



**SPC BENCHMARK 1™  
FULL DISCLOSURE REPORT**

**SUN MICROSYSTEMS, INC.  
SUN STORAGE TEK® D280 DISK SYSTEM  
(MIRRORED WRITE CACHE)**

**SPC-1 V1.8**

**Submitted for Review: February 17, 2004**

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## First Edition – February 2004

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## Notes

The following terms, used in this document, are defined as:

- Kilobyte (KB) is equal to 1,000 ( $10^3$ ) bytes.
- Megabyte (MB) is equal to 1,000,000 ( $10^6$ ) bytes.
- Gigabyte (GB) is equal to 1,000,000,000 ( $10^9$ ) bytes.
- Terabyte (TB) is equal to 1,000,000,000,000 ( $10^{12}$ ) bytes.

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## **AUDIT CERTIFICATION**



Storage Technology Corporation®  
 Jaye L. Alynn  
 1 StorageTek Drive  
 Louisville, Co 80028

February 13, 2004

The SPC Benchmark 1™ results listed below for the StorageTek D280 Disk System (*mirrored write cache*) were produced in compliance with the SPC Benchmark 1™ V1.8 Remote Audit requirements.

| <b>SPC Benchmark 1™ V1.8 Results</b>   |                        |
|--|------------------------|
| <b>Tested Storage Configuration (TSC) Name:</b><br>StorageTek D280 Disk System ( <i>mirrored write cache</i> ) |                        |
| <b>Metric</b>  | <b>Reported Result</b> |
| <b>SPC-1 IOPS™</b>   | 18,447.55              |
| <b>SPC-1 Price-Performance</b>   | \$16.69/SPC-1 IOPS™    |
| <b>Total ASU Capacity</b>  | 1,196.092 GB           |
| <b>Data Protection Level</b>   | Mirroring              |
| <b>Total TSC Price (including three-year maintenance)</b>  | \$307,904              |

The following SPC Benchmark 1™ Remote Audit requirements were reviewed and found compliant with V1.8 of the SPC Benchmark 1™ specification:

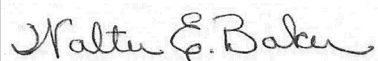
- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified using information supplied by Storage Technology Corporation:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.

- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were reviewed using documentation supplied by Storage Technology Corporation:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The Test Results Files and resultant Summary Results Files received for each of following were authentic, accurate, and compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification:
  - ✓ Data Persistence Test
  - ✓ Sustainability Test Phase
  - ✓ IOPS Test Phase
  - ✓ Response Time Ramp Test Phase
  - ✓ Repeatability Test
- There were no differences between the Tested Storage Configuration (TSC) used for the benchmark and Priced Storage Configuration.
- The final version of the pricing spreadsheet met all of the requirements and constraints of Clause 8 of the SPC-1 Benchmark Specification.
- The Full Disclosure Report (FDR) met all of the requirements in Clause 9 of the SPC-1 Benchmark Specification.

**Audit Notes:**

There were no additional audit notes or exceptions.

Respectfully,



Walter E. Baker  
SPC Auditor

## LETTER OF GOOD FAITH



Storage Technology Corporation  
One StorageTek Drive  
Louisville, CO 80028

Date: 16 February 2004

From: Peter K. Wu, VP Engineering  
One StorageTek Drive  
Louisville, CO 80028

To: Walter E. Baker, SPC Auditor  
Gradient Systems, Inc.  
643 Bair Island Road, Suite 103  
Redwood City, CA 94063-2755

Subject: SPC-1 Letter of Good Faith for the D280 (cache mirroring enabled).

StorageTek Corporation is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with the V1.8.0 of the SPC-1 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Signed:

Date:

  
\_\_\_\_\_  
Peter Wu  
VP, StorageTek Corp., Engineering

  
\_\_\_\_\_  
2/16/04



**EXECUTIVE SUMMARY****Test Sponsor and Contact Information**

| Test Sponsor and Contact Information      |   |
|---|---|
| <b>Test Sponsor<br/>Primary Contact</b>   | Sun Microsystems, Inc. – <a href="http://www.sun.com">http://www.sun.com</a><br>Leah Schoeb – <a href="mailto:leah.schoeb@sun.com">leah.schoeb@sun.com</a><br>5300 Riata Park Court AUS08<br>Austin, TX 78721<br>Phone: (512) 401-1227<br>FAX: (512) 266-2523   |
| <b>Test Sponsor<br/>Alternate Contact</b> | Sun Microsystems, Inc. – <a href="http://www.sun.com">http://www.sun.com</a><br>Jason Scaffer – <a href="mailto:Jason.schaffer@sun.com">Jason.schaffer@sun.com</a><br>500 Eldorado Blvd., UBRM05-211<br>Broomfield, CO 80021<br>Phone: (303) 272-4743<br>FAX: (303) 272-3136  |
| <b>Auditor</b>                            | Storage Performance Council – <a href="http://www.storageperformance.org">www.storageperformance.org</a><br>Walter E. Baker <a href="mailto:AuditService@storageperformance.org">AuditService@storageperformance.org</a><br>643 Bair Island Road, Suite 103<br>Redwood City, CA 94063<br>Phone: (650) 556-9384<br>FAX: (650) 556-9385 |

**Revision Information and Key Dates**

| Revision Information and Key Dates   |                    |
|--|--------------------|
| <b>SPC-1 Specification revision number</b>   | V1.8               |
| <b>SPC-1 Workload Generator revision number</b>  | V2.00.03           |
| <b>Date Results were first used publicly</b>   | February 17, 2004  |
| <b>Date FDR was submitted to the SPC</b>   | February 17, 2004  |
| <b>Date revised FDR was submitted to the SPC</b><br>Revised Test Sponsor Name, product name, and<br>primary/alternate contact information to reflect<br>Sun/StorageTek merger. | September 5, 2006  |
| <b>Date the TSC is/was available for shipment to customers</b>   | September 27, 2002 |
| <b>Date the TSC completed audit certification</b>  | February 13, 2003  |

## Summary of Results

| SPC-1 Results   |                     |
|---|---------------------|
| Tested Storage Configuration (TSC) Name: Sun StorageTek® D280 Disk System ( <i>mirrored write cache</i> ) |                     |
| Metric  | Reported Result     |
| SPC-1 IOPS™   | 18,447.55           |
| SPC-1 Price-Performance   | \$16.69/SPC-1 IOPS™ |
| Total ASU Capacity  | 1,196.092 GB        |
| Data Protection Level   | Mirroring           |
| Total TSC Price (including three-year maintenance)  | \$307,904           |

**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 Mirroring configures two or more identical copies of user data, maintained on separate disks.

## Storage Capacities and Relationships

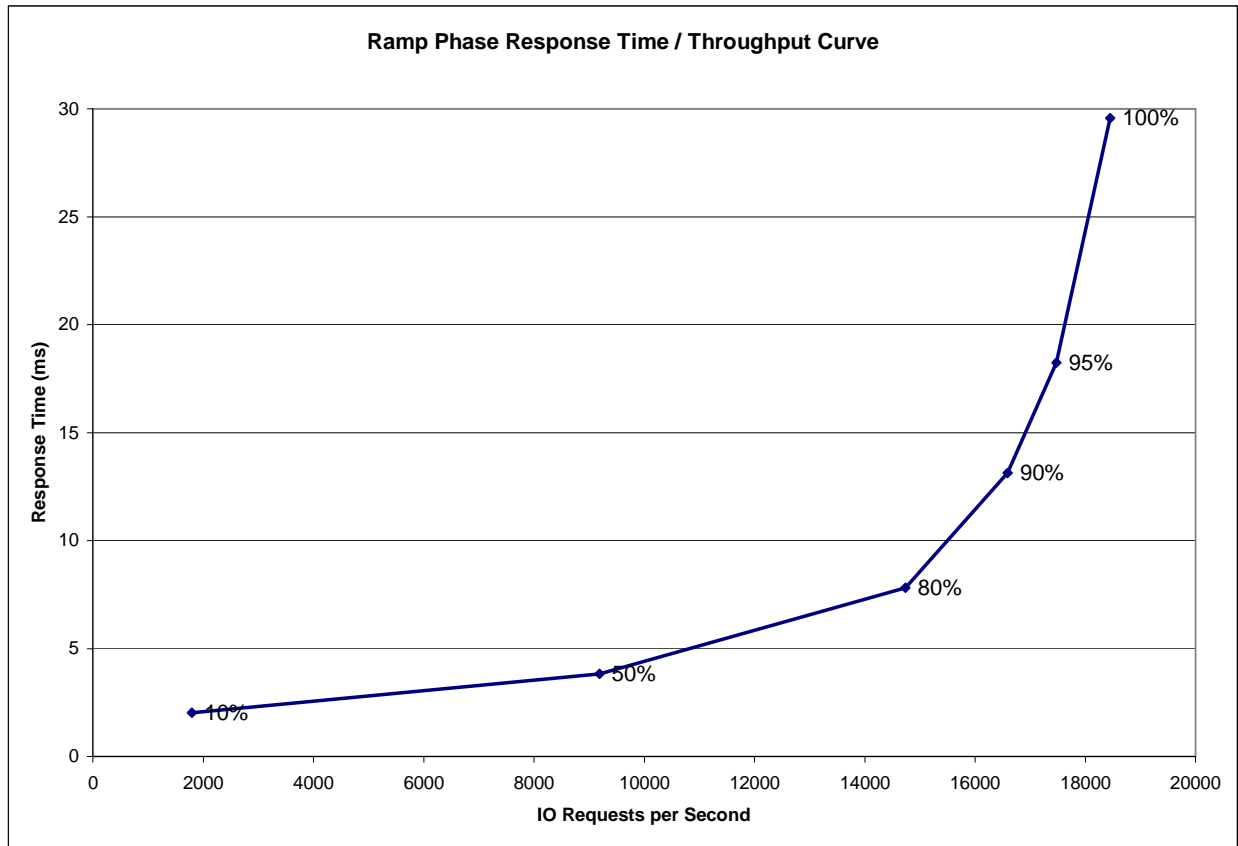
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.

| Physical Capacity<br>3,933.36 GB   |                   |                                  |                              |
|------------------------------------|-------------------|----------------------------------|------------------------------|
| Configured Capacity<br>2,392.18GB  |                   |                                  | Unused Storage<br>1,483.19GB |
| Addressable Capacity<br>1,196.09GB |                   | Addressable Mirror<br>1,196.09GB |                              |
| ASU Capacity<br>1,196.09GB         |                   |                                  |                              |
| ASU 1<br>538.24GB                  | ASU 2<br>538.24GB | ASU 3<br>119.60GB                |                              |

### 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 IOPS™ metric.

The Average Response Time measured at the 100% load point cannot exceed 30 milliseconds or the benchmark measurement is invalid.



### Response Time - Throughput Data

|                                    | 10% Load | 50% Load | 80% Load  | 90% Load  | 95% Load  | 100% Load |
|------------------------------------|----------|----------|-----------|-----------|-----------|-----------|
| <b>I/O Request Throughput</b>      | 1,799.52 | 9,187.16 | 14,741.60 | 16,592.22 | 17,480.36 | 18,447.55 |
| <b>Average Response Time (ms):</b> |          |          |           |           |           |           |
| <b>All ASUs</b>                    | 2.03     | 3.82     | 7.81      | 13.13     | 18.25     | 29.57     |
| <b>ASU-1</b>                       | 2.69     | 4.99     | 9.49      | 14.71     | 19.45     | 32.31     |
| <b>ASU-2</b>                       | 1.96     | 3.52     | 6.33      | 10.28     | 14.41     | 21.00     |
| <b>ASU-3</b>                       | 0.66     | 1.45     | 4.87      | 11.03     | 17.38     | 27.53     |
| <b>Reads</b>                       | 4.23     | 7.46     | 12.00     | 15.83     | 19.13     | 28.20     |
| <b>Writes</b>                      | 0.60     | 1.44     | 5.07      | 11.37     | 17.67     | 30.47     |

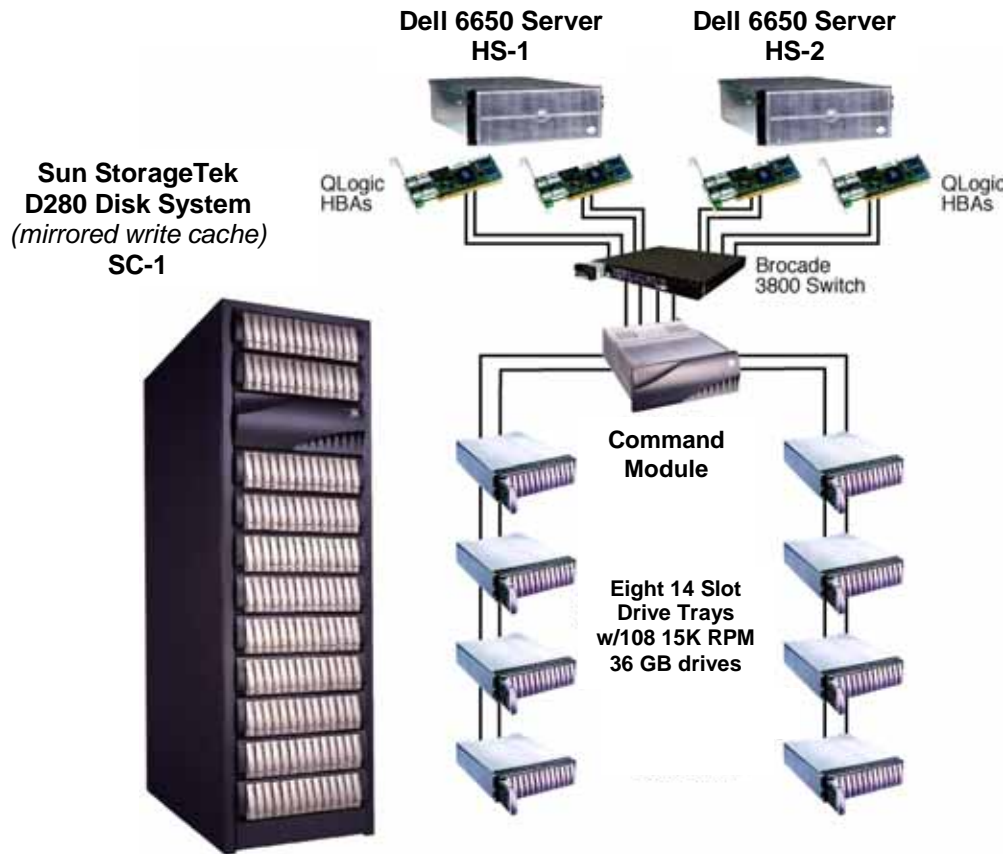
## Tested Storage Configuration Pricing

| StorageTek Item No. | Description   | Unit Price | Qty | Aggregate Price |
|---------------------|---|------------|-----|-----------------|
| D280002             | D280 Command Module, Rack Mount, Dual Controller                    | \$ 62,000  | 1   | \$ 62,000       |
| D200014             | D200 2Gbit Expansion Drive Module, 14 Slot, Rack Mount, Dual FC ESM | \$ 9,000   | 8   | \$ 72,000       |
| SMGR-001            | SANtricity 8.40 for Windows 2000 Software Feature                   | \$ 10,000  | 1   | \$ 10,000       |
| G36                 | 36 GB FC 15K Drive Canister, 2Gb, 1.0" FF                           | \$ 1,050   | 108 | \$ 113,400      |
| 10800281            | FC Optical Cable - 2Gb/2Gb, 3.0m                                    | \$ 121     | 8   | \$ 968          |
| SNFCS64             | Fibre Channel 2Gb Switch, (16 port w/ SFP)                          | \$ 29,400  | 1   | \$ 29,400       |
| HBAQ003             | QLogic 2342 Host Bus Adapter, dualport, 133 MHZ PCI-X               | \$ 3,729   | 4   | \$ 14,916       |
| 126544-01           | 25-meter fibre channel cables, optical, switch to Command Module    | \$ 225     | 4   | \$ 900          |
| Select              | Switch warranty upgrade to 3 yrs                                    | \$ 180     | 24  | \$ 4,320        |
|                     |   |            |     | \$ 307,904      |

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

There were no differences between the Tested Storage Configuration (TSC) and the Priced Storage Configuration.

**Benchmark Configuration/Tested Storage Configuration Diagram**



| Host Systems:                                 | Tested Storage Configuration (TSC):                  |
|---|--|
| UID=HS1, HS2                                  | UID=SC-1   |
| 2 – Dell 6650 Servers                         | 2 – QLogic 2342 HBAs per Host System                 |
| 4 – 2 GHz Pentium 4 Xeon CPUs per Host System | Brocade 3800 Switch                                  |
| 3 GB main memory per Host System              | Command Module (includes 4 miniHubs)                 |
| Windows 2000, SP3                             | 2 –Disk Array Controllers<br>1 GB RAM per controller |
| WG  | 4 – 2gb Fibre Channel host connections               |
|   | 4 – 2gb Fibre Channel drive connections              |
|   | 8 –Drive Modules                                     |
|   | 108 – 36GB 15K RPM Disk Drives                       |

## **CONFIGURATION INFORMATION**

### **Benchmark Configuration (BC)/Tested Storage Configuration (TSC) Diagram**

#### ***Clause 9.2.4.4.1***

*A one page Benchmark Configuration (BC)/Tested Storage Configuration (TSC) diagram shall be included in the Executive Summary...*

A diagram of the benchmark configuration and tested storage configuration is included on the preceding page. The configuration consists of two host systems, with two Qlogic 2342 PCI to dual-channel 2gb fibre channel host adapters each. The eight host system, fibre channel connections are connected to a fibre channel switch. The four fibre channel host connections on the command module are also connected to the switch. The host system is running Windows 2000, with Service Pack 3 applied.

## Storage Network Configuration

### Clause 9.2.4.4.2

*If a storage network is employed in the BC/TSC, the FDR shall contain a topology diagram... . This diagram should include, but is not limited to the following components:*

- 1. Storage Controller and Domain Controllers (see Clause 9.2.4.4.1)*
- 2. Host Systems (see Clause 9.2.4.4.1)*
- 3. Routers and Bridges*
- 4. Hubs and Switches*
- 5. HBAs to Host Systems and Front End Port to Storage Controllers*

*Additionally the diagram shall:*

- Illustrate the physical connection between components.*
- Describe the type of each physical connection.*
- Describe the network protocol used over each physical connection.*
- The maximum theoretical transfer rate of each class of interconnect used in the configuration.*
- Correlate with the BC Configuration Diagram in Clause 9.2.4.4.1.*

*The Test Sponsor shall additionally supply (referenced in an appendix) a wiring diagram of the physical connections and physical port assignments used in the storage network. The diagram should allow anyone to exactly replicate the physical configuration of the storage network.*

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) was configured with local storage and, as such, did not employ a storage network.

## Host System Configuration

### Clause 9.2.4.4.3

The FDR shall minimally contain, for each Host System running the Workload Generator, a listing of the following:

1. Number and type of CPUs.
2. Main memory capacity.
3. Cache memory capacity.
4. Number and type of disk controllers or Host Bus Adapters.

The details of the Host System configuration may be found on 13 (*Benchmark Configuration/ Tested Storage Configuration Diagram*).

## Customer Tuning Parameters and Options

### Clause 9.2.4.5.1

All Benchmark Configuration (BC) components with customer tunable parameter and options that have been altered from their default values must be listed in the FDR. The FDR entry for each of those components must include both the name of the component and the altered value of the parameter or option.

## Windows 2000 Registry Changes

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\MaximumSGList=0xff
```

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\NumberOfRequests=0xe0
```

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
Disk\TimeOutValue=0x78
```

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\
ql2300\Device\DriverParameters=UseSameNN=1;BusChange=0;
```

## Array Controller Options

All array controller configuration options were set by the configuration script list in “Appendix B: Tested Storage Configuration (TSC) Creation/Configuration Script” on page 56.



## Host Bus Adapter Options

The table below lists the Host Bus Adapter options that were changed from their default values.

| Host Bus Adapter Settings         |          |           |
|-----------------------------------|----------|-----------|
| Item                              | Default  | New Value |
| <b>Host Adapter Settings</b>      |          |           |
| Loop Reset Delay                  | 5        | 8         |
| Adapter Hard Loop ID              | Disabled | Enabled   |
| Hard Loop ID (unique for each)    | 0        | Eg. 22    |
| <b>Advanced Adapter Settings</b>  |          |           |
| Execution Throttle                | 16       | 255       |
| Fast Command Posting              | Disabled | Enabled   |
| LUNs per Target                   | 8        | 0         |
| Enable Target Reset               | No       | Yes       |
| Login Retry Count                 | 8        | 30        |
| Port Down Retry Count             | 8        | 70        |
| <b>Extended Firmware Settings</b> |          |           |
| Data Rate                         | 0        | 2         |

## **Tested Storage Configuration (TSC) Description**

### Clause 9.2.4.5.2

*The FDR must include sufficient information to recreate the logical representation of the TSC. In addition to customer tunable parameters and options (Clause 4.2.4.5.3), that information must include, at a minimum, a diagram and/or description of the following:*

- *All physical components that comprise the TSC. Those components are also illustrated in the Benchmark Configuration (BC) diagram in Clause 9.2.4.4.1 and, if applicable, the Storage Network Configuration Diagram in Clause 9.2.4.4.2.*
- *The logical representation of the TSC, configured from the above components that will be presented to the Workload Generator.*

*In addition the FDR may include listings of scripts and/or commands used to configure the physical components that comprise the TSC.*

The Tested Storage Configuration was created and configured using the script that appears in “Appendix B: Tested Storage Configuration (TSC) Creation/Configuration Script” on page 56. The LUNs created by the script comprised the reported Configured Storage Capacity, which contained both the Addressable Storage Capacity and a mirror of the Addressable Storage Capacity.

## **SPC-1 Workload Generator Storage Configuration**

### Clause 9.2.4.5.3

*The FDR must include all SPC-1 Workload Generator storage configuration commands and parameters.*

The SPC-1 Workload Generator storage configuration commands and parameters for this measurement appear in “Appendix A: SPC-1 Workload Generator Storage Configuration Commands and Parameters” on page 52.

