SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS
ETERNUS3000 MODEL 100

SPC-1 V1.8

Submitted for Review: June 22, 2004
Submission Identifier: A00031
Revised: July 9, 2004
Accepted: August 21, 2004

First Edition – June 2004

Trademarks

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

C. A. (Sandy) Wilson
Fujitsu Limited
1250 East Arques Avenue
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June 22, 2004

The SPC Benchmark 1™ results listed below for the Fujitsu Storage Systems ETERNUS3000 Model 100 were produced in compliance with the SPC Benchmark 1™ V1.8 Remote Audit requirements.

SPC Benchmark 1™ V1.8 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS3000 Model 100	
Metric	**Reported Result**
SPC-1 IOPS™	11,201.47
SPC-1 Price-Performance	$9.41/SPC-1 IOPS™
Total ASU Capacity	560.874 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$11,201.47

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 Fujitsu Limited:
  - ✓ 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).

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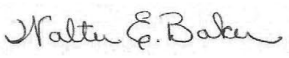
- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters.
- Commands and parameters used to configure the SPC-1 Workload Generator.
- The following Host System requirements were reviewed using documentation supplied by Fujitsu Limited:
  - ✓ 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 from Fujitsu Limited 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

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LETTER OF GOOD FAITH

FUJITSU LIMITED
Kawasaki-shi, Nakahara-ku, Kamikodanaka 4-1-1, JAPAN 211-8588
TEL : 044-754-3605, FAX : 044-754-3609

FUJITSU

From: Fujitsu Limited, Test Sponsor

Submitted by: Hitoshi Matsushima
Vice President, Storage Systems division
Kanagawa-ken, Kanagawa-ken, Kawasaki-shi, Nakahara-ku, Kamikodanaka 4-1-1
Japan 211-8588

Contact Information: Carrel A. (Sandy) Wilson
Fujitsu Computer Systems Corp.
1250 East Arques Ave PO Box 3470
Sunnyvale, CA 94088, U.S.A.

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

Subject: SPC-1 Letter of Good Faith for the ETERNUS3000 Model 100

Fujitsu Limited 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 V1.80 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: H. Matsushima Date: April 20, 2004

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu Computer Systems Corp. C.A. (Sandy) Wilson Sandy_Wilson@us.fujitsu.com 1250 East Arques Ave PO Box 3470 Sunnyvale, CA 94088-3470 Phone: (916) 434-8593
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Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Norihiko Kondo kondo.n@jp.fujitsu.com Kanagawa-ken, Kanagawa-ken, Kawasaki-shi, Nakahara-ku, Kamikodanaka 4-1-1 Japan 211-8588 Phone: 044- 754-3605
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Revision Information and Key Dates

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.8
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	June 22, 2004
Date FDR was submitted to the SPC	June 22, 2004
Date revised FDR was submitted to the SPC Revised pricing-three year maintenance	July 9, 2004
Date the TSC is/was available for shipment to customers	July 10, 2003
Date the TSC completed audit certification	June 4, 2004

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS3000 Model 100	
Metric	**Reported Result**
SPC-1 IOPS™	11,201.47
SPC-1 Price-Performance	$9.69/SPC-1 IOPS™
Total ASU Capacity	560.874 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$108,498

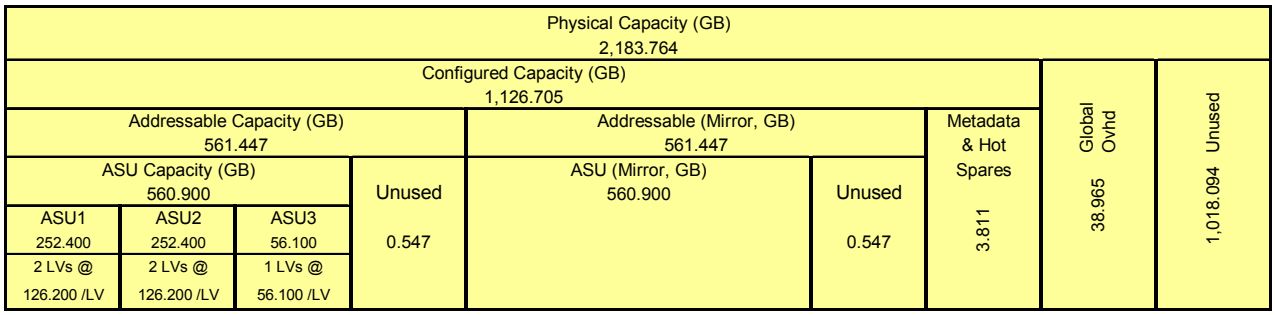
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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.

Storage Capacities and Relationships

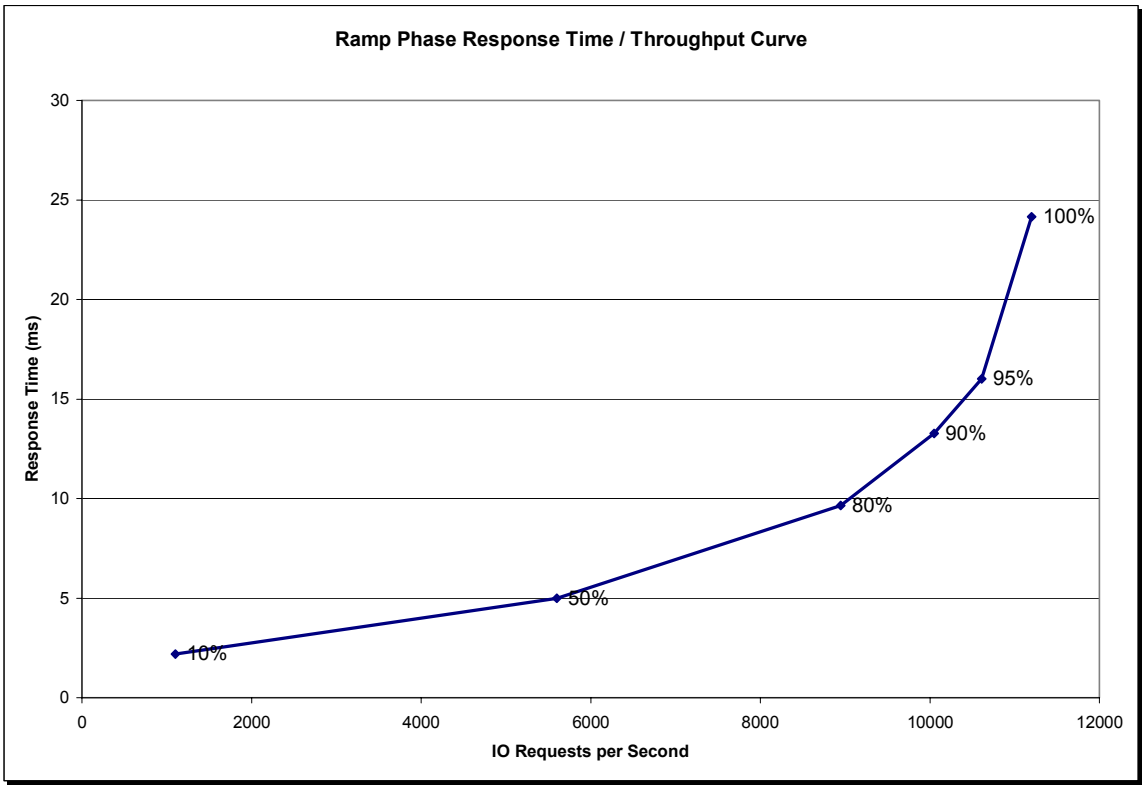
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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 any of the above load points 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
I/O Request Throughput	1,101.00	5,601.60	8,948.95	10,052.17	10,608.65	11,201.47
Average Response Time (ms):						
All ASUs	2.20	5.00	9.65	13.26	16.01	24.15
ASU-1	2.73	6.26	11.82	15.98	19.09	28.63
ASU-2	2.75	6.96	16.92	25.78	32.85	49.00
ASU-3	0.83	1.45	1.87	2.02	2.10	3.76
Reads	4.45	10.67	21.85	30.67	37.47	55.27
Writes	0.73	1.29	1.71	1.91	2.03	3.87

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

Item	Product Id	Description	Qty	Unit $	Extd $
1	E310R24BU	ETERNUS3000 Model 100 - 4 ports (rack mount - 4U) including Controller Enclosure, 2x Controllers, each Controller with 2 ports & 1GB Cache dual power supplies, dual battery units 4x FC cables (5m), 2x LAN cables (5m) rack mount kit, ETERNUSmgr & drivers slots for up to 15 disk drives	1	$20,600	$20,600
2	E310RE2U	Additional Drive Enclosure - (rack mount - 3U) with slots for up to 15 disk drives	1	$7,200	$7,200
3	E310CD7H	73GB/15krpm Disk Drives (set of 5)	6	$14,475	$86,850
4	PW028FC3U	Emulex LP9802	2	$2,590	$5,180
5	FPC58-1213-01	Enhanced Plus Model 100 - Phone 24x7, On-site 24x7, with 4 hour response - 2 year Warranty Uplift	1	$7,380	$7,380
6	FPC58-1217-01	Enhanced Plus Model 100 - Phone 24x7, On-site 24x7, with 4 hour response - 1 year Post Warranty	1		
		Total Product List Price			$119,830
		Product Discount		15%	
		Net Product Price			$101,856
		Total Service List Price			$7,380
		Service Discount		10%	
		Net Service Price			$6,642
		Total Sell Price, including 3 years Service			**$108,498**

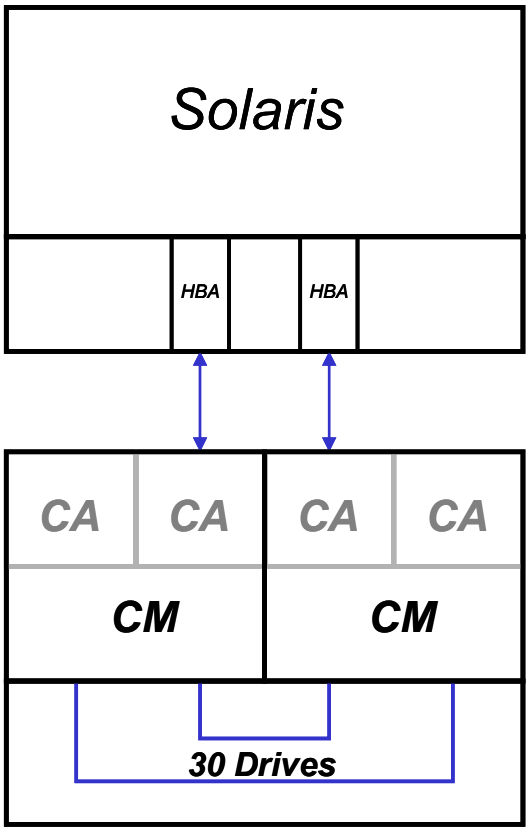
Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

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

Benchmark Configuration/Tested Storage Configuration Diagram

PRIMEPOWER 450

ETERNUS3000 Model 100



Host Systems:	Tested Storage Configuration (TSC):
UID=HS-1	2 – Emulex LP8902 FC HBAs (2 Gbit)
Fujitsu PRIMEPOWER 450R (Rack Mount)	***UID=SC-1:***
2 - SPARC64 V (1.1 GHz) CPUs 128 KB L1 data cache 1 MB L2 cache	Fujitsu ETERNUS3000 Model 100 2 – Controller Modules (CM), each with 1.26 GHz CPU 1 GB cache
16 GB main memory	
Solaris 9	4 – Front side fibre channels (CA) – 2 Gbit each (2 used, 2 unused) 2 – Drive side fibre channel loops – 2 Gbit each
PCI	
WG	30 – 73 GB 15K RPM disk drives
	2 – Drive enclosure modules, each with dual FC-AL interfaces 15 – hot swap drive slots

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…

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC) is illustrated on page 13 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

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 page 13 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Customer Tunable 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.

"Appendix A: Customer Tunable Parameters and Options" on page 50 contains the customer tunable parameters and options that have been altered from their default values for this benchmark.

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.

"Appendix B: Tested Storage Configuration (TSC) Creation" on page 53 contains the detailed information that describes how to create and configure the logical TSC.

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 C: SPC-1 Workload Generator Storage Commands and Parameters" on page 65.

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).

Data Protection Overhead: The storage capacity required to implement the ECC data protection.

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)	560.874
Addressable Storage Capacity	Gigabytes (GB)	561.447
Configured Storage Capacity	Gigabytes (GB)	1,126.705
Physical Storage Capacity	Gigabytes (GB)	2,183,764
Data Protection Overhead (mirror)	Gigabytes (GB)	561.447
Required Storage	Gigabytes (GB)	3.811
Global Storage Overhead	Gigabytes (GB)	38.965
Total Unused Storage	Gigabytes (GB)	1,019.188

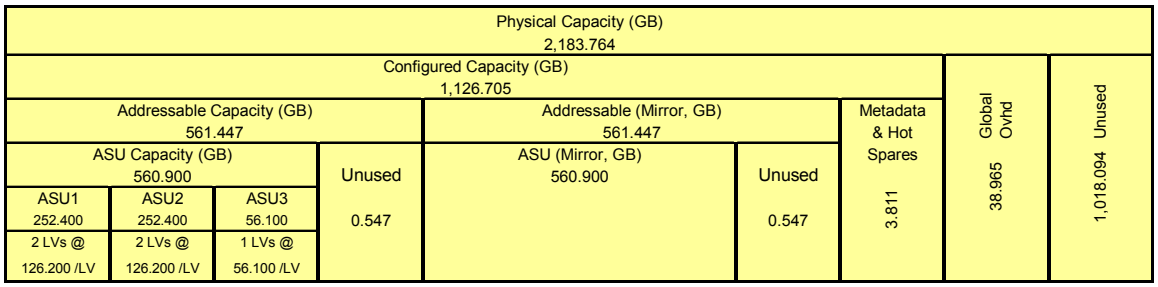
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	99.90%	49.78%	25.69%
Required for Data Protection (Mirroring)		49.83%	25.71%
Addressable Storage Capacity		49.83%	25.71%
Required Storage		0.34%	0.17%
Configured Storage Capacity			51.59%
Global Storage Overhead			1.78%
Unused Storage:			
Addressable	0.10%		
Configured		0.10%	
Physical			46.62%

The Physical Storage Capacity consisted of 2,183.764 GB distributed over 30 disk drives each with a formatted capacity of 72.792 GB. There was 1,018.094 GB (46.62%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 38.965 GB (1.78% of Physical Storage Capacity). There was 1.094 (0.10%) GB of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 99.90% of the Addressable Storage Capacity resulting in 0.547 GB (0.10%) of Unused Storage within the Addressable Storage Capacity.

SPC-1 Storage Capacities and Relationships Illustration

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



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 (252.387 GB)	**ASU-2 (252.387 GB)**	**ASU-3 (56.100 GB)**
2 Logical Volumes 126.207 GB per Logical Volume (126.193 GB used/Logical Volume)	2 Logical Volumes 126.207 GB per Logical Volume (126.193 GB used/Logical Volume)	1 Logical Volume 56.623 GB per Logical Volume (56.100 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.

Assignment of RAID Groups and LUNs

The 15 RAID Group Assignments are RAID1(1+1) sets, each divided into 5 Logical Volumes, for a total of 75 LVs. These are grouped into two separate sets of LUNs, using Host Affinity grouping, one with 40 LUNs and one with 35 LUNs.

