APC by Schneider Electric Comments on ENERGY STAR® Uninterruptible Power Supply (UPS) Specification Eligibility Criteria Draft 1 Version 1.0 & Test Method Draft 2

Thank you for allowing APC by Schneider Electric to provide input into the ENERGY STAR UPS specification development process. This document summarizes our responses to EPA's requests for comments on the Eligibility Criteria Draft 1 Version 1.0 and Draft 2 Test Method. In general our comments follow and elaborate on the points we made during the May 12, 2011 meeting in Washington, DC and are presented in the same order as the documents. We look forward to continued productive dialog with EPA on the specification.

APC by Schneider Electric manufactures, markets and installs Uninterruptible Power Supply (UPS) systems world-wide with ratings from a few hundred watts to several megawatts. In 2007, Schneider Electric acquired APC and combined it with MGE UPS Systems to form Schneider Electric's Critical Power & Cooling Services Business Unit, which recorded 2008 revenue of €2.6 billion and employed 12,000 people worldwide. In addition to UPSs, our other products include precision cooling units, racks, physical security and design, and management software.

Comments

- We suggest that the following definitions be included in the specification:
    - Parallel UPS: A UPS comprised two or more single UPS units whose a.c. outputs, in normal mode of operation, are connected to a common a.c. output bus. The total quantity of single UPS units in a parallel UPS equals "n + r" where n is the quantity of single UPS units required to support the load; r is the quantity of redundant UPS units. Parallel UPSs may be used to provide redundancy, to scale capacity or both.
    - Modular UPS: A UPS comprised two or more single UPS units, sharing 1 or more common frames and a common energy storage system, whose a.c. outputs, in normal mode of operation, are connected to a common a.c. output bus contained entirely within the frames. The total quantity of single UPS units in a modular UPS equals "n + r" where n is the quantity of single UPS units required to support the load; r is the quantity of redundant UPS units. Modular UPSs may be used to provide redundancy, to scale capacity or both.
    - Redundant UPS: A modular or parallel UPS containing at least one redundant UPS unit ("n + 1") presenting an availability higher than that of the single UPS corresponding because any UPS unit may be isolated in case of failure and for maintenance procedures without affecting the continuity of power to the load.

- Multi-mode UPS: A UPS capable of operation in more than one normal mode of operation. Typically each normal mode will have a different Input Dependency Characteristic.

- Consumer UPS: An a.c. output UPS with a total output apparent power rating of less than or equal to 1.5 kVA.

- Commercial UPS: An a.c. output UPS with a total output apparent power rating of greater than 1.5 kVA and less than 10 kVA.

- Data Center UPS: An a.c. output UPS with a total output apparent power rating of greater than or equal to 10 kVA.

- Redundancy Levels:

    - N+0: A modular or parallel UPS that cannot tolerate the failure of any single UPS unit and continue to operate in a Normal Mode.

    - N+1: A modular or parallel UPS that can tolerate the failure of any single UPS unit and continue to operate in a Normal Mode.

    - 2N: A modular or parallel UPS that can tolerate the failure of half of the single UPS units and continue to operate in a Normal Mode.

- We suggest that the following definitions be removed from the specification as they are not referenced by the specification nor the test procedure:

    - Stored Energy Mode

    - Bypass Mode

    - Maintenance bypass (path)

    - Static bypass (electronic bypass)

- We agree that operating redundancy levels for UPSs vary both with applied load and customer deployment strategy. We therefore suggest that all ENERGY STAR testing be done on N+0 UPS configurations, with manufacturer supported redundancy levels and paralleling capabilities described on the PPDS.

- We suggest that the term “Input Dependence Characteristic” be replaced with the term “Input Dependency Characteristic” to be consistent with IEC 62040-3 Ed. 2.

- Regarding the apparent misclassification of the Input Dependency Characteristics of UPSs by vendors during the initial data collection period, we suggest that this is due to the unfamiliarity of some vendors with IEC 62040-3. We do not feel that this represents a weakness with the IEC standard and we are confident that such errors will be eliminated once CBs are involved in the data

submittal process. We suggest that topology be listed on the PPDS, both to serve as a check of declared Input Dependency Characteristic and because of its familiarity to end users.