## **DATA REPOSITORY**

### **Definitions**

**Total ASU Capacity:** The total storage capacity read and written in the course of executing the SPC-1 benchmark.

**Application Storage Unit (ASU):** The logical interface between the storage and SPC-1 Workload Generator. The three ASUs (Data, User, and Log) are typically implemented on one or more Logical Volume.

**Logical Volume:** The division of Addressable Storage Capacity into individually addressable logical units of storage used in the SPC-1 benchmark. Each Logical Volume is implemented as a single, contiguous address space.

**Addressable Storage Capacity:** The total storage (sum of Logical Volumes) that can be read and written by application programs such as the SPC-1 Workload Generator.

**Configured Storage Capacity:** This capacity includes the Addressable Storage Capacity and any other storage (parity disks, hot spares, etc.) necessary to implement the Addressable Storage Capacity.

**Physical Storage Capacity:** The formatted capacity of all storage devices physically present in the Tested Storage Configuration (TSC).

**User Data Copy:** An identical copy of user data maintained on separate disks.

**Required Storage:** The amount of Configured Storage Capacity required to implement the Addressable Storage Configuration, excluding the storage required for the three ASUs.

**Global Storage Overhead:** The amount of Physical Storage Capacity that is required for storage subsystem use and unavailable for use by application programs.

**Total Unused Storage:** The amount of storage capacity available for use by application programs but not included in the Total ASU Capacity.

**Storage Capacities and Relationships**

*Two tables and an illustration documenting the storage capacities and relationships of the SPC-1 Storage Hierarchy (Clause 2.1) shall be included in the FDR.*

**SPC-1 Storage Capacities**

| SPC-1 Storage Capacities                 |                |          |
|--|----------------|----------|
| Storage Hierarchy Component              | Units          | Capacity |
| Total ASU Capacity                       | Gigabytes (GB) | 1,196.09 |
| Addressable Storage Capacity             | Gigabytes (GB) | 1,196.09 |
| Configured Storage Capacity              | Gigabytes (GB) | 2,392.18 |
| Physical Storage Capacity                | Gigabytes (GB) | 3,933.36 |
| User Data Copy (Mirroring)               | Gigabytes (GB) | 1,196.09 |
| Required Storage (metadata) & Hot Spares | Gigabytes (GB) | 0.00     |
| Global Storage Overhead                  | Gigabytes (GB) | 57.98    |
| Total Unused Storage                     | Gigabytes (GB) | 1,483.19 |

The Physical Storage Capacity consisted of 108 disk drives with a formatted capacity of 36.42 GB each. Each disk drive had 0.536 GB reserved by the disk array management firmware, for a total of 57.98 GB of Global Storage Overhead. The Total Unused Storage capacity was 1,483.19 GB.

**SPC-1 Storage Capacities and Relationships Illustration**

The various storage capacities configured in the benchmark result are illustrated below (not to scale).

|                                    |                   |                                  |  |                              |                               |
|------------------------------------|-------------------|----------------------------------|--|------------------------------|-------------------------------|
| Physical Capacity<br>3,933.36 GB   |                   |                                  |  |                              |                               |
| Configured Capacity<br>2,392.18GB  |                   |                                  |  | Unused Storage<br>1,483.19GB | Global<br>Overhead<br>57.98GB |
| Addressable Capacity<br>1,196.09GB |                   | Addressable Mirror<br>1,196.09GB |  |                              |                               |
| ASU Capacity<br>1,196.09GB         |                   |                                  |  |                              |                               |
| ASU 1<br>538.24GB                  | ASU 2<br>538.24GB | ASU 3<br>119.60GB                |  |                              |                               |

## SPC-1 Storage Hierarchy Ratios

|  | Addressable Storage Capacity | Configured Storage Capacity | Physical Storage Capacity |
|--|------------------------------|-----------------------------|---------------------------|
| Total ASU Capacity                       | 100.00%                      | 50.00%                      | 30.41%                    |
| User Data Copy (Mirror)                  |                              | 50.00%                      | 30.41%                    |
| Addressable Storage Capacity             |                              | 50.00%                      | 30.41%                    |
| Required Storage (metadata) & Hot Spares |                              | 0.00%                       | 0.00%                     |
| Configured Storage Capacity              |                              |                             | 60.82%                    |
| Global Storage Overhead                  |                              |                             | 1.47%                     |
| Unused Storage                           | 0.00%                        | 0.00%                       | 37.71%                    |

The Addressable Storage Capacity and Configured Storage Capacity contained no Unused Storage. The Physical Storage Capacity contained 37.71 % (1,483.19 GB) of Unused Storage.

## Logical Volume Capacity and ASU Mapping

### Clause 9.2.4.6.2

*A table illustrating the capacity of each ASU and the mapping of Logical Volumes to ASUs shall be provided in the FDR. Logical Volumes shall be sequenced in the table from top to bottom per its position in the contiguous address space of each ASU. The capacity of each Logical Volume shall be stated. ... In conjunction with this table, the Test Sponsor shall provide a complete description of the type of data protection (see Clause 2.4.5) used on each Logical Volume.*

| Logical Volume Capacity and Mapping   |   |   |
|---|---|---|
| ASU-1 (538.24 GB)   | ASU-2 (538.24 GB)   | ASU-3 (119.60 GB)   |
| 40 Logical Volumes<br>13.46 GB per Logical Volume<br>(13.46 GB used/Logical Volume) | 1 Logical Volume<br>538.24 GB per Logical Volume<br>(538.24 GB used/Logical Volume) | 1 Logical Volume<br>119.60 GB per Logical Volume<br>(119.60 GB used/Logical Volume) |

The Data Protection Level used for all Logical Volumes was Mirroring as described on page 10. See "ASU Configuration" in the [IOPS Test Results File](#) for more detailed configuration information.

## **SPC-1 BENCHMARK EXECUTION RESULTS**

### **Definitions**

**Average Response Time:** *The sum of the Response Times for all Measured I/O Requests divided by the total number of Measured I/O Requests.*

**I/O Request Throughput:** *The total number of Measured I/O requests in an SPC-1 Test Run divided by the duration of the Measurement Interval in seconds.*

**Measurement Interval:** *The finite and contiguous time period, after the Tested Storage Configuration (TSC) has reached Steady State, when data is collected by a Test Sponsor to generate an SPC-1 test result or support an SPC-1 test result.*

**Steady State:** *The consistent and sustainable throughput of the TSC. During this period the load presented to the TSC by the Workload Generator is constant. Comment: Steady Stated is achieved only after caches in the TSC have filled and as a result the I/O Request throughput of the TSC has stabilized.*

**Test:** *A collection of Test Phases or Test Runs sharing a common objective.*

**Test Phase:** *A collection of one or more SPC-1 Test Runs sharing a common objective and intended to be run in a specific sequence.*

**Test Run:** *The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up period, Shut-Down period, and Ramp-Down period as illustrated in the Figure 5-1 below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.*

### **Sustainability Test Phase**

#### **Clause 5.4.2.1**

*The Sustainability Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of three (3) hours. The intent is to demonstrate a sustained maximum I/O Request Throughput as well as insuring the Tested Storage Configuration (TSC) has reached steady state prior to measuring the maximum I/O Request Throughput (SPC-1™ IOPS).*

*The reported I/O Request Throughput of the Sustainability Test Run must be within 5% of the reported SPC-1™ IOPS primary metric. The Average Response Time measured in Sustainability Test Run cannot exceed thirty (30) milliseconds.*

#### **Clause 9.2.4.7.1**

*For the Sustainability Test Phase the FDR shall contain:*

- 1. A Data Rate Distribution (data table and graph).*
- 2. I/O Request Throughput Distribution (data table and graph).*
- 3. The human readable Test Run Results File produced by the Workload Generator.*
- 4. A listing or screen image of all input parameters supplied to the Workload Generator.*
- 5. The Measured Intensity Multiplier for each I/O stream.*
- 6. The variability of the Measured Intensity Multiplier, as defined in Clause 5.3.13.3.*

