ENERGY STAR Draft 3 UPS Specification Comment Summary and Response

Topic	Subtopic	Summary of Comments	EPA Responses
Definitions	Bypass	One stakeholder noted that the bypass definition omits a bypass utilizing a contactor or a switch that can be automatically operated by the UPS. For greater clarity, the stakeholder recommended that EPA substitute the term “Manual Bypass” for “Maintenance Bypass” and include a definition for “Automatic Bypass” that encompasses a bypass utilizing a contactor and a static bypass.	Per the stakeholder's suggestion, EPA has clarified the definition of Bypass in the Final Draft.
Rotary UPS		One stakeholder reiterated that UPS specification definitions and classifications have been elaborated for Static UPSs only and do not explicitly account for Rotary UPSs. Since the scope includes Rotary UPSs, the stakeholder expressed the need for EPA and DOE to validate that all definitions, classification, and measurement methods are also applicable to Rotary UPS. Supporting the applicability of the ENERGY STAR specification and test method to Rotary UPS, a manufacturer of rotary products noted that the IEC 62040-3 procedures are more precisely specified than the IEC 88528-11 procedures for Rotary UPSs. Prior to IEC 88528-11’s release in 2004, the stakeholder used IEC 62040 for Rotary UPSs and generally agrees with its applicability to Rotary UPSs in this instance. Nevertheless, the manufacturer suggested a few modifications to the specification to accommodate Rotary UPS including more specific definitions for Rotary UPS (RUPS) and Diesel coupled rotary UPS (DRUPS). The manufacturer further suggested that the definition for Stored Energy Mode specify that that “all power is derived from the energy storage system or, in case of a DRUPS, from the integrated Diesel engine or a combination of both.”	In the Final Draft, EPA has incorporated stakeholder suggestions to better accommodate Rotary UPS. EPA is unaware of any prohibitive differences between IEC 62040-3 and the ENERGY STAR test method approaches and IEC 88528-11 for Rotary UPSs. As the stakeholder indicated, IEC 62040-3 was previously used for testing Rotary UPSs and the methods referenced by the ENERGY STAR test method should be easily applicable to Rotary UPSs Consistent with the ENERGY STAR guiding principles, inclusion of Rotary UPS permits the Version 1.0 specification to be technology neutral as is already the case with the energy storage mechanism (i.e., does not differentiate between battery versus flywheel). Furthermore, it enhances the value of the specification by providing consumers a wider variety of products for comparison. Nevertheless, EPA welcomes further feedback and data on Rotary UPSs.
Significant Digits and Rounding		To ensure proper measurement and rounding, one stakeholder suggested that the following statement be added to Section 3.1: Significant Digits and Rounding, “according to IEC 62040-3 J.4 c the final efficiency values in % shall be rounded to the first decimal place at the given rated load fraction.”	For consistency with Appendix J of IEC 62040-3 (referenced by the ENERGY STAR test method), EPA has revised its requirements to require rounding to the third decimal place (when the efficiency is expressed as a decimal).
Ac-output Efficiency Requirements	Loading Profiles	A manufacturer of large UPSs commented that there is typically less built-in overcapacity in large-scale systems than in small-scale systems; therefore the manufacturer suggested that EPA add the following loading profile for UPSs with output power greater than 200kW: • 10% weighting at 25% load, • 50% weighting at 50% load and • 40% weighting at 75% load. The load profile takes into account large scale UPSs that usually operate at about 45% load in N+N redundancy and 65% to 85% load in N+1 redundant systems—only a few large scale UPSs operate below a load level of 30%. The manufacturer further noted that the distinction between UPSs greater than 200 kW is also applied in IEC 62040-3 Tables I.4 to I.6. Another stakeholder suggested an additional bin for lower-power UPSs, noting along with an industry group that some UPSs with output power below 1.5 kW are intended for commercial applications, particularly those models with VFI and VI input dependency characteristic. As such, they suggested that the Draft 3 loading assumptions for UPSs in the range of 1.5 kW < P ≤ 10 kW (associated with commercial UPSs) also be applied to VFI and VI models with P ≤ 1.5 kW creating two distinct bins within the UPS ≤ 1.5 kW category.	Based on limited data, EPA has not revised the loading profile for UPSs with output power greater than 200 kW in the Final Draft. EPA continues to welcome data on how to improve loading profiles in a future Version 2.0 of the specification. In the stakeholder memo released on February 3, 2012, EPA proposed that the Draft 3 loading assumptions for UPSs in the range of 1.5 kW < P ≤ 10 kW also be applied to VFI and VI models with P ≤ 1.5 kW since these models rated above and below 1.5 kW are used for the same commercial applications. EPA assessed the impact of this new loading profile using the existing dataset and adjusted the proposed efficiency requirements accordingly. In response to the memo, two stakeholders expressed support for this revision to the loading profile.