The RAID Group assignments to drives in the array are illustrated by the following chart.

Drive:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**A**	**B**	**C**	**D**	**E**
DE:															
00	RG 14	RG 0	RG 1	RG 2	RG 3	RG 4	RG 5	RG 6	RG 7	RG 8	RG 9	RG 10	RG 11	RG 12	RG 13
01															

The RAID Groups and LUN assignments are set up through a series of actions on the GUI Management Interface (ETERNUSmgr). The task of setting up the configuration for each customer is provided as part of the base system price by Fujitsu. Different techniques are applied, depending upon the needs of the customer. This configuration reflects the customary techniques that are applied when a high performance requirement dominates the customer environment. Other techniques are applied when the primary requirement is for maximum capacity. In the case of high performance, it is customary to define RAID Groups arranged in RAID1 configurations.

The LUNs, seen through the two HBAs by Solaris, are grouped into Solars Volume Groups, and used with 128 KB stripe unit depths across the sets. Two Logical Volumes, each with 15 LUNs are used for ASU1 and another two for ASU2, while one Volume, also with 15 LUNs is used for ASU3. The sizes are reflected in the ASU Logical Volume Mapping chart.

As can be provided for any high performance, random access pattern installation, Pre-fetch operations were turned off for all of the LUNs, as part of the configuration set-up.

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.*

The SPC-1 benchmark consists of the following Tests, Test Phases, and Test Runs:

- **Data Persistence Test**
  - Data Persistence Test Run 1
  - Data Persistence Test Run 2
- **Primary Metrics Test**
  - Sustainability Test Phase and Test Run
  - IOPS Test Phase and Test Run
  - Response Time Ramp Test Phase
    - 95% of IOPS Test Run
    - 90% of IOPS Test Run
    - 80% of IOPS Test Run
    - 50% of IOPS Test Run
    - 10% of IOPS Test Run (LRT)
- **Repeatability Test**
  - Repeatability Test Phase 1
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run
  - Repeatability Test Phase 2
    - 10% of IOPS Test Run (LRT)
    - IOPS Test Run

Each Test is an atomic unit that must be executed from start to finish before any other Test, Test Phase, or Test Run may be executed. The Tests may be executed in any sequence.

The results from each Test, Test Phase, and Test Run are listed below along with a more detailed explanation of each component.

Primary Metrics Test – 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 following script containing SPC-1 Workload Generator input parameters was used for the Sustainability, IOPS, and Response Time Ramp Test Runs :

java –Xmx512m –Xss1024k metrics –b 224

Sustainability Test Results File

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

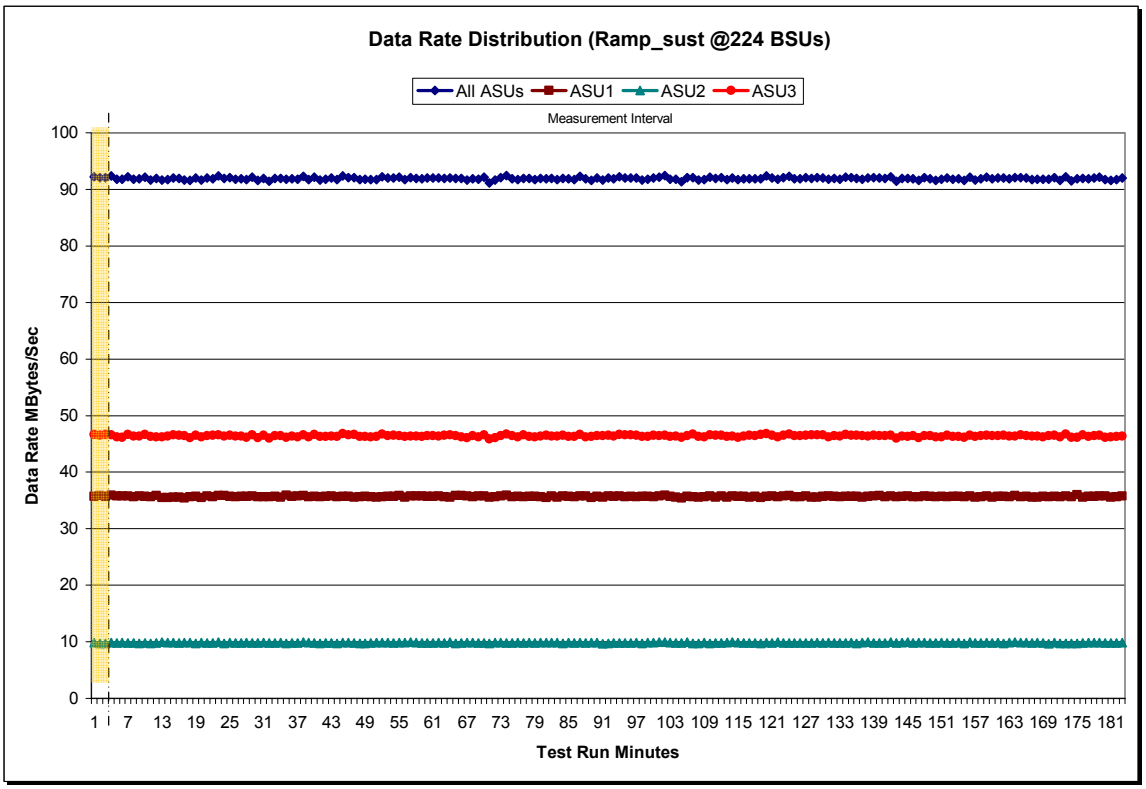
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	10:44:30	10:47:30	0-2	0:03:00
Measurement Interval	10:47:30	13:47:30	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	92.21	35.69	9.86	46.66	63	92.04	35.56	9.90	46.58	126	92.09	35.81	9.81	46.48
1	92.11	35.83	9.74	46.54	64	91.92	35.82	9.70	46.41	127	91.94	35.58	9.80	46.56
2	92.11	35.72	9.74	46.65	65	91.90	35.83	9.82	46.25	128	92.05	35.59	9.86	46.60
3	92.37	35.93	9.86	46.57	66	91.67	35.75	9.83	46.09	129	92.01	35.69	9.77	46.56
4	91.77	35.75	9.82	46.21	67	91.90	35.63	9.85	46.42	130	91.83	35.78	9.85	46.20
5	91.77	35.77	9.86	46.14	68	91.78	35.78	9.80	46.20	131	91.91	35.69	9.78	46.45
6	92.19	35.75	9.81	46.63	69	92.13	35.79	9.77	46.57	132	91.81	35.66	9.78	46.38
7	91.77	35.61	9.81	46.35	70	91.17	35.60	9.75	45.82	133	92.18	35.68	9.82	46.68
8	91.90	35.78	9.73	46.39	71	91.62	35.66	9.87	46.09	134	92.10	35.74	9.87	46.49
9	92.12	35.72	9.76	46.64	72	92.09	35.78	9.88	46.44	135	91.96	35.71	9.75	46.50
10	91.67	35.67	9.69	46.31	73	92.44	35.91	9.79	46.74	136	91.82	35.53	9.88	46.41
11	91.94	35.86	9.83	46.25	74	91.84	35.62	9.79	46.43	137	92.01	35.71	9.92	46.37
12	91.67	35.46	9.95	46.25	75	91.75	35.68	9.87	46.20	138	92.10	35.79	9.82	46.49
13	91.69	35.49	9.84	46.35	76	91.95	35.63	9.76	46.56	139	92.01	35.83	9.77	46.41
14	92.02	35.56	9.84	46.61	77	91.90	35.70	9.88	46.33	140	91.90	35.66	9.81	46.43
15	91.92	35.60	9.80	46.52	78	91.71	35.68	9.77	46.25	141	92.20	35.79	9.91	46.49
16	91.66	35.40	9.85	46.41	79	91.93	35.66	9.87	46.40	142	91.45	35.65	9.79	46.01
17	91.60	35.65	9.85	46.10	80	91.88	35.51	9.86	46.51	143	91.91	35.71	9.86	46.35
18	91.98	35.72	9.72	46.54	81	91.96	35.75	9.87	46.34	144	91.97	35.75	9.92	46.29
19	91.64	35.53	9.88	46.23	82	91.75	35.56	9.84	46.35	145	91.87	35.64	9.81	46.42
20	91.98	35.79	9.79	46.41	83	91.95	35.77	9.69	46.49	146	91.55	35.65	9.83	46.06
21	91.86	35.61	9.77	46.48	84	91.89	35.70	9.89	46.30	147	92.07	35.75	9.86	46.46
22	92.38	35.86	9.91	46.61	85	91.69	35.65	9.77	46.28	148	91.88	35.70	9.77	46.40
23	91.95	35.83	9.75	46.38	86	92.27	35.78	9.85	46.64	149	91.61	35.63	9.76	46.21
24	92.09	35.72	9.88	46.49	87	91.83	35.80	9.79	46.24	150	91.76	35.69	9.83	46.24
25	91.78	35.64	9.78	46.35	88	91.59	35.50	9.84	46.26	151	92.02	35.67	9.81	46.54
26	91.88	35.71	9.79	46.38	89	92.00	35.74	9.85	46.41	152	91.78	35.68	9.83	46.27
27	91.69	35.73	9.84	46.12	90	91.68	35.56	9.66	46.46	153	91.89	35.74	9.84	46.31
28	92.15	35.78	9.79	46.58	91	91.98	35.75	9.72	46.50	154	91.55	35.66	9.74	46.15
29	91.55	35.67	9.79	46.09	92	91.83	35.69	9.79	46.35	155	92.17	35.77	9.90	46.50
30	91.93	35.61	9.83	46.49	93	92.22	35.81	9.79	46.63	156	91.67	35.59	9.76	46.32
31	91.40	35.61	9.79	46.00	94	92.04	35.63	9.82	46.59	157	91.90	35.67	9.82	46.41
32	91.94	35.69	9.77	46.47	95	92.04	35.68	9.81	46.55	158	92.17	35.76	9.87	46.54
33	91.92	35.60	9.89	46.43	96	92.00	35.64	9.84	46.53	159	91.84	35.59	9.80	46.45
34	91.82	35.90	9.75	46.18	97	91.68	35.69	9.69	46.29	160	92.01	35.74	9.85	46.42
35	91.85	35.68	9.77	46.40	98	91.82	35.69	9.83	46.29	161	92.00	35.74	9.72	46.54
36	91.78	35.79	9.80	46.20	99	91.99	35.67	9.83	46.49	162	91.84	35.63	9.86	46.35
37	92.29	35.82	9.92	46.55	100	92.14	35.75	9.94	46.46	163	92.08	35.83	9.91	46.34
38	91.72	35.61	9.89	46.22	101	92.42	35.92	9.97	46.53	164	92.10	35.63	9.89	46.58
39	92.15	35.74	9.78	46.63	102	91.82	35.70	9.83	46.29	165	92.02	35.72	9.83	46.47
40	91.62	35.63	9.73	46.27	103	91.76	35.57	9.83	46.37	166	91.75	35.55	9.81	46.39
41	91.76	35.72	9.77	46.27	104	91.33	35.41	9.78	46.14	167	91.77	35.54	9.88	46.34
42	91.99	35.80	9.82	46.37	105	92.07	35.72	9.91	46.45	168	91.78	35.74	9.82	46.22
43	91.69	35.65	9.75	46.29	106	92.10	35.67	9.73	46.71	169	91.78	35.64	9.67	46.46
44	92.33	35.71	9.86	46.76	107	91.62	35.59	9.73	46.31	170	92.09	35.69	9.87	46.53
45	92.11	35.68	9.83	46.59	108	91.72	35.62	9.86	46.24	171	91.55	35.61	9.73	46.21
46	92.08	35.59	9.81	46.68	109	92.14	35.81	9.74	46.60	172	92.23	35.78	9.75	46.70
47	91.73	35.65	9.75	46.32	110	91.91	35.60	9.80	46.52	173	91.50	35.61	9.71	46.18
48	91.76	35.72	9.75	46.28	111	92.08	35.79	9.78	46.51	174	91.90	36.00	9.72	46.17
49	91.73	35.66	9.82	46.24	112	91.69	35.59	9.84	46.26	175	91.93	35.56	9.80	46.56
50	91.69	35.55	9.83	46.31	113	92.03	35.76	9.94	46.34	176	91.88	35.74	9.84	46.30
51	92.25	35.66	9.84	46.75	114	91.74	35.71	9.89	46.14	177	92.02	35.73	9.84	46.44
52	91.98	35.70	9.84	46.45	115	91.86	35.72	9.79	46.35	178	92.15	35.79	9.85	46.51
53	92.03	35.73	9.83	46.48	116	91.86	35.59	9.77	46.50	179	91.71	35.79	9.78	46.15
54	92.13	35.85	9.85	46.44	117	91.89	35.73	9.76	46.41	180	91.56	35.53	9.80	46.23
55	91.74	35.57	9.84	46.33	118	91.88	35.49	9.75	46.65	181	91.72	35.62	9.78	46.32
56	92.07	35.77	9.95	46.35	119	92.37	35.70	9.88	46.79	182	92.00	35.75	9.90	46.35
57	91.95	35.76	9.84	46.34	120	92.03	35.77	9.78	46.49					
58	91.85	35.75	9.79	46.31	121	91.76	35.66	9.91	46.20					
59	91.99	35.71	9.81	46.47	122	92.10	35.77	9.80	46.53					
60	91.99	35.73	9.81	46.45	123	92.32	35.83	9.78	46.71					
61	91.99	35.76	9.84	46.39	124	91.90	35.65	9.78	46.47					
62	91.92	35.67	9.76	46.48	125	91.85	35.62	9.80	46.43					

