UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

February 2, 2011

Dear Uninterruptible Power Supply Equipment Manufacturers and Other Interested Parties:

On December 27, 2010, the U.S. Environmental Protection Agency (EPA) released the final draft of the ENERGY STAR® Test Method for Uninterruptible Power Supplies (UPSs) and a complementary dataset form, and requested assistance with assembling a dataset of UPS efficiency test results for use in specification development. EPA wishes to thank all manufacturers that provided test results for inclusion in the dataset.

As mentioned in the letter accompanying the release of the test method, EPA decided to split the dataset assembly period into two phases:

- **Phase 1: Sharing of existing test data (through January 14, 2011)**
- **Phase 2: New testing according to Draft ENERGY STAR Test Method (through March 18, 2011)**

By first compiling and analyzing test data obtained previously according to draft versions of the IEC standard 62040-3,[1] EPA intended to identify any gaps in testing as well as potential opportunities for energy savings that can be confirmed through new testing. EPA has completed its analysis of the Phase 1 data and wishes to share its conclusions with stakeholders as well as officially begin Phase 2, which will involve new efficiency tests intended to address the identified gaps and obtain a representative dataset for use in specification development.

Summary of Phase 1 Data

Output Power

Five manufacturers shared the results of 236 previously conducted tests for inclusion in the dataset. The UPSs tested included both consumer and datacenter units, across a wider range of rated output power. The figures below summarize the tests received in terms of UPS output power (in kVA), and the number of output phases (Figure 1), topology (Figure 2), and manufacturer (Figure 3).

[1] International Electrotechnical Committee (IEC). "IEC Standard 62040 Uninterruptible Power Systems - Part 3: Method of Specifying the Performance and Test Requirements." Ed. 2.0 Final Draft International Standard (FDIS). November 26, 2010.