### **SPC-1 Workload Generator Input Parameters**

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java -Xmx64m -Xms64m metrics -b 369 -s 600
```

### **Sustainability Test Results File**

A link to the test results file generated from the Sustainability Test Run is listed below.

[Sustainability Test Results File](#)

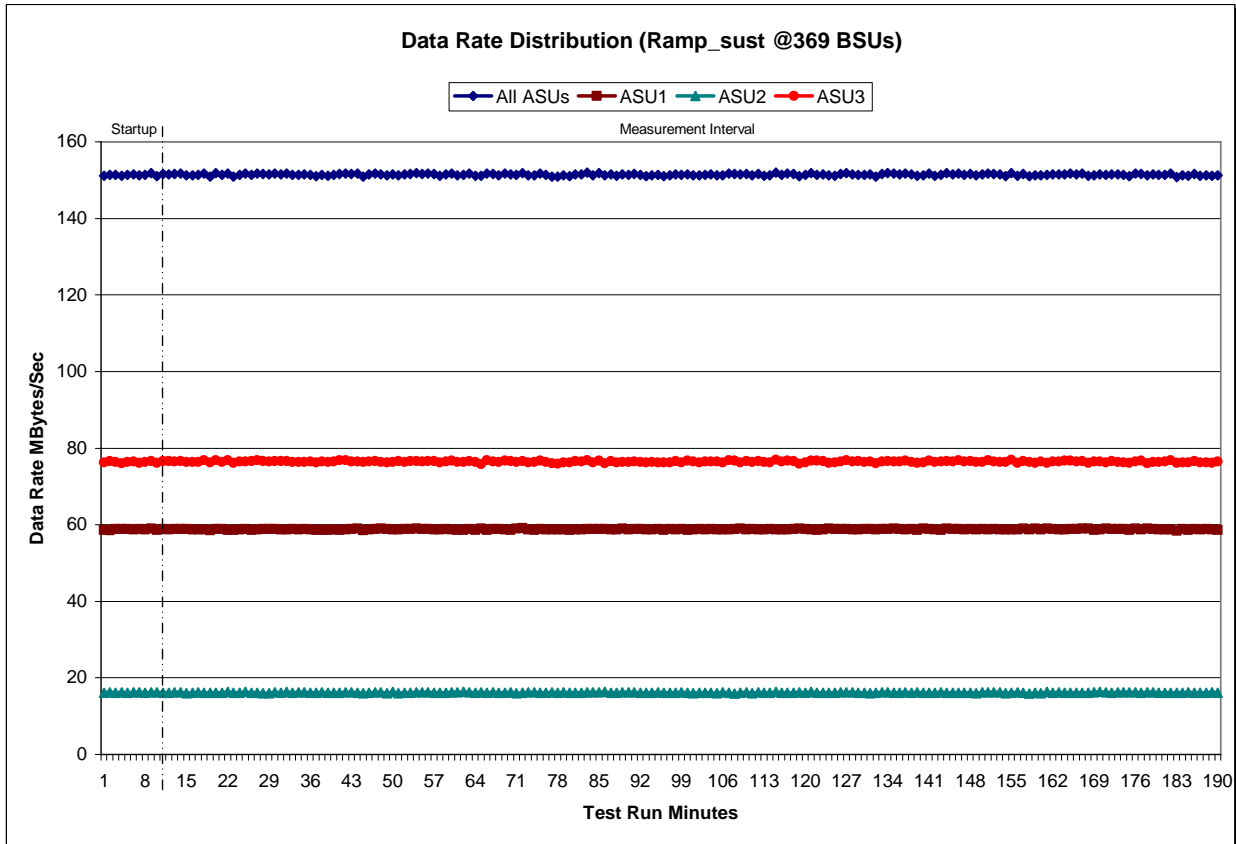
**Sustainability - Data Rate Distribution Data (MB/second)**

Ramp-Up/Start-Up Start Stop Interval Duration  
16:51:13 17:01:13 0-9 0:10:00  
Measurement Interval 17:01:13 20:01:13 9-189 3:00:00

| Interval | All ASUs | ASU1  | ASU2  | ASU3  | Interval | All ASUs | ASU1  | ASU2  | ASU3  | Interval | All ASUs | ASU1  | ASU2  | ASU3  |
|----------|----------|-------|-------|-------|----------|----------|-------|-------|-------|----------|----------|-------|-------|-------|
| 0        | 151.07   | 58.66 | 16.16 | 76.26 | 63       | 151.15   | 58.62 | 16.18 | 76.34 | 126      | 151.85   | 58.82 | 16.24 | 76.78 |
| 1        | 151.35   | 58.53 | 16.21 | 76.61 | 64       | 151.10   | 58.98 | 16.26 | 75.85 | 127      | 151.49   | 58.79 | 16.21 | 76.49 |
| 2        | 151.37   | 58.91 | 16.09 | 76.38 | 65       | 151.68   | 58.68 | 16.15 | 76.84 | 128      | 151.35   | 58.72 | 16.08 | 76.56 |
| 3        | 151.10   | 58.86 | 16.26 | 75.98 | 66       | 151.58   | 58.85 | 16.24 | 76.48 | 129      | 151.34   | 58.85 | 16.16 | 76.33 |
| 4        | 151.32   | 58.83 | 16.14 | 76.35 | 67       | 151.29   | 58.85 | 16.12 | 76.32 | 130      | 151.48   | 58.89 | 16.07 | 76.52 |
| 5        | 151.52   | 58.77 | 16.28 | 76.47 | 68       | 151.65   | 58.79 | 16.15 | 76.71 | 131      | 150.89   | 58.78 | 16.12 | 75.99 |
| 6        | 151.29   | 58.84 | 16.26 | 76.19 | 69       | 151.46   | 58.64 | 16.27 | 76.55 | 132      | 151.62   | 58.89 | 16.21 | 76.52 |
| 7        | 151.35   | 58.74 | 16.18 | 76.43 | 70       | 151.40   | 58.95 | 16.04 | 76.42 | 133      | 151.77   | 58.90 | 16.28 | 76.59 |
| 8        | 151.79   | 59.03 | 16.19 | 76.57 | 71       | 151.78   | 59.09 | 16.09 | 76.60 | 134      | 151.66   | 58.97 | 16.15 | 76.54 |
| 9        | 151.01   | 58.58 | 16.24 | 76.20 | 72       | 151.29   | 58.72 | 16.27 | 76.29 | 135      | 151.50   | 58.90 | 16.14 | 76.46 |
| 10       | 151.57   | 58.84 | 16.15 | 76.58 | 73       | 151.20   | 58.63 | 16.21 | 76.36 | 136      | 151.68   | 58.76 | 16.24 | 76.69 |
| 11       | 151.45   | 58.75 | 16.14 | 76.56 | 74       | 151.68   | 58.84 | 16.18 | 76.66 | 137      | 151.42   | 58.89 | 16.13 | 76.40 |
| 12       | 151.60   | 58.86 | 16.27 | 76.48 | 75       | 151.35   | 58.78 | 16.16 | 76.41 | 138      | 151.12   | 58.68 | 16.27 | 76.16 |
| 13       | 151.67   | 58.84 | 16.25 | 76.59 | 76       | 150.93   | 58.74 | 16.19 | 76.00 | 139      | 151.25   | 58.94 | 16.07 | 76.24 |
| 14       | 151.29   | 58.91 | 16.03 | 76.35 | 77       | 150.87   | 58.78 | 16.12 | 75.96 | 140      | 151.74   | 58.90 | 16.15 | 76.69 |
| 15       | 151.20   | 58.71 | 16.14 | 76.34 | 78       | 151.30   | 58.72 | 16.28 | 76.30 | 141      | 151.18   | 58.70 | 16.12 | 76.36 |
| 16       | 151.39   | 58.78 | 16.21 | 76.40 | 79       | 150.98   | 58.66 | 16.08 | 76.24 | 142      | 151.33   | 58.60 | 16.26 | 76.47 |
| 17       | 151.74   | 58.74 | 16.18 | 76.81 | 80       | 151.51   | 58.78 | 16.15 | 76.57 | 143      | 151.79   | 58.99 | 16.17 | 76.63 |
| 18       | 150.93   | 58.57 | 16.13 | 76.23 | 81       | 151.46   | 58.80 | 16.15 | 76.51 | 144      | 151.50   | 58.83 | 16.18 | 76.50 |
| 19       | 151.79   | 58.88 | 16.09 | 76.82 | 82       | 151.91   | 58.84 | 16.23 | 76.84 | 145      | 151.73   | 58.82 | 16.12 | 76.79 |
| 20       | 151.38   | 58.89 | 16.13 | 76.36 | 83       | 151.28   | 58.81 | 16.25 | 76.22 | 146      | 151.39   | 58.70 | 16.17 | 76.52 |
| 21       | 151.76   | 58.68 | 16.30 | 76.78 | 84       | 151.78   | 58.83 | 16.24 | 76.71 | 147      | 151.64   | 58.90 | 16.08 | 76.65 |
| 22       | 150.93   | 58.65 | 16.11 | 76.17 | 85       | 151.20   | 58.84 | 16.31 | 76.05 | 148      | 151.23   | 58.76 | 16.05 | 76.42 |
| 23       | 151.32   | 58.72 | 16.08 | 76.52 | 86       | 151.46   | 58.74 | 16.10 | 76.63 | 149      | 151.44   | 58.82 | 16.25 | 76.37 |
| 24       | 151.70   | 58.91 | 16.33 | 76.46 | 87       | 151.09   | 58.74 | 16.10 | 76.25 | 150      | 151.71   | 58.72 | 16.20 | 76.79 |
| 25       | 151.33   | 58.66 | 16.11 | 76.57 | 88       | 151.53   | 58.93 | 16.19 | 76.41 | 151      | 151.60   | 58.83 | 16.25 | 76.53 |
| 26       | 151.66   | 58.78 | 16.10 | 76.78 | 89       | 151.32   | 58.79 | 16.21 | 76.32 | 152      | 151.43   | 58.75 | 16.29 | 76.40 |
| 27       | 151.54   | 58.88 | 16.05 | 76.60 | 90       | 151.58   | 58.85 | 16.20 | 76.53 | 153      | 151.06   | 58.70 | 15.99 | 76.37 |
| 28       | 151.45   | 58.90 | 16.03 | 76.51 | 91       | 151.32   | 58.83 | 16.11 | 76.38 | 154      | 151.84   | 58.71 | 16.14 | 77.00 |
| 29       | 151.69   | 58.83 | 16.23 | 76.64 | 92       | 151.07   | 58.76 | 16.11 | 76.21 | 155      | 151.17   | 58.77 | 16.23 | 76.17 |
| 30       | 151.44   | 58.75 | 16.09 | 76.60 | 93       | 151.25   | 58.75 | 16.15 | 76.35 | 156      | 151.64   | 58.95 | 16.11 | 76.58 |
| 31       | 151.65   | 58.79 | 16.31 | 76.55 | 94       | 151.34   | 58.86 | 16.25 | 76.22 | 157      | 151.02   | 58.75 | 15.89 | 76.38 |
| 32       | 151.33   | 58.82 | 16.11 | 76.40 | 95       | 151.04   | 58.68 | 16.14 | 76.22 | 158      | 151.27   | 58.95 | 16.17 | 76.15 |
| 33       | 151.39   | 58.77 | 16.21 | 76.41 | 96       | 151.22   | 58.81 | 16.15 | 76.27 | 159      | 151.24   | 58.70 | 16.04 | 76.50 |
| 34       | 151.48   | 58.81 | 16.26 | 76.41 | 97       | 151.49   | 58.78 | 16.11 | 76.61 | 160      | 151.37   | 58.95 | 16.33 | 76.09 |
| 35       | 151.31   | 58.69 | 16.10 | 76.51 | 98       | 151.40   | 58.90 | 16.23 | 76.27 | 161      | 151.53   | 58.85 | 16.17 | 76.52 |
| 36       | 151.05   | 58.58 | 16.18 | 76.29 | 99       | 151.50   | 58.68 | 16.15 | 76.67 | 162      | 151.51   | 58.75 | 16.27 | 76.49 |
| 37       | 151.31   | 58.62 | 16.23 | 76.46 | 100      | 151.19   | 58.79 | 15.97 | 76.44 | 163      | 151.44   | 58.69 | 16.08 | 76.67 |
| 38       | 151.13   | 58.61 | 16.13 | 76.38 | 101      | 151.27   | 58.89 | 16.16 | 76.22 | 164      | 151.74   | 58.84 | 16.17 | 76.73 |
| 39       | 151.37   | 58.76 | 16.16 | 76.45 | 102      | 151.40   | 58.80 | 16.09 | 76.52 | 165      | 151.46   | 58.85 | 16.16 | 76.45 |
| 40       | 151.56   | 58.68 | 16.09 | 76.79 | 103      | 151.50   | 58.86 | 16.18 | 76.46 | 166      | 151.65   | 58.92 | 16.14 | 76.59 |
| 41       | 151.74   | 58.73 | 16.21 | 76.80 | 104      | 151.20   | 58.71 | 16.03 | 76.45 | 167      | 151.16   | 58.94 | 16.13 | 76.09 |
| 42       | 151.57   | 58.84 | 16.25 | 76.48 | 105      | 151.21   | 58.72 | 16.22 | 76.27 | 168      | 151.29   | 58.65 | 16.19 | 76.45 |
| 43       | 151.65   | 58.99 | 16.18 | 76.48 | 106      | 151.68   | 58.71 | 16.17 | 76.79 | 169      | 151.49   | 58.70 | 16.35 | 76.44 |
| 44       | 150.92   | 58.54 | 16.03 | 76.35 | 107      | 151.56   | 58.91 | 15.91 | 76.74 | 170      | 151.39   | 58.93 | 16.23 | 76.23 |
| 45       | 151.47   | 58.78 | 16.16 | 76.54 | 108      | 151.45   | 59.01 | 16.14 | 76.30 | 171      | 151.52   | 58.81 | 16.12 | 76.59 |
| 46       | 151.68   | 58.81 | 16.24 | 76.63 | 109      | 151.60   | 58.80 | 16.23 | 76.57 | 172      | 151.50   | 58.87 | 16.22 | 76.42 |
| 47       | 151.51   | 58.93 | 16.24 | 76.34 | 110      | 151.30   | 58.82 | 16.06 | 76.42 | 173      | 151.41   | 58.84 | 16.28 | 76.29 |
| 48       | 151.21   | 58.92 | 16.06 | 76.24 | 111      | 151.54   | 58.75 | 16.20 | 76.58 | 174      | 151.07   | 58.61 | 16.30 | 76.16 |
| 49       | 151.49   | 58.77 | 16.30 | 76.42 | 112      | 151.14   | 58.71 | 16.11 | 76.32 | 175      | 151.69   | 58.97 | 16.19 | 76.54 |
| 50       | 151.26   | 58.71 | 16.00 | 76.56 | 113      | 151.24   | 58.82 | 16.17 | 76.25 | 176      | 151.57   | 58.73 | 16.14 | 76.70 |
| 51       | 151.48   | 58.92 | 16.13 | 76.43 | 114      | 151.97   | 58.69 | 16.34 | 76.94 | 177      | 151.20   | 58.92 | 16.25 | 76.02 |
| 52       | 151.62   | 58.88 | 16.13 | 76.61 | 115      | 151.39   | 58.70 | 16.17 | 76.52 | 178      | 151.43   | 58.83 | 16.24 | 76.36 |
| 53       | 151.83   | 58.97 | 16.23 | 76.63 | 116      | 151.70   | 58.79 | 16.15 | 76.77 | 179      | 151.33   | 58.80 | 16.18 | 76.35 |
| 54       | 151.62   | 58.83 | 16.27 | 76.52 | 117      | 151.54   | 58.85 | 16.12 | 76.57 | 180      | 151.38   | 58.76 | 16.18 | 76.44 |
| 55       | 151.73   | 58.86 | 16.28 | 76.59 | 118      | 151.05   | 58.92 | 16.23 | 75.89 | 181      | 151.72   | 58.74 | 16.15 | 76.82 |
| 56       | 151.56   | 58.79 | 16.12 | 76.66 | 119      | 151.31   | 58.88 | 16.16 | 76.27 | 182      | 150.80   | 58.45 | 16.18 | 76.17 |
| 57       | 151.15   | 58.77 | 16.11 | 76.28 | 120      | 151.85   | 58.78 | 16.33 | 76.74 | 183      | 151.27   | 58.82 | 16.14 | 76.31 |
| 58       | 151.44   | 58.82 | 16.17 | 76.45 | 121      | 151.41   | 58.62 | 16.12 | 76.67 | 184      | 151.11   | 58.63 | 16.20 | 76.27 |
| 59       | 151.67   | 58.71 | 16.23 | 76.73 | 122      | 151.47   | 58.73 | 16.16 | 76.58 | 185      | 151.62   | 58.88 | 16.13 | 76.61 |
| 60       | 151.28   | 58.69 | 16.21 | 76.38 | 123      | 151.28   | 58.97 | 16.18 | 76.13 | 186      | 151.09   | 58.76 | 16.12 | 76.21 |
| 61       | 151.37   | 58.66 | 16.31 | 76.40 | 124      | 151.14   | 58.81 | 16.07 | 76.26 | 187      | 151.24   | 58.85 | 16.08 | 76.31 |
| 62       | 151.69   | 58.83 | 16.25 | 76.62 | 125      | 151.57   | 58.87 | 16.24 | 76.46 | 188      | 151.10   | 58.73 | 16.27 | 76.09 |
|          |          |       |       |       |          |          |       |       |       | 189      | 151.29   | 58.65 | 16.15 | 76.50 |



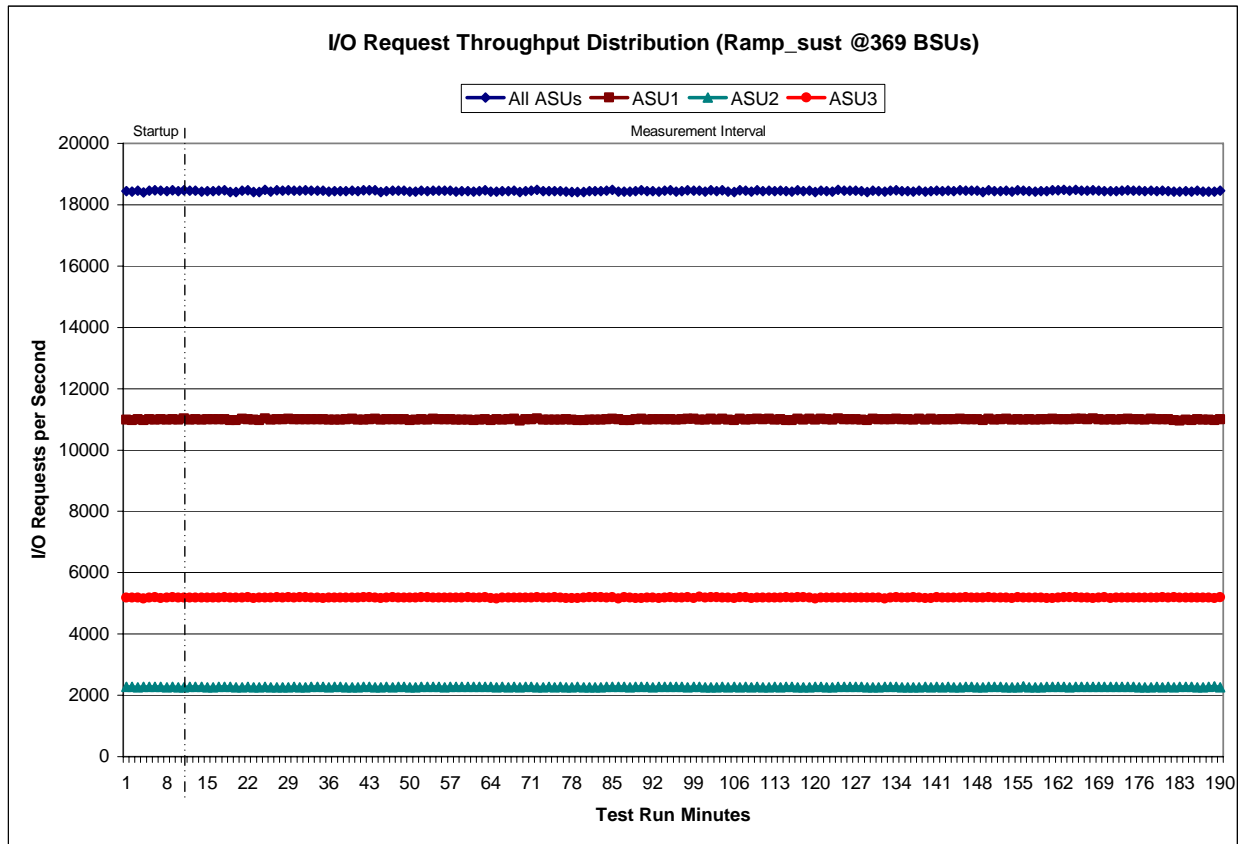
### Sustainability - Data Rate Distribution Graph



**Sustainability – I/O Request Throughput Distribution Data**

| Ramp-Up/Start-Up     |           | Start     | Stop     | Interval | Duration |           |           |          |          |          |           |           |          |          |  |
|----------------------|-----------|-----------|----------|----------|----------|-----------|-----------|----------|----------|----------|-----------|-----------|----------|----------|--|
| Measurement Interval |           | 16:51:13  | 17:01:13 | 0-9      | 0:10:00  |           |           |          |          |          |           |           |          |          |  |
|                      |           | 17:01:13  | 20:01:13 | 10-189   | 3:00:00  |           |           |          |          |          |           |           |          |          |  |
| Interval             | All ASUs  | ASU1      | ASU2     | ASU3     | Interval | All ASUs  | ASU1      | ASU2     | ASU3     | Interval | All ASUs  | ASU1      | ASU2     | ASU3     |  |
| 0                    | 18,448.33 | 10,987.10 | 2,275.17 | 5,186.07 | 63       | 18,424.50 | 10,976.17 | 2,272.33 | 5,176.00 | 126      | 18,459.23 | 11,003.95 | 2,271.45 | 5,183.83 |  |
| 1                    | 18,429.30 | 10,972.15 | 2,275.05 | 5,182.10 | 64       | 18,430.32 | 11,007.33 | 2,267.00 | 5,155.98 | 127      | 18,440.20 | 10,985.12 | 2,273.92 | 5,181.17 |  |
| 2                    | 18,452.23 | 11,005.13 | 2,258.77 | 5,188.33 | 65       | 18,442.98 | 10,979.38 | 2,273.67 | 5,189.93 | 128      | 18,412.38 | 10,968.80 | 2,265.60 | 5,177.98 |  |
| 3                    | 18,408.02 | 10,970.22 | 2,276.53 | 5,161.27 | 66       | 18,451.72 | 11,001.37 | 2,267.13 | 5,183.22 | 129      | 18,464.38 | 11,013.28 | 2,267.20 | 5,183.90 |  |
| 4                    | 18,459.65 | 11,006.90 | 2,269.63 | 5,183.12 | 67       | 18,458.45 | 11,011.33 | 2,267.85 | 5,179.27 | 130      | 18,451.28 | 11,001.95 | 2,264.30 | 5,185.03 |  |
| 5                    | 18,472.17 | 10,989.97 | 2,280.35 | 5,201.85 | 68       | 18,412.87 | 10,958.48 | 2,266.60 | 5,187.78 | 131      | 18,428.80 | 11,004.03 | 2,271.93 | 5,152.83 |  |
| 6                    | 18,452.32 | 11,007.12 | 2,273.45 | 5,171.75 | 69       | 18,447.80 | 10,994.97 | 2,269.70 | 5,183.13 | 132      | 18,466.42 | 10,994.25 | 2,281.95 | 5,190.22 |  |
| 7                    | 18,438.23 | 10,992.67 | 2,265.50 | 5,180.07 | 70       | 18,461.92 | 11,004.25 | 2,273.98 | 5,183.68 | 133      | 18,472.98 | 11,010.45 | 2,271.10 | 5,191.43 |  |
| 8                    | 18,477.73 | 11,003.57 | 2,275.00 | 5,199.17 | 71       | 18,484.53 | 11,022.52 | 2,265.78 | 5,196.23 | 134      | 18,439.68 | 10,999.00 | 2,263.83 | 5,176.85 |  |
| 9                    | 18,441.05 | 10,991.98 | 2,263.15 | 5,185.92 | 72       | 18,438.92 | 10,984.50 | 2,266.15 | 5,188.27 | 135      | 18,444.87 | 10,998.30 | 2,265.43 | 5,181.13 |  |
| 10                   | 18,472.87 | 11,023.75 | 2,265.53 | 5,183.58 | 73       | 18,442.80 | 10,991.07 | 2,273.38 | 5,178.35 | 136      | 18,436.22 | 10,981.92 | 2,263.45 | 5,190.85 |  |
| 11                   | 18,452.88 | 10,992.53 | 2,274.70 | 5,185.65 | 74       | 18,440.67 | 10,985.80 | 2,263.80 | 5,191.07 | 137      | 18,458.85 | 11,010.15 | 2,263.88 | 5,184.82 |  |
| 12                   | 18,463.32 | 11,003.48 | 2,280.78 | 5,179.05 | 75       | 18,438.20 | 10,980.85 | 2,274.35 | 5,183.00 | 138      | 18,432.95 | 10,989.60 | 2,274.00 | 5,169.35 |  |
| 13                   | 18,436.33 | 10,985.45 | 2,271.42 | 5,179.47 | 76       | 18,435.48 | 10,994.28 | 2,267.07 | 5,174.13 | 139      | 18,440.63 | 11,020.35 | 2,258.17 | 5,162.12 |  |
| 14                   | 18,448.43 | 11,004.87 | 2,257.48 | 5,186.08 | 77       | 18,418.18 | 10,980.98 | 2,264.43 | 5,172.77 | 140      | 18,462.55 | 10,993.15 | 2,269.72 | 5,199.68 |  |
| 15                   | 18,446.50 | 10,994.22 | 2,264.97 | 5,187.32 | 78       | 18,419.45 | 10,975.45 | 2,268.25 | 5,175.75 | 141      | 18,449.78 | 10,997.28 | 2,267.50 | 5,185.00 |  |
| 16                   | 18,454.52 | 11,003.40 | 2,274.45 | 5,176.67 | 79       | 18,415.75 | 10,974.43 | 2,260.32 | 5,181.00 | 142      | 18,458.15 | 10,993.55 | 2,280.83 | 5,183.77 |  |
| 17                   | 18,479.37 | 11,006.82 | 2,275.10 | 5,197.45 | 80       | 18,442.83 | 10,987.62 | 2,257.20 | 5,198.02 | 143      | 18,445.98 | 10,996.95 | 2,261.52 | 5,187.52 |  |
| 18                   | 18,422.95 | 10,965.63 | 2,279.20 | 5,178.12 | 81       | 18,449.37 | 10,992.18 | 2,265.10 | 5,192.08 | 144      | 18,471.13 | 11,014.47 | 2,267.05 | 5,189.62 |  |
| 19                   | 18,419.50 | 10,972.62 | 2,261.27 | 5,185.62 | 82       | 18,444.50 | 10,988.47 | 2,261.58 | 5,194.45 | 145      | 18,460.60 | 10,996.75 | 2,270.70 | 5,193.15 |  |
| 20                   | 18,466.35 | 11,020.63 | 2,262.25 | 5,183.47 | 83       | 18,456.12 | 11,005.42 | 2,271.35 | 5,179.35 | 146      | 18,458.52 | 10,998.88 | 2,273.00 | 5,186.63 |  |
| 21                   | 18,470.93 | 10,999.12 | 2,272.52 | 5,199.30 | 84       | 18,487.10 | 11,019.62 | 2,272.30 | 5,195.18 | 147      | 18,455.63 | 11,004.87 | 2,262.02 | 5,188.75 |  |
| 22                   | 18,422.05 | 10,979.65 | 2,266.98 | 5,175.42 | 85       | 18,425.22 | 10,996.42 | 2,272.27 | 5,156.53 | 148      | 18,419.15 | 10,976.07 | 2,266.55 | 5,176.53 |  |
| 23                   | 18,415.50 | 10,970.60 | 2,258.98 | 5,185.92 | 86       | 18,434.12 | 10,970.23 | 2,271.73 | 5,192.15 | 149      | 18,480.45 | 11,011.87 | 2,274.93 | 5,193.65 |  |
| 24                   | 18,480.95 | 11,022.58 | 2,279.20 | 5,179.17 | 87       | 18,423.62 | 10,967.73 | 2,265.80 | 5,190.08 | 150      | 18,445.98 | 10,990.18 | 2,270.38 | 5,185.42 |  |
| 25                   | 18,430.13 | 10,979.87 | 2,264.30 | 5,185.97 | 88       | 18,447.02 | 11,002.73 | 2,273.02 | 5,171.27 | 151      | 18,449.22 | 11,000.42 | 2,269.88 | 5,178.92 |  |
| 26                   | 18,471.02 | 11,007.28 | 2,263.18 | 5,200.55 | 89       | 18,468.43 | 11,019.80 | 2,272.35 | 5,176.28 | 152      | 18,452.53 | 11,009.40 | 2,265.65 | 5,177.48 |  |
| 27                   | 18,461.33 | 11,006.85 | 2,264.53 | 5,189.95 | 90       | 18,445.48 | 10,984.43 | 2,270.80 | 5,190.25 | 153      | 18,433.73 | 10,992.13 | 2,266.68 | 5,174.92 |  |
| 28                   | 18,470.73 | 11,013.67 | 2,259.77 | 5,197.30 | 91       | 18,445.18 | 10,997.53 | 2,264.93 | 5,182.72 | 154      | 18,468.57 | 11,006.72 | 2,260.32 | 5,201.53 |  |
| 29                   | 18,458.68 | 11,003.82 | 2,276.58 | 5,178.28 | 92       | 18,436.57 | 10,994.73 | 2,269.48 | 5,172.35 | 155      | 18,453.68 | 10,992.25 | 2,283.78 | 5,177.65 |  |
| 30                   | 18,454.33 | 10,996.20 | 2,263.73 | 5,194.40 | 93       | 18,458.55 | 11,003.98 | 2,268.48 | 5,186.08 | 156      | 18,448.33 | 10,999.82 | 2,263.37 | 5,185.15 |  |
| 31                   | 18,470.03 | 11,005.28 | 2,264.53 | 5,200.22 | 94       | 18,476.55 | 11,003.45 | 2,275.28 | 5,197.82 | 157      | 18,432.32 | 10,989.52 | 2,258.62 | 5,184.18 |  |
| 32                   | 18,453.45 | 11,007.83 | 2,268.85 | 5,176.77 | 95       | 18,434.20 | 10,984.18 | 2,271.53 | 5,178.48 | 158      | 18,451.13 | 11,007.42 | 2,266.33 | 5,177.38 |  |
| 33                   | 18,453.70 | 11,001.42 | 2,269.65 | 5,182.63 | 96       | 18,450.98 | 10,999.33 | 2,270.03 | 5,181.62 | 159      | 18,443.33 | 10,999.47 | 2,269.42 | 5,174.45 |  |
| 34                   | 18,456.40 | 11,003.25 | 2,280.55 | 5,172.60 | 97       | 18,467.25 | 11,008.83 | 2,264.82 | 5,193.60 | 160      | 18,467.32 | 11,009.45 | 2,281.60 | 5,176.27 |  |
| 35                   | 18,433.03 | 10,989.18 | 2,264.95 | 5,178.90 | 98       | 18,460.13 | 11,012.42 | 2,271.45 | 5,176.27 | 161      | 18,470.82 | 11,007.00 | 2,274.85 | 5,188.97 |  |
| 36                   | 18,438.07 | 10,982.48 | 2,275.95 | 5,179.63 | 99       | 18,461.07 | 10,986.60 | 2,267.87 | 5,206.60 | 162      | 18,483.13 | 11,005.45 | 2,276.38 | 5,201.30 |  |
| 37                   | 18,446.70 | 10,988.83 | 2,269.37 | 5,188.50 | 100      | 18,434.50 | 10,990.18 | 2,257.75 | 5,186.57 | 163      | 18,454.72 | 10,997.82 | 2,264.95 | 5,191.95 |  |
| 38                   | 18,449.68 | 10,997.35 | 2,265.90 | 5,186.43 | 101      | 18,470.40 | 11,011.60 | 2,263.85 | 5,194.95 | 164      | 18,487.30 | 11,014.55 | 2,278.25 | 5,194.50 |  |
| 39                   | 18,453.10 | 11,008.33 | 2,261.12 | 5,183.65 | 102      | 18,444.85 | 10,987.58 | 2,264.15 | 5,193.12 | 165      | 18,465.45 | 11,012.50 | 2,272.70 | 5,180.25 |  |
| 40                   | 18,440.62 | 10,989.17 | 2,263.32 | 5,188.13 | 103      | 18,476.10 | 11,018.05 | 2,275.02 | 5,183.03 | 166      | 18,457.90 | 11,002.75 | 2,273.80 | 5,181.35 |  |
| 41                   | 18,467.60 | 10,990.52 | 2,275.55 | 5,201.53 | 104      | 18,436.12 | 10,993.18 | 2,261.28 | 5,181.65 | 167      | 18,467.15 | 11,031.83 | 2,269.47 | 5,165.85 |  |
| 42                   | 18,474.60 | 11,001.20 | 2,271.32 | 5,202.08 | 105      | 18,418.98 | 10,974.93 | 2,269.07 | 5,174.98 | 168      | 18,466.13 | 11,005.88 | 2,271.30 | 5,188.95 |  |
| 43                   | 18,471.43 | 11,022.15 | 2,264.30 | 5,184.98 | 106      | 18,473.62 | 11,014.48 | 2,259.62 | 5,199.52 | 169      | 18,452.07 | 10,979.23 | 2,281.42 | 5,191.42 |  |
| 44                   | 18,412.42 | 10,979.43 | 2,259.12 | 5,173.87 | 107      | 18,459.50 | 10,992.00 | 2,268.42 | 5,199.08 | 170      | 18,444.17 | 10,997.42 | 2,271.97 | 5,174.78 |  |
| 45                   | 18,451.38 | 10,994.82 | 2,270.53 | 5,186.03 | 108      | 18,433.02 | 11,007.15 | 2,263.35 | 5,162.52 | 171      | 18,448.33 | 10,993.23 | 2,273.13 | 5,181.97 |  |
| 46                   | 18,466.32 | 11,005.92 | 2,265.42 | 5,194.98 | 109      | 18,474.75 | 11,010.80 | 2,276.38 | 5,187.57 | 172      | 18,460.38 | 11,005.15 | 2,269.40 | 5,185.83 |  |
| 47                   | 18,454.80 | 11,000.87 | 2,270.48 | 5,183.45 | 110      | 18,444.62 | 10,999.40 | 2,267.07 | 5,178.15 | 173      | 18,471.47 | 11,008.53 | 2,276.32 | 5,186.62 |  |
| 48                   | 18,453.93 | 10,995.93 | 2,270.23 | 5,187.77 | 111      | 18,464.33 | 11,012.73 | 2,263.93 | 5,187.67 | 174      | 18,458.67 | 11,001.08 | 2,273.37 | 5,184.22 |  |
| 49                   | 18,427.88 | 10,978.05 | 2,265.10 | 5,184.73 | 112      | 18,445.03 | 10,992.77 | 2,271.03 | 5,181.23 | 175      | 18,458.03 | 11,004.80 | 2,266.07 | 5,187.17 |  |
| 50                   | 18,430.93 | 10,984.48 | 2,264.48 | 5,181.97 | 113      | 18,452.48 | 11,005.90 | 2,266.58 | 5,180.00 | 176      | 18,448.27 | 10,991.55 | 2,267.23 | 5,189.48 |  |
| 51                   | 18,464.08 | 11,001.95 | 2,268.42 | 5,193.72 | 114      | 18,449.00 | 10,973.43 | 2,277.93 | 5,197.63 | 177      | 18,459.23 | 11,013.62 | 2,263.22 | 5,182.40 |  |
| 52                   | 18,452.02 | 10,982.57 | 2,277.18 | 5,192.27 | 115      | 18,430.90 | 10,974.32 | 2,268.80 | 5,187.78 | 178      | 18,444.70 | 10,997.13 | 2,269.90 | 5,177.67 |  |
| 53                   | 18,461.30 | 11,012.25 | 2,268.92 | 5,180.13 | 116      | 18,474.08 | 11,011.62 | 2,263.58 | 5,198.88 | 179      | 18,464.20 | 11,000.48 | 2,264.28 | 5,199.43 |  |
| 54                   | 18,460.12 | 10,998.35 | 2,277.18 | 5,184.58 | 117      | 18,451.87 | 10,990.47 | 2,266.35 | 5,195.05 | 180      | 18,442.58 | 10,994.57 | 2,268.28 | 5,179.73 |  |
| 55                   | 18,454.85 | 11,005.67 | 2,265.63 | 5,183.55 | 118      | 18,456.70 | 11,012.60 | 2,263.48 | 5,180.62 | 181      | 18,426.70 | 10,977.33 | 2,256.07 | 5,193.30 |  |
| 56                   | 18,464.07 | 11,004.97 | 2,271.95 | 5,187.15 | 119      | 18,415.23 | 10,985.17 | 2,271.87 | 5,158.20 | 182      | 18,425.12 | 10,963.47 | 2,274.77 | 5,186.88 |  |
| 57                   | 18,433.15 | 10,988.25 | 2,268.13 | 5,176.77 | 120      | 18,464.90 | 11,011.68 | 2,272.45 | 5,180.77 | 183      | 18,440.43 | 10,990.05 | 2,270.97 | 5,179.42 |  |
| 58                   | 18,447.42 | 10,989.23 | 2,274.85 | 5,183.33 | 121      | 18,448.32 | 10,996.97 | 2,266.95 | 5,184.40 | 184      | 18,432.50 | 10,972.55 | 2,273.35 | 5,186.60 |  |
| 59                   | 18,449.17 | 10,981.35 | 2,269.93 | 5,197.88 | 122      | 18,432.27 | 10,980.03 | 2,267.68 | 5,184.55 | 185      | 18,454.75 | 11,006.62 | 2,264.12 | 5,184.02 |  |
| 60                   | 18,424.03 | 10,968.77 | 2,268.18 | 5,187.08 | 123      | 18,485.47 | 11,029.70 | 2,274.18 | 5,181.58 | 186      | 18,434.45 | 10,988.43 | 2,263.15 | 5,182.87 |  |
| 61                   | 18,445.28 | 10,984.68 | 2,275.60 | 5,185.00 | 124      | 18,453.05 | 10,994.35 | 2,276.28 | 5,182.42 | 187      | 18,430.98 | 10,984.23 | 2,268.43 | 5,178.32 |  |
| 62                   | 18,477.02 | 11,006.90 | 2,270.22 | 5,199.90 | 125      | 18,457.67 | 10,995.72 | 2,272.   |          |          |           |           |          |          |  |

### Sustainability - I/O Request Throughput Distribution Graph



### Sustainability - Measured Intensity Multiplier and Coefficient of Variation

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| COV | 0.005  | 0.001  | 0.003  | 0.002  | 0.007  | 0.003  | 0.005  | 0.002  |

**IM - Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM - Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV - Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

## **IOPS Test Phase**

### Clause 5.4.2.2

*The IOPS Test Phase consists of one Test Run at the 100% load point with a Measurement Interval of ten (10) minutes. The IOPS Test Phase immediately follows the Sustainability Test Phase without any interruption or manual intervention.*

*The IOPS Test Run generates the SPC-1 IOPS™ primary metric, which is computed as the I/O Request Throughput for the Measurement Interval of the IOPS Test Run.*

*The Average Response Time is computed for the IOPS Test Run and cannot exceed 30 milliseconds. If the Average Response Time exceeds the 30 millisecond constraint, the measurement is invalid.*

### Clause 9.2.4.7.2

*For the IOPS Test Phase the FDR shall contain:*

- 1. I/O Request Throughput Distribution (data and graph).*
- 2. A Response Time Frequency Distribution.*
- 3. An Average Response Time Distribution.*
- 4. The human readable Test Run Results File produced by the Workload Generator.*
- 5. A listing or screen image of all input parameters supplied to the Workload Generator.*
- 6. The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

## **SPC-1 Workload Generator Input Parameters**

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java -Xmx64m -Xms64m metrics -b 369 -s 600
```

