



## Comments and Response to Issues Discussed at August 8<sup>th</sup> 2011 UPS EnergyStar Webinar

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On Monday August 8<sup>th</sup>, the 7x24 Exchange participated in a webinar hosted by the EPA to discuss the potential requirement for providing metering capability for UPS devices seeking an EnergyStar rating. The EPA, along with speakers from the 7x24 Exchange, Jones Lang LaSalle, and APC presented. The presentations were followed by an open discussion of industry stakeholders participating on the call. During the course of the discussion several concerns were raised by representatives from the UPS manufacturing industry. The general consensus from these representatives was a strong objection to the requirement to equip EnergyStar compliant UPS devices with the metering equipment necessary to accurately measure UPS device KW, KWH and device efficiency, particularly as it relates to providing a representation of IT load for the use in calculating PUE. This consensus suggested that placement of measurement devices at other points in the critical power path would be more beneficial, potentially less costly, and provide a more accurate representation of performance.

While a number of valid points were raised warranting further discussion, the 7x24 Exchange respectfully disagrees with the position to omit a metering requirement for UPS devices seeking an EnergyStar rating and offers the following review of the core points discussed during the meeting.

### POINT #1

Reference was made by an equipment manufacturer that the current transformers (CT's) and metering devices currently deployed in UPS devices are of much lesser accuracy than revenue grade devices and therefore unsuitable for use in representing UPS device output values for PUE calculations as defined for Category 0 and 1 in the "Recommendations for Measuring and Reporting Data Center Efficiency" document released by the EPA and DOE sponsored industry task force earlier this year. As stated by a manufacturer's representative, these devices are installed for the specific purpose of internal operation and control of the UPS device and in such application do not require accuracy greater than +/- 5%.

### Response

1. KW information obtained from the display of UPS devices is by far the most common method of obtaining a representation of IT loading for the use of PUE reporting and in managing overall data center capacity and performance. This data is almost certainly the data that is used in the reporting of IT energy to the EPA's Portfolio Manager program in the overwhelming majority of cases. Even when facilities have more sophisticated downstream metering systems, e.g., PDU's, rack-level power strips, that can support Category 2 and/or 3 measurements, those measurements are typically aligned with readings obtained from the display of UPS devices as a check and balance. **It is strongly recommended that the EnergyStar specification include a requirement for revenue grade metering accuracy to be incorporated into approved UPS devices. At minimum, the UPS device should provide reading of both KW and KWH at the device output. Capability to measure device input KW should be strongly considered as well so**

that accurate calculation of losses and resultant efficiency across the device can be verified for each operational mode.

## POINT #2

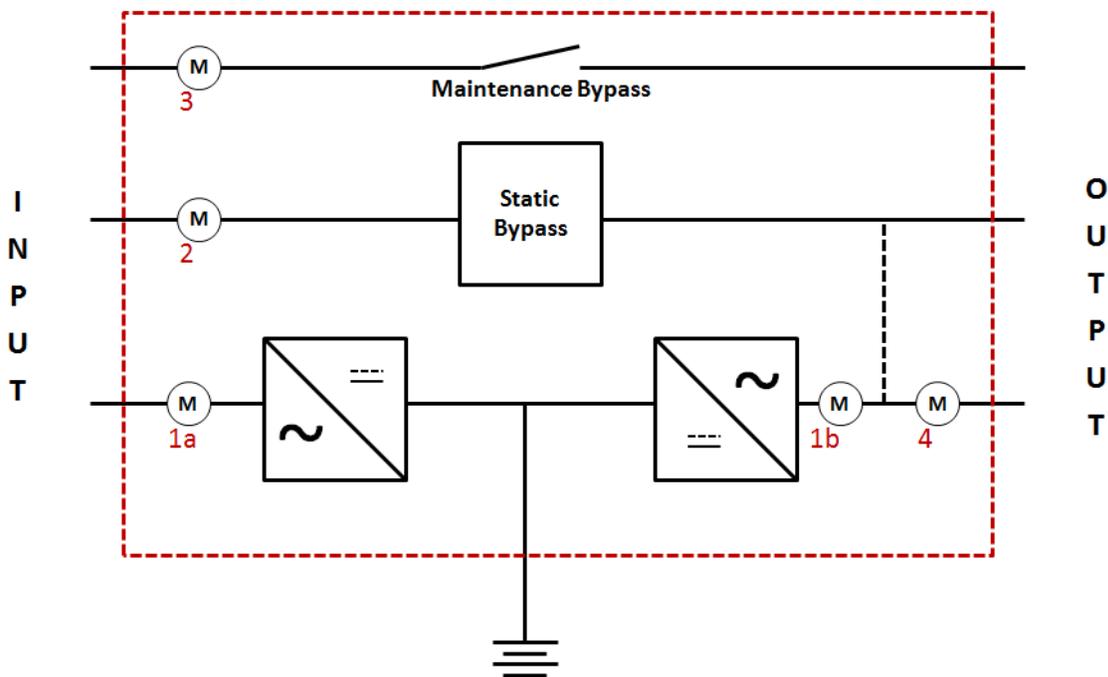
Reference was made by an equipment manufacturer that in order to capture an accurate representation of UPS output loading, and by surrogate, a representation of IT loading, that numerous metering devices would be required for even simple single module installations. Powerpoint slides were provided depicting both single module and multi-module one-line drawings representing the complexity of the challenge.