Sustainability – Data Rate Distribution Graph

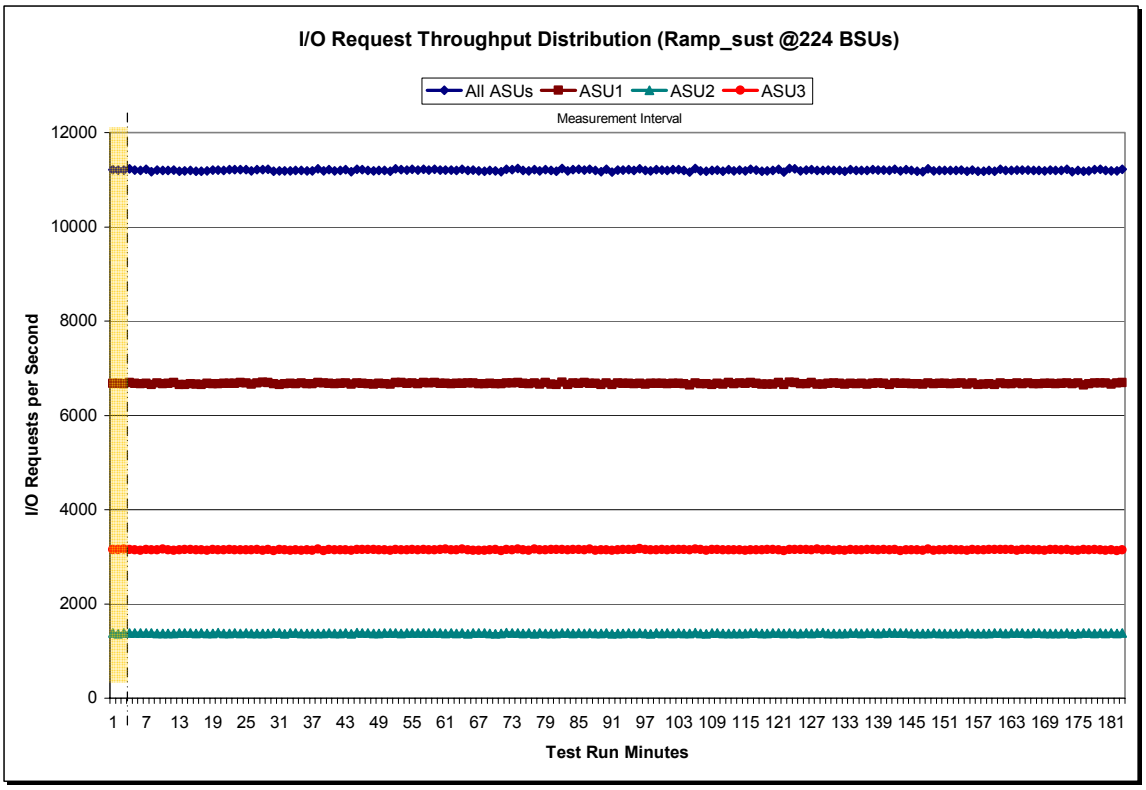


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	10:44:30	10:47:30	0-2	0:03:00
Measurement Interval	10:47:30	13:47:30	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	11,215.92	6,680.55	1,379.98	3,155.38	63	11,218.77	6,679.42	1,381.55	3,157.80	126	11,216.08	6,695.15	1,376.95	3,143.98
1	11,205.23	6,682.30	1,367.33	3,155.60	64	11,196.90	6,685.65	1,368.25	3,143.00	127	11,197.67	6,659.37	1,378.65	3,159.65
2	11,206.98	6,668.00	1,379.82	3,159.17	65	11,206.78	6,683.08	1,383.92	3,139.78	128	11,192.93	6,660.07	1,387.35	3,145.52
3	11,229.50	6,696.35	1,383.38	3,149.77	66	11,190.20	6,672.90	1,381.33	3,135.97	129	11,201.02	6,676.50	1,372.57	3,151.95
4	11,201.48	6,676.22	1,382.45	3,142.82	67	11,181.37	6,668.23	1,378.27	3,134.87	130	11,197.97	6,683.50	1,376.73	3,137.73
5	11,194.30	6,673.40	1,381.45	3,139.45	68	11,199.25	6,681.73	1,370.07	3,147.45	131	11,199.82	6,681.65	1,371.77	3,146.40
6	11,218.77	6,681.98	1,383.50	3,153.28	69	11,191.90	6,668.42	1,367.42	3,156.07	132	11,179.53	6,664.72	1,376.27	3,138.55
7	11,174.48	6,653.85	1,378.40	3,142.23	70	11,166.83	6,665.88	1,370.65	3,130.30	133	11,214.08	6,676.63	1,380.37	3,157.08
8	11,201.12	6,689.47	1,369.88	3,141.77	71	11,222.87	6,684.97	1,388.72	3,149.18	134	11,197.60	6,671.68	1,380.30	3,145.62
9	11,200.65	6,666.98	1,373.87	3,159.80	72	11,215.27	6,683.20	1,384.23	3,147.83	135	11,196.30	6,678.35	1,370.67	3,147.28
10	11,192.53	6,674.77	1,372.87	3,144.90	73	11,241.33	6,699.68	1,379.57	3,162.08	136	11,193.82	6,661.22	1,383.47	3,149.13
11	11,206.30	6,697.83	1,376.58	3,131.88	74	11,195.47	6,681.87	1,369.87	3,143.73	137	11,212.75	6,677.37	1,383.88	3,151.50
12	11,175.17	6,648.83	1,384.35	3,141.98	75	11,184.33	6,665.43	1,381.75	3,137.15	138	11,204.03	6,683.33	1,374.52	3,146.18
13	11,185.17	6,654.95	1,377.98	3,152.23	76	11,215.50	6,684.45	1,367.88	3,163.17	139	11,206.70	6,676.62	1,378.13	3,151.95
14	11,199.53	6,665.37	1,380.30	3,153.87	77	11,184.80	6,662.18	1,378.12	3,144.50	140	11,192.55	6,656.50	1,388.65	3,147.40
15	11,181.70	6,658.90	1,375.03	3,147.77	78	11,213.42	6,692.28	1,376.70	3,144.43	141	11,223.50	6,683.95	1,382.42	3,157.13
16	11,183.13	6,656.40	1,381.57	3,145.17	79	11,196.58	6,664.40	1,377.35	3,154.83	142	11,183.68	6,674.78	1,382.52	3,126.38
17	11,188.80	6,675.92	1,376.50	3,136.38	80	11,181.23	6,653.82	1,372.42	3,155.00	143	11,210.85	6,681.25	1,383.77	3,145.83
18	11,201.27	6,671.95	1,377.28	3,152.03	81	11,236.15	6,702.55	1,382.87	3,150.73	144	11,192.27	6,673.17	1,377.62	3,141.48
19	11,206.38	6,672.55	1,388.33	3,145.50	82	11,184.32	6,651.60	1,384.03	3,148.68	145	11,179.63	6,666.83	1,369.40	3,143.40
20	11,197.45	6,681.57	1,371.22	3,144.67	83	11,213.90	6,686.73	1,376.18	3,150.98	146	11,172.70	6,658.45	1,376.52	3,137.73
21	11,209.75	6,678.85	1,373.93	3,156.97	84	11,218.58	6,675.17	1,386.45	3,156.97	147	11,228.10	6,690.27	1,376.38	3,161.45
22	11,213.62	6,680.55	1,384.25	3,148.82	85	11,206.80	6,693.57	1,369.57	3,143.67	148	11,186.02	6,667.45	1,380.43	3,138.13
23	11,213.83	6,696.77	1,374.43	3,142.63	86	11,220.00	6,677.20	1,379.32	3,163.48	149	11,196.87	6,676.33	1,374.87	3,145.67
24	11,211.40	6,684.02	1,379.30	3,148.08	87	11,194.62	6,676.35	1,377.92	3,140.35	150	11,197.00	6,679.83	1,373.65	3,143.52
25	11,184.48	6,663.47	1,375.83	3,145.18	88	11,170.22	6,655.63	1,373.60	3,140.98	151	11,195.22	6,665.32	1,374.98	3,154.92
26	11,209.98	6,683.32	1,375.85	3,150.82	89	11,218.57	6,686.55	1,385.78	3,146.23	152	11,199.45	6,673.90	1,376.87	3,148.68
27	11,215.07	6,703.37	1,375.63	3,136.07	90	11,158.55	6,654.93	1,366.73	3,136.88	153	11,203.45	6,685.42	1,376.20	3,141.83
28	11,223.72	6,698.02	1,373.05	3,152.65	91	11,205.03	6,686.60	1,373.57	3,144.87	154	11,180.63	6,664.03	1,379.57	3,137.03
29	11,183.33	6,670.18	1,381.72	3,131.43	92	11,206.47	6,674.88	1,374.40	3,157.18	155	11,208.82	6,684.07	1,373.73	3,151.02
30	11,185.72	6,653.97	1,380.08	3,151.67	93	11,212.70	6,680.22	1,380.73	3,151.75	156	11,176.98	6,654.63	1,375.32	3,147.03
31	11,185.28	6,672.90	1,369.23	3,143.15	94	11,192.73	6,666.97	1,375.88	3,149.88	157	11,179.53	6,656.78	1,376.50	3,146.25
32	11,189.77	6,674.53	1,378.28	3,136.95	95	11,230.30	6,679.30	1,382.38	3,168.62	158	11,198.97	6,672.42	1,377.08	3,149.47
33	11,200.33	6,668.58	1,382.98	3,148.77	96	11,197.17	6,664.92	1,376.35	3,155.90	159	11,176.78	6,648.37	1,378.42	3,150.00
34	11,194.17	6,688.03	1,372.88	3,133.25	97	11,186.75	6,674.32	1,366.75	3,145.68	160	11,225.85	6,689.08	1,379.65	3,157.12
35	11,187.37	6,665.30	1,374.73	3,147.33	98	11,211.12	6,679.82	1,386.43	3,144.87	161	11,198.72	6,670.22	1,373.70	3,154.80
36	11,189.12	6,671.72	1,377.10	3,140.30	99	11,202.45	6,674.40	1,375.80	3,152.25	162	11,197.68	6,666.83	1,380.95	3,149.90
37	11,232.27	6,699.42	1,374.60	3,158.25	100	11,198.92	6,670.00	1,386.07	3,142.85	163	11,202.65	6,686.50	1,379.33	3,136.82
38	11,189.08	6,686.40	1,374.52	3,128.17	101	11,214.03	6,682.43	1,377.50	3,154.10	164	11,206.75	6,669.47	1,385.02	3,152.27
39	11,215.12	6,678.85	1,381.38	3,154.88	102	11,217.33	6,681.02	1,383.48	3,152.83	165	11,209.30	6,683.47	1,372.45	3,153.38
40	11,188.62	6,670.85	1,372.32	3,145.45	103	11,193.80	6,665.32	1,377.52	3,150.97	166	11,193.50	6,667.70	1,379.02	3,146.78
41	11,196.25	6,674.83	1,376.97	3,144.45	104	11,160.05	6,644.62	1,369.73	3,145.70	167	11,198.47	6,670.23	1,380.50	3,147.73
42	11,215.58	6,688.67	1,381.73	3,145.18	105	11,238.83	6,687.23	1,392.23	3,159.37	168	11,190.03	6,676.72	1,373.28	3,140.03
43	11,173.23	6,665.18	1,368.13	3,139.92	106	11,189.87	6,665.60	1,370.92	3,153.35	169	11,205.88	6,681.58	1,370.10	3,154.20
44	11,222.98	6,684.17	1,386.77	3,152.05	107	11,175.57	6,670.55	1,365.50	3,139.52	170	11,199.93	6,671.17	1,374.30	3,154.47
45	11,212.35	6,675.72	1,380.88	3,155.75	108	11,194.47	6,656.37	1,386.13	3,151.97	171	11,194.32	6,677.88	1,375.53	3,140.90
46	11,193.82	6,665.82	1,378.58	3,149.42	109	11,204.42	6,673.93	1,380.23	3,150.25	172	11,222.90	6,686.55	1,379.85	3,156.50
47	11,188.00	6,661.88	1,370.72	3,155.40	110	11,181.17	6,658.93	1,373.68	3,148.55	173	11,172.95	6,666.50	1,369.28	3,137.17
48	11,195.50	6,676.57	1,377.18	3,141.75	111	11,210.12	6,691.25	1,374.68	3,144.18	174	11,199.37	6,686.33	1,377.05	3,135.98
49	11,200.60	6,673.13	1,381.72	3,145.75	112	11,188.38	6,668.23	1,373.98	3,146.17	175	11,180.68	6,647.83	1,381.37	3,151.48
50	11,176.80	6,657.48	1,380.82	3,138.50	113	11,208.05	6,684.50	1,377.78	3,145.77	176	11,191.05	6,667.33	1,379.43	3,144.28
51	11,232.80	6,692.33	1,382.83	3,157.63	114	11,188.07	6,676.03	1,377.80	3,134.23	177	11,216.43	6,685.83	1,376.93	3,153.67
52	11,215.78	6,692.80	1,375.98	3,147.00	115	11,222.78	6,692.20	1,383.35	3,147.23	178	11,222.43	6,689.50	1,386.37	3,146.57
53	11,205.62	6,677.25	1,381.35	3,147.02	116	11,201.07	6,673.88	1,382.02	3,145.17	179	11,195.98	6,686.73	1,375.40	3,133.85
54	11,221.47	6,690.35	1,381.72	3,149.40	117	11,178.73	6,658.82	1,372.98	3,146.93	180	11,188.60	6,662.00	1,382.67	3,143.93
55	11,202.68	6,673.12	1,383.23	3,146.33	118	11,189.40	6,662.28	1,373.03	3,154.08	181	11,191.07	6,687.07	1,374.77	3,129.23
56	11,226.70	6,691.67	1,381.88	3,153.15	119	11,197.48	6,663.98	1,383.03	3,150.47	182	11,220.15	6,692.55	1,379.67	3,147.93
57	11,207.85	6,684.88	1,379.47	3,143.50	120	11,221.42	6,698.85	1,378.28	3,144.28	Average	11,200.37	6,675.42	1,377.75	3,147.21
58	11,219.32	6,695.70	1,378.77	3,144.85	121	11,157.95	6,654.15	1,376.57	3,127.23					
59	11,208.15	6,674.07	1,379.60	3,154.48	122	11,243.13	6,701.65	1,385.50	3,155.98					
60	11,205.75	6,675.95	1,370.47	3,159.33	123	11,234.42	6,699.38	1,377.95	3,157.08					
61	11,201.32	6,671.37	1,382.00	3,147.95	124	11,190.77	6,667.27	1,370.73	3,152.77					
62	11,195.83	6,677.33	1,371.47	3,147.03	125	11,201.67	6,672.48	1,378.35	3,150.83					

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	0.006	0.002	0.005	0.002	0.009	0.004	0.006	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.*

Primary Metrics Test – 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 t 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 following script containing SPC-1 Workload Generator input parameters was used for the Sustainability, IOPS, and Response Time Ramp Test Runs :

```
java –Xmx512m –Xss1024k metrics –b 224
```