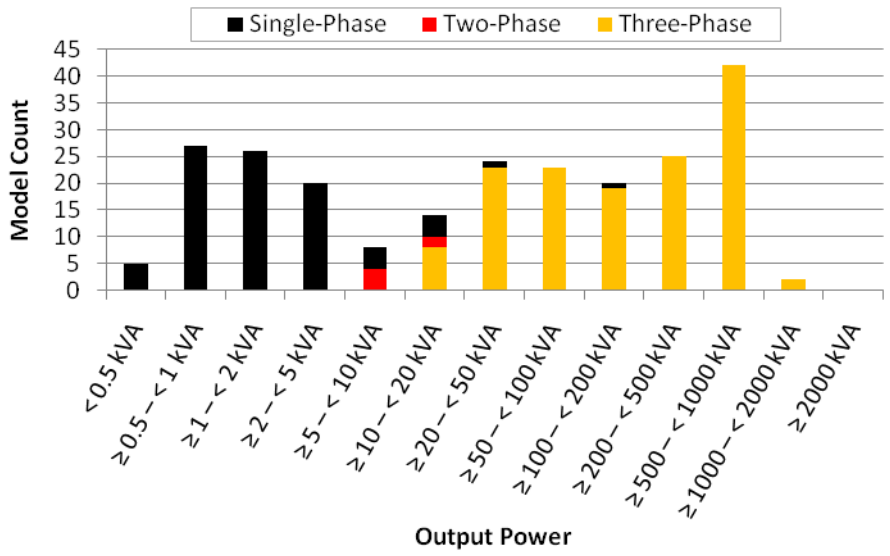


Figure 1: Output Power and Number of Output Phases of Units Tested

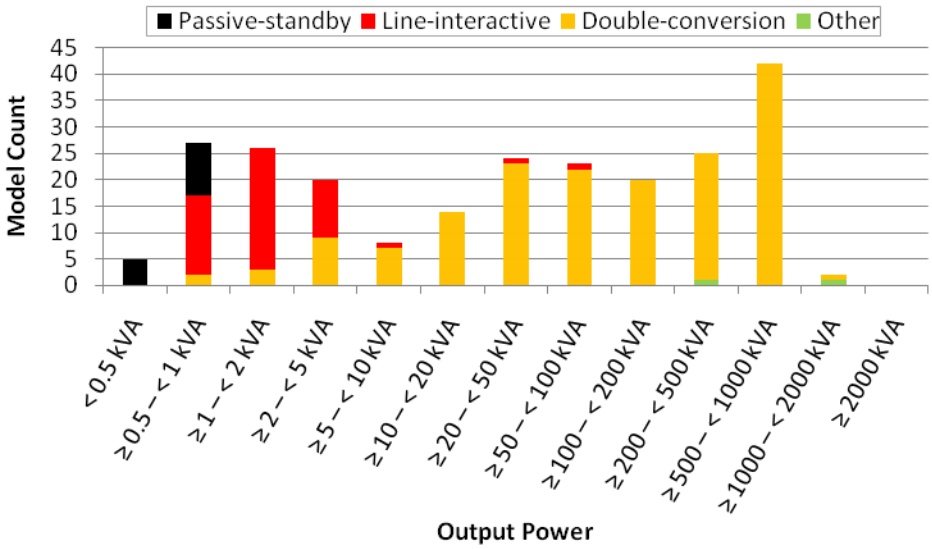


Figure 2: Output Power and Topology of Units Tested

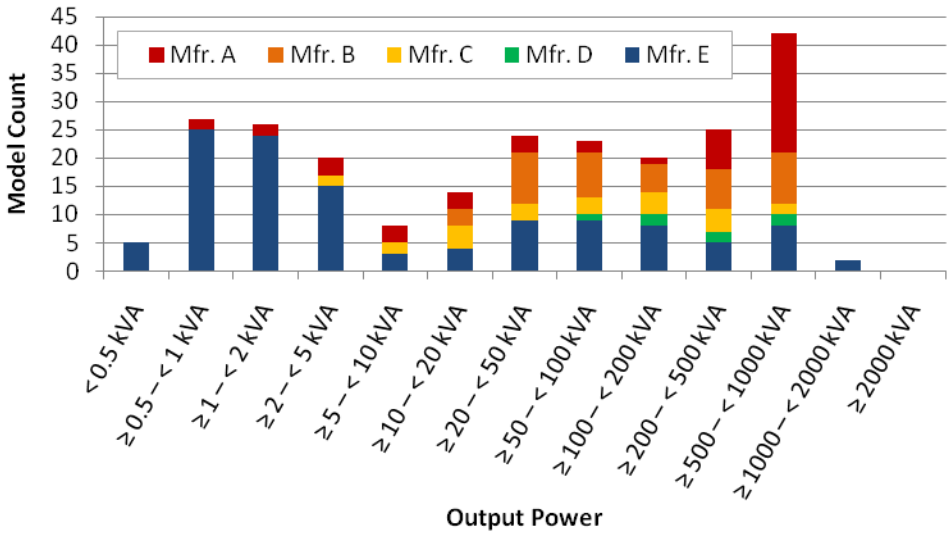


Figure 3: Number of Test Results Submitted by Each of the Five Manufacturers

In general, both the number and characteristics of units tested in each output power category are representative of the market. According to a market report published by the VDC Research Group,[2] single-phase UPSs are most common below 5 kVA, while three-phase UPSs are most common above 20 kVA, where they constitute 97% of shipments (2007). Similarly, double-conversion UPSs are most common above 20 kVA, where they constitute 99% of shipments (2007). Finally, the decrease in the number of units tested between 5 and 20 kVA is indicative of the low shipments of UPSs in this output power category (rackmount).[3]

According to the VDC Research Group market report, no manufacturer controls more than one-third of the UPS market in the power ranges 20–100 kVA and greater than 250 kVA. EPA is therefore concerned that the test results submitted in the range 500–1000 kVA may not be diverse enough as over half were submitted by only one manufacturer. Although the market report did not include analysis of UPSs with output power less than 20 kVA, EPA is similarly concerned that one manufacturer (Manufacturer E in Figure 3) provided the overwhelming majority of data for UPSs with output power less than 5 kVA.