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Ac-output Efficiency Requirements	Efficiency Requirements	One stakeholder suggested EPA consider loosening efficiency requirements for VFD and VI UPSs with output power less than 1.5 kW to account for fixed losses (fans, LEDs displays, etc.) that are a significant percentage of rated output power. Another stakeholder and industry group similarly requested lowering efficiency requirements by at least 0.5% to provide a margin for unit-to-unit and lab-to-lab variations. The stakeholder further pointed out the lower efficiency of 120 V units and that lower overall efficiency requirements would be preferable to creating a distinct bin/category specifically for the 120 V units. For VFI UPSs with output power less than 1.5kW, EPA revised the requirement from 0.97 to a logarithmic line in Draft 3. One stakeholder noted that the Draft 3 requirement is about 10 percentage points less stringent than Draft 2 levels and commented that price differences between VFI, VI, and VFD UPSs do not fully justify the revision. Instead EPA should reconsider the VFI efficiency requirement against the ENERGY STAR guiding principle of setting levels such that only 25% of products on the market qualify. In the February 3rd stakeholder memo, EPA proposed to raise the requirement for VI UPSs between 1.5 kW and 10 kW, and that for VFI UPSs by 1 percentage point (to 0.97 for VI and 0.0099 x ln(P) + 0.815 for VFI). In response to this most recent proposal, three stakeholders requested that at this late stage, EPA retain the Draft 3 VFI level, citing adverse impacts on manufacturers' design planning. Two of these stakeholders commented that if the qualification rates below 10 kW are expected to be too high, then EPA should only adjust the requirements in that range, retaining the Draft 3 requirement for VFI units above 10 kW.	EPA is sensitive to the impact of testing variation on efficiency results, as well as to the fact that this is a completely new specification. EPA also acknowledges that there are some areas of the UPS market that have a relatively tight energy efficiency range from product to product--though there is still room to differentiate efficient products in all areas of the UPS market. Stakeholder comments from many diverse groups have been very valuable in providing guidance as to appropriate level changes that maintain ENERGY STAR's standard for energy efficiency while preventing undue burden on specific segments of the UPS market. EPA therefore proposes the following level changes for the final draft. VFD < 1.5kW: 96.7% (-0.3% from Draft 3) VI < 1.5kW: 96.7% (-0.3% from Draft 3) 1.5kW < VI < 10kW: 96.7% (+0.7% from Draft 3) VFI < 10kW: 0.0099*ln(P) + 0.815 (+1% from Draft 3) VFI > 10kW: 0.0099*ln(P) + 0.805 (unchanged from Draft 3) Per stakeholder feedback, EPA also analyzed the impacts of the revised requirements on UPSs with 120 V output and concludes that a representative proportion of UPSs at that low output voltage will be able to qualify with the levels above, such that no separate requirement for low-voltage UPSs will be necessary.