## **IOPS Test Results File**

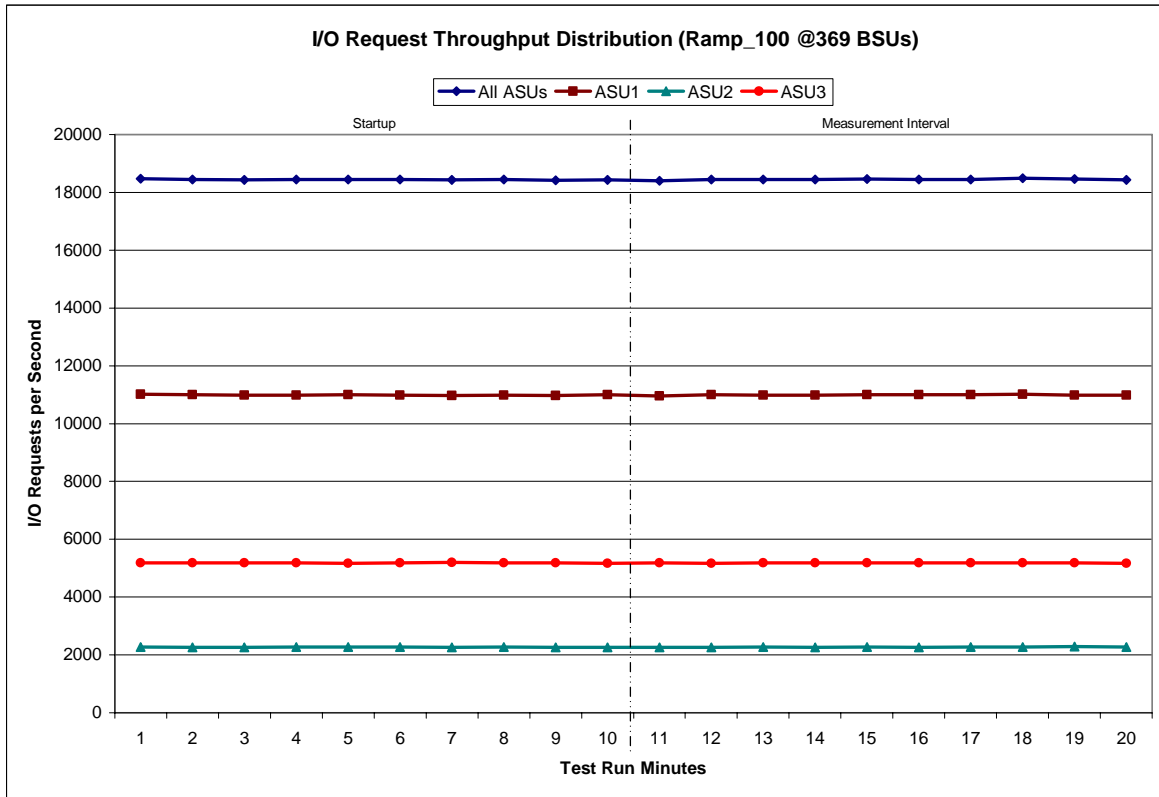
A link to the test results file generated from the IOPS Test Run is listed below.

[IOPS Test Results File](#)

**IOPS Test Run - I/O Request Throughput Distribution Data**

| 369 BSUs             | Start     | Stop      | Interval | Duration |
|----------------------|-----------|-----------|----------|----------|
| Start-Up/Ramp-Up     | 20:02:06  | 20:12:07  | 0-9      | 0:10:01  |
| Measurement Interval | 20:12:07  | 20:22:07  | 10-19    | 0:10:00  |
| 60 second intervals  | All ASUs  | ASU1      | ASU2     | ASU3     |
| 0                    | 18,467.33 | 11,010.92 | 2,279.55 | 5,176.87 |
| 1                    | 18,448.57 | 10,997.15 | 2,264.07 | 5,187.35 |
| 2                    | 18,432.22 | 10,981.90 | 2,265.47 | 5,184.85 |
| 3                    | 18,446.20 | 10,982.88 | 2,275.62 | 5,187.70 |
| 4                    | 18,445.67 | 11,004.35 | 2,270.72 | 5,170.60 |
| 5                    | 18,446.07 | 10,992.52 | 2,268.08 | 5,185.47 |
| 6                    | 18,430.75 | 10,973.80 | 2,259.38 | 5,197.57 |
| 7                    | 18,446.75 | 10,992.78 | 2,276.18 | 5,177.78 |
| 8                    | 18,421.50 | 10,973.07 | 2,262.55 | 5,185.88 |
| 9                    | 18,428.07 | 10,995.70 | 2,267.17 | 5,165.20 |
| 10                   | 18,405.27 | 10,959.83 | 2,258.30 | 5,187.13 |
| 11                   | 18,443.75 | 11,004.70 | 2,264.13 | 5,174.92 |
| 12                   | 18,446.73 | 10,987.15 | 2,275.83 | 5,183.75 |
| 13                   | 18,441.88 | 10,990.53 | 2,262.93 | 5,188.42 |
| 14                   | 18,461.45 | 10,998.98 | 2,274.07 | 5,188.40 |
| 15                   | 18,451.37 | 11,002.63 | 2,264.73 | 5,184.00 |
| 16                   | 18,451.10 | 11,004.40 | 2,269.78 | 5,176.92 |
| 17                   | 18,482.62 | 11,013.80 | 2,279.72 | 5,189.10 |
| 18                   | 18,460.33 | 10,990.63 | 2,283.02 | 5,186.68 |
| 19                   | 18,431.03 | 10,985.25 | 2,270.68 | 5,175.10 |
| Average              | 18,447.55 | 10,993.79 | 2,270.32 | 5,183.44 |

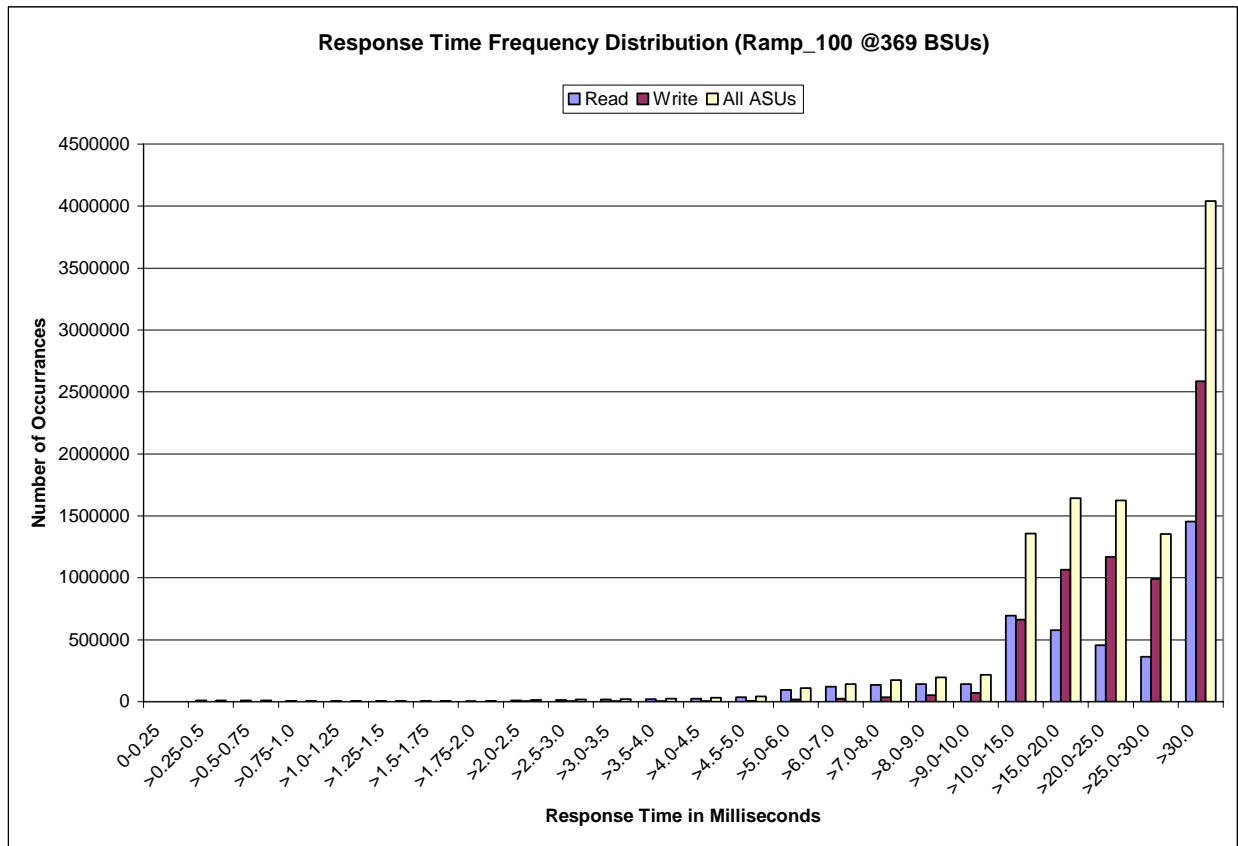
**IOPS Test Run - I/O Request Throughput Distribution Graph**



**IOPS Test Run – Response Time Frequency Distribution Data**

| Response Time (ms) | 0-0.25   | >0.25-0.5 | >0.5-0.75 | >0.75-1.0  | >1.0-1.25  | >1.25-1.5  | >1.5-1.75  | >1.75-2.0 |
|--------------------|----------|-----------|-----------|------------|------------|------------|------------|-----------|
| Read               | 1680     | 12,202    | 10,219    | 7,702      | 6,730      | 5,708      | 5,425      | 4,777     |
| Write              | 0        | 5         | 193       | 541        | 782        | 1,148      | 1,459      | 1,355     |
| All ASUs           | 1680     | 12,207    | 10,412    | 8,243      | 7,512      | 6,856      | 6,884      | 6,132     |
| ASU1               | 1519     | 11,006    | 8,661     | 6,501      | 5,746      | 4,958      | 4,673      | 4,148     |
| ASU2               | 161      | 1,199     | 1,660     | 1,467      | 1,356      | 1,319      | 1,447      | 1,300     |
| ASU3               | 0        | 2         | 91        | 275        | 410        | 579        | 764        | 684       |
| Response Time (ms) | >2.0-2.5 | >2.5-3.0  | >3.0-3.5  | >3.5-4.0   | >4.0-4.5   | >4.5-5.0   | >5.0-6.0   | >6.0-7.0  |
| Read               | 11,228   | 14,015    | 17,644    | 21,170     | 26,289     | 35,864     | 95,025     | 119,484   |
| Write              | 2,565    | 3,182     | 3,495     | 4,029      | 4,964      | 5,934      | 16,392     | 24,113    |
| All ASUs           | 13,793   | 17,197    | 21,139    | 25,199     | 31,253     | 41,798     | 111,417    | 143,597   |
| ASU1               | 9,526    | 11,974    | 14,898    | 17,917     | 21,949     | 30,405     | 81,437     | 104,034   |
| ASU2               | 3,079    | 3,801     | 4,868     | 5,826      | 7,602      | 9,471      | 24,895     | 32,409    |
| ASU3               | 1,188    | 1,422     | 1,373     | 1,456      | 1,702      | 1,922      | 5,085      | 7,154     |
| Response Time (ms) | >7.0-8.0 | >8.0-9.0  | >9.0-10.0 | >10.0-15.0 | >15.0-20.0 | >20.0-25.0 | >25.0-30.0 | >30.0     |
| Read               | 136,808  | 144,284   | 143,834   | 694,891    | 576,657    | 456,799    | 362,470    | 1,454,439 |
| Write              | 36,150   | 51,862    | 71,787    | 662,941    | 1,064,119  | 1,167,737  | 991,704    | 2,585,951 |
| All ASUs           | 172,958  | 196,146   | 215,621   | 1,357,832  | 1,640,776  | 1,624,536  | 1,354,174  | 4,040,390 |
| ASU1               | 123,782  | 137,424   | 145,867   | 837,028    | 857,629    | 781,358    | 659,108    | 2,714,169 |
| ASU2               | 38,552   | 42,848    | 46,791    | 258,684    | 253,781    | 207,928    | 150,038    | 261,655   |
| ASU3               | 10,624   | 15,874    | 22,963    | 262,120    | 529,366    | 635,250    | 545,028    | 1,064,566 |

**IOPS Test Run –Response Time Frequency Distribution Graph**



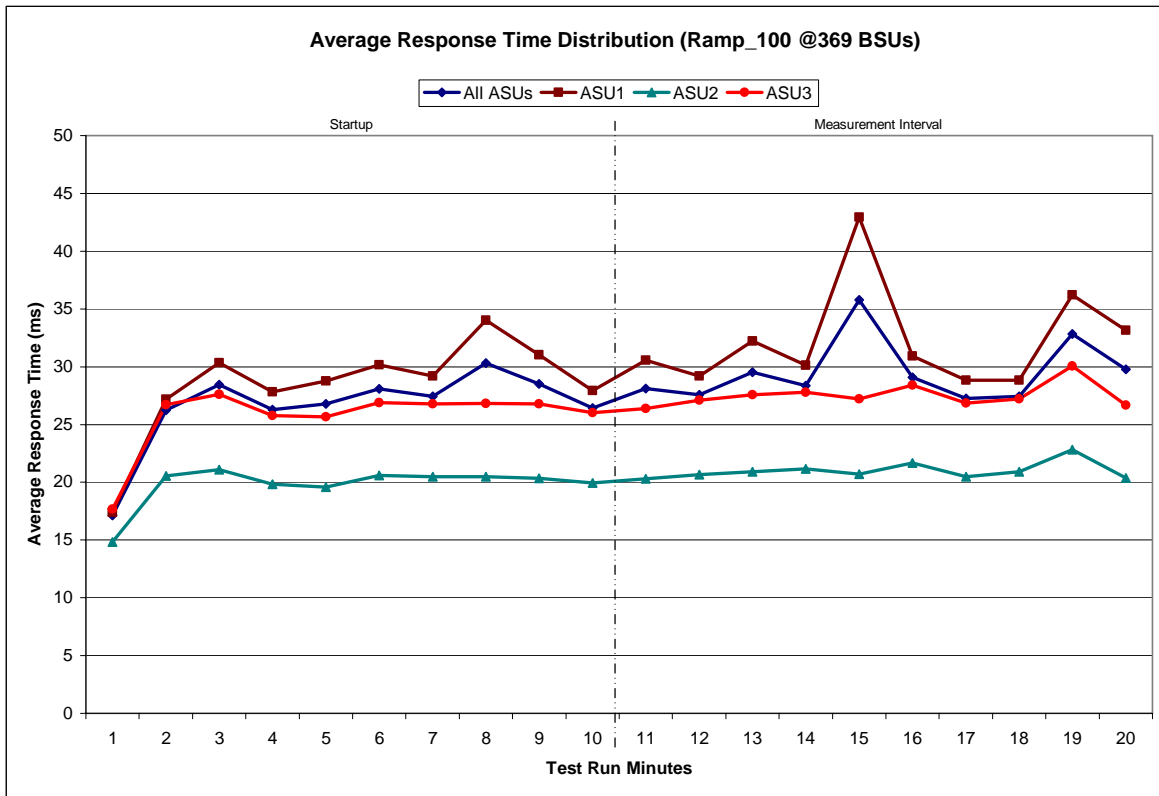
**IOPS Test Run - Average Response Time (ms) Distribution Data**

| 369 BSUs             | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 20:02:06 | 20:12:07 | 0-9      | 0:10:01  |
| Measurement Interval | 20:12:07 | 20:22:07 | 9-19     | 0:10:00  |

| 60 second intervals | All ASUs | ASU1  | ASU2  | ASU3  |
|---------------------|----------|-------|-------|-------|
| 0                   | 17.14    | 17.37 | 14.84 | 17.67 |
| 1                   | 26.24    | 27.19 | 20.56 | 26.70 |
| 2                   | 28.43    | 30.33 | 21.11 | 27.60 |
| 3                   | 26.28    | 27.84 | 19.83 | 25.79 |
| 4                   | 26.77    | 28.77 | 19.60 | 25.67 |
| 5                   | 28.07    | 30.17 | 20.59 | 26.91 |
| 6                   | 27.44    | 29.18 | 20.50 | 26.78 |
| 7                   | 30.32    | 34.01 | 20.47 | 26.80 |
| 8                   | 28.51    | 31.02 | 20.32 | 26.78 |
| 9                   | 26.42    | 27.95 | 19.94 | 26.02 |
| 10                  | 28.12    | 30.55 | 20.32 | 26.38 |
| 11                  | 27.56    | 29.21 | 20.65 | 27.10 |
| 12                  | 29.53    | 32.22 | 20.93 | 27.59 |
| 13                  | 28.37    | 30.13 | 21.15 | 27.80 |
| 14                  | 35.80    | 42.96 | 20.70 | 27.22 |
| 15                  | 29.08    | 30.93 | 21.66 | 28.39 |
| 16                  | 27.26    | 28.85 | 20.48 | 26.84 |
| 17                  | 27.41    | 28.85 | 20.90 | 27.22 |
| 18                  | 32.81    | 36.20 | 22.82 | 30.04 |
| 19                  | 29.77    | 33.16 | 20.38 | 26.68 |
| Average             | 29.57    | 32.31 | 21.00 | 27.53 |

**IOPS Test Run - Average Response Time (ms) Distribution Graph**



**IOPS Test Run – I/O Request Information**

| I/O Requests Completed in the Measurement Interval | I/O Requests Completed with Response Time = or < 30 ms | I/O Requests Completed with Response Time > 30 ms |
|--|--|---|
| 11,067,752   | 7,027,362  | 4,040,390   |

**IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0350 | 0.2811 | 0.0700 | 0.2099 | 0.0180 | 0.0701 | 0.0350 | 0.2810 |
| COV | 0.004  | 0.002  | 0.003  | 0.003  | 0.009  | 0.005  | 0.005  | 0.001  |

**IM – Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM – Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV – Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.



