SPC BENCHMARK 1™
EXECUTIVE SUMMARY

HEWLETT-PACKARD COMPANY
HP P6500 ENTERPRISE VIRTUAL ARRAY

SPC-1 V1.12

Submitted for Review: February 17, 2012
Submission Identifier: AE00005
## EXECUTIVE SUMMARY

### Test Sponsor and Contact Information

<table>
<thead>
<tr>
<th>Test Sponsor</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Contact</strong></td>
<td>Hewlett-Packard Company – <a href="http://www.hp.com">http://www.hp.com</a></td>
</tr>
<tr>
<td></td>
<td>Chuck Paridon – <a href="mailto:chuck.paridon@hp.com">chuck.paridon@hp.com</a></td>
</tr>
<tr>
<td></td>
<td>8000 Foothills Blvd</td>
</tr>
<tr>
<td></td>
<td>M/S 5785</td>
</tr>
<tr>
<td></td>
<td>Roseville, CA 95747-5785</td>
</tr>
<tr>
<td></td>
<td>Phone: (916) 785-5155</td>
</tr>
<tr>
<td></td>
<td>FAX: (916) 785-1648</td>
</tr>
<tr>
<td><strong>Alternate Contact</strong></td>
<td>Hewlett-Packard Company – <a href="http://www.hp.com">http://www.hp.com</a></td>
</tr>
<tr>
<td></td>
<td>Joe Tarr – <a href="mailto:joseph.tarr@hp.com">joseph.tarr@hp.com</a></td>
</tr>
<tr>
<td></td>
<td>8000 Foothills Blvd</td>
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<tr>
<td></td>
<td>M/S 5785</td>
</tr>
<tr>
<td></td>
<td>Roseville, CA 95747-5785</td>
</tr>
<tr>
<td></td>
<td>Phone: (916) 785.2967</td>
</tr>
<tr>
<td></td>
<td>FAX: (916) 785-1648</td>
</tr>
<tr>
<td></td>
<td>Walter E. Baker – <a href="mailto:AuditService@StoragePerformance.org">AuditService@StoragePerformance.org</a></td>
</tr>
<tr>
<td></td>
<td>643 Bair Island Road, Suite 103</td>
</tr>
<tr>
<td></td>
<td>Redwood City, CA 94063</td>
</tr>
<tr>
<td></td>
<td>Phone: (650) 556-9384</td>
</tr>
<tr>
<td></td>
<td>FAX: (650) 556-9385</td>
</tr>
</tbody>
</table>

### Revision Information and Key Dates

| Date Results were first used publicly | February 17, 2012                  |
| Date the FDR was submitted to the SPC | February 17, 2012                  |
| Date the Priced Storage Configuration is available for shipment to customers | currently available |
| Date the TSC completed audit certification | February 16, 2012                  |
Tested Storage Product (TSP) Description

The HP P6000 Enterprise Virtual Array is an easy to use, capacity enhanced storage system with built-in virtualization letting you to consolidate storage and simplify your IT. The P6000 EVA also offers high performance, high availability, and robust data protection. Combined with your favorite database, email, ERP or other applications, the P6000 EVA provides an integrated end-to-end solution that helps drive your business.

See improved storage density with built-in Thin Provisioning and a smaller footprint in your data center with 2.5-inch form factor storage devices. The P6000 EVA offers multi-protocol support to your SAN with 8 Gb/s Fibre Channel, 1 Gb/s iSCSI, and 10 Gb/s iSCSI/FCoE options.

It provides a better business value by eliminating stranded capacity and maximizing performance. P6000 EVA uses all the disks to send and retrieve data and can dynamically expand virtual disks as data grows.

Summary of Results

<table>
<thead>
<tr>
<th>SPC-1 Reported Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested Storage Product (TSP) Name: HP P6500 Enterprise Virtual Array</td>
</tr>
<tr>
<td>Metric</td>
</tr>
<tr>
<td>SPC-1 IOPS™</td>
</tr>
<tr>
<td>SPC-1 Price-Performance</td>
</tr>
<tr>
<td>Total ASU Capacity</td>
</tr>
<tr>
<td>Data Protection Level</td>
</tr>
<tr>
<td>Total TSC Price (including three-year maintenance)</td>
</tr>
</tbody>
</table>

SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

Total ASU (Application Storage Unit) Capacity represents the total storage capacity read and written in the course of executing the SPC-1 benchmark.

A Data Protection Level of Protected (Mirroring) configures two or more identical copies of user data.
Storage Capacities, Relationships, and Utilization

The following diagram and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.

