Storage Power Measurement

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Black box boundary

- Clearly define the system which requires power measurement
Black box boundary continued

- I/O generator server may be in the same rack
  - Rack level fans, rack level controller, switch
  - What is the real system under test
Redundancy in power supplies

- Measure both power feeds
- Both power supplies operational
Systems get large

- Multiple racks of equipment to measure
- Use a clamp on the main line feed
Double check

- Power should be close to what is expected
- Verify power factor
- Three phase setup
- Syncing clocks between power meter and Vdbench
## Input power requirements

<table>
<thead>
<tr>
<th>NOMINAL INPUT VOLTAGE RANGE</th>
<th>Phases</th>
<th>AC INPUT FREQUENCY RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-120 VAC RMS</td>
<td>1</td>
<td>47 – 63 Hz</td>
</tr>
<tr>
<td>200 – 240 VAC RMS</td>
<td>1</td>
<td>47 – 63 Hz</td>
</tr>
<tr>
<td>200 - 480 VAC RMS</td>
<td>3</td>
<td>47 – 63 Hz</td>
</tr>
</tbody>
</table>
Power meter requirements

- **Power Meter accuracy**

<table>
<thead>
<tr>
<th>Power Consumption (p)</th>
<th>Minimum Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p \leq 10$ W</td>
<td>± 0.01 W</td>
</tr>
<tr>
<td>$10 &lt; p \leq 100$ W</td>
<td>± 0.1 W</td>
</tr>
<tr>
<td>$p &gt; 100$ W</td>
<td>± 1.0 W</td>
</tr>
</tbody>
</table>

- **Sampling period of 5 second or less**
- **Sampling rate of 0.2 samples/second or greater**
Environmental monitoring

- Monitor temperature during the test
  - Measure in degrees Celsius
  - Measured in 0.1 degree resolution
  - Sample in a period not greater than 1 minute
  - Measured at primary air inlet
    - Center of the storage configuration
**Difference between Emerald and ENERGY STAR**

- **ENERGY STAR has tighter input voltage requirements**
  - For systems Equal to or less than 1500W
    - Standard input voltages with ±1.0%
    - Total Harmonic Distortion (THD) of 2.0%
  - For systems greater than 1500W
    - Standard input voltage ±5.0%
    - Total Harmonic Distortion (THD) of 5.0%

- **With tight THD requirements need to get the power meter as close to the System Under Test**

- **Temperature sensor**
  - Overall accuracy of ±0.5°C or better
  - 50 mm in front of the main airflow inlet