## RESPONSE

While there is theoretical validity to the points raised, the concerns do not accurately reflect the use of these devices in real-world operational situations. In the interest of clarity, the following responses will address single module and multi-module systems separately.

### *Single Module Configurations*

As the slides from the presentation are not immediately available, a rough approximation of the single module UPS device that was depicted on the call is provided below for reference.



1. As understood from the statements from the manufacturer's representative, points 1a and 1b as depicted on the above diagram are approximate locations for the CT's installed in current UPS

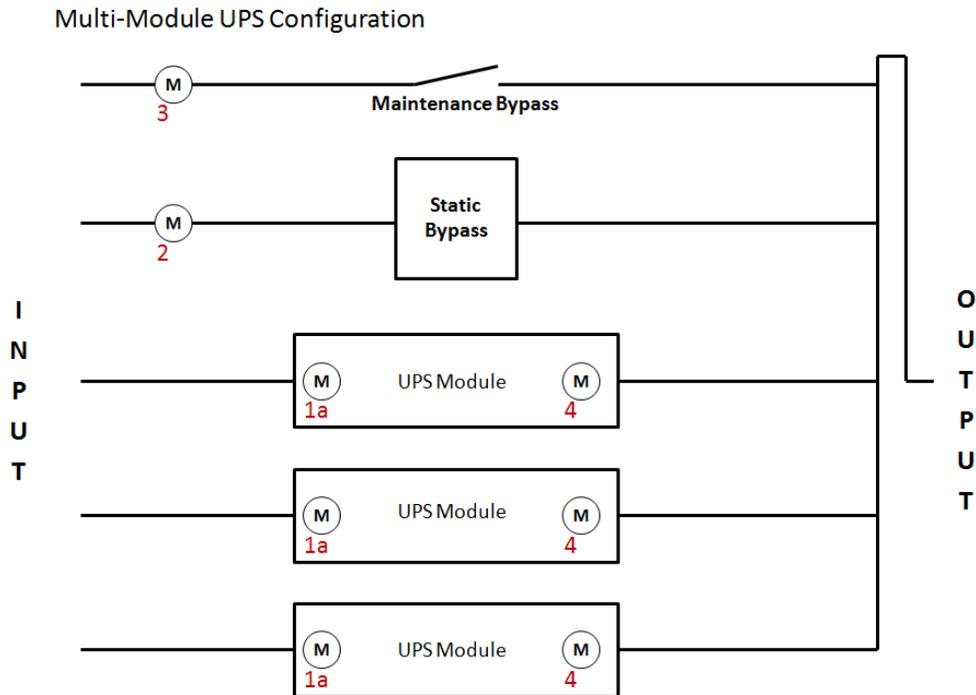
devices. These locations represent the input and output of the rectifier/inverter assembly of a double conversion (VFI) type device. Based on statements made on the call, these devices are of primary use for device protection and validation of internal operational status, and are not of sufficient accuracy for use as a representation of IT load. A quote from the representative “an astute operator might notice that on occasion the output reading could be greater than the input rating which would reflect an impossible condition of greater than 100% efficiency”. Given that common commercially available VFI type UPS modules typically have efficiencies below 97% and frequently well lower, it can be taken from the comment that inaccuracies of 4-5% individually and greater in aggregate, would not be uncommon for these types of devices. This a far lower level of accuracy than that of commonly available and comparatively inexpensive revenue grade metering devices used in the utility industry. **As previously stated, it is believed that the overwhelming majority of operators use the data from these meters for reporting purposes. Accuracy of data for such a key component of the PUE metric, and for other operational uses of this information, is absolutely critical.**