Multi-Mode UPS		One stakeholder and an industry group commented that Multiple-normal-mode UPSs that meet ENERGY STAR efficiency requirements for Single-normal-mode UPSs when operating in their lowest input dependency mode should not be required to ship in the highest input dependency mode. In other words, the stakeholder proposed that only those models that receive a benefit from their highest input dependency be required to ship with that mode enabled by default. For example, a Multiple-normal-mode UPS with VFI efficiency sufficient to meet the requirements, should have to test and report both VFI and VFD performance, but should not have to ship in VFD mode. The stakeholder and industry group noted that if this requirement is retained, vendors may remove high efficiency modes from models altogether to prevent shipping in a higher input dependency mode and putting "critical systems at risk." The stakeholder further recommended that all supported normal models be listed on the PPDS and efficiency at each load step, for every tested normal mode, be reported on the PPDS.	EPA has clarified the Multiple-normal mode UPS requirements in the final specification. EPA agrees that Multiple-normal-mode UPSs that meet ENERGY STAR efficiency requirements for Single-normal-mode UPSs when operating in their lowest input dependency mode should not be required to ship in the highest input dependency mode. EPA has further specified that all supported normal modes and tested efficiencies at each load step shall be listed on the PPDS regardless of whether the Multiple-normal-mode average efficiency calculation is applied in the model's qualification. Stakeholders confirmed support for this proposal in comments responses to the February 3rd memo.
Dc-output Efficiency Requirements		One stakeholder reiterated that the efficiency of rectifiers tends to decrease slightly as the output voltage decreases -- best-in-class 24 V models are generally about 1% lower in efficiency than their 48 V counterparts. As such, the stakeholder recommended that EPA loosen the Dc-output UPS/Rectifier efficiency requirement from 0.955 to 0.950 noting that it would accommodate 24 V models (common to numerous cell sites) while still maintaining an aggressive requirement for 48 V models. During the stakeholder webinar, stakeholders expressed support for EPAs Draft 3 proposal that vendors may qualify both Dc-output UPS systems and individual rectifier modules.	As noted previously, EPA has decided not to revise the minimum average efficiency requirement of 0.995 in this Version 1.0 of the specification due to a lack of data for Dc-output UPS/rectifiers at lower output voltages (24 V). At this time, the most efficient 24 V models may qualify for ENERGY STAR. EPA welcomes further data to inform future versions of the specification. EPA has maintained the eligibility for both Dc-output UPS systems and rectifier modules to separately qualify for ENERGY STAR in the Final Draft.

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Metering	Dc-output UPS	One stakeholder noted that EPA should revise the specification to explicitly include a metering incentive for eligible Dc-output/Rectifier models. Another stakeholder commented that most Dc-output UPS systems are usually in dark, unmanned facilities where measurements are read via electronic communications rather than a physical display on the product. The stakeholder also noted that dc-power plant monitoring has been common for over two decades.	Since Dc-output UPS users would benefit from energy metering for PUE measurement, EPA has extended the metering requirement to Dc-output UPSs/Rectifiers in the Final Draft.
Metering	Metering Credit	Multiple stakeholders expressed support for EPA's Draft 3 proposal to include a metering efficiency credit for eligible models. Three of the stakeholders suggested that EPA extend an incentive (even if it were smaller) to eligible products with output power ≤ 10 kW since metering is useful to operators of UPSs of all sizes. In contrast, another stakeholder was uncertain whether a meter would result in direct energy savings for data centers and did not think incentivizing metering warrants a loosening of the efficiency requirements. Instead of an optional efficiency incentive for installed or bundled meters, the stakeholder recommended that either the meter be a mandatory requirement for models with output power greater than 10 kW or that ENERGY STAR partners be required to inform customers of the benefits of meters.	EPA has retained a metering incentive for Ac-output UPS models with output power greater than 10 kW in the Final Draft (and extended it to Dc-output UPSs/Rectifiers of similar size). Upon further review of the dataset, EPA has reduced the efficiency credit to 1% instead of 2% to maintain qualification rates low enough that the ENERGY STAR mark serves as a differentiator in the market. EPA will not provide a meter credit for UPSs with output power ≤ 10 kW due to their lesser prevalence in datacenters and the significant impact of a metering credit on qualification rates.