- UPSs with all three Input Dependency Characteristics exist in the market because UPSs are used for many different purposes, by customers in need of varying amounts of protection, and with varying budgets. In general VFD UPSs are the least complex and lowest cost, but they also provide the least protection for the load (i.e.: only blackout protection with a relatively long gap in output power while transitioning to stored energy mode of operation). VI UPSs are more complicated and more costly but they provide higher protection than VFD because they regulate the magnitude of the voltage supplying the load (during brownouts and swells) and generally have a smaller gap in output power while transitioning to stored energy mode of operation than VFD UPSs. VFI UPSs are the most complicated and costly because they create a tightly regulated sine-wave output to supply the load and have no gap in the output power while transitioning to stored energy mode of operation.

- We suggest that section 2.1.1 explicitly include DC output UPSs.

- We suggest that section 2.2 explicitly exclude all outdoor UPSs (e.g.: pole mounted or ground mounted cable TV UPSs, electrical substation UPSs, etc.), industrial UPSs and rectifier systems not intended for use as UPSs.

- We believe that UPSs, refurbished exclusively by manufacturers or their authorized partners, to meet or exceed their original performance levels, using components of equal or better specifications, should be eligible for inclusion in the ENERGY STAR program utilizing the version of the specification that was in effect on their original date of manufacture, provided that the original date of manufacture is marked on the product.

- Because there are 3 main classes of UPSs: consumer, commercial and data center; each tailored to the needs and usage patterns of these market segments, we believe that the ENERGY STAR specification should have 3 specific average loading-adjusted efficiency formulas.

    - Consumer UPSs (≤ 1,500 VA) typically protect desktop computers and their associated peripherals, small network gear, home servers and audio visual equipment. These UPSs are commonly heavily loaded when the protected equipment is operating (because consumers typically buy the smallest/cheapest UPS that will power their equipment) and lightly loaded when the protected equipment is in standby or turned off. Accordingly we recommend the following formula that recognizes all possible modes of operation for these products:

      $$Eff_{AVG} = 0.20 \times Eff|_{25\%} + 0.20 \times Eff|_{50\%} + 0.30 \times Eff|_{75\%} + 0.30 \times Eff|_{100\%}$$

Note that just as $Eff|_{25\%}$ is a proxy for light loads, $Eff|_{100\%}$ is a proxy for loads above 87.5%. Note also that many consumer UPSs lack load level indicators so many customers may be running near full load without realizing it.

- Commercial UPSs (1.5 kVA to 10 kVA) are generally used to power small installations of servers and networking equipment which are constantly operational. These UPSs generally do not support parallel operation and due to their cost, they are commonly utilized at higher loadings. Therefore, we recommend the following formula for these products:

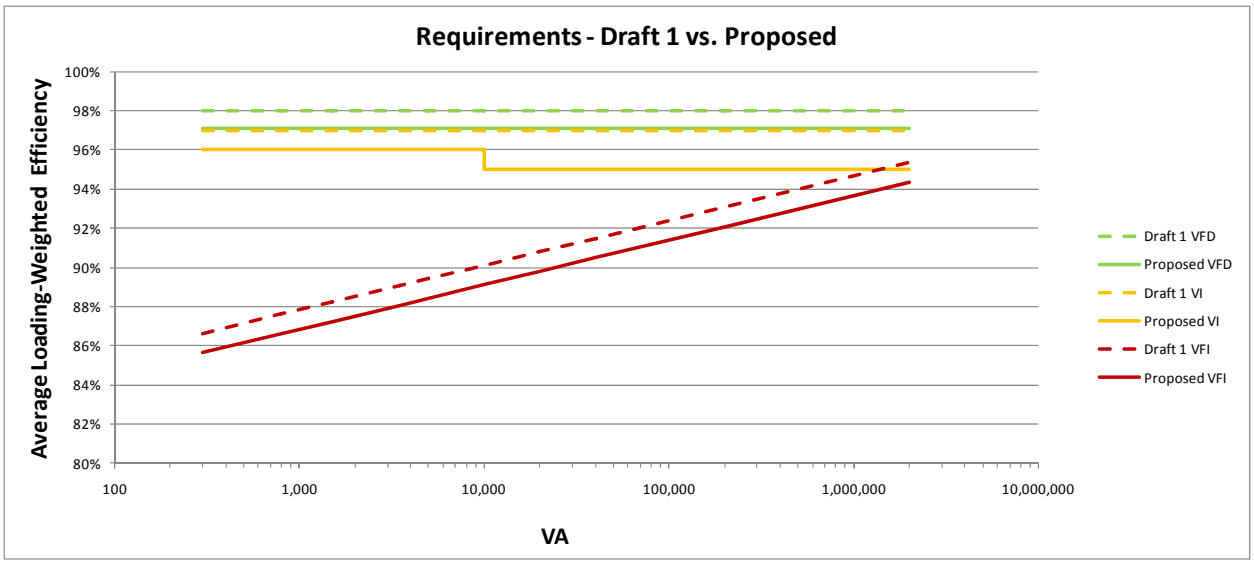
  $Eff_{AVG} = 0.00 \times Eff|_{25\%} + 0.30 \times Eff|_{50\%} + 0.40 \times Eff|_{75\%} + 0.30 \times Eff|_{100\%}$