## Response Time Ramp Test Phase

### Clause 5.4.2.3

*The Response Time Ramp Test Phase consists of five Test Runs, one each at 95%, 90%, 80%, 50%, and 10% of the load point (100%) used to generate the SPC-1 IOPS™ primary metric. Each of the five Test Runs has a Measurement Interval of ten (10) minutes. The Response Time Ramp Test Phase immediately follows the IOPS Test Phase without any interruption or manual intervention.*

*The five Response Time Ramp Test Runs, in conjunction with the IOPS Test Run (100%), demonstrate the relationship between Average Response Time and I/O Request Throughput for the Tested Storage Configuration (TSC) as illustrated in the response time/throughput curve on page 11.*

*In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ primary metric. That value represents the Average Response Time of a lightly loaded TSC.*

### Clause 9.2.4.7.3

*The following content shall appear in the FDR for the Response Time Ramp Phase:*

- 1. A Response Time Ramp Distribution.*
- 2. The human readable Test Run Results File produced by the Workload Generator for each Test Run within the Response Time Ramp Test Phase.*
- 3. For the 10% Load Level Test Run (SPC-1 LRT™ metric) an Average Response Time Distribution.*
- 4. A listing or screen image of all input parameters supplied to the Workload Generator.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are listed below.

```
java -Xmx64m -Xms64m metrics -b 369 -s 600
```

## Response Time Ramp Test Results File

A link to each test result file generated from each Response Time Ramp Test Run list listed below.

[95% Load Level](#)

[90% Load Level](#)

[80% Load Level](#)

[50% Load Level](#)

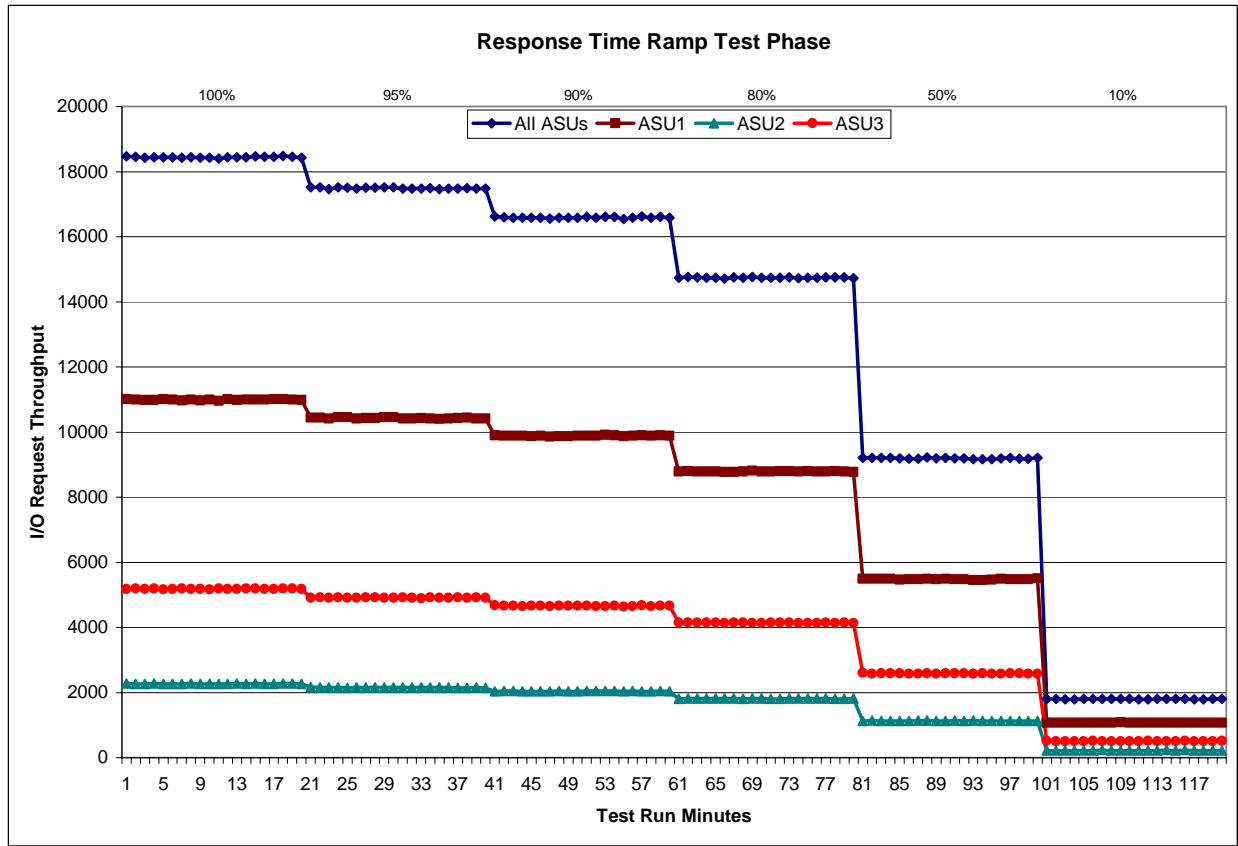
[10% Load Level](#)

**Response Time Ramp Distribution (IOPS) Data**

The five Test Runs that comprise the Response Time Ramp Phase are executed at 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit (BSU) load level used to produce the SPC-1 IOPS™ primary metric. The 100% BSU load level is included in the following Response Time Ramp data tables and graphs for completeness.

| 100% Load Level - 389 BSUs |           |           |          |          | 95% Load Level - 350 BSUs |           |           |          |          |
|----------------------------|-----------|-----------|----------|----------|---------------------------|-----------|-----------|----------|----------|
| Start-Up/Ramp-Up           | Start     | Stop      | Interval | Duration | Start-Up/Ramp-Up          | Start     | Stop      | Interval | Duration |
| Measurement Interval       | 20:02:06  | 20:12:07  | 0-9      | 0:10:01  | Measurement Interval      | 20:22:18  | 20:32:19  | 0-9      | 0:10:01  |
| (60 second intervals)      | 20:12:07  | 20:22:07  | 10-19    | 0:10:00  | (60 second intervals)     | 20:32:19  | 20:42:19  | 10-19    | 0:10:00  |
| All ASUs                   | ASU-1     | ASU-2     | ASU-3    | ASU-3    | All ASUs                  | ASU-1     | ASU-2     | ASU-3    | ASU-3    |
| 0                          | 18,467.33 | 11,010.92 | 2,279.55 | 5,176.87 | 0                         | 17,517.23 | 10,445.25 | 2,165.45 | 4,906.53 |
| 1                          | 18,448.57 | 10,997.15 | 2,264.07 | 5,187.35 | 1                         | 17,519.08 | 10,438.90 | 2,159.23 | 4,920.95 |
| 2                          | 18,432.22 | 10,981.90 | 2,265.47 | 5,184.85 | 2                         | 17,470.35 | 10,408.13 | 2,159.25 | 4,902.97 |
| 3                          | 18,446.20 | 10,982.88 | 2,275.62 | 5,187.70 | 3                         | 17,517.83 | 10,451.27 | 2,149.78 | 4,916.78 |
| 4                          | 18,445.67 | 11,004.35 | 2,270.72 | 5,170.60 | 4                         | 17,503.05 | 10,447.73 | 2,142.62 | 4,912.70 |
| 5                          | 18,446.07 | 10,992.52 | 2,268.08 | 5,185.47 | 5                         | 17,477.00 | 10,415.63 | 2,152.88 | 4,908.48 |
| 6                          | 18,430.75 | 10,973.80 | 2,259.38 | 5,197.57 | 6                         | 17,510.65 | 10,430.85 | 2,157.62 | 4,922.18 |
| 7                          | 18,446.75 | 10,992.78 | 2,276.18 | 5,177.78 | 7                         | 17,502.40 | 10,428.80 | 2,156.27 | 4,917.33 |
| 8                          | 18,421.50 | 10,973.07 | 2,262.55 | 5,185.88 | 8                         | 17,517.15 | 10,449.82 | 2,156.37 | 4,910.97 |
| 9                          | 18,428.07 | 10,995.70 | 2,267.17 | 5,165.20 | 9                         | 17,516.40 | 10,449.27 | 2,152.77 | 4,914.37 |
| 10                         | 18,405.27 | 10,959.83 | 2,258.30 | 5,187.13 | 10                        | 17,480.20 | 10,409.85 | 2,152.45 | 4,917.90 |
| 11                         | 18,443.75 | 11,004.70 | 2,264.13 | 5,174.92 | 11                        | 17,483.32 | 10,417.95 | 2,152.57 | 4,912.80 |
| 12                         | 18,446.73 | 10,987.15 | 2,275.83 | 5,183.75 | 12                        | 17,479.18 | 10,429.18 | 2,152.47 | 4,897.53 |
| 13                         | 18,441.88 | 10,990.53 | 2,262.93 | 5,188.42 | 13                        | 17,485.97 | 10,408.50 | 2,155.00 | 4,922.47 |
| 14                         | 18,461.45 | 10,998.98 | 2,274.07 | 5,188.40 | 14                        | 17,468.65 | 10,404.20 | 2,152.38 | 4,912.07 |
| 15                         | 18,451.37 | 11,002.63 | 2,264.73 | 5,184.00 | 15                        | 17,473.33 | 10,411.13 | 2,156.77 | 4,905.43 |
| 16                         | 18,451.10 | 11,004.40 | 2,269.78 | 5,176.92 | 16                        | 17,484.02 | 10,423.43 | 2,145.03 | 4,915.55 |
| 17                         | 18,482.62 | 11,013.80 | 2,279.72 | 5,189.10 | 17                        | 17,494.05 | 10,434.82 | 2,145.52 | 4,913.72 |
| 18                         | 18,460.33 | 10,990.63 | 2,283.02 | 5,186.68 | 18                        | 17,478.43 | 10,412.92 | 2,149.22 | 4,916.30 |
| 19                         | 18,431.03 | 10,985.25 | 2,270.68 | 5,175.10 | 19                        | 17,476.40 | 10,419.28 | 2,147.43 | 4,909.68 |
| Average                    | 18,447.55 | 10,993.79 | 2,270.32 | 5,183.44 | Average                   | 17,480.36 | 10,417.13 | 2,150.88 | 4,912.35 |
| 90% Load Level - 332 BSUs  |           |           |          |          | 80% Load Level - 295 BSUs |           |           |          |          |
| Start-Up/Ramp-Up           | Start     | Stop      | Interval | Duration | Start-Up/Ramp-Up          | Start     | Stop      | Interval | Duration |
| Measurement Interval       | 20:52:29  | 20:52:30  | 0-9      | 0:10:01  | Measurement Interval      | 21:02:40  | 21:12:41  | 0-9      | 0:10:01  |
| (60 second intervals)      | 20:52:30  | 21:02:30  | 10-19    | 0:10:00  | (60 second intervals)     | 21:12:41  | 21:22:41  | 10-19    | 0:10:00  |
| All ASUs                   | ASU-1     | ASU-2     | ASU-3    | ASU-3    | All ASUs                  | ASU-1     | ASU-2     | ASU-3    | ASU-3    |
| 0                          | 16,619.32 | 9,903.42  | 2,036.95 | 4,678.95 | 0                         | 14,745.22 | 8,792.12  | 1,810.05 | 4,143.05 |
| 1                          | 16,589.97 | 9,878.53  | 2,042.88 | 4,668.55 | 1                         | 14,767.05 | 8,799.98  | 1,818.85 | 4,148.22 |
| 2                          | 16,588.68 | 9,879.57  | 2,042.93 | 4,666.18 | 2                         | 14,751.80 | 8,787.52  | 1,817.25 | 4,147.03 |
| 3                          | 16,577.55 | 9,890.08  | 2,034.80 | 4,652.67 | 3                         | 14,740.70 | 8,779.87  | 1,813.93 | 4,146.90 |
| 4                          | 16,577.90 | 9,870.08  | 2,039.37 | 4,668.45 | 4                         | 14,745.63 | 8,785.92  | 1,811.75 | 4,147.97 |
| 5                          | 16,589.17 | 9,891.12  | 2,034.03 | 4,664.02 | 5                         | 14,718.48 | 8,771.72  | 1,810.20 | 4,136.57 |
| 6                          | 16,554.47 | 9,864.30  | 2,033.42 | 4,656.75 | 6                         | 14,752.68 | 8,778.85  | 1,820.97 | 4,152.87 |
| 7                          | 16,579.65 | 9,870.30  | 2,042.55 | 4,666.80 | 7                         | 14,738.18 | 8,784.48  | 1,808.73 | 4,144.97 |
| 8                          | 16,583.47 | 9,876.43  | 2,040.18 | 4,666.85 | 8                         | 14,761.10 | 8,810.02  | 1,813.58 | 4,137.50 |
| 9                          | 16,589.23 | 9,889.15  | 2,040.02 | 4,660.07 | 9                         | 14,733.35 | 8,787.90  | 1,812.95 | 4,132.50 |
| 10                         | 16,604.55 | 9,890.62  | 2,050.07 | 4,663.87 | 10                        | 14,735.82 | 8,782.43  | 1,807.17 | 4,146.22 |
| 11                         | 16,577.18 | 9,880.23  | 2,047.30 | 4,649.65 | 11                        | 14,743.93 | 8,794.45  | 1,805.23 | 4,144.25 |
| 12                         | 16,610.17 | 9,906.55  | 2,049.23 | 4,654.38 | 12                        | 14,752.52 | 8,794.50  | 1,813.63 | 4,144.38 |
| 13                         | 16,603.83 | 9,896.23  | 2,043.57 | 4,664.03 | 13                        | 14,731.62 | 8,784.60  | 1,814.68 | 4,132.33 |
| 14                         | 16,543.42 | 9,870.53  | 2,039.25 | 4,633.63 | 14                        | 14,742.73 | 8,793.70  | 1,810.88 | 4,138.15 |
| 15                         | 16,587.85 | 9,889.28  | 2,043.50 | 4,655.07 | 15                        | 14,740.33 | 8,792.45  | 1,813.05 | 4,134.83 |
| 16                         | 16,619.67 | 9,904.90  | 2,036.38 | 4,678.38 | 16                        | 14,746.52 | 8,786.45  | 1,812.20 | 4,147.87 |
| 17                         | 16,581.55 | 9,887.32  | 2,038.30 | 4,655.93 | 17                        | 14,751.10 | 8,804.30  | 1,805.03 | 4,141.77 |
| 18                         | 16,606.95 | 9,899.43  | 2,040.83 | 4,666.68 | 18                        | 14,747.77 | 8,788.15  | 1,809.47 | 4,150.15 |
| 19                         | 16,587.07 | 9,880.87  | 2,038.23 | 4,667.97 | 19                        | 14,723.65 | 8,768.70  | 1,817.90 | 4,137.05 |
| Average                    | 16,592.22 | 9,890.60  | 2,042.67 | 4,658.96 | Average                   | 14,741.60 | 8,788.97  | 1,810.93 | 4,141.70 |
| 50% Load Level - 184 BSUs  |           |           |          |          | 10% Load Level - 36 BSUs  |           |           |          |          |
| Start-Up/Ramp-Up           | Start     | Stop      | Interval | Duration | Start-Up/Ramp-Up          | Start     | Stop      | Interval | Duration |
| Measurement Interval       | 21:22:50  | 21:32:51  | 0-9      | 0:10:01  | Measurement Interval      | 21:42:58  | 21:52:59  | 0-9      | 0:10:01  |
| (60 second intervals)      | 21:32:51  | 21:42:51  | 9-19     | 0:10:00  | (60 second intervals)     | 21:52:59  | 22:02:59  | 9-19     | 0:10:00  |
| All ASUs                   | ASU-1     | ASU-2     | ASU-3    | ASU-3    | All ASUs                  | ASU-1     | ASU-2     | ASU-3    | ASU-3    |
| 0                          | 9,212.00  | 5,485.30  | 1,128.00 | 2,598.70 | 0                         | 1,807.60  | 1,070.28  | 223.02   | 514.30   |
| 1                          | 9,208.12  | 5,496.23  | 1,133.40 | 2,578.48 | 1                         | 1,796.77  | 1,070.52  | 218.05   | 508.20   |
| 2                          | 9,211.83  | 5,490.82  | 1,129.95 | 2,591.07 | 2                         | 1,792.82  | 1,071.63  | 218.03   | 503.15   |
| 3                          | 9,205.25  | 5,486.33  | 1,129.23 | 2,589.68 | 3                         | 1,795.65  | 1,066.75  | 223.62   | 505.28   |
| 4                          | 9,193.88  | 5,470.88  | 1,130.65 | 2,592.35 | 4                         | 1,798.07  | 1,074.10  | 220.83   | 503.13   |
| 5                          | 9,180.92  | 5,475.60  | 1,132.07 | 2,573.25 | 5                         | 1,800.75  | 1,066.62  | 221.82   | 512.32   |
| 6                          | 9,182.73  | 5,471.28  | 1,134.03 | 2,577.42 | 6                         | 1,800.22  | 1,069.93  | 224.55   | 505.73   |
| 7                          | 9,225.02  | 5,495.12  | 1,141.82 | 2,588.08 | 7                         | 1,800.43  | 1,074.77  | 217.53   | 508.13   |
| 8                          | 9,189.40  | 5,480.98  | 1,131.95 | 2,576.47 | 8                         | 1,804.57  | 1,079.85  | 221.92   | 502.80   |
| 9                          | 9,207.95  | 5,485.63  | 1,131.37 | 2,590.95 | 9                         | 1,796.68  | 1,067.40  | 223.38   | 505.90   |
| 10                         | 9,198.08  | 5,476.62  | 1,134.77 | 2,586.70 | 10                        | 1,795.12  | 1,068.93  | 221.68   | 504.50   |
| 11                         | 9,193.27  | 5,479.22  | 1,127.43 | 2,586.62 | 11                        | 1,796.48  | 1,066.68  | 220.67   | 509.13   |
| 12                         | 9,169.18  | 5,457.12  | 1,137.73 | 2,574.33 | 12                        | 1,800.58  | 1,071.88  | 221.32   | 507.38   |
| 13                         | 9,167.45  | 5,448.23  | 1,128.03 | 2,591.18 | 13                        | 1,806.53  | 1,073.58  | 225.00   | 507.95   |
| 14                         | 9,167.30  | 5,467.70  | 1,126.72 | 2,572.88 | 14                        | 1,799.10  | 1,070.50  | 220.72   | 507.88   |
| 15                         | 9,196.88  | 5,491.77  | 1,127.23 | 2,577.88 | 15                        | 1,806.33  | 1,071.10  | 224.80   | 510.43   |
| 16                         | 9,201.28  | 5,479.98  | 1,131.87 | 2,589.43 | 16                        | 1,792.12  | 1,069.85  | 218.63   | 503.63   |
| 17                         | 9,182.08  | 5,476.05  | 1,122.20 | 2,583.83 | 17                        | 1,795.50  | 1,071.45  | 220.50   | 503.55   |
| 18                         | 9,185.60  | 5,476.15  | 1,127.68 | 2,581.77 | 18                        | 1,797.52  | 1,072.63  | 221.98   | 502.90   |
| 19                         | 9,210.43  | 5,499.07  | 1,131.70 | 2,579.67 | 19                        | 1,805.87  | 1,071.47  | 223.45   | 510.95   |
| Average                    | 9,187.16  | 5,475.19  | 1,129.54 | 2,582.43 | Average                   | 1,799.52  | 1,070.81  | 221.88   | 506.83   |

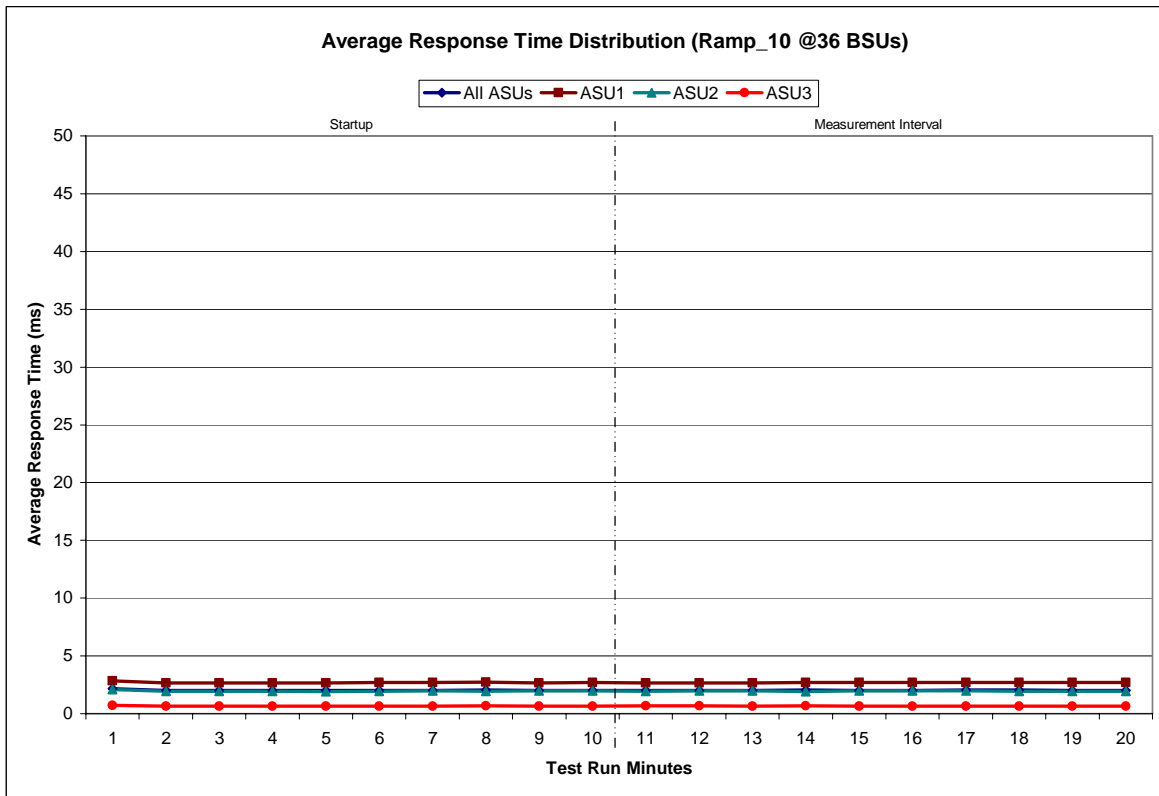
### Response Time Ramp Distribution (IOPS) Graph