2. A second point made by a manufacturer’s representative on the call, was that in order to capture an accurate KW/KWH value for use as a surrogate for IT load, CT measurement points would be required at points 2, 3, and 4 as shown on the above diagram in addition to point 1a. While this is theoretically valid, it should be noted that under normal operation, no energy value would be measurable at points 2 and 3. Point 2 represents the static bypass function which is only active as a result of a device failure or during the performance of maintenance of the UPS device. Point 3 represents the maintenance bypass and is used only when the UPS device is taken out of service. UPS devices are designed to a very high reliability standard and are typically maintained with minimal requirement for operation in static or maintenance bypass mode. A conservative estimate of the amount of time that a single module UPS device may be subject to these modes of operation in the span of a year would be 8 hours or less. When applied to the 8760 hours per year, the interval of lost data as a result of not measuring these points for this period would be a small fraction of 1 percent (0.09%) and not within the 0.20% accuracy range of a revenue grade meter to discern. It should be noted that when the UPS system is operated in these non-standard modes, the facility remains unprotected from utility events – a highly undesirable operating condition that would discourage any operator from maintaining any longer than necessary. Further while the depiction of the output of the static switch is shown to be separate from the output of the inverter, in many if not all instances, these 2 pathways are combined at the output internal to the device – avoiding the concern altogether if the CT’s are properly placed. Addition of a new CT or relocation of the existing output metering point to location 4 would in fact capture both the normal output and the static bypass output with one set of CT’s. **In summary, accurate capture of the output power and energy pathway as a surrogate for IT load can be readily accomplished with a single meter and CT set placed at location 4. As previously stated, additional, consideration should be given to adding a revenue grade CT set at position 1a which would than provide accurate**

representation of input load and resultant device efficiency. The statement that accurate capture of information for a single module UPS device would require an additional 3-4 meter/CT measurement points is, from a real world operational perspective, not accurate.

### Multi-Module Configurations

As the slides from the presentation are not immediately available, a rough approximation of the multi-module UPS system that was depicted on the call is provided below for reference.



1. Multi-module systems are available in a wide variety of configurations; however 2 baseline configurations are most common. The first, (not depicted) is simply a combination of several single module devices similar to what has been described in the previous section. The devices automatically sync with each other and do not require an external master static switch / system control cabinet assembly. In those configurations the same recommendations apply as for single module systems however, the operator would need to aggregate power and energy meter readings from each of the installed modules – a simple and straightforward process that many operators are already accustomed to. In the second configuration (depicted above), individual modules do not have integral static switches, and the static bypass and maintenance bypass are located external to the UPS devices. As with single module systems, operation in static bypass or maintenance bypass modes is highly restricted and occurs only as a result of system failure or maintenance operations. A conservative estimate of the length of time that these operations would be scheduled on an annual basis would be 16 hours. When applied to the 8760 hours per year, the interval of lost data as a result of not measuring these points for this period would be a fraction of 1 percent (0.18%) and marginally outside the 0.2% accuracy range of a revenue grade