- Data center UPSs (≥ 10 kVA) are used to power large installations of servers, storage and networking equipment which are constantly operational. These UPSs are deployed in N+0 configurations in less critical data centers, N+1 configurations in more critical data centers and 2N configurations in the most critical data centers. Therefore, we recommend the following formula for these products:

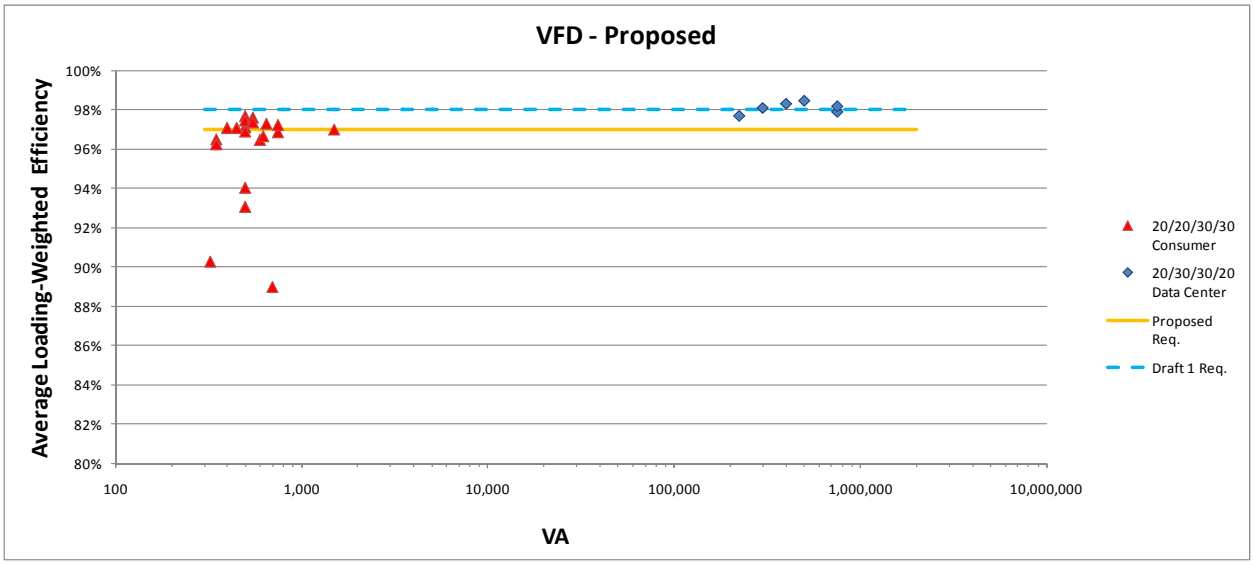
  $Eff_{AVG} = 0.20 \times Eff|_{25\%} + 0.30 \times Eff|_{50\%} + 0.30 \times Eff|_{75\%} + 0.20 \times Eff|_{100\%}$