Input and Output Voltage

Manufacturers had previously commented that the majority of UPSs are transformerless, with the same input and output voltage. As can be seen in Table 1, below, most of the tests submitted to date support this, with the main differences in input and output voltage due to measuring the voltage line-to-line versus line-to-neutral. Also consistent with expectations are the higher voltages at the higher power levels.

[2] VDC Research Group. "2008 Power Protection: Global Market Demand Analysis, Volume 4: UPS 20.1kVA and Over, Americas," Natick, MA. September 2008.
[3] William Muscato. "Datacenter Trends Create Sweetspot for Entry of New Materials." Presented at Battery Power 2010 International Conference & Expo. Dallas, TX., October 29, 2010.

Table 1: The Nominal Input and Output Voltage of the UPSs Tested for Different Power Levels.

		Nominal input voltage used for test (VAC)								
EU Code of Conduct Power Range	Nominal output voltage used for test (VAC)	100	208	208Δ	208Y/ 120	400Y/ 230	480Δ	480Y/ 277	575Y/ 332	600Y/ 346
< 10 kVA	100	1								
	208		3							
	208Δ		1							
	208Y/120				63					
	400Y/230					17				
	240		1							
≥ 10 – < 20 kVA	208		3							
	208Y/120			1	9					
	480Y/277							1		
≥ 20 – < 40 kVA	208		1							
	208Y/120			2	9					
	400Y/230					1				
	480Y/277							2		
≥ 40 – < 200 kVA	208Y/120			2	18					
	400Y/230					9				
	480Δ						8			
	480Y/277						2	13		
≥ 200 kVA	400Y/230					8				
	480Δ						9	1		
	480Y/277						2	40		
	575Y/332								6	
	600Y/346									3

Efficiency

Although 236 test results were shared by manufacturers for inclusion in the dataset, not all tests results included data at all the loading points prescribed by IEC standard 62040-3 (i.e., 100%, 75%, 50%, and 25% of the reference test load). Some included data at numerous other loading points, while some others (especially in the middle of the output power range, 10–200 kVA) included only results at 100% of the reference test load.

In the former case, which applied to six units, EPA used a quadratic loss model to interpolate the UPS efficiency between the points used during the test and calculate the efficiency at the four IEC 62040-3 loading points. The example results for one of the units are shown in Figure 4; this result is typical for all the interpolations, which were accurate (when tested against the original data) to within 0.8%. The errors were concentrated at the lower loading conditions (10–20% of reference test load); typical errors at the remaining loading points were 0.1–0.3%.

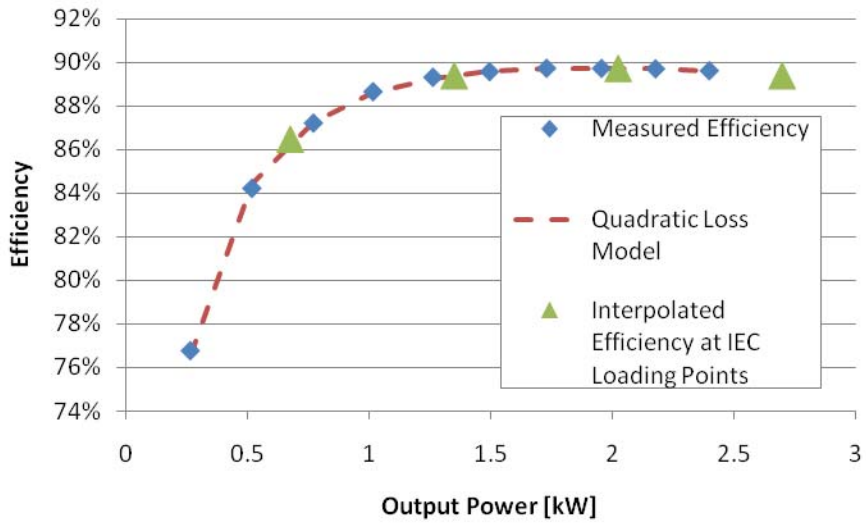


Figure 4: Illustration of Efficiency Interpolation for Units Tested at Loading Points Other than Those Specified in IEC 62040-3.