meter to discern. As previously stated, it should be noted that when the UPS system is operated in these non-standard modes, the facility remains unprotected from utility events – a highly undesirable operating condition that would discourage any operator from maintaining any longer than necessary. **In summary, accurate capture of the output power and energy pathway as a surrogate for IT load can be readily accomplished with a single meter and CT set placed in each module of a multi-module system at the same locations as described for the single module systems. As with a single module system, it is additionally recommended to give consideration to adding a revenue grade CT set at the input position of each module which would then provide accurate representation of input load and resultant device efficiency for each module individually and the system when aggregated. The statement that accurate capture of information for a multi- module UPS device will require an unrealistic quantity of meter/CT measurement points that are difficult to place and complex to read is, from a real world operational perspective, not accurate. While it is true that a properly placed meter/CT set in both the input and output boards could reduce the device count by a few meter/CT sets, this type of placement would not yield a more accurate reading. Further, given the broad range of input/output board configurations available, placement would require careful consideration by an engineer for each design type. Lastly, specification of meters in input and output boards are often downgraded or deleted as part of the procurement and value engineering processes during the construction phase without knowledge of the operations personnel. Requiring placement within an EnergyStar certified device would assure in every instance, that an operator would have consistent and ready access to accurate performance data. Further the added value of accurate metering available in each module will assist operational personnel with identifying deteriorating performance at the module level – a condition that could be masked by the less accurate meters currently deployed at the module level.**

### **POINT #3**

Reference was made by an equipment manufacturer that the provision of remote monitoring capability for the proposed metering/CT arrangements could represent a security threat relating to unauthorized dissemination of confidential and proprietary load and/or operation mode information, or inadvertent remote interruption of load due to accidental or intentional actions. There was also a statement that there is limited market demand for this type of functionality.

### **RESPONSE**

The ability to remotely access power, energy and efficiency data using a non-proprietary web-based interface would be extremely beneficial to data center operators and operators of remote office technology installations. As evidenced by the rapid growth in companies reporting data to the EPA's Portfolio Manager, access to accurate and readily accessible power and energy data is a trend in the industry that is expected to grow rapidly. Further evidence of this growth is in the wide range of vendors

both within the UPS industry and in the third-party data center performance management software arena that are developing products to perform this function. Accessing data from existing UPS devices however can be difficult and/or expensive as it requires the purchase of proprietary gateway cards (where available) and often the purchase of complex and expensive OEM or third-party software products to display the data. Incorporating a simple web accessible metering configuration within EnergyStar approved UPS devices would encourage operators to more aggressively collect the required data and increase industry awareness of inefficient operational practices. A wide variety of aftermarket metering products that can provide both the required accuracy and an IP based web interface are readily available.

The security concern relating to accidental or intentional remote interruption of the UPS device is easily addressed by either modifying the logic in the existing system to preclude this feature set if the current control/display interface is to be used, or by the addition of a separate metering package that does not have control capability. Data security can be readily addressed by the provision of a simple password configuration to access the meter, or even more simply, by limiting access to the device by not publishing the IP address or by limiting communication port access on the operators network.

#### **POINT #4**

Reference was made by an equipment manufacturer that the support of these requirements would materially increase the purchase cost of UPS devices.

#### **RESPONSE**

Current pricing of UPS devices of the size and scale discussed for the commercial office IT and data center markets range from the “tens of thousands” through “hundreds of thousands” of dollars. Very large parallel system installations can easily run into a mid-seven figure installation expense. Even a comparatively small 200KW rated single module UPS device running at 90% loading can consume close to 1.6 MWh of energy per annum in a typical 24/7/365 data center application. This equates to an annual energy cost that could range from \$100K - \$300K+ dollars depending on local utility rates. A random check of pricing on the internet for the CT devices and a web based meter display assembly that would far exceed the suggested requirement was in the range of 1,000 dollars for a single unit retail purchase. It is assumed that hardware expense for a manufacturer would be significantly less. **If an energy reduction of as little as 0.01% is achieved as a result of increased operator awareness, it is suggested that the resultant payback should more than cover the increased hardware cost over the life of the device.**