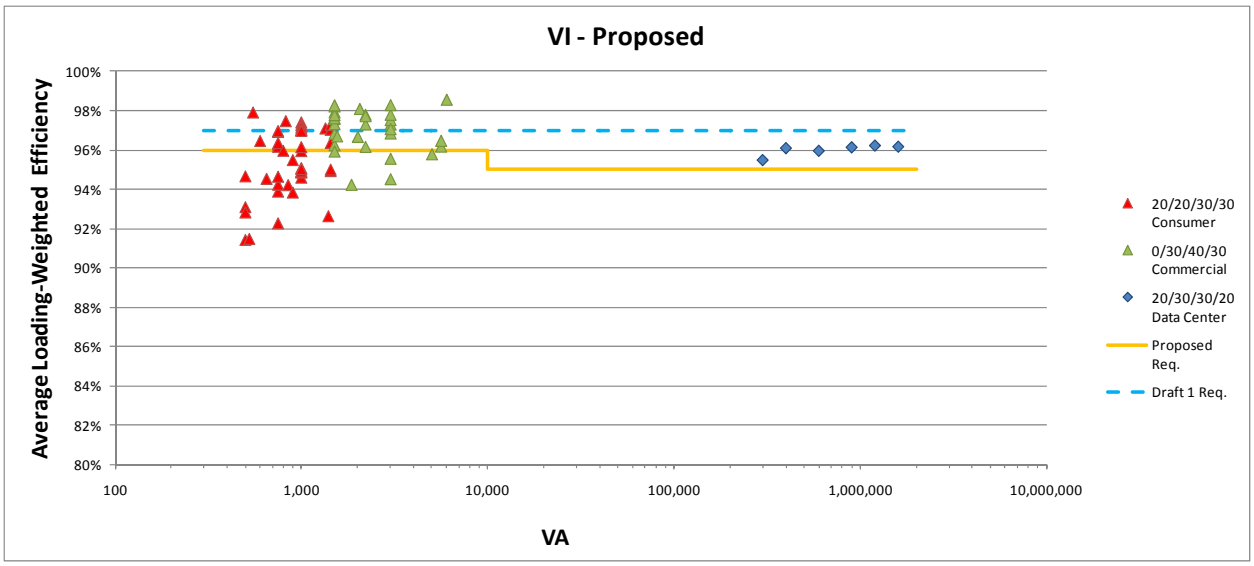
- Similarly, because each of the 3 Input Dependency Characteristics has one or more topologies best suited to delivering the associated level of performance and because the anonyimized data set clearly reveals the inherent efficiency differences of each topology, we recommend the following Minimum Average Efficiency Requirements:

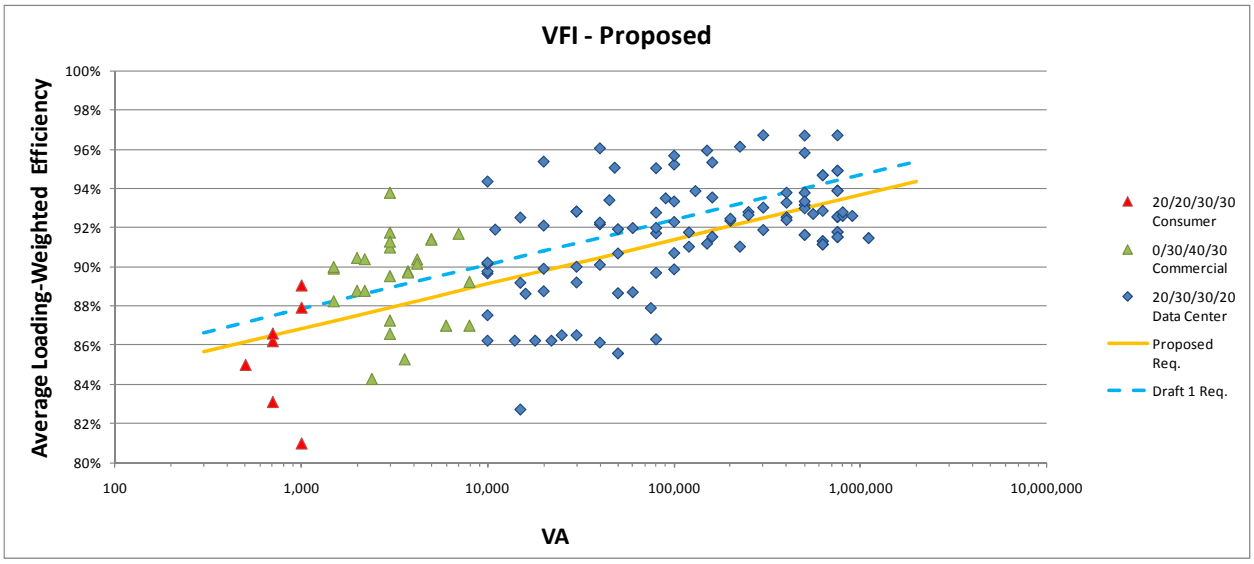
	Minimum Average Efficiency Requirement		
Input Dependency	**Consumer** (≤1.5kVA)	**Commercial** (1.5kVA-10kVA)	**Data Center** (≥10kVA)
VFD	97%		
VI	96%		95%
VFI	$0.0099 \times \ln(S) + 0.80$		