---

**Application Storage Unit (ASU) Capacity**
515.396 GB

- **ASU 1**
  231.928 GB
  1 Logical Volume

- **ASU 2**
  231.928 GB
  1 Logical Volume

- **ASU 3**
  51.540 GB
  1 Logical Volume

**Addressable Storage Capacity**
515.396 GB

**Configured Storage Capacity**
1,064.078 GB

**Physical Storage Capacity**
1,600.391 GB

**Data Protection (Mirroring)**
515.396 GB

**Global Storage Overhead**
536.313 GB

---

<table>
<thead>
<tr>
<th>SPC-1 Storage Capacity Utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Utilization</td>
</tr>
<tr>
<td>Protected Application Utilization</td>
</tr>
<tr>
<td>Unused Storage Ratio</td>
</tr>
</tbody>
</table>

**Application Utilization:** Total ASU Capacity (515.396 GB) divided by Physical Storage Capacity (1600.391 GB).

**Protected Application Utilization:** Total ASU Capacity (515.396 GB) plus total Data Protection Capacity (515.396 GB) minus unused Data Protection Capacity (0.000 GB) divided by Physical Storage Capacity (1600.391 GB).

**Unused Storage Ratio:** Total unused capacity (33.286 GB) divided by Physical Storage Capacity (1600.391 GB). The Unused Storage Ratio cannot exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 25-26 in the Full Disclosure Report.
Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPSTM metric.

The Average Response Time measured at any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.

Response Time – Throughput Data

<table>
<thead>
<tr>
<th>I/O Request Throughput</th>
<th>10% Load</th>
<th>50% Load</th>
<th>80% Load</th>
<th>90% Load</th>
<th>95% Load</th>
<th>100% Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Response Time (ms):</td>
<td>1,999.26</td>
<td>9,999.41</td>
<td>15,999.52</td>
<td>17,990.02</td>
<td>18,998.58</td>
<td>20,003.66</td>
</tr>
<tr>
<td>All ASUs</td>
<td>0.43</td>
<td>0.99</td>
<td>2.27</td>
<td>3.85</td>
<td>5.30</td>
<td>11.23</td>
</tr>
<tr>
<td>ASU-1</td>
<td>0.43</td>
<td>1.02</td>
<td>2.33</td>
<td>3.90</td>
<td>5.36</td>
<td>12.24</td>
</tr>
<tr>
<td>ASU-2</td>
<td>0.40</td>
<td>0.88</td>
<td>2.08</td>
<td>3.59</td>
<td>5.00</td>
<td>10.38</td>
</tr>
<tr>
<td>ASU-3</td>
<td>0.45</td>
<td>0.99</td>
<td>2.23</td>
<td>3.84</td>
<td>5.29</td>
<td>9.46</td>
</tr>
<tr>
<td>Reads</td>
<td>0.42</td>
<td>1.01</td>
<td>2.38</td>
<td>3.91</td>
<td>5.36</td>
<td>12.94</td>
</tr>
<tr>
<td>Writes</td>
<td>0.43</td>
<td>0.98</td>
<td>2.20</td>
<td>3.80</td>
<td>5.25</td>
<td>10.11</td>
</tr>
</tbody>
</table>
SPC-1/E Reported Data

The initial SPC-1/E energy extension temperature, recorded during the first one minute of the Idle Test was 81.50F. The final SPC-1/E energy extension temperature, recorded during the last one minute of the Primary Metrics Test was 82.64F.

<table>
<thead>
<tr>
<th>Usage Profile</th>
<th>Average RMS Voltage</th>
<th>Power Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>211.14</td>
<td>Average Power Factor: 0.809</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Heavy</th>
<th>Moderate</th>
<th>Idle</th>
<th>Nominal Power, W</th>
<th>Nominal Traffic, IOPS</th>
<th>Nominal IOPS/W</th>
<th>Nominal Heat, BTU/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Daily Usage:</td>
<td>0</td>
<td>8</td>
<td>16</td>
<td>227.85</td>
<td>3333.14</td>
<td>14.63</td>
<td>777.44</td>
</tr>
<tr>
<td>Medium Daily Usage:</td>
<td>4</td>
<td>14</td>
<td>6</td>
<td>231.49</td>
<td>8499.58</td>
<td>36.72</td>
<td>789.87</td>
</tr>
<tr>
<td>High Daily Usage:</td>
<td>18</td>
<td>6</td>
<td>0</td>
<td>235.84</td>
<td>14499.49</td>
<td>61.48</td>
<td>804.72</td>
</tr>
</tbody>
</table>

| Composite Metrics: | 231.73 | 8,777.40 | 37.88 |
| Annual Energy Use, kWh: | 2,029.93 |
| Energy Cost, $/kWh: | $ 0.12 |
| Annual Energy Cost, $: $ 243.59 |

The above usage profile describes conditions in environments that respectively impose light (“low”), moderate (“medium”), and extensive (“high”) demands on the Tested Storage Configuration (TSC).