IOPS Test Results File

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

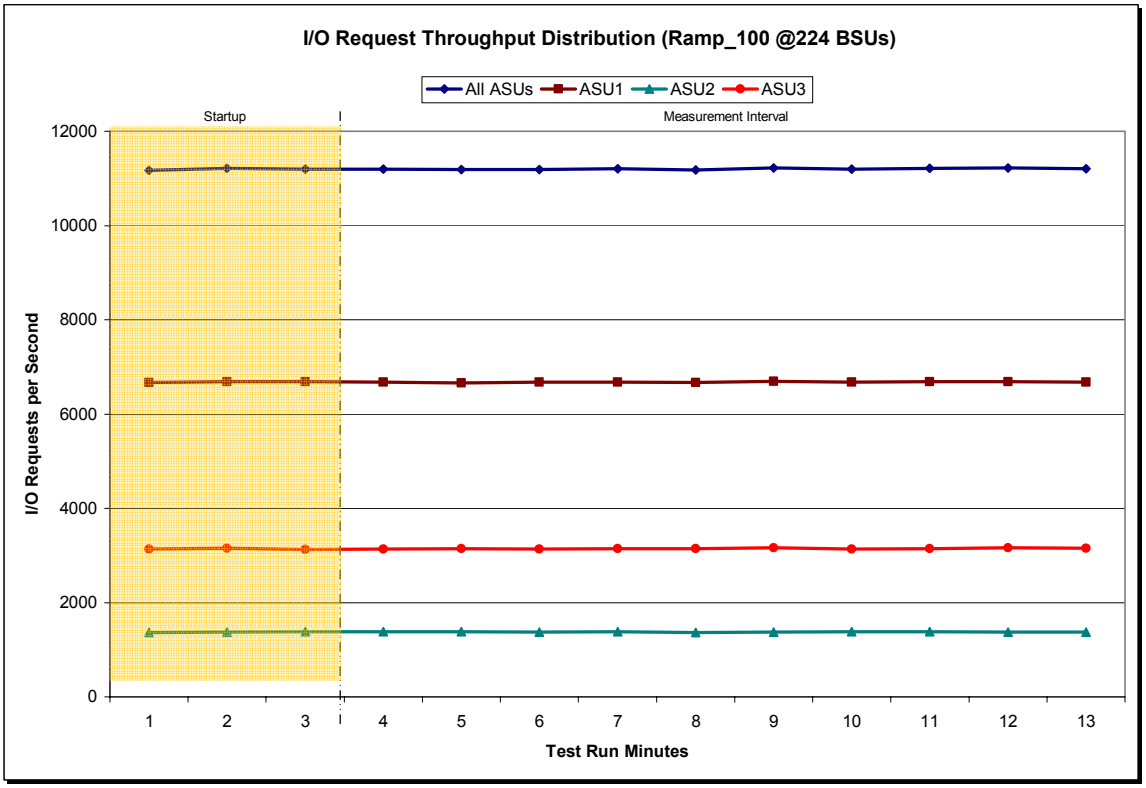
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:47:39	13:50:40	0-2	0:03:01
Measurement Interval	13:50:40	14:00:40	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	11,174.18	6,669.23	1,369.28	3,135.67
1	11,209.95	6,687.40	1,371.90	3,150.65
2	11,200.83	6,688.93	1,384.28	3,127.62
3	11,194.83	6,676.30	1,379.97	3,138.57
4	11,187.35	6,660.60	1,381.22	3,145.53
5	11,191.20	6,676.63	1,375.78	3,138.78
6	11,203.00	6,679.57	1,380.23	3,143.20
7	11,180.98	6,666.18	1,367.63	3,147.17
8	11,224.50	6,691.28	1,373.63	3,159.58
9	11,200.32	6,677.75	1,383.57	3,139.00
10	11,209.78	6,685.15	1,383.63	3,141.00
11	11,221.78	6,685.07	1,377.83	3,158.88
12	11,200.93	6,679.28	1,369.35	3,152.30
Average	11,201.47	6,677.78	1,377.29	3,146.40

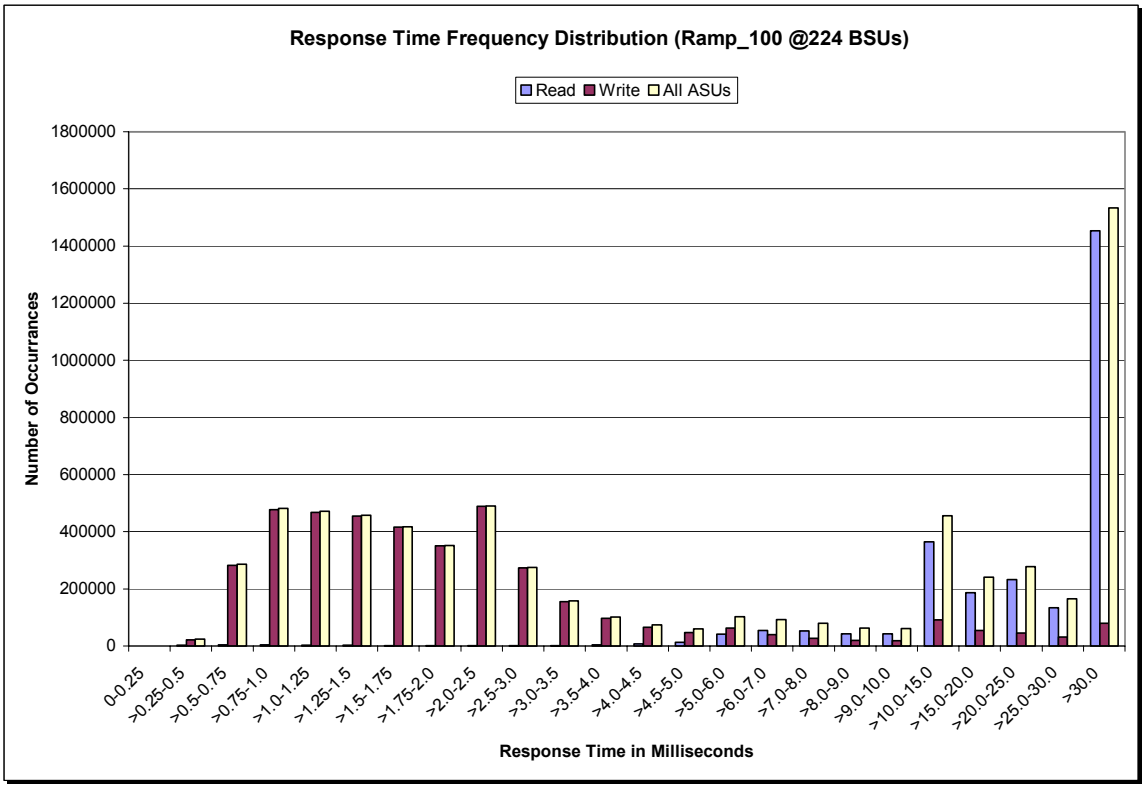
IOPS Test Run – I/O Request Throughput Distribution Graph



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	2	2,868	4,665	4,211	3,361	2,375	1,608	942
Write	0	21,047	282,177	477,808	468,022	454,724	415,507	350,778
All ASUs	2	23,915	286,842	482,019	471,383	457,099	417,115	351,720
ASU1	1	14,391	152,795	240,144	225,894	214,910	191,850	156,247
ASU2	1	2,733	35,083	55,836	51,706	49,753	44,194	36,285
ASU3	0	6,791	98,964	186,039	193,783	192,436	181,071	159,188
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	1,289	1,225	1,956	3,993	7,650	12,456	40,657	53,739
Write	489,034	273,703	155,587	96,870	65,761	47,271	62,451	39,454
All ASUs	490,323	274,928	157,543	100,863	73,411	59,727	103,108	93,193
ASU1	204,447	100,618	50,113	29,984	23,723	23,627	56,039	63,532
ASU2	47,526	22,852	11,042	5,928	3,889	3,134	5,812	6,498
ASU3	238,350	151,458	96,388	64,951	45,799	32,966	41,257	23,163
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	53,065	42,839	42,080	364,521	186,421	232,076	133,395	1,453,643
Write	27,332	20,115	18,597	91,609	54,428	45,969	31,373	79,975
All ASUs	80,397	62,954	60,677	456,130	240,849	278,045	164,768	1,533,618
ASU1	59,489	47,266	46,233	368,160	189,434	225,260	130,496	1,191,838
ASU2	6,270	5,361	4,902	42,499	25,145	30,893	19,347	309,612
ASU3	14,638	10,327	9,542	45,471	26,270	21,892	14,925	32,168

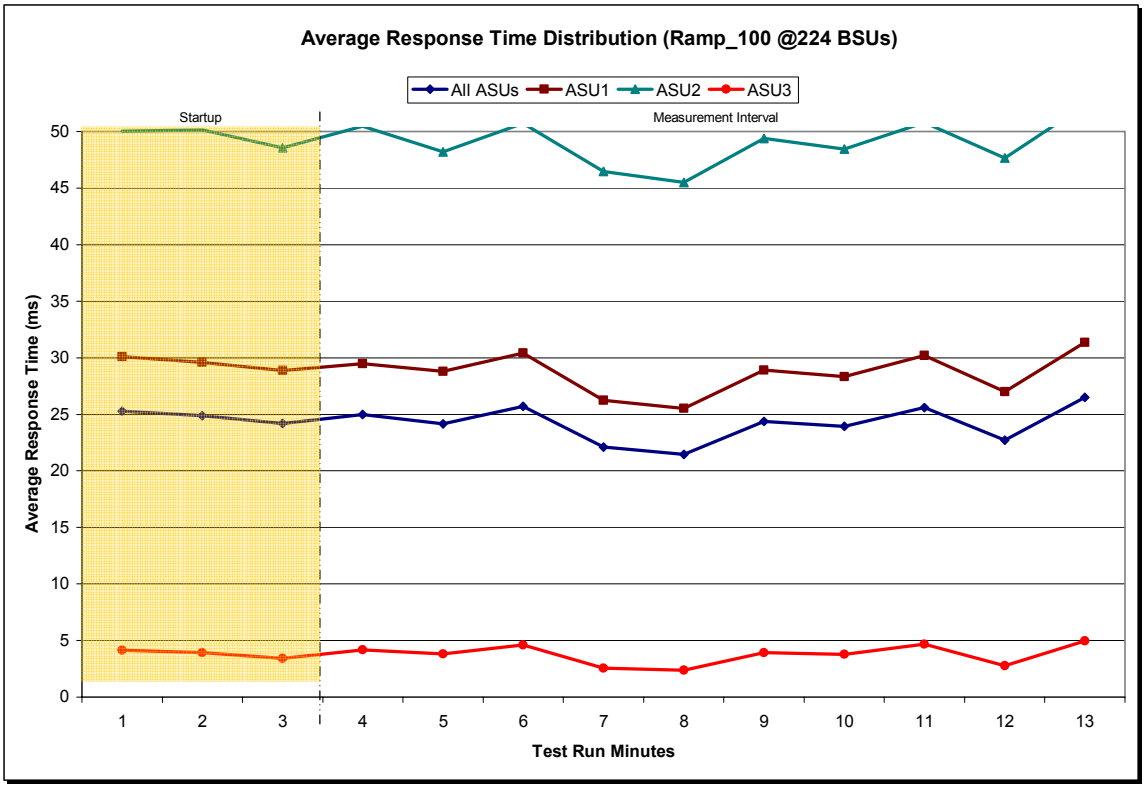
IOPS Test Run –Response Time Frequency Distribution Graph



IOPS Test Run – Average Response Time (ms) Distribution Data

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:47:39	13:50:40	0-2	0:03:01
Measurement Interval	13:50:40	14:00:40	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	25.26	30.11	50.03	4.14
1	24.89	29.59	50.13	3.92
2	24.20	28.88	48.54	3.43
3	24.98	29.48	50.48	4.18
4	24.17	28.80	48.20	3.81
5	25.69	30.43	50.73	4.62
6	22.10	26.26	46.46	2.56
7	21.45	25.52	45.49	2.36
8	24.38	28.91	49.37	3.92
9	23.93	28.32	48.46	3.78
10	25.59	30.20	50.78	4.68
11	22.71	27.00	47.65	2.76
12	26.50	31.36	52.35	4.98
Average	24.15	28.63	49.00	3.76

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
6,720,629	5,187,011	1,533,618

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	0.2812	0.0700	0.2098	0.0181	0.0699	0.0350	0.2809
COV	0.006	0.001	0.006	0.002	0.008	0.005	0.006	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.*

Primary Metrics Test – 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 following script containing SPC-1 Workload Generator input parameters was used for the Sustainability, IOPS, and Response Time Ramp Test Runs :

```
java –Xmx512m –Xss1024k metrics –b 224
```

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 - 224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	13:47:39	13:50:40	0-2	0:03:01
Measurement Interval	13:50:40	14:00:40	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	11,174.18	6,669.23	1,369.28	3,135.67
1	11,209.95	6,687.40	1,371.90	3,150.65
2	11,200.83	6,688.93	1,384.28	3,127.62
3	11,194.83	6,676.30	1,379.97	3,138.57
4	11,187.35	6,660.60	1,381.22	3,145.53
5	11,191.20	6,676.63	1,375.78	3,138.78
6	11,203.00	6,679.57	1,380.23	3,143.20
7	11,180.98	6,666.18	1,367.63	3,147.17
8	11,224.50	6,691.28	1,373.63	3,159.58
9	11,200.32	6,677.75	1,383.57	3,139.00
10	11,209.78	6,685.15	1,383.63	3,141.00
11	11,221.78	6,685.07	1,377.83	3,158.88
12	11,200.93	6,679.28	1,369.35	3,152.30
Average	11,201.47	6,677.78	1,377.29	3,146.40

95% Load Level - 212 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:00:45	14:03:46	0-2	0:03:01
Measurement Interval	14:03:46	14:13:46	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	10,610.52	6,322.88	1,302.92	2,984.72
1	10,599.43	6,317.98	1,306.28	2,975.17
2	10,610.05	6,308.87	1,308.08	2,993.10
3	10,608.75	6,312.28	1,315.58	2,980.88
4	10,597.60	6,321.75	1,301.37	2,974.48
5	10,616.53	6,319.20	1,306.32	2,991.02
6	10,614.28	6,323.67	1,310.55	2,980.07
7	10,606.50	6,324.98	1,297.70	2,983.82
8	10,585.15	6,321.30	1,305.83	2,958.02
9	10,635.08	6,343.75	1,303.70	2,987.63
10	10,597.90	6,314.87	1,303.42	2,979.62
11	10,603.12	6,338.25	1,301.58	2,963.28
12	10,621.57	6,324.28	1,311.82	2,985.47
Average	10,608.65	6,324.43	1,305.79	2,978.43

90% Load Level - 201 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:13:51	14:16:52	0-2	0:03:01
Measurement Interval	14:16:52	14:26:52	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	10,041.22	5,983.47	1,239.25	2,818.50
1	10,057.83	5,996.55	1,236.32	2,824.97
2	10,040.38	5,991.43	1,232.87	2,816.08
3	10,047.58	5,982.08	1,236.47	2,829.03
4	10,038.27	5,981.22	1,237.63	2,819.42
5	10,049.10	5,982.23	1,233.25	2,833.62
6	10,043.55	5,994.25	1,234.10	2,815.20
7	10,050.20	5,987.72	1,236.67	2,825.82
8	10,057.97	5,996.47	1,241.30	2,820.20
9	10,059.70	5,998.97	1,230.33	2,830.40
10	10,044.28	5,988.18	1,237.40	2,818.70
11	10,062.82	5,985.35	1,247.55	2,829.92
12	10,068.22	5,999.60	1,233.33	2,835.28
Average	10,052.17	5,989.61	1,236.80	2,825.76

80% Load Level - 179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:26:57	14:29:58	0-2	0:03:01
Measurement Interval	14:29:58	14:39:58	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	8,932.52	5,324.25	1,097.97	2,510.30
1	8,949.57	5,331.05	1,105.08	2,513.43
2	8,940.48	5,334.45	1,101.22	2,504.82
3	8,958.82	5,341.20	1,104.83	2,512.78
4	8,944.37	5,325.23	1,098.48	2,520.65
5	8,946.37	5,341.37	1,097.67	2,507.33
6	8,953.83	5,325.75	1,106.37	2,521.72
7	8,946.88	5,327.38	1,097.48	2,522.02
8	8,964.77	5,345.30	1,100.33	2,519.13
9	8,945.20	5,335.37	1,094.45	2,515.38
10	8,961.78	5,344.40	1,097.97	2,519.42
11	8,927.27	5,321.55	1,098.08	2,507.63
12	8,940.25	5,323.42	1,098.72	2,518.12
Average	8,948.95	5,333.10	1,099.44	2,516.42