**SPC-1 LRT™ Average Response Time (ms) Distribution Data**

| 36 BSUs              | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 21:42:58 | 21:52:59 | 0-9      | 0:10:01  |
| Measurement Interval | 21:52:59 | 22:02:59 | 9-19     | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 2.15     | 2.85     | 2.08     | 0.72     |
| 1                    | 2.02     | 2.68     | 1.96     | 0.65     |
| 2                    | 2.01     | 2.67     | 1.93     | 0.66     |
| 3                    | 2.01     | 2.66     | 1.96     | 0.66     |
| 4                    | 2.00     | 2.65     | 1.91     | 0.65     |
| 5                    | 2.01     | 2.69     | 1.93     | 0.65     |
| 6                    | 2.03     | 2.69     | 1.96     | 0.66     |
| 7                    | 2.06     | 2.74     | 1.95     | 0.67     |
| 8                    | 2.02     | 2.67     | 1.97     | 0.66     |
| 9                    | 2.03     | 2.69     | 1.97     | 0.67     |
| 10                   | 2.02     | 2.67     | 1.94     | 0.67     |
| 11                   | 2.02     | 2.67     | 1.97     | 0.67     |
| 12                   | 2.01     | 2.66     | 1.98     | 0.66     |
| 13                   | 2.04     | 2.71     | 1.93     | 0.67     |
| 14                   | 2.03     | 2.69     | 1.99     | 0.66     |
| 15                   | 2.03     | 2.69     | 1.96     | 0.66     |
| 16                   | 2.04     | 2.72     | 1.97     | 0.65     |
| 17                   | 2.04     | 2.71     | 1.96     | 0.66     |
| 18                   | 2.03     | 2.69     | 1.94     | 0.66     |
| 19                   | 2.03     | 2.71     | 1.94     | 0.65     |
| Average              | 2.03     | 2.69     | 1.96     | 0.66     |

**SPC-1 LRT™ Average Response Time (ms) Distribution Graph**



**SPC-1 LRT™ (10%) – Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0351 | 0.2803 | 0.0701 | 0.2095 | 0.0180 | 0.0702 | 0.0351 | 0.2816 |
| COV | 0.012  | 0.003  | 0.011  | 0.004  | 0.026  | 0.010  | 0.017  | 0.004  |

**IM – Intensity Multiplier:** *The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.*

**MIM – Measured Intensity Multiplier:** *The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.*

**COV – Coefficient of Variation:** *This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.*

## Repeatability Test

### Clause 5.4.3

*The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ and SPC-1 LRT™ primary metrics generated in earlier Test Runs.*

*There are two identical Repeatability Test Phases. Each Test Phase contains two Test Runs. Each of the Test Runs will have a Measurement Interval of no less than ten (10) minutes. The two Test Runs in each Test Phase will be executed without interruption or any type of manual intervention.*

*The first Test Run in each Test Phase is executed at the 10% load point. The Average Response Time from each of the Test Runs is compared to the SPC-1 LRT™ primary metric. Each Average Response Time value must be less than the SPC-1 LRT™ primary metric plus 5%.*

*The second Test Run in each Test Phase is executed at the 100% load point. The I/O Request Throughput from the Test Runs is compared to the SPC-1 IOPS™ primary metric. Each I/O Request Throughput value must be greater than the SPC-1 IOPS™ primary metric minus 5%. In addition, the Average Response Time for each Test Run cannot exceed 30 milliseconds.*

*If any of the above constraints are not met, the benchmark measurement is invalid.*

### Clause 9.2.4.7.3

*The following content shall appear in the FDR for each Test Run in the two Repeatability Test Phases:*

- 1. A table containing the results of the two Repeatability Test Phases. The content, appearance, and format of the table are specified in Table 9-11.*
- 2. An I/O Request Throughput Distribution (data and graph).*
- 3. An Average Response Time Distribution (data and graph).*
- 4. The human readable Test Run Results File produced by the Workload Generator.*
- 5. A listing or screen image of all input parameters supplied to the Workload Generator.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Repeatability Test Runs are listed below.

```
java -Xmx64m -Xms64m repeat1 -b 369 -s 600
```

```
java -Xmx64m -Xms64m repeat1 -b 369 -s 600
```

### Repeatability Test Results File

The values for the SPC-1 IOPS™, SPC-1 LRT™, and the Repeatability Test measurements are listed below.

|                            | SPC-1 IOPS™ | SPC-1 LRT™ |
|----------------------------|-------------|------------|
| <i>Primary Metrics</i>     | 18,447.55   | 2.03       |
| Repeatability Test Phase 1 | 18,447.25   | 2.03       |
| Repeatability Test Phase 2 | 18,441.27   | 2.04       |

A link to the test result file generated from each Repeatability Test Run list is listed below.

[Repeatability Test Phase 1, Test Run 1 \(LRT\)](#)

[Repeatability Test Phase 1, Test Run 2 \(IOPS\)](#)

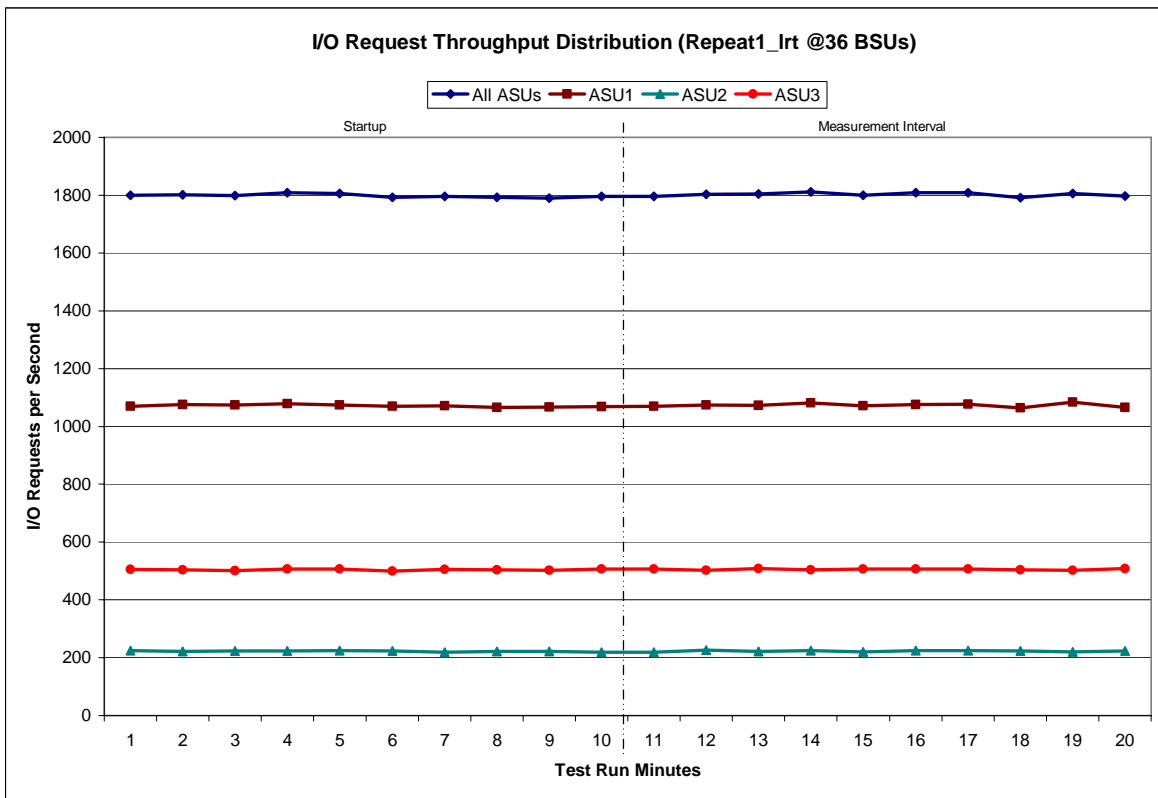
[Repeatability Test Phase 2, Test Run 1 \(LRT\)](#)

[Repeatability Test Phase 2, Test Run 2 \(IOPS\)](#)

**Repeatability 1 LRT - I/O Request Throughput Distribution Data**

| 36 BSUs              | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 15:30:26 | 15:40:26 | 0-9      | 0:10:00  |
| Measurement Interval | 15:40:26 | 15:50:26 | 10-19    | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 1,799.50 | 1,069.37 | 224.78   | 505.35   |
| 1                    | 1,801.98 | 1,075.45 | 222.40   | 504.13   |
| 2                    | 1,798.67 | 1,074.33 | 223.03   | 501.30   |
| 3                    | 1,808.95 | 1,079.02 | 223.75   | 506.18   |
| 4                    | 1,805.80 | 1,074.12 | 224.83   | 506.85   |
| 5                    | 1,792.13 | 1,069.98 | 223.15   | 499.00   |
| 6                    | 1,795.12 | 1,071.47 | 218.18   | 505.47   |
| 7                    | 1,792.78 | 1,065.87 | 222.25   | 504.67   |
| 8                    | 1,789.23 | 1,066.28 | 221.12   | 501.83   |
| 9                    | 1,794.92 | 1,069.03 | 218.95   | 506.93   |
| 10                   | 1,794.88 | 1,070.05 | 218.55   | 506.28   |
| 11                   | 1,802.80 | 1,074.13 | 225.63   | 503.03   |
| 12                   | 1,803.97 | 1,073.28 | 222.42   | 508.27   |
| 13                   | 1,810.85 | 1,081.37 | 225.23   | 504.25   |
| 14                   | 1,799.32 | 1,071.78 | 220.40   | 507.13   |
| 15                   | 1,808.12 | 1,075.93 | 224.90   | 507.28   |
| 16                   | 1,808.60 | 1,077.50 | 224.53   | 506.57   |
| 17                   | 1,791.80 | 1,063.92 | 223.48   | 504.40   |
| 18                   | 1,806.10 | 1,083.55 | 220.25   | 502.30   |
| 19                   | 1,797.02 | 1,065.27 | 223.00   | 508.75   |
| Average              | 1,802.35 | 1,073.68 | 222.84   | 505.83   |

**Repeatability 1 LRT - I/O Request Throughput Distribution Graph**

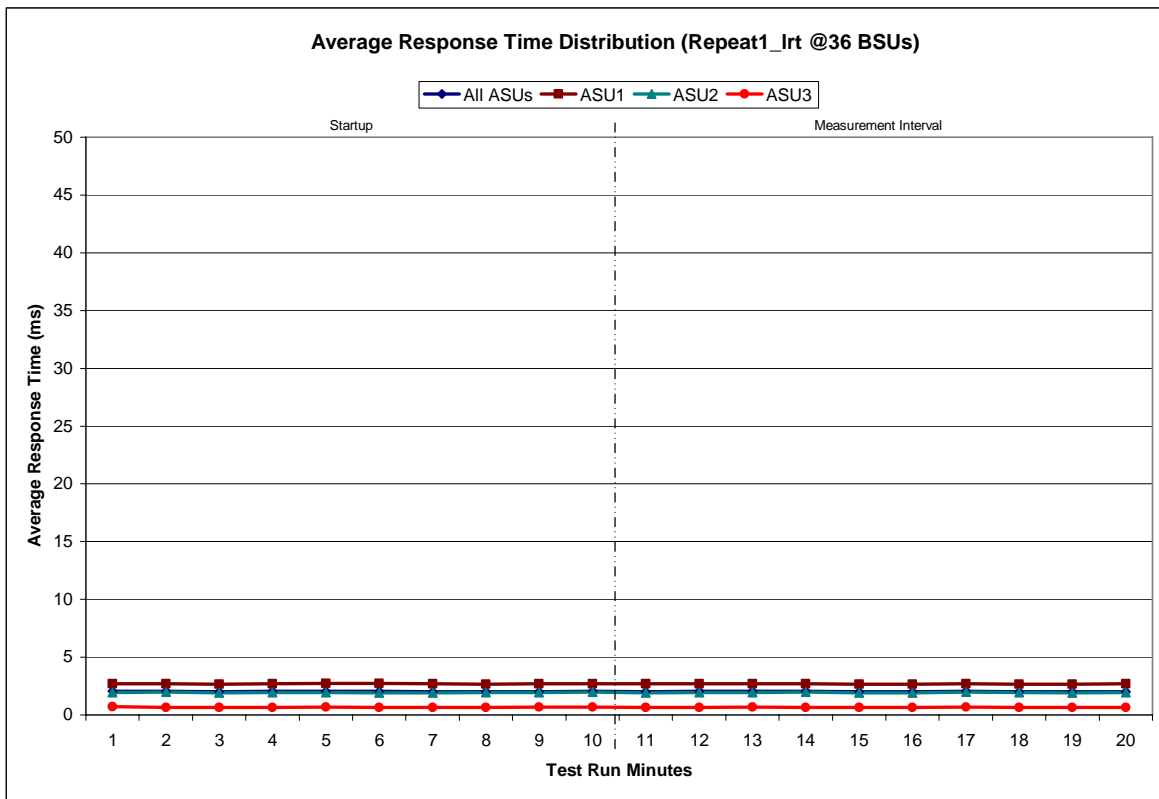




**Repeatability 1 LRT –Average Response Time (ms) Distribution Data**

| 36 BSUs              | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 15:30:26 | 15:40:26 | 0-9      | 0:10:00  |
| Measurement Interval | 15:40:26 | 15:50:26 | 9-19     | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 2.06     | 2.72     | 1.94     | 0.71     |
| 1                    | 2.05     | 2.72     | 1.97     | 0.66     |
| 2                    | 2.02     | 2.67     | 1.91     | 0.65     |
| 3                    | 2.04     | 2.72     | 1.94     | 0.65     |
| 4                    | 2.05     | 2.72     | 1.96     | 0.67     |
| 5                    | 2.05     | 2.72     | 1.91     | 0.67     |
| 6                    | 2.02     | 2.68     | 1.90     | 0.66     |
| 7                    | 2.01     | 2.67     | 1.94     | 0.65     |
| 8                    | 2.03     | 2.69     | 1.95     | 0.67     |
| 9                    | 2.04     | 2.71     | 1.97     | 0.67     |
| 10                   | 2.02     | 2.69     | 1.91     | 0.65     |
| 11                   | 2.04     | 2.72     | 1.95     | 0.65     |
| 12                   | 2.04     | 2.71     | 1.94     | 0.68     |
| 13                   | 2.05     | 2.71     | 1.97     | 0.66     |
| 14                   | 2.01     | 2.68     | 1.90     | 0.66     |
| 15                   | 2.01     | 2.67     | 1.92     | 0.65     |
| 16                   | 2.04     | 2.69     | 1.99     | 0.67     |
| 17                   | 2.02     | 2.68     | 1.95     | 0.66     |
| 18                   | 2.00     | 2.65     | 1.89     | 0.64     |
| 19                   | 2.02     | 2.69     | 1.93     | 0.66     |
| Average              | 2.03     | 2.69     | 1.93     | 0.66     |

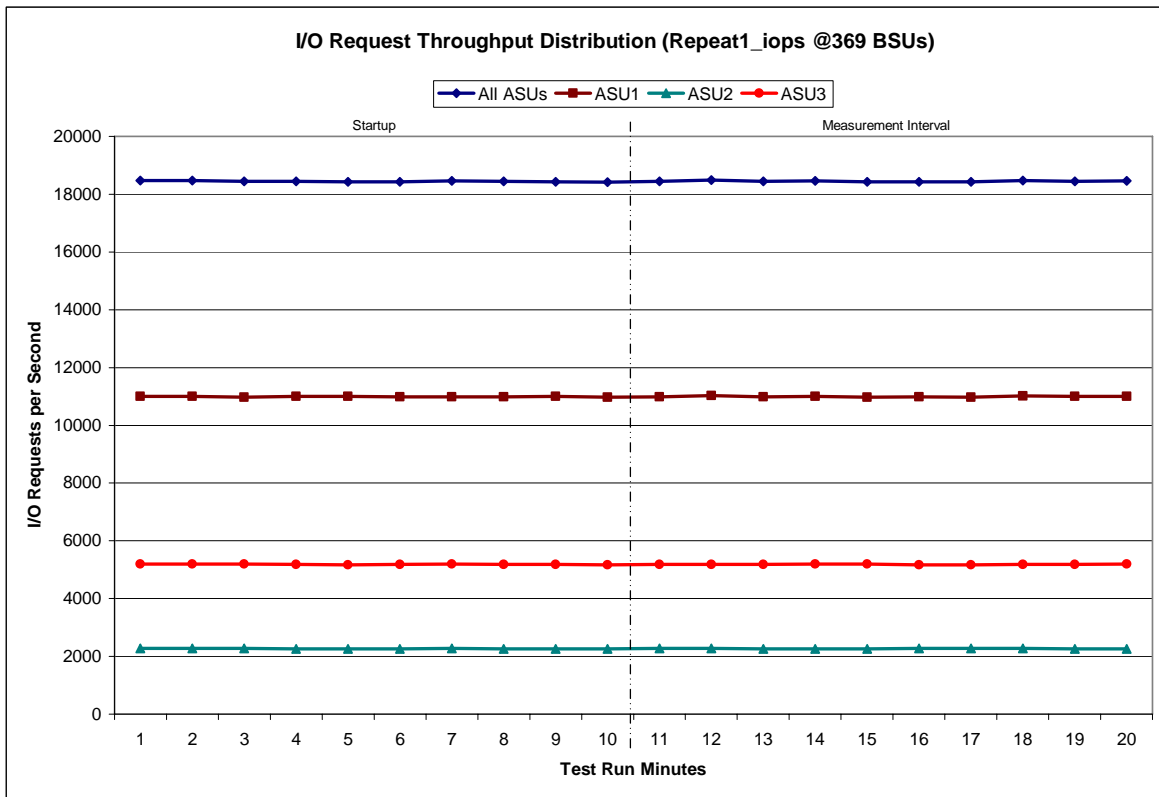
**Repeatability 1 LRT –Average Response Time (ms) Distribution Graph**



**Repeatability 1 IOPS - I/O Request Throughput Distribution Data**

| 369 BSUs             | Start     | Stop      | Interval | Duration |
|----------------------|-----------|-----------|----------|----------|
| Start-Up/Ramp-Up     | 15:50:34  | 16:00:35  | 0-9      | 0:10:01  |
| Measurement Interval | 16:00:35  | 16:10:35  | 10-19    | 0:10:00  |
| 60 second intervals  | All ASUs  | ASU1      | ASU2     | ASU3     |
| 0                    | 18,474.12 | 10,998.42 | 2,277.15 | 5,198.55 |
| 1                    | 18,478.28 | 11,003.90 | 2,276.78 | 5,197.60 |
| 2                    | 18,441.27 | 10,973.72 | 2,274.48 | 5,193.07 |
| 3                    | 18,439.02 | 11,000.05 | 2,262.50 | 5,176.47 |
| 4                    | 18,434.23 | 11,005.28 | 2,260.13 | 5,168.82 |
| 5                    | 18,433.28 | 10,986.43 | 2,262.17 | 5,184.68 |
| 6                    | 18,461.95 | 10,985.97 | 2,271.55 | 5,204.43 |
| 7                    | 18,449.32 | 10,993.27 | 2,267.52 | 5,188.53 |
| 8                    | 18,435.72 | 10,995.18 | 2,263.00 | 5,177.53 |
| 9                    | 18,416.13 | 10,975.53 | 2,265.72 | 5,174.88 |
| 10                   | 18,439.67 | 10,981.22 | 2,270.25 | 5,188.20 |
| 11                   | 18,481.43 | 11,028.18 | 2,274.02 | 5,179.23 |
| 12                   | 18,440.13 | 10,991.12 | 2,265.78 | 5,183.23 |
| 13                   | 18,453.37 | 10,994.70 | 2,266.48 | 5,192.18 |
| 14                   | 18,424.22 | 10,966.58 | 2,265.83 | 5,191.80 |
| 15                   | 18,426.33 | 10,980.77 | 2,270.28 | 5,175.28 |
| 16                   | 18,428.65 | 10,978.52 | 2,273.85 | 5,176.28 |
| 17                   | 18,472.32 | 11,012.07 | 2,273.05 | 5,187.20 |
| 18                   | 18,448.83 | 10,998.37 | 2,262.85 | 5,187.62 |
| 19                   | 18,457.55 | 10,994.73 | 2,263.58 | 5,199.23 |
| Average              | 18,447.25 | 10,992.63 | 2,268.60 | 5,186.03 |