- The following charts show the anonyimized data set, reweighted according to our proposals, along with the Draft 1 and our proposed requirements:







- By analyzing the above charts, we feel that the Draft 1 requirements are too high because many sizes and categories would have very few or no qualifying products:
    - Consumer VFD (the majority of the consumer market)
    - Data Center VFD (eco-mode double conversion UPSs)
    - Data Center VI (delta conversion UPSs)
    - Consumer VFI (small double conversion UPSs)

- Additionally we feel that the limits should be lowered for the following reasons:
    - ENERGY STAR is meant to distinguish the top 25% of available products, not the top 20%, and the market is unlikely to evolve significantly in the time prior to implementation of the version 1.0 specification.
    - The best performing products likely use proprietary (patented) technologies to achieve such high performance.
    - There may not have been sufficient participation in all product categories to get a true sense of the performance of the entire market.
    - As evidenced in other successfully deployed global programs, vendors need reasonable margin above the requirements to be confident that every product will pass verification testing regardless of: product to product variations, minor design changes, test equipment tolerances and other test repeatability factors.
    - Slightly lower requirements will likely lead to greater participation and provide a roadmap for future improvements.
- We feel that our proposals adequately address all of the above concerns.
- Regarding UPSs with multiple normal modes, we emphatically believe that all products must qualify solely on the basis of their performance in their most protective mode. We believe this because:
    - End users operate UPSs almost exclusively in their most protective mode because it is usually impossible to determine the ride-through capabilities and other electrical compatibility requirements of the ICT equipment which generally constitutes the majority of the UPS load.
        - ICT power supplies from tier 1 vendors no longer meet the CBEMA/ITIC requirement of 20ms holdup time at full load with low line. Note that the curve was last updated in 2000.
        - 10ms holdup time at 80% load with nominal line is more common now, but not guaranteed.
        - PFC power supplies draw high peak currents after even brief glitches which can overload the UPS.
        - While individual power supplies can be adequately characterized, entire data centers containing thousands of devices cannot be.
- Allowing UPSs with the same topology to qualify in different modes could be confusing to customers and potentially enable manipulation by unscrupulous vendors. Consider for example 2 UPSs: UPS X, a 100kVA double conversion

UPS without an eco mode that has a weighted average efficiency of 96% in VFI mode, and UPS Y, a different 100kVA double conversion UPS with an eco mode that has weighted average efficiencies of 90% in VFI mode and 98% in VFD mode.

  - If UPSs are allowed to qualify in different normal modes, then both UPSs will qualify (UPS X as VFI and UPS Y as VFD). For those few customers who can safely utilize VFD mode, UPS Y has a 2% efficiency advantage, provided that they constantly use VFD mode. For customers who need VFI mode (the vast majority – at least in data center applications), UPS X has a 6% efficiency advantage. The main concern is that customers may not know the difference between VFD and VFI modes and consider the performance of both UPSs as equal because they are both double conversion topologies. These customers could easily reach, or be lead to, either of the following false conclusions:

    - UPS Y will always operate at 98% efficiency - This will only happen when the UPS is configured to operate in VFD mode and the input power is sufficiently good for the UPS to operate in VFD mode. At all other times UPS Y will operate in VFI mode at 90% efficiency.

    - UPS Y will provide the same level of protection as UPS X – This will only happen when UPS Y is configured to operate exclusively in VFI mode resulting in operation at only 90% efficiency.

  - If, on the other hand, UPSs must all qualify in their most protective mode, then only UPS X will qualify and the vast majority of customers will easily identify the UPS which is more efficient in the mode they are most likely to operate it in.