**HEAVY** SPC-1 Workload: 236.96W at 80% of maximum reported performance (15,999.52 SPC-1 IOPS).

**MODERATE** SPC-1 Workload: 232.48W at 50% of maximum reported performance (9,999.41 SPC-1 IOPS).

**IDLE** SPC-1 Workload: 225.53W at 0% of maximum reported performance (0.00 SPC-1 IOPS).

**AVERAGE RMS VOLTAGE**: The average supply voltage applied to the Tested Storage Product (TSP) as measured during the Measurement Intervals of the SPC-1/E Tests.

**AVERAGE POWER FACTOR**: The ratio of average real power, in watts, to the average apparent power, in volt-amps flowing into the Tested Storage Product (TSP) during the Measurement Intervals of the SPC-1/E Tests.

**NOMINAL POWER, W**: The average power consumption over the course of a day (24 hours), taking into account hourly load variations.

**NOMINAL TRAFFIC, IOPS**: The average level of I/O requests over the course of a day (24 hours), taking into account hourly load variations.
**NOMINAL IOPS/W**: The overall efficiency with which I/O requests can be supported, reflected by the ratio of **NOMINAL TRAFFIC** versus the **NOMINAL POWER**.

**NOMINAL HEAT, BTU/HR**: The average amount of heat required to be dissipated over the course of a day (24 hours), taking into account hourly load variations. (1 watt = 3.412 BTU/hr)

**COMPOSITE METRICS**: The aggregated **NOMINAL POWER**, **NOMINAL TRAFFIC**, and **NOMINAL IOPS/W** for all three environments: **LOW**, **MEDIUM**, and **HIGH DAILY USAGE**.

**ANNUAL ENERGY USE, kWh**: An estimate of the average energy use across the three environments over the course of a year and computed as (**NOMINAL POWER** * 24 *0.365).

**ENERGY COST, $/kWh**: A standardized energy cost per kilowatt hour.

**ANNUAL ENERGY COST**: An estimate of the annual energy use across the three environments over the course of a year and computed as (**ANNUAL ENERGY USE** * **ENERGY COST**).
SPC-1/E Power/Performance Profile

The SPC-1/E Power/Performance Profile chart provides a complete “at a glance” illustration and report for each SPC-1/E execution component. The power consumption at each step is reported and, where appropriate the measured SPC-1 performance (SPC-1 IOPS™) is also reported.

The **Load Level** value in the table represents the percentage of the maximum, specified offered load that was used for a specific execution component. Each **Execution Component** entry includes the acronym, in parenthesis, which is used in the corresponding chart to identify the execution component.

### SPC-1/E Power/Performance Profile Data

<table>
<thead>
<tr>
<th>Execution Component</th>
<th>Load Level</th>
<th>SPC-1 IOPS™</th>
<th>Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Idle (<strong>cndtn</strong>)</td>
<td>100%</td>
<td>19,998.32</td>
<td>237.98</td>
</tr>
<tr>
<td>Idle (<strong>idle-L</strong>)</td>
<td>0%</td>
<td>0.00</td>
<td>225.53</td>
</tr>
<tr>
<td>Post-Idle (<strong>rcvry</strong>)</td>
<td>10%</td>
<td>1,998.11</td>
<td>225.88</td>
</tr>
<tr>
<td>Sustainability (<strong>sustain</strong>)</td>
<td>100%</td>
<td>19,999.92</td>
<td>239.78</td>
</tr>
<tr>
<td>IOPS (<strong>r100</strong>)</td>
<td>100%</td>
<td>20,003.66</td>
<td>241.49</td>
</tr>
<tr>
<td>Ramp95 (<strong>r95</strong>)</td>
<td>95%</td>
<td>18,998.58</td>
<td>239.54</td>
</tr>
<tr>
<td>Ramp90 (<strong>r90</strong>)</td>
<td>90%</td>
<td>17,990.02</td>
<td>238.18</td>
</tr>
<tr>
<td>Ramp80 (<strong>r80</strong>)</td>
<td>80%</td>
<td>15,999.52</td>
<td>236.96</td>
</tr>
<tr>
<td>Ramp50 (<strong>r50</strong>)</td>
<td>50%</td>
<td>9,999.41</td>
<td>232.48</td>
</tr>
<tr>
<td>Ramp10 (<strong>r19</strong>)</td>
<td>10%</td>
<td>1,999.26</td>
<td>227.48</td>
</tr>
<tr>
<td>Repeat1 LRT (<strong>rp1-10</strong>)</td>
<td>10%</td>
<td>2,001.16</td>
<td>227.56</td>
</tr>
<tr>
<td>Repeat1 IOPS (<strong>rp1-100</strong>)</td>
<td>100%</td>
<td>19,991.99</td>
<td>240.97</td>
</tr>
<tr>
<td>Repeat2 LRT (<strong>rp2-10</strong>)</td>
<td>10%</td>
<td>2,002.29</td>
<td>227.65</td>
</tr>
<tr>
<td>Repeat2 IOPS (<strong>rp2-100</strong>)</td>
<td>100%</td>
<td>20,003.03</td>
<td>241.08</td>
</tr>
</tbody>
</table>
SPC-1/E Power/Performance Profile Chart