**Repeatability 1 IOPS - I/O Request Throughput Distribution Graph**



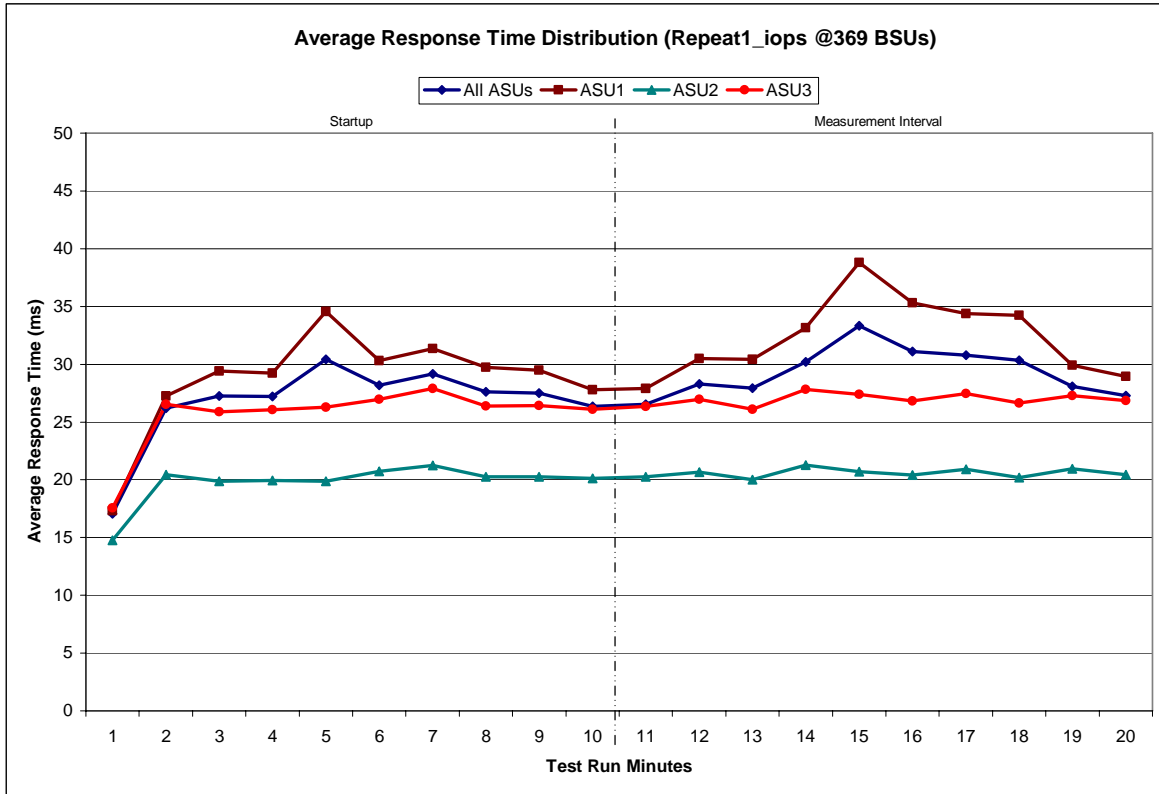
**Repeatability 1 IOPS –Average Response Time (ms) Distribution Data**

| 369 BSUs             | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 15:50:34 | 16:00:35 | 0-9      | 0:10:01  |
| Measurement Interval | 16:00:35 | 16:10:35 | 9-19     | 0:10:00  |

| 60 second intervals | All ASUs | ASU1  | ASU2  | ASU3  |
|---------------------|----------|-------|-------|-------|
| 0                   | 17.06    | 17.30 | 14.75 | 17.56 |
| 1                   | 26.19    | 27.23 | 20.44 | 26.51 |
| 2                   | 27.23    | 29.41 | 19.86 | 25.87 |
| 3                   | 27.20    | 29.23 | 19.94 | 26.05 |
| 4                   | 30.43    | 34.55 | 19.88 | 26.27 |
| 5                   | 28.19    | 30.30 | 20.72 | 26.96 |
| 6                   | 29.14    | 31.37 | 21.25 | 27.90 |
| 7                   | 27.61    | 29.72 | 20.26 | 26.37 |
| 8                   | 27.49    | 29.48 | 20.25 | 26.41 |
| 9                   | 26.36    | 27.77 | 20.13 | 26.08 |
| 10                  | 26.52    | 27.89 | 20.27 | 26.34 |
| 11                  | 28.28    | 30.47 | 20.65 | 26.97 |
| 12                  | 27.93    | 30.43 | 20.03 | 26.10 |
| 13                  | 30.20    | 33.15 | 21.28 | 27.83 |
| 14                  | 33.35    | 38.79 | 20.68 | 27.38 |
| 15                  | 31.10    | 35.32 | 20.42 | 26.83 |
| 16                  | 30.76    | 34.36 | 20.90 | 27.46 |
| 17                  | 30.36    | 34.22 | 20.18 | 26.63 |
| 18                  | 28.09    | 29.93 | 20.95 | 27.30 |
| 19                  | 27.30    | 28.92 | 20.46 | 26.85 |
| Average             | 29.39    | 32.35 | 20.58 | 26.97 |

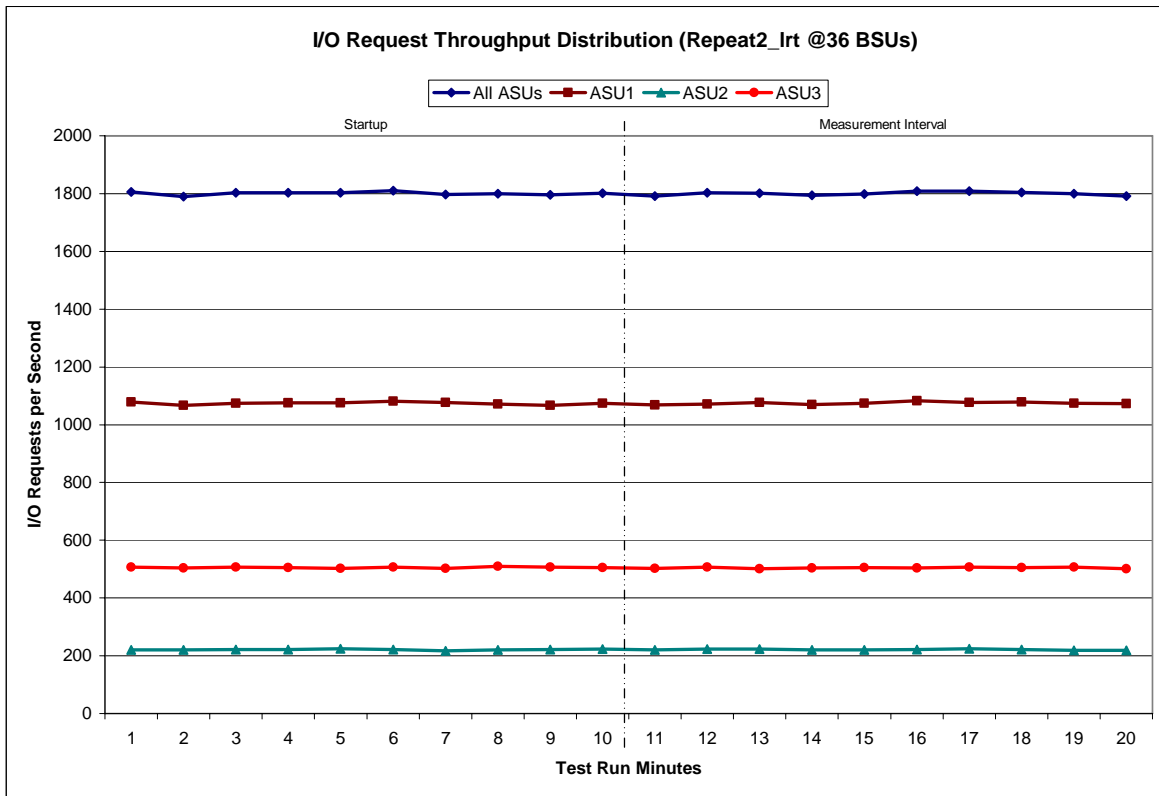
**Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph**



**Repeatability 2 LRT - I/O Request Throughput Distribution Data**

| 36 BSUs              | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 16:10:49 | 16:20:49 | 0-9      | 0:10:00  |
| Measurement Interval | 16:20:49 | 16:30:49 | 10-19    | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 1,804.93 | 1,078.35 | 220.25   | 506.33   |
| 1                    | 1,790.25 | 1,066.28 | 219.68   | 504.28   |
| 2                    | 1,802.80 | 1,073.77 | 222.12   | 506.92   |
| 3                    | 1,802.98 | 1,075.70 | 221.47   | 505.82   |
| 4                    | 1,802.77 | 1,076.15 | 224.00   | 502.62   |
| 5                    | 1,809.83 | 1,080.92 | 222.17   | 506.75   |
| 6                    | 1,797.47 | 1,076.43 | 217.82   | 503.22   |
| 7                    | 1,800.50 | 1,071.12 | 219.80   | 509.58   |
| 8                    | 1,795.43 | 1,066.68 | 221.40   | 507.35   |
| 9                    | 1,801.75 | 1,073.75 | 222.90   | 505.10   |
| 10                   | 1,791.75 | 1,068.47 | 220.98   | 502.30   |
| 11                   | 1,802.32 | 1,071.18 | 223.62   | 507.52   |
| 12                   | 1,801.20 | 1,077.52 | 222.68   | 501.00   |
| 13                   | 1,793.93 | 1,070.30 | 220.32   | 503.32   |
| 14                   | 1,798.45 | 1,073.93 | 219.68   | 504.83   |
| 15                   | 1,808.55 | 1,083.45 | 221.75   | 503.35   |
| 16                   | 1,809.13 | 1,076.65 | 225.10   | 507.38   |
| 17                   | 1,804.88 | 1,077.98 | 222.22   | 504.68   |
| 18                   | 1,800.32 | 1,073.92 | 218.85   | 507.55   |
| 19                   | 1,791.23 | 1,072.28 | 218.18   | 500.77   |
| Average              | 1,800.18 | 1,074.57 | 221.34   | 504.27   |

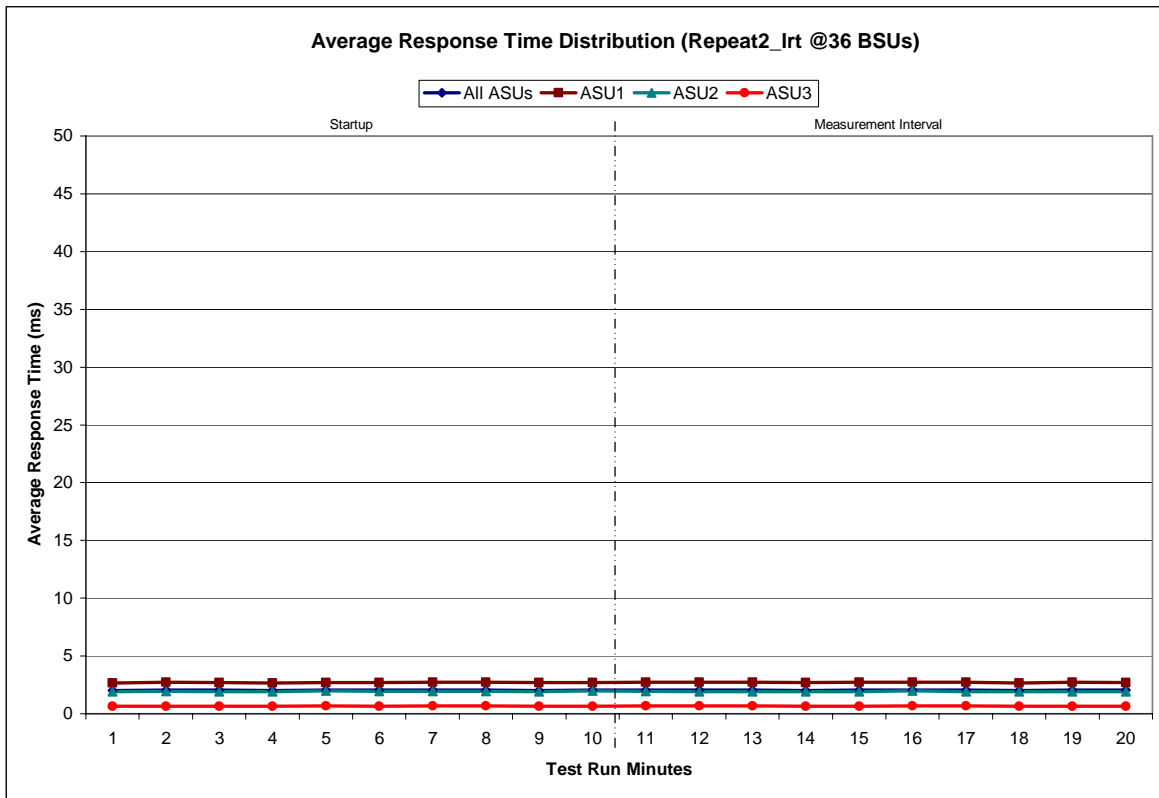
**Repeatability 2 LRT - I/O Request Throughput Distribution Graph**



**Repeatability 2 LRT –Average Response Time (ms) Distribution Data**

| 36 BSUs              | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 16:10:49 | 16:20:49 | 0-9      | 0:10:00  |
| Measurement Interval | 16:20:49 | 16:30:49 | 9-19     | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 2.01     | 2.66     | 1.92     | 0.66     |
| 1                    | 2.04     | 2.72     | 1.93     | 0.66     |
| 2                    | 2.03     | 2.71     | 1.92     | 0.66     |
| 3                    | 2.01     | 2.67     | 1.90     | 0.66     |
| 4                    | 2.04     | 2.70     | 1.98     | 0.67     |
| 5                    | 2.04     | 2.71     | 1.95     | 0.65     |
| 6                    | 2.07     | 2.75     | 1.96     | 0.67     |
| 7                    | 2.05     | 2.73     | 1.95     | 0.67     |
| 8                    | 2.03     | 2.71     | 1.90     | 0.65     |
| 9                    | 2.04     | 2.71     | 1.96     | 0.66     |
| 10                   | 2.05     | 2.72     | 1.96     | 0.67     |
| 11                   | 2.05     | 2.73     | 1.92     | 0.67     |
| 12                   | 2.05     | 2.72     | 1.91     | 0.67     |
| 13                   | 2.03     | 2.70     | 1.89     | 0.65     |
| 14                   | 2.05     | 2.73     | 1.90     | 0.66     |
| 15                   | 2.07     | 2.73     | 1.99     | 0.67     |
| 16                   | 2.06     | 2.74     | 1.92     | 0.67     |
| 17                   | 2.01     | 2.67     | 1.92     | 0.65     |
| 18                   | 2.04     | 2.73     | 1.91     | 0.65     |
| 19                   | 2.03     | 2.70     | 1.90     | 0.66     |
| Average              | 2.04     | 2.72     | 1.92     | 0.66     |

**Repeatability 2 LRT –Average Response Time (ms) Distribution Graph**



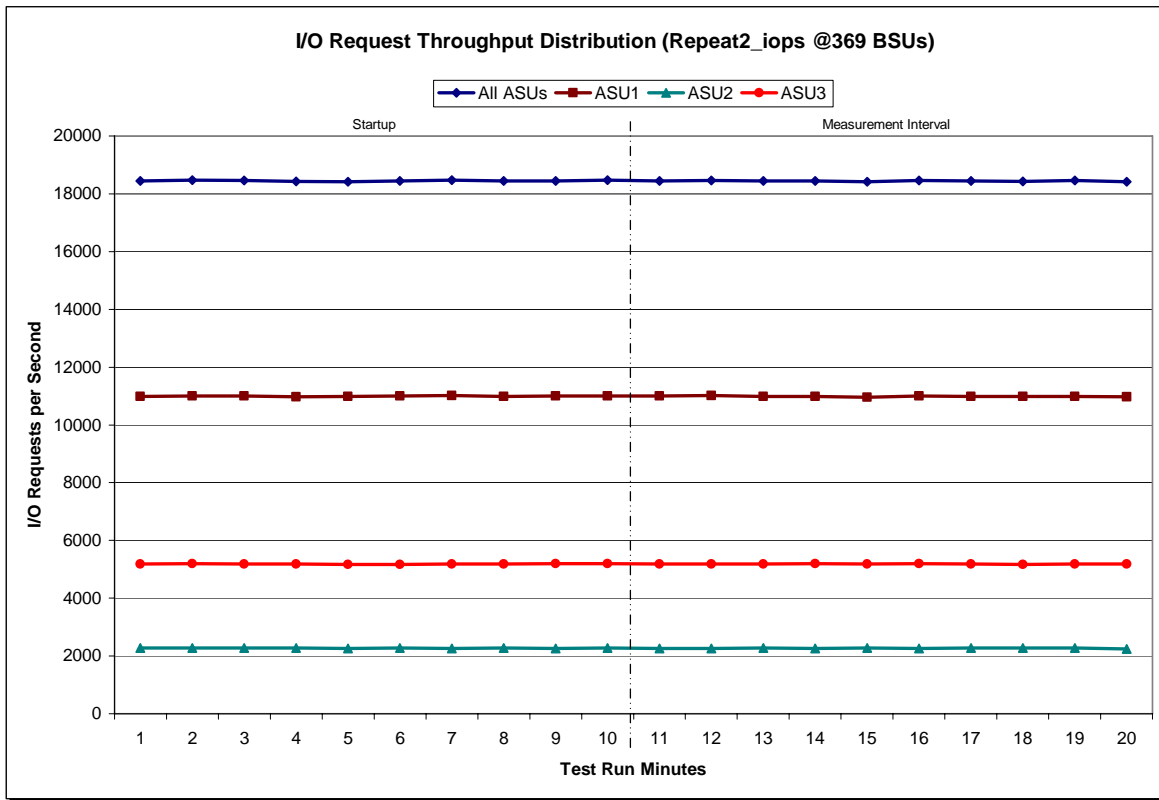
**Repeatability 2 IOPS - I/O Request Throughput Distribution Data**

| 369 BSUs             | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 16:30:56 | 16:40:57 | 0-9      | 0:10:01  |
| Measurement Interval | 16:40:57 | 16:50:57 | 10-19    | 0:10:00  |

| 60 second intervals | All ASUs  | ASU1      | ASU2     | ASU3     |
|---------------------|-----------|-----------|----------|----------|
| 0                   | 18,443.98 | 10,985.02 | 2,273.55 | 5,185.42 |
| 1                   | 18,473.40 | 11,006.40 | 2,270.67 | 5,196.33 |
| 2                   | 18,452.20 | 10,994.75 | 2,272.15 | 5,185.30 |
| 3                   | 18,430.85 | 10,970.58 | 2,275.13 | 5,185.13 |
| 4                   | 18,418.88 | 10,979.83 | 2,264.15 | 5,174.90 |
| 5                   | 18,443.18 | 10,998.47 | 2,276.33 | 5,168.38 |
| 6                   | 18,472.48 | 11,017.20 | 2,266.33 | 5,188.95 |
| 7                   | 18,440.32 | 10,988.80 | 2,272.25 | 5,179.27 |
| 8                   | 18,445.78 | 10,994.32 | 2,258.80 | 5,192.67 |
| 9                   | 18,475.50 | 11,002.38 | 2,268.48 | 5,204.63 |
| 10                  | 18,443.50 | 10,997.22 | 2,266.33 | 5,179.95 |
| 11                  | 18,456.48 | 11,011.95 | 2,262.52 | 5,182.02 |
| 12                  | 18,448.62 | 10,992.72 | 2,270.58 | 5,185.32 |
| 13                  | 18,451.48 | 10,992.68 | 2,260.47 | 5,198.33 |
| 14                  | 18,411.62 | 10,961.33 | 2,268.23 | 5,182.05 |
| 15                  | 18,459.28 | 10,997.10 | 2,267.63 | 5,194.55 |
| 16                  | 18,440.43 | 10,991.05 | 2,269.80 | 5,179.58 |
| 17                  | 18,434.58 | 10,988.65 | 2,275.13 | 5,170.80 |
| 18                  | 18,454.02 | 10,989.53 | 2,274.73 | 5,189.75 |
| 19                  | 18,412.72 | 10,975.77 | 2,248.65 | 5,188.30 |
| Average             | 18,441.27 | 10,989.80 | 2,266.41 | 5,185.07 |

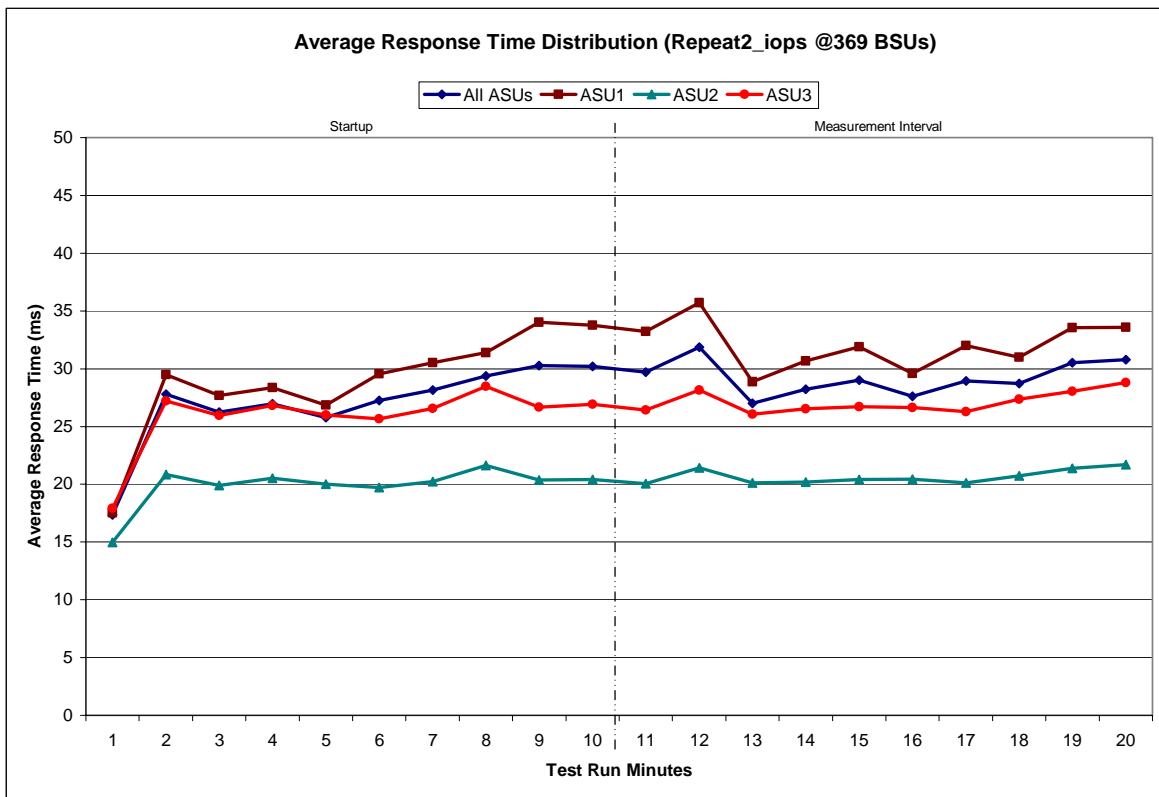
**Repeatability 2 IOPS - I/O Request Throughput Distribution Graph**



**Repeatability 2 IOPS –Average Response Time (ms) Distribution Data**

| 369 BSUs             | Start    | Stop     | Interval | Duration |
|----------------------|----------|----------|----------|----------|
| Start-Up/Ramp-Up     | 16:30:56 | 16:40:57 | 0-9      | 0:10:01  |
| Measurement Interval | 16:40:57 | 16:50:57 | 9-19     | 0:10:00  |
| 60 second intervals  | All ASUs | ASU1     | ASU2     | ASU3     |
| 0                    | 17.34    | 17.54    | 14.98    | 17.94    |
| 1                    | 27.79    | 29.50    | 20.85    | 27.22    |
| 2                    | 26.23    | 27.67    | 19.90    | 25.97    |
| 3                    | 26.95    | 28.35    | 20.52    | 26.80    |
| 4                    | 25.77    | 26.84    | 20.03    | 26.00    |
| 5                    | 27.25    | 29.55    | 19.71    | 25.68    |
| 6                    | 28.15    | 30.53    | 20.22    | 26.58    |
| 7                    | 29.37    | 31.39    | 21.65    | 28.47    |
| 8                    | 30.28    | 34.03    | 20.36    | 26.68    |
| 9                    | 30.20    | 33.78    | 20.41    | 26.91    |
| 10                   | 29.69    | 33.23    | 20.03    | 26.42    |
| 11                   | 31.84    | 35.72    | 21.41    | 28.16    |
| 12                   | 27.00    | 28.87    | 20.13    | 26.05    |
| 13                   | 28.22    | 30.67    | 20.20    | 26.53    |
| 14                   | 29.02    | 31.90    | 20.40    | 26.72    |
| 15                   | 27.63    | 29.58    | 20.43    | 26.64    |
| 16                   | 28.93    | 31.99    | 20.11    | 26.29    |
| 17                   | 28.71    | 31.00    | 20.73    | 27.37    |
| 18                   | 30.51    | 33.56    | 21.38    | 28.06    |
| 19                   | 30.78    | 33.58    | 21.72    | 28.80    |
| Average              | 29.23    | 32.01    | 20.65    | 27.10    |

**Repeatability 2 IOPS –Average Response Time (ms) Distribution Graph**



**Repeatability 1 (LRT)**

**Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0351 | 0.2800 | 0.0698 | 0.2108 | 0.0180 | 0.0704 | 0.0352 | 0.2806 |
| COV | 0.019  | 0.006  | 0.013  | 0.006  | 0.029  | 0.012  | 0.010  | 0.006  |

**IM – Intensity Multiplier:** The ratio of I/Os for each I/O stream relative to the total I/Os for all I/O streams (ASU1-1 – ASU3-1) as required by the benchmark specification.