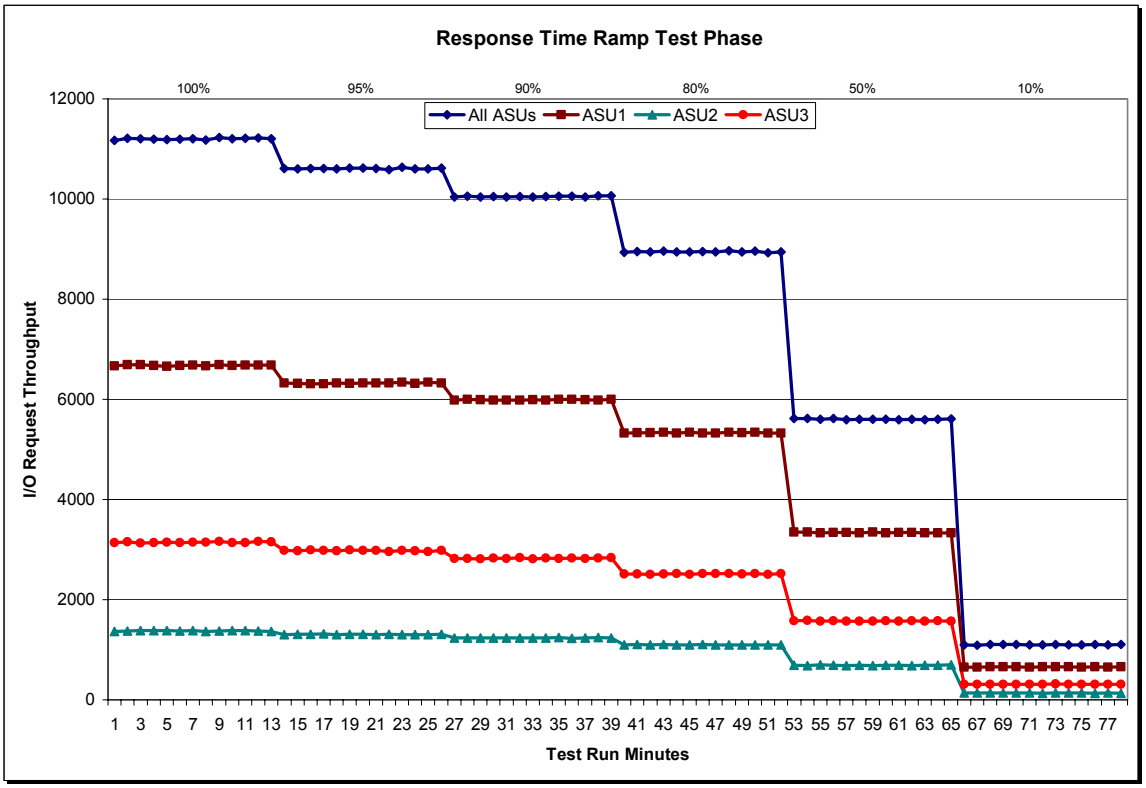
50% Load Level - 112 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:40:03	14:43:04	0-2	0:03:01
Measurement Interval	14:43:04	14:53:04	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	5,617.95	3,352.35	688.55	1,577.05
1	5,614.73	3,346.78	686.62	1,581.33
2	5,599.27	3,336.47	696.48	1,566.32
3	5,614.22	3,344.60	689.58	1,580.03
4	5,589.93	3,338.00	683.02	1,568.92
5	5,601.98	3,336.20	694.32	1,571.47
6	5,605.50	3,349.00	684.27	1,572.23
7	5,599.15	3,332.95	691.40	1,574.80
8	5,596.98	3,338.33	689.68	1,568.97
9	5,604.03	3,343.88	683.95	1,576.20
10	5,591.72	3,332.42	687.40	1,571.90
11	5,605.23	3,336.63	687.95	1,580.65
12	5,607.23	3,335.65	698.83	1,572.75
Average	5,601.60	3,338.77	689.04	1,573.79

10% Load Level - 22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:53:09	14:56:10	0-2	0:03:01
Measurement Interval	14:56:10	15:06:10	3-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	1,099.32	653.98	135.30	310.03
1	1,091.63	649.30	135.05	307.28
2	1,101.98	656.18	137.05	308.75
3	1,107.15	659.75	137.77	309.63
4	1,103.28	656.72	137.00	309.57
5	1,099.20	654.10	136.05	309.05
6	1,094.70	655.02	133.28	306.40
7	1,107.55	660.00	134.18	313.37
8	1,100.75	656.55	134.40	309.80
9	1,098.57	654.00	134.88	309.68
10	1,102.08	657.78	132.43	311.87
11	1,094.85	651.72	135.55	307.58
12	1,101.87	656.33	133.77	311.77
Average	1,101.00	656.20	134.93	309.87

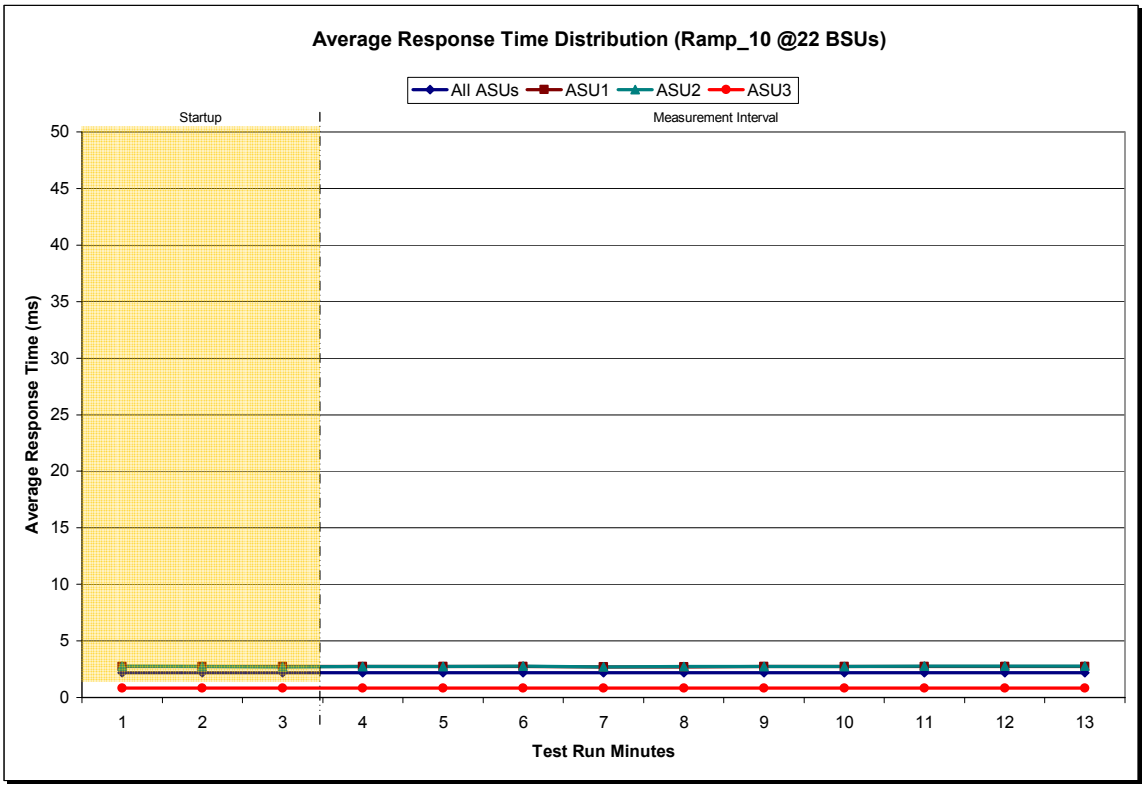
Response Time Ramp Distribution (IOPS) Graph



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

22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:53:09	14:56:10	0-2	0:03:01
Measurement Interval	14:53:09	14:53:09	3-12	0:00:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.21	2.75	2.77	0.83
1	2.20	2.74	2.73	0.82
2	2.20	2.74	2.72	0.83
3	2.21	2.74	2.74	0.83
4	2.19	2.72	2.74	0.83
5	2.21	2.74	2.75	0.82
6	2.18	2.70	2.72	0.83
7	2.18	2.71	2.72	0.83
8	2.20	2.74	2.75	0.82
9	2.19	2.73	2.75	0.83
10	2.20	2.74	2.76	0.83
11	2.20	2.74	2.76	0.83
12	2.21	2.75	2.77	0.83
Average	2.20	2.73	2.75	0.83

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	0.2106	0.0179	0.0697	0.0349	0.2814
COV	0.021	0.007	0.013	0.007	0.028	0.011	0.029	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 following script containing SPC-1 Workload Generator input parameters was used for the Repeatability Test Runs:

```
java –Xmx512m –Xss1024k repeat1 –b 224
java –Xmx512m –Xss1024k repeat2 –b 224
```

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™
Primary Metrics	*11,201.47*	*2.20*
Repeatability Test Phase 1	11,204.76	2.19
Repeatability Test Phase 2	11,203.71	2.20

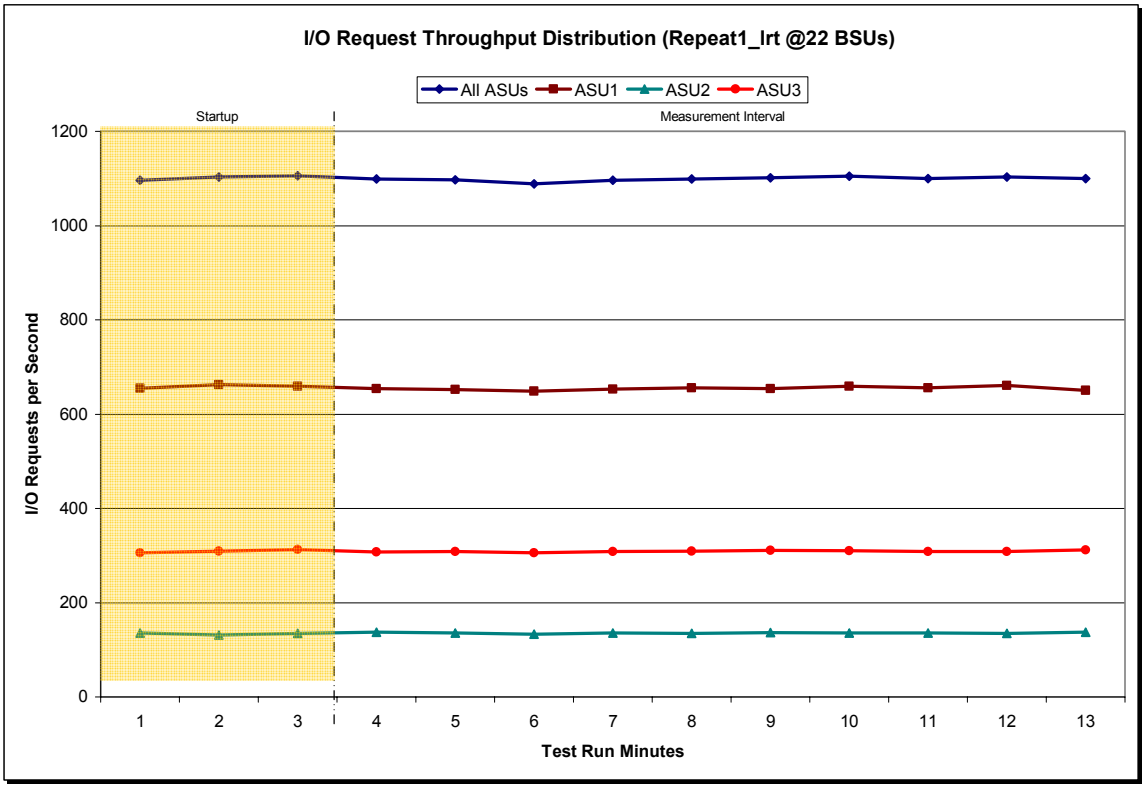
A link to the test result file generated from each Repeatability Test Run list is listed below.

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

22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:06:45	15:09:45	0-2	0:03:00
Measurement Interval	15:09:45	15:19:45	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1,095.97	654.55	135.58	305.83
1	1,103.28	662.72	131.33	309.23
2	1,105.77	658.92	134.35	312.50
3	1,099.27	654.03	137.78	307.45
4	1,096.90	652.55	135.72	308.63
5	1,088.37	648.90	133.28	306.18
6	1,096.63	652.87	135.62	308.15
7	1,098.90	655.45	134.45	309.00
8	1,101.47	653.75	136.42	311.30
9	1,105.02	659.25	135.38	310.38
10	1,099.68	655.68	135.68	308.32
11	1,103.48	660.58	134.67	308.23
12	1,099.68	650.73	137.02	311.93
Average	1,098.94	654.38	135.60	308.96

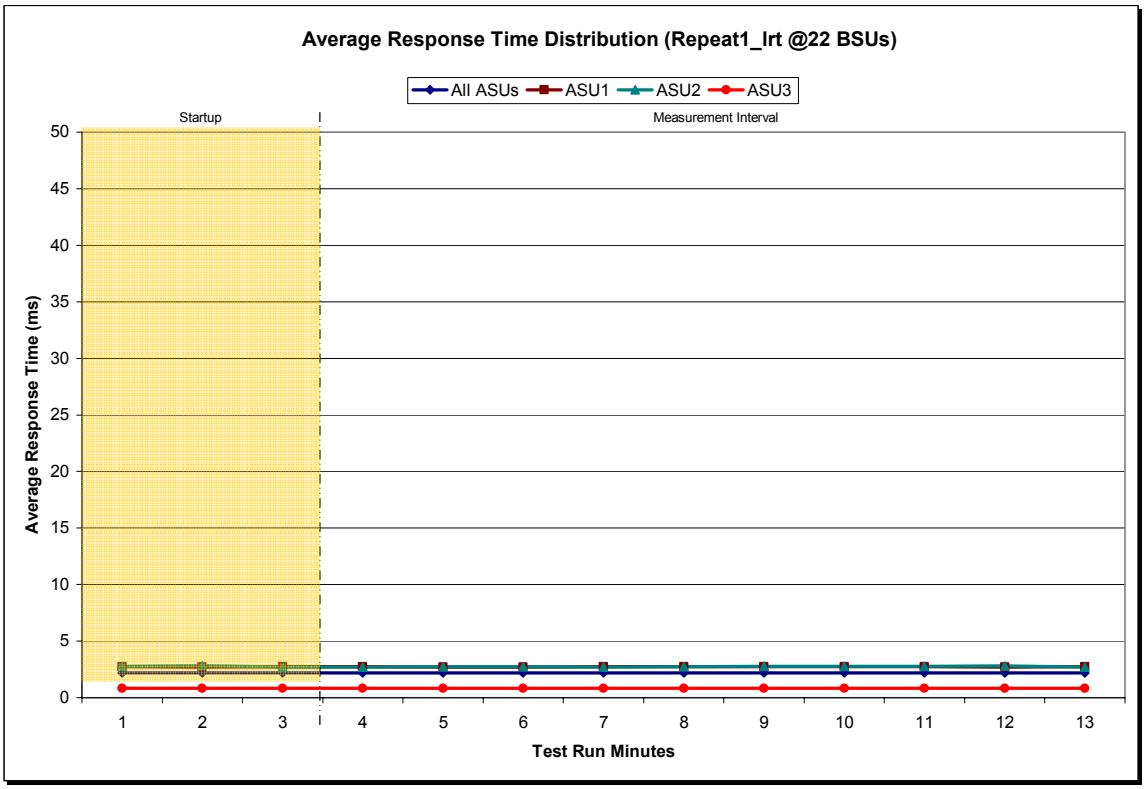
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:06:45	15:09:45	0-2	0:03:00
Measurement Interval	15:09:45	15:19:45	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.21	2.75	2.76	0.82
1	2.19	2.70	2.84	0.82
2	2.20	2.74	2.71	0.83
3	2.19	2.73	2.71	0.83
4	2.18	2.71	2.75	0.82
5	2.18	2.71	2.73	0.82
6	2.18	2.72	2.68	0.82
7	2.20	2.73	2.75	0.83
8	2.21	2.74	2.78	0.83
9	2.20	2.73	2.77	0.83
10	2.21	2.74	2.77	0.83
11	2.20	2.72	2.80	0.83
12	2.18	2.73	2.71	0.83
Average	2.19	2.73	2.74	0.83