- A final argument as to why all UPSs must qualify in their most protective mode is as follows. If EPA allows UPSs to qualify in less protective modes, then vendors will have incentive to invest in improving the efficiency of these modes and will cease to improve, or possibly cut costs and decrease the performance of, their most protective mode. If customers continue to use the most protective mode, then, at best, ENERGY STAR saved no energy and at worst it actually caused an increase in UPS energy consumption!

- EPA should not lose sight of the fact that UPSs that natively have different most protective modes exist in all sizes. Customers who know with certainty the level of protection required by their load seek out products with the required mode of operation and typically realize significant cost savings compared to buying a higher performance UPS and operating it in a lesser protective mode.

- In spite of the above, we believe that products with multiple normal modes should be able to declare their presence on the PPDS.

- Regarding UPS input power factor requirements, we prefer that they be excluded from the standard because high efficiency UPS typically have high input power factor and the upstream losses related to UPS power factor are small.

- With respect to power, energy and efficiency measurement and reporting requirements, we recommend that these also be absent from the standard. In consumer and commercial applications either no metering is required or the display on the UPS is adequate. In data center applications, often multiple UPSs are deployed in parallel. In such instances, metering in the output panel board or paralleling box is far simpler, more accurate and more cost effective than metering individual UPSs and summing their outputs to determine totals.

- In regard to life cycle assessment, we feel that declaration and requirements should not be part of the program until such time as IEC 62040-4 is released and widely utilized by our industry. Any LCA related information prior to that time would likely be more confusing than useful, fall outside of the WTO accepted global industry standard practices of the IEC, and won't be performed on a consistent basis from product to product or vendor to vendor.

- With respect to the facilitation of battery recycling there are extraordinary programs in place lead with distinction by two organizations. The Rechargeable Battery Association (PRBA), and the Call2Recycle (RBRC mark). We would be happy to connect the EPA with both organizations. In almost all cases UPS systems use lead acid battery technology. There are 30 States which ban the improper disposal of lead acid batteries, and RBRC is funded by manufacturers to properly recycle all rechargeable batteries. It is generally accepted that, in the USA, 99% of stationary lead acid batteries are recycled already.

- Regarding alignment with DOE battery charger regulations, we believe there should be no coordination or overlap of the programs for the following reasons:

    - ENERGY STAR applies to all UPSs; DOE only regulates consumer UPSs

    - ENERGY STAR applies to UPSs with all types of energy storage; DOE regulations only apply to UPSs with chemical batteries

    - ENERGY STAR tests UPSs with their output on (as they are typically used); DOE tests UPSs with their output off

    - ENERGY STAR uses the International Standard test procedure for UPSs (IEC 62040-3 Ed. 2); DOE uses a non-standard test procedure designed to test battery chargers, not UPSs

    - ENERGY STAR has global reach; DOE regulations apply only in the USA

    - ENERGY STAR is a voluntary program that recognizes the most efficient products; DOE regulations legally prevent low efficiency products from being sold

- With respect to testing, we feel that EPA needs to make it very clear that the UPS Test Method document is only a supplement to IEC 62040-3 Ed. 2 and is not intended to be a standalone document nor a different test method. IEC 62040-3 Ed. 2 is readily available online and may be purchased by UPS vendors and CBs for a reasonable cost.

- Lastly, we feel that proposed effective date of September 1, 2011 will be difficult to achieve for even the most committed CBs and vendors. Despite the fact that it has not been typical practice to release a new standard and not have it take immediate effect, we feel that it would be beneficial to all parties to have a 90 or 120 day period after publication of the final specification before the program goes live. This time will be used by CBs to accredit vendor labs and by vendors to test products so that multiple qualifying products will be available on launch day, further building upon the success of ENERGY STAR.

Conclusion

Thank you again for allowing APC by Schneider Electric to provide input into the ENERGY STAR UPS specification. As explained above, we strongly believe that EPA should adopt different weighted average formulas for each market segment and the proposed requirements for each performance category should be lowered. We look forward to working closely with EPA on this important work.

Please contact Jim Spitaels via email at jspitael@apcc.com with any questions or concerns you may have regarding these responses or any of our earlier correspondence.