Metering	Display & Communications	Three stakeholders recommended that UPSs communicate information using a common protocol, with one stakeholder suggesting: Modbus RTU, Modbus TCP, and SNMP (v1, 2, or 3). For Ac-output UPSs with output power greater than 10 kW, one stakeholder suggested that the UPS physically display output energy while Ac-output UPSs with output power less than or equal to 10 kW should have the option to use a software-based interface. In contrast, another stakeholder suggested that in order to reduce cost, and speed time to market, that EPA include a provision that will enable UPSs to receive the metering incentive if it provides an energy (in kWh) data output either by a display *or* via an industry-standard protocol.	Per stakeholder suggestions, EPA has incorporated communication requirements into the Final Draft, specifying that the meter must use one of the following common protocols: Modbus RTU, Modbus TCP, or SNMP (v1, 2, or 3). At this time, EPA will not require the meters to provide a display, though manufacturers are encouraged to provide one if possible.

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Metering	Measurement Requirements	In response to Draft 3, one stakeholder suggested that EPA require that the meter measure the UPS's output energy (current and voltage monitors are not sufficient) in all non-failure modes where the UPS is supplying power to the load (e.g., normal, bypass and stored energy modes). In the February 3rd memo, EPA proposed referencing the IEC 62053-21 Class 2 standard for (kWh) measurement accuracy. However, stakeholders commented that UPS watt-hour metering circuitry is not able to comply with any accuracy standards developed for stand-alone energy meters. Stakeholders recommended that EPA omit requirements not applicable to a stable UPS environment and instead develop language from relevant sections of the following standards: • IEC (relevant to U.S. and international markets): IEC 60687 Classes 0.2 S or 0.5 S, IEC 61036 Classes 1.0 or 2.0, IEC 62053-21 Classes 1.0 or 2.0, IEC 62053-22 Classes 0.2 S or 0.5 S • ANSI (commonly referenced in U.S. market): ANSI C12.1, ANSI C12.16 Classes 0.5 or 1.0, ANSI C12.20 Classes 0.2 or 0.5 Stakeholders further suggested that EPA take into account the current transformers (relevant for high output power models) by setting a metering system accuracy level (meter % accuracy + current transformer % accuracy = metering system accuracy). One stakeholder suggested EPA consider referencing the following current transformer standards: • IEC 60044-1 / IEC 61869-2 Classes 0.1, 0.2, 0.2 S, 0.5, 0.5 S, 1, 3 or 5 • ANSI /IEEE C57.13 Classes 0.3, 0.6 or 1.2 Based on the typical capabilities of UPS metering circuitry, stakeholders recommended that the meter measure energy at an accuracy of ± 5% of the maximum system rating at loads above 10%. A couple of stakeholders commented that a 2% level of metering accuracy would significantly increase design costs and reduce the prevalence of eligible meters internal to the UPS.	The intent of the metering requirements is to provide end-users with the means to more accurately monitor their data center energy consumption, calculate Power Usage Effectiveness (PUE), and have the option to participate in the ENERGY STAR Buildings labeling program. For external meters that are bundled with a UPS, EPA proposes an error of less than or equal to 2 percent, exclusive of current transformers and other accessories, and when operated at conditions typical of the UPS. Because these external UPS meters are used in a controlled environment, they do not need to be evaluated against all the criteria (e.g., power factor, harmonics, load imbalance) in the more general IEC 62053 and ANSI C12.1 meter standards. This allows external meters that already comply with IEC and ANSI Class 2 or better to qualify, while enabling the use of meters that have the required accuracy but have not been fully tested to the other requirements of these standards. In the case of integrated/internal meters that are built into a UPS, there is no known standard to reference. EPA therefore proposes an overall 5 percent accuracy requirement for the whole metering system, inclusive of current transformers, etc. Together, these two options provide manufacturers the option to choose between adding to their existing system capabilities with an internal meter or bundling an external meter. The external meter requirement ensures the accuracy of the provided meter while allowing customizations of current transformers, etc. to take place according to the needs of the UPS operator on site, acknowledging that the final "meter system" error will be higher than 2% due to other added components that are outside the purview of the UPS manufacturer. However, all aspects of an internal/integrated meter system are within the control of a UPS manufacturer, so an overall "meter system" requirement of 5% (which account for the meter, current transformers, etc.) is proposed. After discussions with stakeholders, EPA believes that this 5% internal meter system accuracy is roughly aligned with the full accuracy of an external meter system when the 2% meter error is combined with the errors that arise from current transformers and other equipment.