- cndtn - 238.0 w, 19998.3 IOPS
- Idle-L - 225.5 w
- rcvry - 225.9 w, 1998.1 IOPS
- sustain - 239.8 w, 19999.9 IOPS
- r100 - 241.5 w, 20003.7 IOPS
- r95 - 239.5 w, 18998.6 IOPS
- r90 - 238.2 w, 17990.0 IOPS
- r80 - 237.0 w, 15999.5 IOPS
- r50 - 232.5 w, 9999.4 IOPS
- r10 - 227.5 w, 1999.3 IOPS
- rp1-10 - 227.6 w, 2001.2 IOPS
- rp1-100 - 241.0 w, 19992.0 IOPS
- rp2-10 - 227.7 w, 2002.3 IOPS
- rp2-100 - 241.1 w, 20003.0 IOPS
Priced Storage Configuration Pricing

<table>
<thead>
<tr>
<th>Quan</th>
<th>Product Number</th>
<th>Description</th>
<th>List Price</th>
<th>Ext Price</th>
<th>Discount</th>
<th>Ext. Net Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AF002A</td>
<td>HP Universal Rack 10642 G2 Shock Rack</td>
<td>1,489.00</td>
<td>1,489.00</td>
<td>27%</td>
<td>1,086.97</td>
</tr>
<tr>
<td>1</td>
<td>AF002A 001</td>
<td>Factory Express Base Racking</td>
<td>300.00</td>
<td>300.00</td>
<td>27%</td>
<td>219.00</td>
</tr>
<tr>
<td>1</td>
<td>AJ939A</td>
<td>HP P6500 EVA Dual Controller FC Array</td>
<td>18,500.00</td>
<td>18,500.00</td>
<td>27%</td>
<td>13,505.00</td>
</tr>
<tr>
<td>1</td>
<td>AJ939A 0D1</td>
<td>Factory integrated</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>AJ840A</td>
<td>HP M6625 2.5-inch SAS Drive Enclosure</td>
<td>4,326.00</td>
<td>8,652.00</td>
<td>27%</td>
<td>6,315.96</td>
</tr>
<tr>
<td>2</td>
<td>AJ840A 0D1</td>
<td>Factory integrated</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>QK757A</td>
<td>HP M5524 6G 200GB SAS SFF SSD</td>
<td>9,800.00</td>
<td>78,400.00</td>
<td>27%</td>
<td>57,232.00</td>
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<tr>
<td>8</td>
<td>QK757A 0D1</td>
<td>Factory integrated</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
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<tr>
<td>2</td>
<td>252863-D72</td>
<td>HP 24A High Voltage US/JP Modular PDU</td>
<td>299.00</td>
<td>598.00</td>
<td>27%</td>
<td>436.54</td>
</tr>
<tr>
<td>2</td>
<td>252863-D72 0D2</td>
<td>Factory horizontal mount of PDU</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
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<td>1</td>
<td>AF062A</td>
<td>HP 10K G2 600mm Stabilizer Kit</td>
<td>229.00</td>
<td>229.00</td>
<td>27%</td>
<td>167.17</td>
</tr>
<tr>
<td>1</td>
<td>AF062A B01</td>
<td>Include with complete system</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>AF054A</td>
<td>HP 10642 G2 Sidepanel Kit</td>
<td>359.00</td>
<td>359.00</td>
<td>27%</td>
<td>262.07</td>
</tr>
<tr>
<td>1</td>
<td>AF054A 0D1</td>
<td>Factory integrated</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>T5494GAE</td>
<td>HP P6000 CV V9.4 RSM V5.3 E-Media Kit</td>
<td>125.00</td>
<td>125.00</td>
<td>27%</td>
<td>91.25</td>
</tr>
<tr>
<td>1</td>
<td>TA811AAE</td>
<td>HP P6500 Command View SW E-LTU</td>
<td>22,200.00</td>
<td>22,200.00</td>
<td>27%</td>
<td>16,206.00</td>
</tr>
<tr>
<td>1</td>
<td>HK777A3</td>
<td>HP 3Y Critical Advantage L3 Service</td>
<td>-</td>
<td>-</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>HK777A3 Q1Y</td>