In the latter case, when only one or two loading points were available, EPA was unable to use interpolation to fill in the data. The proportion of tests results that did not have efficiency results at each loading point is indicated for each output power range in Figure 5.

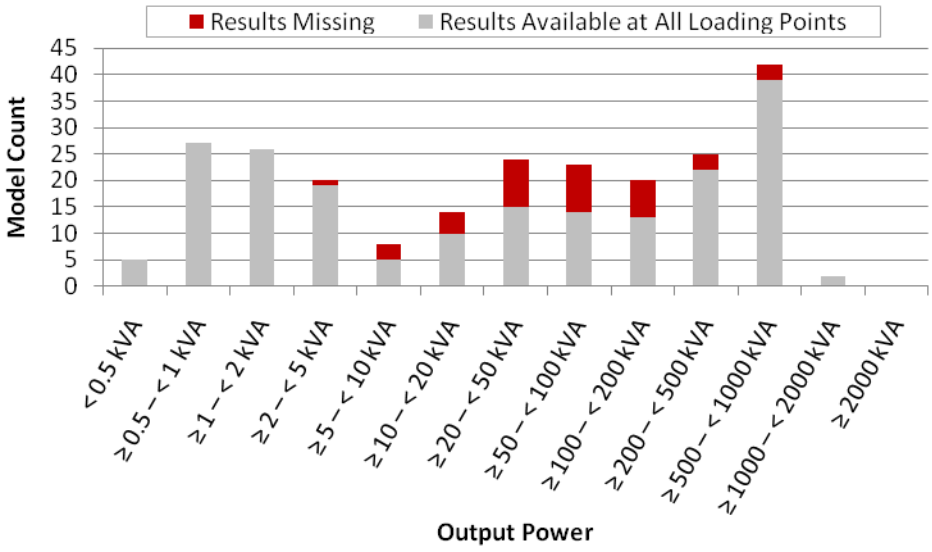


Figure 5: Number of Tests with and without Results at All Four IEC 62040-3 Loading Points (100%, 75%, 50%, and 25% of Reference Test Load), Following Interpolation.

Phase 2 Data

EPA has begun analyzing the efficiency results in the dataset, and the impact of various UPS features on efficiency, as exemplified in Figure 6, below. EPA would like to continue this

process by further building its dataset. EPA is interested in examining any additional data concerning the following:

- Double-conversion UPSs in high-efficiency VFD modes (e.g., Eco modes)
- Modular UPSs at both their maximum and minimum output power configurations
- UPSs with output power in the range of 10–200 kVA
- DC-output UPSs
- Rotary UPSs