Metering	External Meter	In Draft 3, EPA proposed that UPSs may either be installed with an internal meter or sold with a bundled external meter. For the external meter, two stakeholders recommended that only the meter itself be required to be sold with the UPS unit whereas meter accessories (i.e., voltage and current transducers) need not be included due to the variability of installation. On the contrary, another stakeholder suggested that EPA incorporate the ease of the installation of the external meter into the requirement.	In the Final Draft specification, in the case of an external meter, EPA is requiring that only the meter be sold with the UPS unit. EPA agrees that meter accessories (e.g., current transformers) vary with each installation and are often sold separately, and therefore need not be bundled with a meter to receive the metering incentive. To ease installation, EPA proposes that manufacturers may direct end users to available meter accessories for purchase via a URL on the PPDS.
Modular UPS		In the Draft 3 specification, EPA proposed that manufacturers test the minimum and maximum configurations of a Modular UPS as determined by the physical capabilities of the chassis. In response, two stakeholders commented that manufacturers should define the minimum and maximum configurations since models that are not sold to consumers should not be required for testing. The stakeholder also noted that since the VFI efficiency requirements increase with output power or system capacity it is possible that a minimum configuration would meet the ENERGY STAR requirements while the maximum configuration would not. In general, stakeholders were concerned that an entire Product Family could be disqualified because one or more member models of the Product Family do not qualify.	Per the stakeholder's comments, EPA has modified the Modular UPS Representative Model requirements such that manufacturers may determine both the minimum and maximum configurations for testing. Stakeholders indicated support for this proposal in comment responses to the February 15th webinar. In cases such as the ones mentioned by stakeholders, where one or more of the Modular UPS Representative Units does not meet the ENERGY STAR requirement or intermediate models within the Product Family do not qualify, manufacturers are still welcome to qualify each of the Modular UPS configurations as individual models, with each one tested and qualified separately. Using Product Families for qualification is intended to decrease qualification burden, but EPA acknowledges that it may not be practicable in all cases.

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Power Factor		Stakeholders recommended that EPA clarify in the specification that the power factor requirement of 0.90 is met at 100% resistive load. An industry group further suggested that the unit meet the 0.90 power factor requirement in every tested normal mode. The industry group also recommended defining Power Factor (PF) as Real Power (P, in Watts) divided by Apparent Power (S, in Volt-Amperes). Alternatively, one stakeholder suggested that EPA include the IEC 62040-3 definition of power factor to avoid confusion with displacement power factor. Several stakeholders noted that input power factor is most relevant to UPSs operating in VFI and VI modes and as such, EPA should consider excluding VFD (and potentially VI) modes from the input power factor requirement---in the VFD case, the load is connected directly to the voltage source, and the UPS has no impact on the power factor, such that setting requirements is unnecessary.	The Draft 3 ENERGY STAR Test Method cites Section 6.4.1.5 of IEC 62040-3 for the power factor test, which requires that the test be conducted at the reference test load—i.e., at 100% of the UPSs rated active power. Although the Test Method references the industry standard test method, EPA has nonetheless clarified the definition of power factor in the Final Draft specification. Furthermore, although the test method already requires testing power factor in each mode, EPA will further clarify that the UPS shall meet the power factor requirement in all normal modes required for qualification, with the exception VFD modes. EPA will not apply the power factor requirement to those modes, as the load is connected directly to the source in VFD modes and the UPS does not impact power factor.