<td>Command View P6500 EVA Unlimited SW Sup</td>
<td>8,030.00</td>
<td>8,030.00</td>
<td>27%</td>
<td>5,861.90</td>
</tr>
<tr>
<td>1</td>
<td>HK777A3 Q24</td>
<td>P6500 EVA Dual Controller Array JW Sup</td>
<td>8,524.00</td>
<td>8,524.00</td>
<td>27%</td>
<td>6,222.52</td>
</tr>
<tr>
<td>2</td>
<td>HK777A3 Q25</td>
<td>P6300/P6500 Drive Enclosure JW Sup</td>
<td>2,050.00</td>
<td>4,100.00</td>
<td>27%</td>
<td>2,993.00</td>
</tr>
<tr>
<td>8</td>
<td>HA104A3 WSK</td>
<td>P6300/P6500 SSD Support HW Sup</td>
<td>760.00</td>
<td>6,240.00</td>
<td>27%</td>
<td>4,555.20</td>
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<tr>
<td>2</td>
<td>456972 B21</td>
<td>HP BLC Emulex LPe1205 8Gb FC HBA Opt</td>
<td>849.00</td>
<td>1,698.00</td>
<td>12%</td>
<td>1,494.24</td>
</tr>
<tr>
<td>2</td>
<td>AJ716A</td>
<td>HP 8Gb Shortwave B-series FC SFP</td>
<td>199.00</td>
<td>398.00</td>
<td>12%</td>
<td>350.24</td>
</tr>
<tr>
<td>2</td>
<td>AJ821A</td>
<td>Brocade HPB series 8/24c Blade SAN Switch</td>
<td>9,285.00</td>
<td>18,570.00</td>
<td>27%</td>
<td>13,556.10</td>
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<tr>
<td>2</td>
<td>AJ839A</td>
<td>HP 5m Multi-mode OM3 LC/LC FC Cable</td>
<td>95.00</td>
<td>190.00</td>
<td>27%</td>
<td>138.70</td>
</tr>
<tr>
<td>4</td>
<td>AJ706A</td>
<td>HP EVA Loopback Connector</td>
<td>99.00</td>
<td>396.00</td>
<td>27%</td>
<td>289.08</td>
</tr>
</tbody>
</table>

**Totals**: 178,998.00

The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems with four (4) hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

There were no differences between the TSC and Priced Storage Configuration.
Priced Storage Configuration Diagram

HP ProLiant
BL460c G6 Server
HP BladeSystem
C7000 Enclosure
2 – 24 Port 8 Gb zoned
Blade Enclosure Switches

2 – Dual Port 8 Gb FC HBAs
2 – 8 Gb Shortwave SFPs
2 – LC-LC cables

HP P6500 Enterprise Virtual Array
Dual Controllers with 8 GB cache/controller
8 – 200 GB Solid State Devices (SSDs)
### Priced Storage Configuration Components

<table>
<thead>
<tr>
<th>Priced Storage Configuration:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 – Dual Port 8 Gb FC HBAs</td>
</tr>
<tr>
<td>2 – 8 Gb Shortwave FC SFPs</td>
</tr>
<tr>
<td>2 – 24 Port, 8 Gb zoned Blade Enclosure switches</td>
</tr>
</tbody>
</table>

#### HP P6500 Enterprise Virtual Array
- Dual Controllers with 8 GB cache/controller (16 GB total)
- Dual power supplies for each controller (4 total)
- 2 – 8 Gb FC front-end physical connection, both used
- 2 – SAS backend physical connections, both used

<table>
<thead>
<tr>
<th>1 – HP Universal Rack</th>
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</thead>
<tbody>
<tr>
<td>2 – HP SAS Drive Enclosures</td>
</tr>
<tr>
<td>dual power supplies for each drive enclosure (4 total)</td>
</tr>
<tr>
<td>8 – 200 GB FC Solid State Devices (SSDs)</td>
</tr>
<tr>
<td>HP StorageWorks Command View EVA</td>
</tr>
</tbody>
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