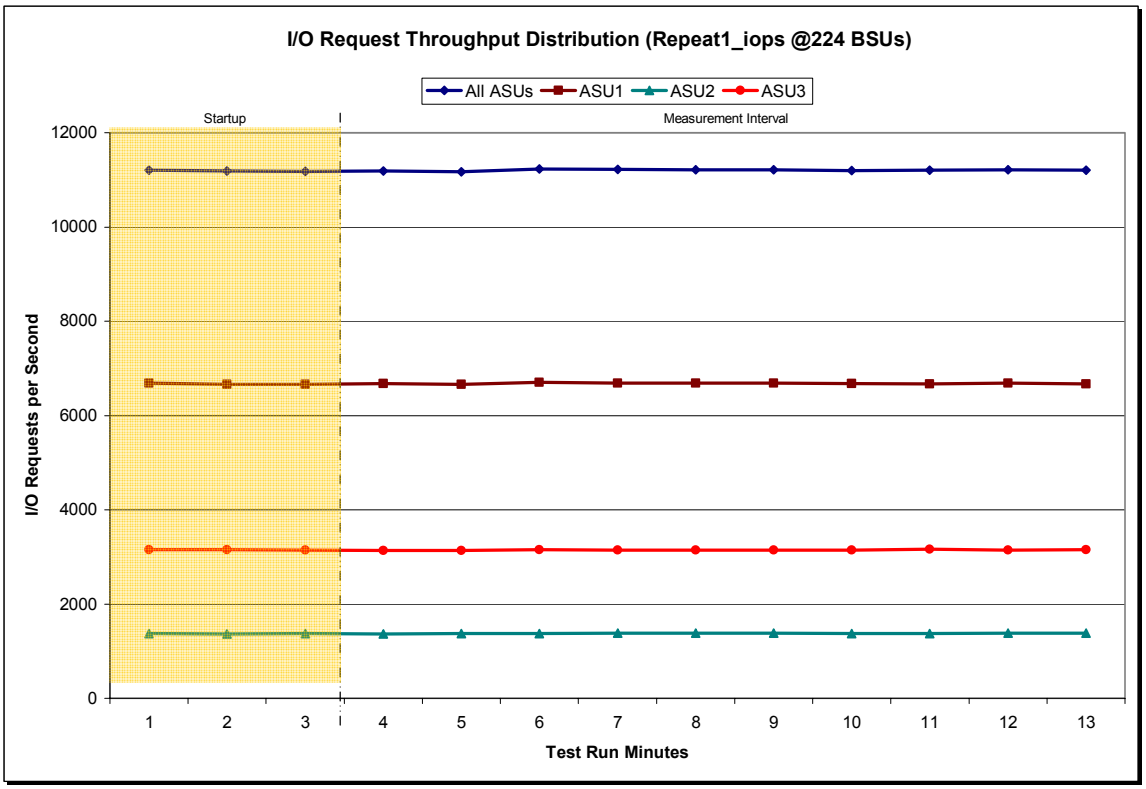
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:19:50	15:22:51	0-2	0:03:01
Measurement Interval	15:22:51	15:32:51	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	11,208.80	6,684.05	1,372.92	3,151.83
1	11,188.90	6,663.42	1,367.95	3,157.53
2	11,183.17	6,662.05	1,376.17	3,144.95
3	11,184.63	6,679.43	1,369.05	3,136.15
4	11,172.85	6,661.52	1,376.37	3,134.97
5	11,228.53	6,704.58	1,372.20	3,151.75
6	11,218.25	6,690.00	1,380.15	3,148.10
7	11,211.57	6,685.07	1,380.80	3,145.70
8	11,211.18	6,682.88	1,383.00	3,145.30
9	11,199.18	6,675.40	1,376.12	3,147.67
10	11,201.48	6,668.35	1,375.23	3,157.90
11	11,210.75	6,683.82	1,383.63	3,143.30
12	11,209.20	6,673.32	1,383.65	3,152.23
Average	11,204.76	6,680.44	1,378.02	3,146.31

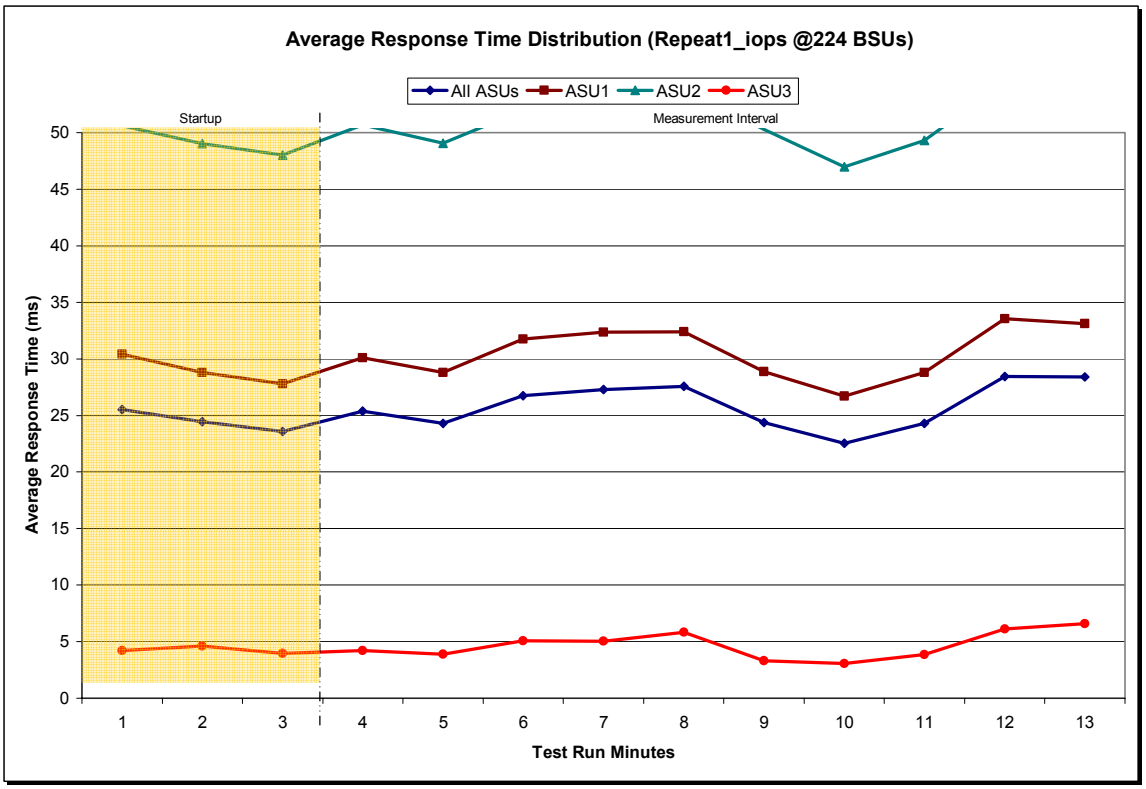
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:19:50	15:22:51	0-2	0:03:01
Measurement Interval	15:22:51	15:32:51	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	25.51	30.41	50.61	4.20
1	24.44	28.79	49.01	4.61
2	23.58	27.80	48.03	3.95
3	25.37	30.11	50.69	4.22
4	24.29	28.78	49.06	3.87
5	26.74	31.75	51.98	5.08
6	27.29	32.36	53.45	5.05
7	27.58	32.39	53.83	5.82
8	24.35	28.88	50.30	3.33
9	22.54	26.70	46.97	3.06
10	24.29	28.80	49.30	3.87
11	28.44	33.55	54.47	6.13
12	28.41	33.11	55.43	6.58
Average	25.93	30.64	51.55	4.70

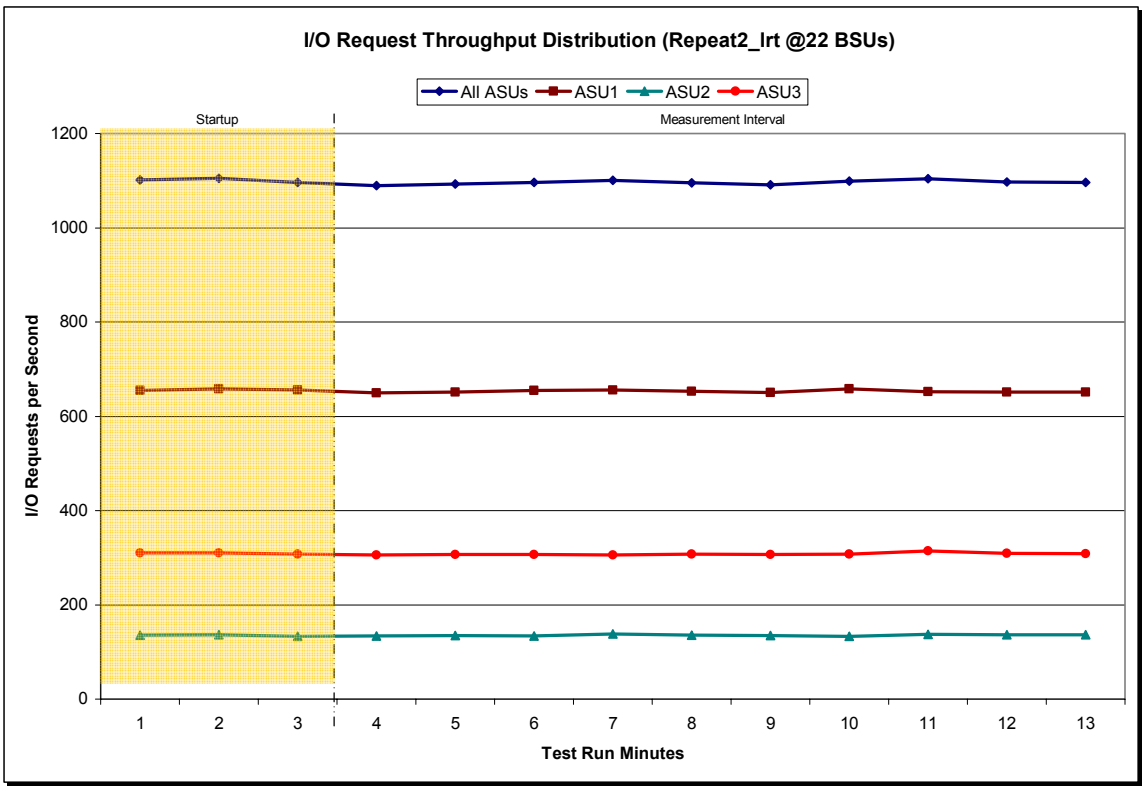
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:35:37	15:38:37	0-2	0:03:00
Measurement Interval	15:38:37	15:48:37	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	1,101.17	654.82	135.80	310.55
1	1,105.08	658.47	136.28	310.33
2	1,096.58	655.80	132.83	307.95
3	1,089.58	650.07	134.05	305.47
4	1,093.30	651.68	135.02	306.60
5	1,096.08	655.23	134.10	306.75
6	1,100.32	655.78	138.50	306.03
7	1,095.87	652.82	135.68	307.37
8	1,091.08	650.25	134.45	306.38
9	1,098.95	658.32	133.38	307.25
10	1,103.90	652.15	137.18	314.57
11	1,096.95	651.68	136.28	308.98
12	1,096.50	651.80	136.62	308.08
Average	1,096.25	652.98	135.53	307.75

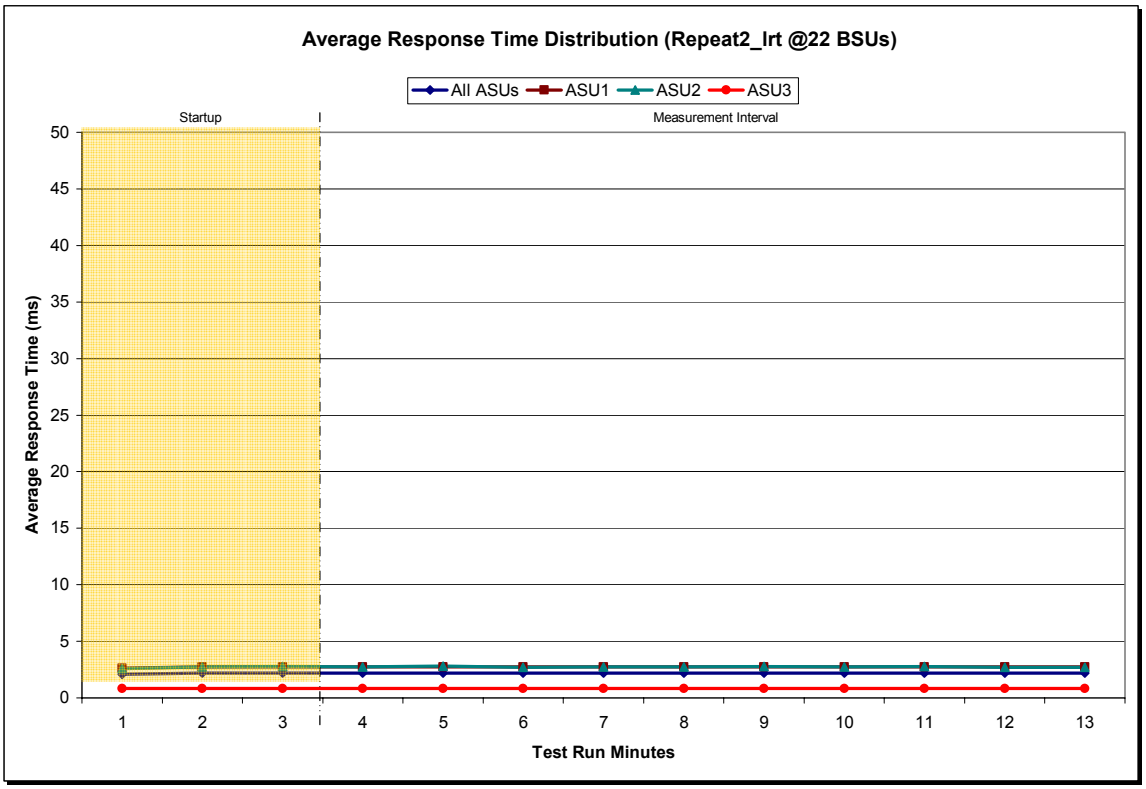
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

22 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:35:37	15:38:37	0-2	0:03:00
Measurement Interval	15:38:37	15:48:37	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.10	2.62	2.58	0.82
1	2.20	2.73	2.73	0.82
2	2.20	2.72	2.77	0.82
3	2.20	2.73	2.74	0.82
4	2.20	2.72	2.80	0.82
5	2.20	2.74	2.71	0.83
6	2.20	2.73	2.75	0.82
7	2.20	2.74	2.73	0.83
8	2.21	2.75	2.77	0.82
9	2.20	2.73	2.72	0.82
10	2.20	2.74	2.76	0.83
11	2.20	2.75	2.71	0.82
12	2.20	2.75	2.70	0.82
Average	2.20	2.74	2.74	0.82