**MIM – Measured Intensity Multiplier:** The Measured Intensity Multiplier represents the ratio of measured I/Os for each I/O stream relative to the total I/Os measured for all I/O streams (ASU1-1 – ASU3-1). This value may differ from the corresponding Expected Intensity Multiplier by no more than 5%.

**COV – Coefficient of Variation:** This measure of variation for the Measured Intensity Multiplier cannot exceed 0.2.

**Repeatability 1 (IOPS)**

**Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0349 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0699 | 0.0350 | 0.2811 |
| COV | 0.008  | 0.001  | 0.002  | 0.002  | 0.006  | 0.002  | 0.006  | 0.002  |

**Repeatability 2 (LRT)**

**Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0351 | 0.2819 | 0.0702 | 0.2097 | 0.0179 | 0.0702 | 0.0349 | 0.2801 |
| COV | 0.021  | 0.003  | 0.012  | 0.002  | 0.024  | 0.009  | 0.012  | 0.004  |

**Repeatability 2 (IOPS)**

**Measured Intensity Multiplier and Coefficient of Variation**

|     | ASU1-1 | ASU1-2 | ASU1-3 | ASU1-4 | ASU2-1 | ASU2-2 | ASU2-3 | ASU3-1 |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|
| IM  | 0.0350 | 0.2810 | 0.0700 | 0.2100 | 0.0180 | 0.0700 | 0.0350 | 0.2810 |
| MIM | 0.0351 | 0.2810 | 0.0700 | 0.2098 | 0.0180 | 0.0699 | 0.0349 | 0.2812 |
| COV | 0.006  | 0.001  | 0.003  | 0.002  | 0.006  | 0.004  | 0.004  | 0.002  |



## Data Persistence Test

### Clause 6

*The Data Persistence Test demonstrates the Tested Storage Configuration (TSC):*

- *Is capable of maintain data integrity across a power cycle.*
- *Ensures the transfer of data between Logical Volumes and host systems occurs without corruption or loss.*

*The SPC-1 Workload Generator will write 16 block I/O requests at random over the total Addressable Storage Capacity of the TSC for ten (10) minutes at a minimum of 25% of the load used to generate the SPC-1 IOP™ primary metric. The bit pattern selected to be written to each block as well as the address of the block will be retained in a log file.*

*The Benchmark Configuration will be shutdown and restarted using a power off/power on cycle at the end of the above sequence of write operations. In addition, any caches employing battery backup must be flushed/emptied.*

*The SPC-1 Workload Generator will then use the above log file to verify each block written contains the correct bit pattern.*

### Clause 9.2.4.8

*The following content shall appear in this section of the FDR:*

1. *A listing or screen image of all input parameters supplied to the Workload Generator.*
2. *For the successful Data Persistence Test Run, able illustrating key results. The content, appearance, and format of this table are specified in Table 9-12. Information displayed in this table shall be obtained from the Test Run Results File referenced below in #3.*
3. *For the successful Data Persistence Test Run, the human readable Test Run Results File produced by the Workload Generator.*

## SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Data Persistence Test are listed below.

```
java -Xmx256m -Xms256m persist1 -b 369
```

```
java -Xmx256m -Xms256m persist2
```

## Data Persistence Test Results File

A link to each test result file generated from each Data Persistence Test is listed below.

[Persistence 1 Test Results File](#)

[Persistence 2 Test Results File](#)

### Data Persistence Test Results

| <b>Data Persistence Test Results</b>                     |            |
|--|------------|
| Data Persistence Test Run Number: 1                      |            |
| Total Number of Logical Blocks Written                   | 44,134,528 |
| Total Number of Logical Blocks Verified                  | 37,896,720 |
| Total Number of Logical Blocks that Failed Verification  | 0          |
| Time Duration for Writing Test Logical Blocks            | 10 minutes |
| Size in Bytes of each Logical Block                      | 512        |
| Number of Failed I/O Requests in the process of the Test | 0          |

In some cases the same address was the target of multiple writes, which resulted in more Logical Blocks Written than Logical Blocks Verified. In the case of multiple writes to the same address, the pattern written and verified must be associated with the last write to that address.

## **PRICED STORAGE CONFIGURATION AVAILABILITY DATE**

### **Clause 9.2.4.9**

*The committed delivery data for general availability (Availability Date) of all products that comprise the Priced Storage Configuration must be reported. When the Priced Storage Configuration includes products or components with different availability dates, the reported Availability Date must be the date at which all components are committed to be available.*

*The FDR shall state: "The Priced Storage Configuration, as documented in this Full Disclosure Report will be available for shipment to customers on MMMM DD, YYYY." Where Priced Storage Configuration is the TSC Configuration Name as described in Clause 9.2.4.3.3 and MMMM is the alphanumeric month, DD is the numeric day, and YYYY is the numeric year of the date that the Priced Storage Configuration, as documented, is available for shipment to customers as described above.*

The Sun StorageTek® D280 Disk System (*mirrored write cache*), as documented in this Full Disclosure Report became available for customer purchase and shipment on September 27, 2002.

## **PRICING INFORMATION**

### **Clause 9.2.4.11**

*A statement of the respective calculations for pricing must be included.*

Pricing information may found in the Tested Storage Configuration Pricing section on page 12.

## **ANOMALIES OR IRREGULARITIES**

### **Clause 9.2.4.10**

*The FDR shall include a clear and complete description of any anomalies or irregularities encountered in the course of executing the SPC-1 benchmark that may in any way call into question the accuracy, verifiability, or authenticity of information published in this FDR.*

There were no anomalies or irregularities encountered during the SPC-1 Remote Audit of the Sun StorageTek® D280 Disk System (*mirrored write cache*).

## **APPENDIX A: SPC-1 WORKLOAD GENERATOR STORAGE CONFIGURATION COMMANDS AND PARAMETERS**

### **Master Host System:**

```
host=master
slaves=(bm6650a_1,bm6650a_2,bm6650a_3,bm6650c_1,bm6650c_2,bm6650c_3)

javaparms="-Xmx64m -Xms64m"

sd=asul_1,lun=\\.\PhysicalDrive1,size=13456048128
sd=asul_2,lun=\\.\PhysicalDrive21,size=13456048128
sd=asul_3,lun=\\.\PhysicalDrive2,size=13456048128
sd=asul_4,lun=\\.\PhysicalDrive22,size=13456048128
sd=asul_5,lun=\\.\PhysicalDrive3,size=13456048128
sd=asul_6,lun=\\.\PhysicalDrive23,size=13456048128
sd=asul_7,lun=\\.\PhysicalDrive4,size=13456048128
sd=asul_8,lun=\\.\PhysicalDrive24,size=13456048128
sd=asul_9,lun=\\.\PhysicalDrive5,size=13456048128
sd=asul_10,lun=\\.\PhysicalDrive25,size=13456048128

sd=asul_11,lun=\\.\PhysicalDrive6,size=13456048128
sd=asul_12,lun=\\.\PhysicalDrive26,size=13456048128
sd=asul_13,lun=\\.\PhysicalDrive7,size=13456048128
sd=asul_14,lun=\\.\PhysicalDrive27,size=13456048128
sd=asul_15,lun=\\.\PhysicalDrive8,size=13456048128
sd=asul_16,lun=\\.\PhysicalDrive28,size=13456048128
sd=asul_17,lun=\\.\PhysicalDrive9,size=13456048128
sd=asul_18,lun=\\.\PhysicalDrive29,size=13456048128
sd=asul_19,lun=\\.\PhysicalDrive10,size=13456048128
sd=asul_20,lun=\\.\PhysicalDrive30,size=13456048128

sd=asul_21,lun=\\.\PhysicalDrive11,size=13456048128
sd=asul_22,lun=\\.\PhysicalDrive31,size=13456048128
sd=asul_23,lun=\\.\PhysicalDrive12,size=13456048128
sd=asul_24,lun=\\.\PhysicalDrive32,size=13456048128
sd=asul_25,lun=\\.\PhysicalDrive13,size=13456048128
sd=asul_26,lun=\\.\PhysicalDrive33,size=13456048128
sd=asul_27,lun=\\.\PhysicalDrive14,size=13456048128
sd=asul_28,lun=\\.\PhysicalDrive34,size=13456048128
sd=asul_29,lun=\\.\PhysicalDrive15,size=13456048128
sd=asul_30,lun=\\.\PhysicalDrive35,size=13456048128

sd=asul_31,lun=\\.\PhysicalDrive16,size=13456048128
sd=asul_32,lun=\\.\PhysicalDrive36,size=13456048128
sd=asul_33,lun=\\.\PhysicalDrive17,size=13456048128
sd=asul_34,lun=\\.\PhysicalDrive37,size=13456048128
sd=asul_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asul_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asul_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asul_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asul_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asul_40,lun=\\.\PhysicalDrive40,size=13456048128
```

```
sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120  
sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693
```

### Slave Host System 1:

The SPC-1 Workload Generator commands and parameters listed below were used for all three instances executing on the Slave Host System. The only difference in the commands for each instance was the "host=..." command, which differed for each individual instance.

```
host=bm6650c_1  
master=bm6650c  
  
javaparms="-Xmx64m -Xms64m"  
  
sd=asul_1,lun=\\.\PhysicalDrive1,size=13456048128  
sd=asul_2,lun=\\.\PhysicalDrive21,size=13456048128  
sd=asul_3,lun=\\.\PhysicalDrive2,size=13456048128  
sd=asul_4,lun=\\.\PhysicalDrive22,size=13456048128  
sd=asul_5,lun=\\.\PhysicalDrive3,size=13456048128  
sd=asul_6,lun=\\.\PhysicalDrive23,size=13456048128  
sd=asul_7,lun=\\.\PhysicalDrive4,size=13456048128  
sd=asul_8,lun=\\.\PhysicalDrive24,size=13456048128  
sd=asul_9,lun=\\.\PhysicalDrive5,size=13456048128  
sd=asul_10,lun=\\.\PhysicalDrive25,size=13456048128  
  
sd=asul_11,lun=\\.\PhysicalDrive6,size=13456048128  
sd=asul_12,lun=\\.\PhysicalDrive26,size=13456048128  
sd=asul_13,lun=\\.\PhysicalDrive7,size=13456048128  
sd=asul_14,lun=\\.\PhysicalDrive27,size=13456048128  
sd=asul_15,lun=\\.\PhysicalDrive8,size=13456048128  
sd=asul_16,lun=\\.\PhysicalDrive28,size=13456048128  
sd=asul_17,lun=\\.\PhysicalDrive9,size=13456048128  
sd=asul_18,lun=\\.\PhysicalDrive29,size=13456048128  
sd=asul_19,lun=\\.\PhysicalDrive10,size=13456048128  
sd=asul_20,lun=\\.\PhysicalDrive30,size=13456048128  
  
sd=asul_21,lun=\\.\PhysicalDrive11,size=13456048128  
sd=asul_22,lun=\\.\PhysicalDrive31,size=13456048128  
sd=asul_23,lun=\\.\PhysicalDrive12,size=13456048128  
sd=asul_24,lun=\\.\PhysicalDrive32,size=13456048128  
sd=asul_25,lun=\\.\PhysicalDrive13,size=13456048128  
sd=asul_26,lun=\\.\PhysicalDrive33,size=13456048128  
sd=asul_27,lun=\\.\PhysicalDrive14,size=13456048128  
sd=asul_28,lun=\\.\PhysicalDrive34,size=13456048128  
sd=asul_29,lun=\\.\PhysicalDrive15,size=13456048128  
sd=asul_30,lun=\\.\PhysicalDrive35,size=13456048128  
  
sd=asul_31,lun=\\.\PhysicalDrive16,size=13456048128  
sd=asul_32,lun=\\.\PhysicalDrive36,size=13456048128  
sd=asul_33,lun=\\.\PhysicalDrive17,size=13456048128  
sd=asul_34,lun=\\.\PhysicalDrive37,size=13456048128
```

## SPC-1 WORKLOAD GENERATOR STORAGE CONFIGURATION COMMANDS AND PARAMETERS

```

sd=asul_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asul_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asul_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asul_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asul_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asul_40,lun=\\.\PhysicalDrive40,size=13456048128

sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120

sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693

```

**Slave Host System 2:**

The SPC-1 Workload Generator commands and parameters listed below were used for all three instances executing on the Slave Host System. The only difference in the commands for each instance was the "host=..." command, which differed for each individual instance.

```

host=bm6650a_1
master=bm6650a

```

```

javaparms="-Xmx64m -Xms64m"

```

```

sd=asul_1,lun=\\.\PhysicalDrive1,size=13456048128
sd=asul_2,lun=\\.\PhysicalDrive21,size=13456048128
sd=asul_3,lun=\\.\PhysicalDrive2,size=13456048128
sd=asul_4,lun=\\.\PhysicalDrive22,size=13456048128
sd=asul_5,lun=\\.\PhysicalDrive3,size=13456048128
sd=asul_6,lun=\\.\PhysicalDrive23,size=13456048128
sd=asul_7,lun=\\.\PhysicalDrive4,size=13456048128
sd=asul_8,lun=\\.\PhysicalDrive24,size=13456048128
sd=asul_9,lun=\\.\PhysicalDrive5,size=13456048128
sd=asul_10,lun=\\.\PhysicalDrive25,size=13456048128

sd=asul_11,lun=\\.\PhysicalDrive6,size=13456048128
sd=asul_12,lun=\\.\PhysicalDrive26,size=13456048128
sd=asul_13,lun=\\.\PhysicalDrive7,size=13456048128
sd=asul_14,lun=\\.\PhysicalDrive27,size=13456048128
sd=asul_15,lun=\\.\PhysicalDrive8,size=13456048128
sd=asul_16,lun=\\.\PhysicalDrive28,size=13456048128
sd=asul_17,lun=\\.\PhysicalDrive9,size=13456048128
sd=asul_18,lun=\\.\PhysicalDrive29,size=13456048128
sd=asul_19,lun=\\.\PhysicalDrive10,size=13456048128
sd=asul_20,lun=\\.\PhysicalDrive30,size=13456048128

sd=asul_21,lun=\\.\PhysicalDrive11,size=13456048128
sd=asul_22,lun=\\.\PhysicalDrive31,size=13456048128
sd=asul_23,lun=\\.\PhysicalDrive12,size=13456048128
sd=asul_24,lun=\\.\PhysicalDrive32,size=13456048128
sd=asul_25,lun=\\.\PhysicalDrive13,size=13456048128
sd=asul_26,lun=\\.\PhysicalDrive33,size=13456048128
sd=asul_27,lun=\\.\PhysicalDrive14,size=13456048128
sd=asul_28,lun=\\.\PhysicalDrive34,size=13456048128
sd=asul_29,lun=\\.\PhysicalDrive15,size=13456048128
sd=asul_30,lun=\\.\PhysicalDrive35,size=13456048128

```

## SPC-1 WORKLOAD GENERATOR STORAGE CONFIGURATION COMMANDS AND PARAMETERS

```
sd=asul_31,lun=\\.\PhysicalDrive16,size=13456048128
sd=asul_32,lun=\\.\PhysicalDrive36,size=13456048128
sd=asul_33,lun=\\.\PhysicalDrive17,size=13456048128
sd=asul_34,lun=\\.\PhysicalDrive37,size=13456048128
sd=asul_35,lun=\\.\PhysicalDrive18,size=13456048128
sd=asul_36,lun=\\.\PhysicalDrive38,size=13456048128
sd=asul_37,lun=\\.\PhysicalDrive19,size=13456048128
sd=asul_38,lun=\\.\PhysicalDrive39,size=13456048128
sd=asul_39,lun=\\.\PhysicalDrive20,size=13456048128
sd=asul_40,lun=\\.\PhysicalDrive40,size=13456048128

sd=asu2_1,lun=\\.\PhysicalDrive41,size=538241925120

sd=asu3_1,lun=\\.\PhysicalDrive42,size=119609316693
```

## **APPENDIX B: TESTED STORAGE CONFIGURATION (TSC) CREATION/CONFIGURATION SCRIPT**

```
/* SPC-1 configuration script */
/* 108 drives - 8/07/03 */

set controller[a] mode = active;
set controller[b] mode = active;

create volume drives[ 0,1 0,2 10,1 10,2 0,3 0,4 10,3 10,4 0,5 0,6 10,5 10,6 0,7 0,8 10,7
                    10,8 0,9 0,10 10,9 10,10 0,11 0,12 10,11 10,12 0,13 0,14 10,13 10,14 2,1 12,1 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 0"
capacity=13456048128
owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 1" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 2" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 3" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 4" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 5" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 6" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 7" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 8" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 9" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 10" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=512 userLabel="LUN 11" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 12" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 13" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 14" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 15" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 16" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 17" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 18" capacity=13456048128 owner = A;
create volume volumeGroup=1 RAIDLevel=1 segmentSize=128 userLabel="LUN 19" capacity=13456048128 owner = A;

create volume drives[ 1,1 1,2 11,1 11,2 1,3 1,4 11,3 11,4 1,5 1,6 11,5 11,6 1,7 1,8
                    11,7 11,8 1,9 1,10 11,9 11,10 1,11 1,12 11,11 11,12 1,13 1,14 11,13 11,14 2,10 12,10 ]
RAIDLevel=1
segmentSize=128
userLabel="LUN 20"
capacity=13456048128
owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 21" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 22" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 23" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 24" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 25" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 26" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 27" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 28" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 29" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 30" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=512 userLabel="LUN 31" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 32" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 33" capacity=13456048128 owner = A;
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 34" capacity=13456048128 owner = A;
```



```
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 35" capacity=13456048128 owner = A;  
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 36" capacity=13456048128 owner = A;  
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 37" capacity=13456048128 owner = A;  
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 38" capacity=13456048128 owner = A;  
create volume volumeGroup=2 RAIDLevel=1 segmentSize=128 userLabel="LUN 39" capacity=13456048128 owner = A;
```

```
create volume drives[ 2,2 12,2 2,3 2,4 12,3 12,4 2,5 2,6 12,5 12,6 2,7 2,8 12,7 12,8 2,9  
12,9 2,11 2,12 12,11 12,12 2,13 2,14 12,13 12,14 3,1 3,2 13,1 13,2 3,3 13,3 ]  
RAIDLevel=1  
segmentSize=512  
userLabel="LUN 40"  
capacity=538241925120  
owner = b;
```

```
create volume drives[ 3,4 13,4 3,5 3,6 13,5 13,6 3,7 3,8 13,7 13,8 3,9 3,10 13,9 13,10 3,11 3,12 13,11 13,12 ]  
RAIDLevel=1  
segmentSize=128  
userLabel="LUN 41"  
capacity=119609316864  
owner = b;
```

```
set volume["LUN 0"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 1"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 2"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 3"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 4"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 5"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 6"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 7"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 8"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 9"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 10"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 11"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 12"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 13"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 14"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 15"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 16"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 17"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 18"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 19"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 20"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 21"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 22"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 23"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 24"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 25"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 26"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 27"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 28"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 29"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 30"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 31"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 32"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 33"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 34"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 35"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 36"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 37"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 38"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 39"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
```

```
set volume["LUN 40"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;  
set volume["LUN 41"] mirrorEnabled = True writeCacheEnabled = True cacheWithoutBatteryEnabled = False readAheadMultiplier = 0;
```

```
set storageArray cacheFlushStop = 70 cacheFlushStart = 70;
```

```
set storageArray defaultHostType = "Windows 2000/Server 2003 Non-Clustered";
```

```
set controller[a] HostNVSRAMByte[0x01, 0x17]=0x01;  
set controller[b] HostNVSRAMByte[0x01, 0x17]=0x01;
```

```
/* Setup for RDAC failover environment */
```

```
set controller[a] HostNVSRAMByte[0x00, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x01, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x02, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x03, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x04, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x05, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x06, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x07, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x08, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x09, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0a, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0b, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0c, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0d, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0e, 0x24]=0x00;  
set controller[a] HostNVSRAMByte[0x0f, 0x24]=0x00;
```

```
set controller[b] HostNVSRAMByte[0x00, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x01, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x02, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x03, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x04, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x05, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x06, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x07, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x08, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x09, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0a, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0b, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0c, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0d, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0e, 0x24]=0x00;  
set controller[b] HostNVSRAMByte[0x0f, 0x24]=0x00;
```