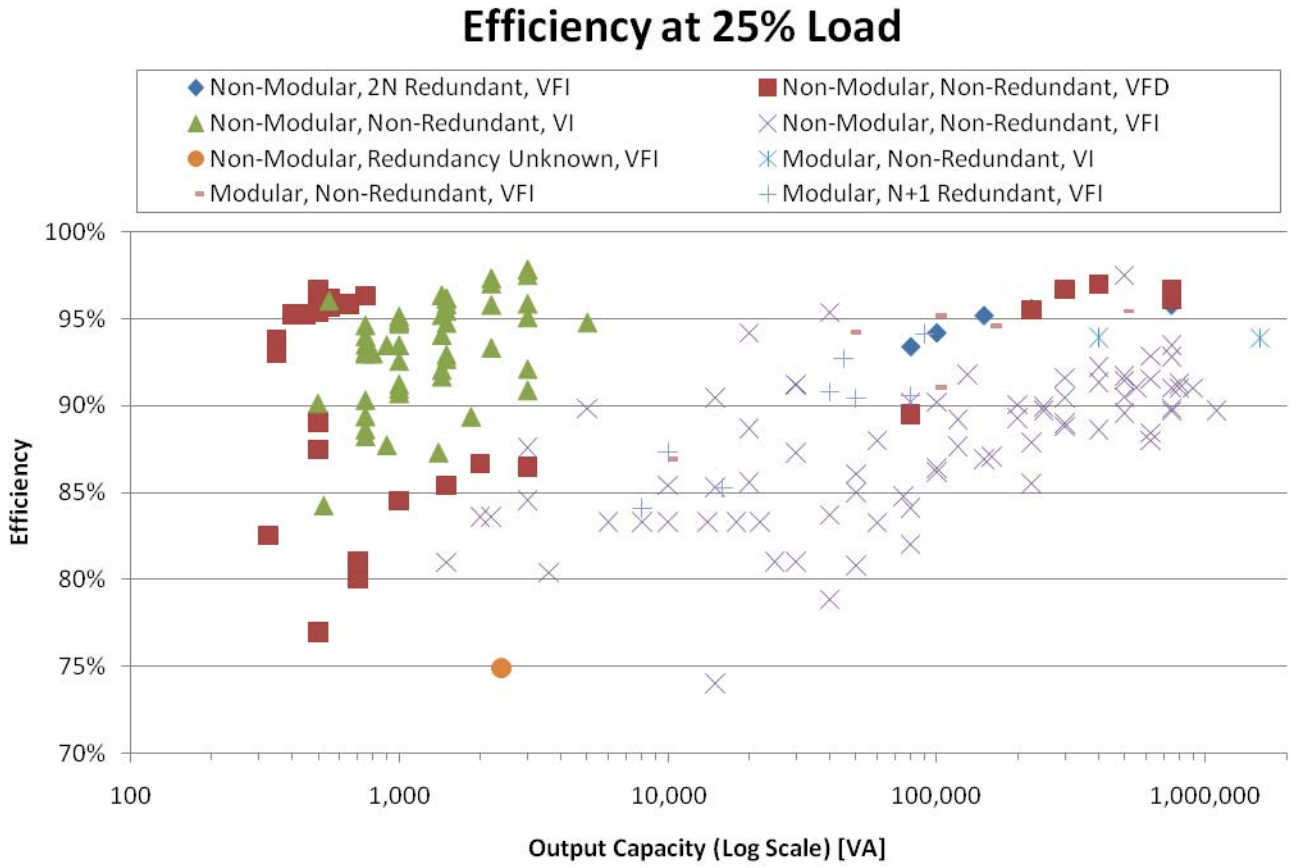


Figure 6: Efficiency Test Results for Various UPS Configurations at 25% Load

EPA would particularly like to encourage additional manufacturers to conduct tests and share results at the low and high ends of the output power spectrum (i.e., less than 5 kVA and greater than or equal to 500 kVA), as these two output power ranges were dominated by data shared by one manufacturer. EPA would also like to encourage participating manufacturers to rely on the Final Draft ENERGY STAR Test Method for UPSs—which includes all four IEC 62040-3 loading points—when conducting efficiency tests.

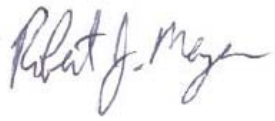
Next Steps

EPA representatives will contact select manufacturers in the next several days to discuss this letter and priorities for Phase 2 testing. However, please do not hesitate to direct any specific

questions about the test procedure, the efficiency dataset currently under assembly, or any other issues to RJ Meyers, EPA, at Meyers.Robert@epamail.epa.gov or 202-343-9923, or Matt Malinowski, ICF International, at MMalinowski@icfi.com or 202-862-2693. We look forward to working with you and thank you for your interest in ENERGY STAR.

As always, if you know of others who may be interested in participating in this process, please forward this announcement and encourage them to send their contact information to UPS@energystar.gov to be added to the stakeholder contact list.

Sincerely,



RJ Meyers
U.S. Environmental Protection Agency
ENERGY STAR for UPS