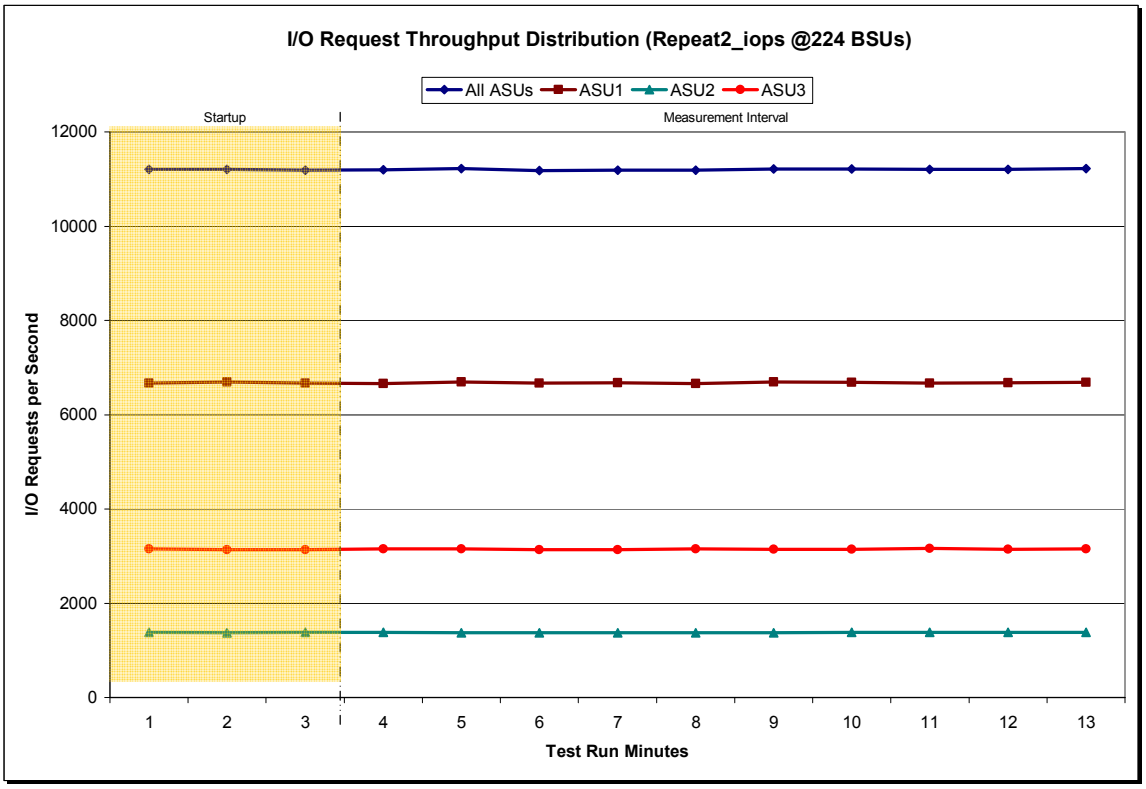
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:48:42	15:51:43	0-2	0:03:01
Measurement Interval	15:51:43	16:01:43	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	11,202.33	6,670.05	1,380.97	3,151.32
1	11,208.93	6,695.48	1,376.97	3,136.48
2	11,191.17	6,673.10	1,380.77	3,137.30
3	11,196.65	6,663.82	1,381.58	3,151.25
4	11,223.70	6,694.87	1,373.08	3,155.75
5	11,181.18	6,669.77	1,373.37	3,138.05
6	11,190.68	6,674.35	1,377.23	3,139.10
7	11,189.53	6,664.07	1,374.90	3,150.57
8	11,215.82	6,695.78	1,373.75	3,146.28
9	11,211.53	6,685.10	1,382.53	3,143.90
10	11,204.00	6,666.77	1,378.95	3,158.28
11	11,201.73	6,678.87	1,381.07	3,141.80
12	11,222.23	6,689.60	1,379.52	3,153.12
Average	11,203.71	6,678.30	1,377.60	3,147.81

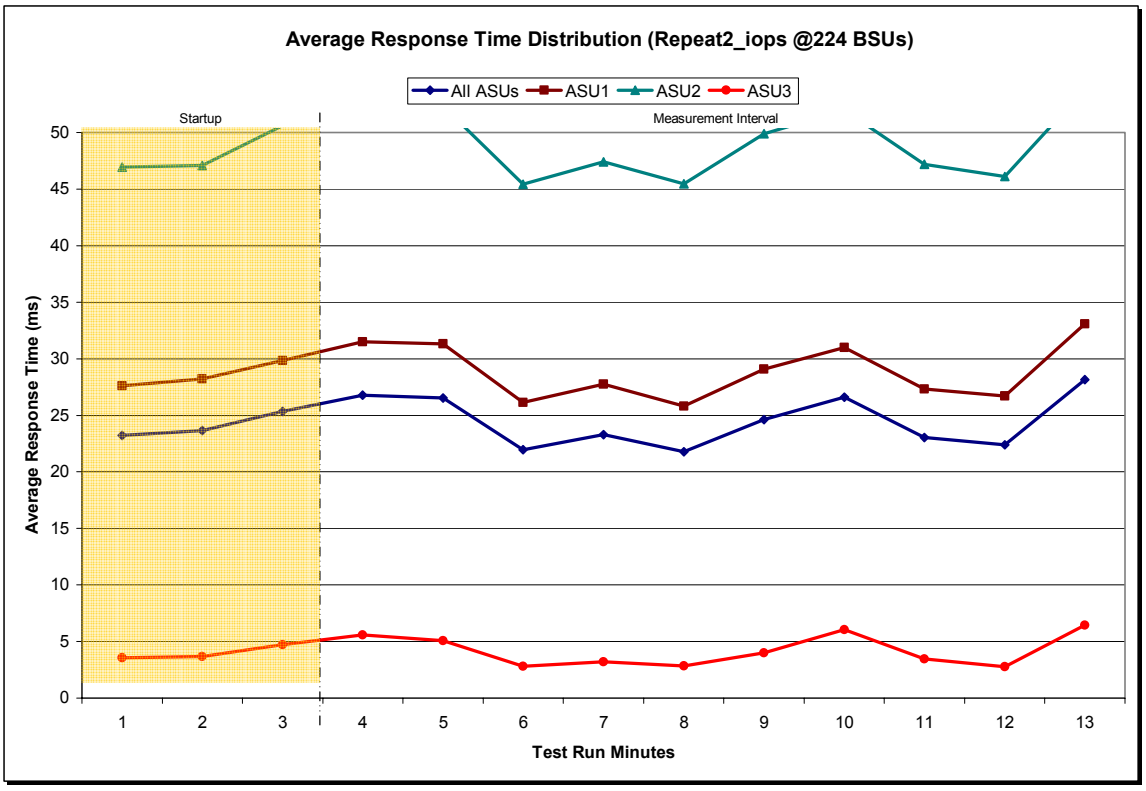
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

224 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:48:42	15:51:43	0-2	0:03:01
Measurement Interval	15:51:43	16:01:43	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	23.22	27.61	46.94	3.55
1	23.66	28.21	47.07	3.68
2	25.36	29.84	50.62	4.70
3	26.79	31.51	52.39	5.57
4	26.51	31.32	52.32	5.08
5	21.97	26.15	45.45	2.80
6	23.28	27.75	47.39	3.19
7	21.77	25.82	45.47	2.86
8	24.60	29.10	49.89	4.00
9	26.60	31.01	51.99	6.05
10	23.04	27.31	47.18	3.47
11	22.40	26.72	46.11	2.79
12	28.14	33.07	53.83	6.43
Average	24.51	28.97	49.20	4.23

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	0.2815	0.0698	0.2090	0.0178	0.0705	0.0351	0.2811
COV	0.024	0.003	0.019	0.007	0.029	0.011	0.028	0.005

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	0.0350	0.2810	0.0700	0.2102	0.0180	0.0700	0.0350	0.2808
COV	0.004	0.001	0.004	0.003	0.006	0.003	0.007	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	0.0347	0.2814	0.0695	0.2100	0.0181	0.0702	0.0353	0.2807
COV	0.025	0.009	0.016	0.009	0.032	0.011	0.016	0.006

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	0.0350	0.2810	0.0701	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.006	0.002	0.004	0.002	0.008	0.006	0.006	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, a table 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 scripts containing SPC-1 Workload Generator input parameters for the Data Persistence Test are listed below:

```
java –Xmx512m –Xss1024k persist1 –b 224

java –Xmx512m –Xss1024k 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

Data Persistence Test Results	
Data Persistence Test Run Number: 1	
Total Number of Logical Blocks Written	28,880,768
Total Number of Logical Blocks Verified	22,220,304
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 Fujitsu Storage Systems ETERNUS3000 Model 100, as documented in this Full Disclosure Report became available for customer purchase and shipment on July 10, 2003.

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 Fujitsu Storage Systems ETERNUS3000 Model 100.

APPENDIX A: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

Solaris Parameter Adjustments

The following settings were made in the Solaris /etc/system control file information for execution of the Workload Generator on the PRIMEPOWER450:

```
*ident "@(#)system       1.18       97/06/27 SMI" /* SVR4 1.5 */
*
* SYSTEM SPECIFICATION FILE
*

* moddir:
*
*       Set the search path for modules.  This has a format similar to the
*       csh path variable. If the module isn't found in the first directory
*       it tries the second and so on. The default is /kernel /usr/kernel
*
*       Example:
*               moddir: /kernel /usr/kernel /other/modules



* root device and root filesystem configuration:
*
*       The following may be used to override the defaults provided by
*       the boot program:
*
*       rootfs:         Set the filesystem type of the root.
*
*       rootdev: Set the root device.  This should be a fully
*                       expanded physical pathname.  The default is the
*                       physical pathname of the device where the boot
*                       program resides.  The physical pathname is
*                       highly platform and configuration dependent.
*
*       Example:
*               rootfs:ufs
*               rootdev:/sbus@1,f8000000/esp@0,800000/sd@3,0:a
*
*       (Swap device configuration should be specified in /etc/vfstab.)



* exclude:
*
*       Modules appearing in the moddir path which are NOT to be loaded,
*       even if referenced. Note that `exclude' accepts either a module name,
*       or a filename which includes the directory.
*
*       Examples:
*               exclude: win
*               exclude: sys/shmsys



* forceload:
*
*       Cause these modules to be loaded at boot time, (just before mounting
```

```
*       the root filesystem) rather than at first reference. Note that
*       forceload expects a filename which includes the directory. Also
*       note that loading a module does not necessarily imply that it will
*       be installed.
*
*       Example:
*               forceload: drv/foo



* set:
*
*       Set an integer variable in the kernel or a module to a new value.
*       This facility should be used with caution.  See system(4).
*
*       Examples:
*
*       To set variables in 'unix':
*
*               set nautopush=32
*               set maxusers=40
*
*       To set a variable named 'debug' in the module named 'test_module'
*
*               set test_module:debug = 0x13

* Begin FJSVssf (do not edit)
set ftrace_atboot = 1
set kmem_flags = 0x100
set kmem_lite_maxalign = 8192
* End FJSVssf (do not edit)
* Begin FJSVpnl (do not edit)
forceload:      drv/FJSVpanel
* End FJSVpnl (do not edit)

* The forceload of drv/clone is required for successful
* IP operation of EMULEX fibre channel drivers lpfc / lpfs
* and for the diagnostics (dfc) interface.
forceload: drv/clone

set hddv:hddv_max_throttle=32
```

Emulex HBA Configuration Parameters

These parameters are set in "lpfc.conf" for controlling the operation of the Emulex Fibre Channel HBAs. The following values have been changed from their default values for accessing the ETERNUS3000 Model 100 Storage System:

```
# Setup FCP persistent bindings,
# fcp-bind-WWPN binds a specific WorldWide PortName to a target id,
# fcp-bind-WWNN binds a specific WorldWide NodeName to a target id,
# fcp-bind-DID binds a specific DID to a target id.
# Only one binding method can be used.
# WWNN, WWPN and DID are hexadecimal values.
# WWNN must be 16 digits with leading 0s.
# WWPN must be 16 digits with leading 0s.
# DID must be 6 digits with leading 0s.
# The SCSI ID to bind to consists of two parts, the lpfc interface
# to bind to, and the target number for that interface.
# Thus lpfc0t2 specifies target 2 on interface lpfc0.
```

```
# NOTE: Target ids, with all luns supported, must also be in sd.conf.
# scan-down must be set to 0 or 1, not 2 which is the default!!
#
# Here are some examples:
#                WWNN             SCSI ID
# fcp-bind-WWNN="2000123456789abc:lpfc1t0",
#               "20000020370c27f7:lpfc0t2";
#
#                WWPN             SCSI ID
# fcp-bind-WWPN="2100123456789abc:lpfc0t0",
#               "21000020370c2855:lpfc0t1",
#               "2100122222222222:lpfc2t2";
#
#                DID   SCSI ID
# fcp-bind-DID="0000ef:lpfc0t3";
# BEGIN: LPUTIL-managed Persistent Bindings
   fcp-bind-WWPN="210000e000a804e4:lpfc0t0",
                 "250000e000a804e4:lpfc1t0";
#   fcp-bind-WWPN="210000000e00000a:lpfc0t5",
#                 "250000000e00000a:lpfc1t6";

# If automap is set, SCSI IDs for all FCP nodes without
# persistent bindings will be automatically generated.
# If new FCP devices are added to the network when the system is down,
# there is no guarantee that these SCSI IDs will remain the same
# when the system is booted again.
# If one of the above fcp binding methods is specified, then automap
# devices will use the same mapping method to preserve
# SCSI IDs between link down and link up.
# If no bindings are specified above, a value of 1 will force WWNN
# binding, 2 for WWPN binding, and 3 for DID binding.
# If automap is 0, only devices with persistent bindings will be
# recognized by the system.
automap=2;

# fcp-on:  true (1) if FCP access is enabled, false (0) if not.
fcp-on=1;

# tgt-queue-depth:  the default value lpfc will use to limit
# the number of outstanding commands per FCP target.  This value is
# global, affecting each target recognized by the driver, but may be
# overridden on a per-target basis (see below). RAID arrays may want
# to be configured using the per-target tunable throttles. A value
# of 0 means don't throttle the target.
tgt-queue-depth=192;

# topology:  link topology for initializing the Fibre Channel connection.
#          0 = attempt loop mode, if it fails attempt point-to-point mode
#          2 = attempt point-to-point mode only
#          4 = attempt loop mode only
#          6 = attempt point-to-point mode, if it fails attempt loop mode
# Set point-to-point mode if you want to run as an N_Port.
# Set loop mode if you want to run as an NL_Port.
topology=0;
```

APPENDIX B: TESTED STORAGE CONFIGURATION (TSC) CREATION

Entries in "sd.conf"

The following entries in sd.conf were defined to enable the Emulex HBAs for accessing the LUNs defined in the ETERNUS3000 Model 100.

