

Sincerely,

Pierre Delforge
Director, High Tech Sector Energy Efficiency
Natural Resources Defense Council