Reference Test Load		In the Draft 3 specification, EPA omitted a previous footnote cited from IEC 62040-3 permitting "when in test-mode and subject to local regulations, the UPS output to be injected into the input a.c. supply." In response to prior draft specifications, a stakeholder noted that while back-feeding into the power supply should be encouraged during actual operation when able to do so safely and within local regulations, it is should not be used for testing. Presently, however, a stakeholder suggested the method specified in IEC 62040-3 is viable and accurate enough at least for VFI type UPS with high power rating (> 100kVA) while allowing for significant energy conservation during efficiency measurements where UPS are feeding resistive loads that dissipate many GWh. As such, the stakeholder proposes that backfeeding into the power supply per the IEC 62040-3 reference test load should be permissible during testing at least for UPSs with a power rating greater than 100 kVA.	EPA previously removed the backfeeding allowance based on a stakeholder comment on Draft 2, which recommended removing based on the lower repeatability of backfeeding as opposed to using a dedicated test load. However, omitting the backfeeding option could require test houses to purchase very large dedicated test loads, which would increase the test burden. In light of these competing viewpoints and the absence of additional information quantifying this repeatability/test burden tradeoff, EPA will allow backfeeding during testing as long as it meets the definition of Reference Test Load for UPSs with output power greater than 100 kW. This level has been suggested by a stakeholder as a reasonable cutoff.
Power and Performance Data Sheet	Processes	Given the need for additional revisions and further development, two stakeholders suggested that EPA initially pilot a few products with the proposed Power and Performance Data Sheet format and certification body submittal process. Additionally, the stakeholder requested that EPA develop a prototype for the proposed electronic comparison tool before deploying the final version. Echoing these recommendations, an industry stakeholder suggested that EPA work with stakeholders and certification bodies to further refine the PPDS, beyond the finalization of the specification as necessary, to ensure that the PPDS is simple to complete for partners and useful to EPA and end users.	EPA intends to share prototype versions of the PPDS for stakeholder review and comment as the widget continues its development.
Power and Performance Data Sheet	Mode Transition Time	One stakeholder commented that the ENERGY STAR specification and test method should focus only on energy efficiency. As such, mode transition time should not be included in the Power and Performance Data Sheet reporting requirements.	Since mode transition time is not tested and verified by ENERGY STAR, EPA has decided to remove this field from the PPDS in the interest of maintaining the focus on standardized efficiency data.

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Power and Performance Data Sheet	Content	In comparing products for purchase, stakeholders noted that end users would be most interested in the following characteristics: topology, input dependency, input and output voltage, modularity, runtime at several load conditions, and number of outlets (for UPSs ≤ 1500 W). For information that may not be within the scope of ENERGY STAR such as UPS runtime, a stakeholder suggested that the PPDS include links to the vendor's website. To allow for reproducibility of the measured efficiency data, one stakeholder proposed reporting the UUT power at each loading point (including input power at 0% load) on the PPDS, allowing for a fuller picture of the UUT losses. Stakeholders also recommended that the PPDS indicate measurement and communication capabilities and how a model was tested (battery connection status, etc.) and qualified (specific ENERGY STAR criteria met, i.e., whether the model was multiple-normal-mode or whether it qualified for the metering incentive) Finally, one stakeholder recommended that EPA ensure that all data fields are specific and unambiguous.	EPA thanks stakeholders for their suggestions on how to make the PPDS most useful to end-users and will incorporate information most likely to influence the purchase decision. To that end, EPA will include standardized, unambiguous efficiency data on the PPDS and may include battery runtime insofar as that is an important parameter for end-users.
Power and Performance Data Sheet	User Interface and Design	Stakeholders inquired whether EPA intended for the PPDS to be primarily a selection or comparison tool. Should the PPDS be a comparison tool between one or more products, one stakeholder recommended that no more that 4 information fields be displayed at a time. In order to further enhance the visual clarity, the same stakeholder suggested that the tool employ a color coding scheme for different types of information. To enable equivalent comparison between products, one stakeholder suggested that information be limited to a check box format where possible. The stakeholder also recommended that data submission fields be clarified such that only one specific type of information is presented, e.g., split the proposed “Visual Display of Input/Output kW (Y/N)” field into two fields for Visual Display of Input kW (Y/N) and Visual Display of Output (Y/N).	Again, EPA thanks stakeholders for their suggestions on how to make the PPDS most useful to end-users and will incorporate information most likely to influence the purchase decision, presenting it in a logical and unambiguous manner.