```
name="sd" parent="lpfc" target=0 lun=0;
name="sd" parent="lpfc" target=0 lun=1;
name="sd" parent="lpfc" target=0 lun=2;
name="sd" parent="lpfc" target=0 lun=3;
name="sd" parent="lpfc" target=0 lun=4;
name="sd" parent="lpfc" target=0 lun=5;
name="sd" parent="lpfc" target=0 lun=6;
name="sd" parent="lpfc" target=0 lun=7;
name="sd" parent="lpfc" target=0 lun=8;
name="sd" parent="lpfc" target=0 lun=9;
name="sd" parent="lpfc" target=0 lun=10;
name="sd" parent="lpfc" target=0 lun=11;
name="sd" parent="lpfc" target=0 lun=12;
name="sd" parent="lpfc" target=0 lun=13;
name="sd" parent="lpfc" target=0 lun=14;
name="sd" parent="lpfc" target=0 lun=15;
name="sd" parent="lpfc" target=0 lun=16;
name="sd" parent="lpfc" target=0 lun=17;
name="sd" parent="lpfc" target=0 lun=18;
name="sd" parent="lpfc" target=0 lun=19;
name="sd" parent="lpfc" target=0 lun=20;
name="sd" parent="lpfc" target=0 lun=21;
name="sd" parent="lpfc" target=0 lun=22;
name="sd" parent="lpfc" target=0 lun=23;
name="sd" parent="lpfc" target=0 lun=24;
name="sd" parent="lpfc" target=0 lun=25;
name="sd" parent="lpfc" target=0 lun=26;
name="sd" parent="lpfc" target=0 lun=27;
name="sd" parent="lpfc" target=0 lun=28;
name="sd" parent="lpfc" target=0 lun=29;
name="sd" parent="lpfc" target=0 lun=30;
name="sd" parent="lpfc" target=0 lun=31;
name="sd" parent="lpfc" target=0 lun=32;
name="sd" parent="lpfc" target=0 lun=33;
name="sd" parent="lpfc" target=0 lun=34;
name="sd" parent="lpfc" target=0 lun=35;
name="sd" parent="lpfc" target=0 lun=36;
name="sd" parent="lpfc" target=0 lun=37;
name="sd" parent="lpfc" target=0 lun=38;
name="sd" parent="lpfc" target=0 lun=39;
name="sd" parent="lpfc" target=0 lun=40;
name="sd" parent="lpfc" target=0 lun=41;
name="sd" parent="lpfc" target=0 lun=42;
name="sd" parent="lpfc" target=0 lun=43;
name="sd" parent="lpfc" target=0 lun=44;
name="sd" parent="lpfc" target=0 lun=45;
name="sd" parent="lpfc" target=0 lun=46;
name="sd" parent="lpfc" target=0 lun=47;
name="sd" parent="lpfc" target=0 lun=48;
name="sd" parent="lpfc" target=0 lun=49;
```

The following script (**makesol**) and commands were used to create the logical representation of the TSC used in the benchmark measurement for the ETERNUS3000 Model 100 Storage system.

1. makesol

The **makesol** script is used to create the Solaris Volume Manage (SVM) logical volumes based on a configuration description file, **e3km100_B6d-3-1_svmake.txt**. This script is called by:

```
./makesol e3km100_B6d-3-1_svmake.txt
```

2. e3km100_B6d-3-1_svmake.txt

This file contains the list of the raw disks that are used to create the SVM logical volumes assigned to ASU1, ASU2, and ASU3. This script is called by the **makesol** script.

3. metastat.txt

This file contains the list of the SVM logical volumes resulting from the execution of the **makesol** script using the **e3km100_B6d-3-1_svmake.txt** control file.

The detailed script contents follow:

makesol

```
#!/bin/ksh
# Usage: usage
#                   makesol configFile
#
LABELFILE="/tmp/makesollabel"
STATFILE="/tmp/makesolstat"
AWK=nawk
usage()
{
      echo "\nUsage: $0 configFile\n"
      exit 1
}

labelDisk()
{
        echo "l" > $LABELFILE
        echo "q" >> $LABELFILE
        format -s -f $LABELFILE $1
}

checkStat()
{
        typeset -i i=0
        del1=`grep $1 $STATFILE|$AWK '{ print $1 }'`
        if [ "$del1" != "" ] ; then
                for del in $del1
                do
                        i=0
                        while (( $i < $delete ))
                        do
                                if [ ${DELETE[(($i+1))]} == $del ] ; then
                                        break
```

```
                                        fi
                                        i=$i+1
                                done
                                if (( $i == $delete )) ; then
                                        delete=$delete+1
                                        DELETE[$delete]=$del
                                fi
                        done
        fi
}

getDiskSlice()
{
        vDisks=""
        for disk in ${DISKS[$1]}
        do
                ndisk=`echo $disk|$AWK 'BEGIN { FS="s"} ; { print $1 }'`
                vDisks=$vDisks$ndisk"s"$2" "
        done
}

makevol()
{
        typeset -i count=0
        typeset -i i=0
        typeset -i vcount
       tmp=`/usr/sbin/metastat -p|$AWK '{ print substr( $1, 2, length($1)-1 )}'`
        if [ "$tmp" == "" ] ; then
                i=0
        else
                for dgroup in $tmp
                do
                        if (( $dgroup > $i )) ; then
                                i=$dgroup
                        fi
                done
                i=$i+1
        fi
        while (( $count < $groups ))
        do
                count=$count+1
#echo "/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} ${DISKS[$count]} ${STRIPE[$count]}"
          tmp=`/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} ${DISKS[$count]} ${STRIPE[$count]}`
                i=$i+1
                if [ "${VCOUNT[$count]}" != "" ] ; then
                    vcount=1
                    while (( $vcount < ${VCOUNT[$count]} ))
                    do
                        getSlice $vcount
                        getDiskSlice $count $num
                        tmp=`/usr/sbin/metainit d$i 1 ${DISK_COUNT[$count]} $vDisks ${STRIPE[$count]}`
                        i=$i+1
                        vcount=$vcount+1
                    done
                fi
        done
}

checkDisk()
{
        typeset -i i=0
        tmp=$1"s"
```

```
        test=`grep $tmp /etc/vfstab`
        if [ "$test" != "" ] ; then
                echo "Found disk $1 in /etc/vfstab, we really shouldn't use it here"
                exit 4
        fi
        while (( $i < $groups ))
        do
                i=$i+1
        for disk in ${DISKS[$i]}
        do
                tmp=$1"s0"
                if [ "$disk" == $tmp ] ; then
                echo "disk $1 repeated at line $lineno"
                exit 4
                fi
                done
          done
          disks=$disks+1
        part=$1"s0"
        DISKS[$groups]=${DISKS[$groups]}$part" "
        tmp=`prtvtoc -h /dev/dsk/$part 2>/dev/null`
        if [ $? != 0 ] ; then
                labelDisk $part
                tmp=`prtvtoc -h /dev/dsk/$part 2>/dev/null`
                if [ $? != 0 ] ; then
                        echo "prtvtoc failed for $part"
                        exit 4
                fi
        fi
        checkStat $1"s"
}

getSlice()
{
         num=0
       case $1 in
       0)
             num=0
             ;;
       1)
             num=1
             ;;
       2|3|4|5|6)
             (( num=$1+1 ))
             ;;
       esac
}

setVtoc()
{
       typeset -i count=0
       typeset -i i=0
       while (( $i < $groups ))
       do
             i=$i+1
             for disk in ${DISKS[$i]}
             do
                   if [ "${VCOUNT[$i]}" != "" ] ; then
                         sectors=`prtvtoc /dev/dsk/$disk 2>/dev/null|grep "accessible cylinders"|$AWK '{ print $2 }'`
                          seccyl=`prtvtoc /dev/dsk/$disk 2>/dev/null|grep "sectors/cylinder"|$AWK '{ print $2 }'`
                          (( sectors=$sectors-1 ))
                   fi
```

```
                tmp=`prtvtoc -h /dev/dsk/$disk 2>/dev/null`
                set $tmp
                while (( $# > 5 ))
                do
                        if (( $1 == 2 )) ; then
                                if [ "${VCOUNT[$i]}" == "" ] ; then
                                echo "0 4 $3 $4 $5 $6" > $LABELFILE
                                else
                                        echo "* labelfile" > $LABELFILE
                                        (( secCount=$sectors/${VCOUNT[$i]} ))
                                        count=0
                                            (( sc=$secCount*$seccyl ))
                                            fs=$seccyl
                                        while (( $count < ${VCOUNT[$i]} ))
                                        do
                                                (( ls=$fs+$sc ))
                                                getSlice $count
                                                echo "$num 4 $3 $fs $sc $ls" >> $LABELFILE
                                                    count=$count+1
                                                    (( fs=$fs+$sc ))
                                        done
                                fi
                        echo "$1 $2 $3 $4 $5 $6" >> $LABELFILE
                        tmp=`fmthard -s $LABELFILE /dev/rdsk/$disk`
                        break
                        fi
                        shift 6
                done
            done
        done
}

delGroups()
{
        typeset -i i=0
        if [ $DELETE_ALL == "yes" ] ; then
                tmp=`/usr/sbin/metastat -p |$AWK '{ print $1 }'`
                for del in $tmp
                do
                        tmp=`/usr/sbin/metaclear $del`
                        if [ $? != 0 ] ; then
                        echo "Failed to delete volume $del"
                        exit 4
                        fi
                done
                return
        fi
        while (( $i < $delete ))
        do
                i=$i+1
                tmp=`/usr/sbin/metaclear ${DELETE[$i]}`
                if [ $? != 0 ] ; then
                        echo "Failed to delete volume ${DELETE[$i]}"
                        exit 4
                fi
        done
}

addDisks()
{
        typeset -i diskNum=0
        typeset -i count=$name
```

```
        typeset -i jump=1
        diskNum=${label#*d}
        if (( $diskNum < 10 ))
        then
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-1 ) }'`
        elif (( $diskNum < 100 ))
        then
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-2 ) }'`
        else
                diskPrefix=`echo $label|awk '{ print substr( $1, 0, length($1)-3 ) }'`
        fi
        if [ "$skip" != "" ]
        then
                jump=$skip
        fi
        count=$count-1
        while [ $count != 0 ]
        do
                count=$count-1
                diskNum=$diskNum+$jump
                diskName=$diskPrefix$diskNum
                checkDisk $diskName
        done

}

checkConfig()
{
        typeset -i lineno=1
        invg="no"
        DELETE_ALL="no"
        while read -r label name skip
        do
                case $label in
                "VOLUME_GROUP:")
                        VGNAME=$VGNAME$name" "
                        invg="yes"
                        groups=$groups+1
                        getSize="yes"
                        ;;
                "#")
                        ;;
                "")
                        ;;
                "VOLUME")
                        if [ "$invg" != "yes" ]
                        then
                                echo "invalid line in config file line=$lineno data=\"$label $name\""
                                echo "VOLUME line must be in a volume_group definition"
                                exit 4
                        fi
                         tmp=`echo $name|grep ^[1-7]$`
                         if [ "$tmp" == "" ] ; then
                                echo "invalid line in config file line=$lineno data=\"$label $name\""
                                echo "VOLUME count must be from 1-7"
                                exit 4
                         fi
                         VCOUNT[groups]=$name
                         ;;
                "STRIPE")
                        if [ "$invg" != "yes" ]
                        then
```

```
                        echo "invalid line in config file line=$lineno data=\"$label $name\""
                        echo "STRIPE line must be in a volume_group definition"
                        exit 4
                fi
                STRIPE[groups]="-i $name"
                ;;
        "DELETE_ALL")
                DELETE_ALL="yes"
                ;;
        "END")
                DISK_COUNT[$groups]=$disks
                disks=0
                invg="no"
                ;;
        *)
                if [ "$invg" != "yes" ]
                then
                        echo "invalid line in config file line=$lineno data=\"$label $name\""
                        exit 4
                fi
                diskName=$label
                checkDisk $diskName
                if [ "$name" != "" ]
                then
                        addDisks
                fi
        esac
        lineno=$lineno+1
done < $CONFIG
}


# main()

        typeset -i delete=0
        typeset -i groups=0
        typeset -i disks=0
        test=`uname -a|grep "Linux"`
        if [ "$test" != "" ]
        then
                AWK=awk
        fi
          case $# in
          1)
                        CONFIG=$1
                        echo "Doing solvm config from $1"
                        ;;
          *)
                        usage
                        ;;
          esac
          tmp=`/usr/sbin/metadb`
          if [ "$tmp" == "" ] ; then
                        echo "No replica database is defined"
                        exit 4
          fi
          tmp=`/usr/sbin/metastat -p > $STATFILE`
          checkConfig
          delGroups
          setVtoc
          makevol
```

e3km100_B6d-3-1_svmake.txt

```
DELETE_ALL
VOLUME_GROUP: asu1-1 (d0)
STRIPE 128k
VOLUME 1
c3t0d1
c4t0d1
c3t0d6
c4t0d6
c3t0d11
c4t0d11
c3t0d16
c4t0d16
c3t0d21
c4t0d21
c3t0d26
c4t0d26
c3t0d31
c4t0d31
c3t0d36
END
VOLUME_GROUP: asu1-2 (d1)
STRIPE 128k
VOLUME 1
c3t0d3
c4t0d3
c3t0d8
c4t0d8
c3t0d13
c4t0d13
c3t0d18
c4t0d18
c3t0d23
c4t0d23
c3t0d28
c4t0d28
c3t0d33
c4t0d33
c3t0d38
END
VOLUME_GROUP: asu2-1 (d2)
STRIPE 128k
VOLUME 1
c3t0d0
c4t0d0
c3t0d5
c4t0d5
c3t0d10
c4t0d10
c3t0d15
c4t0d15
c3t0d20
c4t0d20
c3t0d25
c4t0d25
c3t0d30
c4t0d30
c3t0d35
END
VOLUME_GROUP: asu2-2 (d3)
STRIPE 128k
```

```
VOLUME 1
c3t0d4
c4t0d4
c3t0d9
c4t0d9
c3t0d14
c4t0d14
c3t0d19
c4t0d19
c3t0d24
c4t0d24
c3t0d29
c4t0d29
c3t0d34
c4t0d34
c3t0d39
END
VOLUME_GROUP: asu3-1 (d4)
STRIPE 128k
VOLUME 1
c3t0d2
c4t0d2
c3t0d7
c4t0d7
c3t0d12
c4t0d12
c3t0d17
c4t0d17
c3t0d22
c4t0d22
c3t0d27
c4t0d27
c3t0d32
c4t0d32
c3t0d37
END
```

metastat.txt

```
d4: Concat/Stripe
   Size: 110592000 blocks (52 GB)
   Stripe 0: (interlace: 256 blocks)
       Device      Start Block  Dbase        Reloc
       c3t0d2s0          0     No     Yes
       c4t0d2s0          0     No     Yes
       c3t0d7s0          0     No     Yes
       c4t0d7s0          0     No     Yes
       c3t0d12s0         0     No     Yes
       c4t0d12s0         0     No     Yes
       c3t0d17s0         0     No     Yes
       c4t0d17s0         0     No     Yes
       c3t0d22s0         0     No     Yes
       c4t0d22s0         0     No     Yes
       c3t0d27s0         0     No     Yes
       c4t0d27s0         0     No     Yes
       c3t0d32s0         0     No     Yes
       c4t0d32s0         0     No     Yes
       c3t0d37s0         0     No     Yes
```

d3: Concat/Stripe
Size: 246497280 blocks (117 GB)
Stripe 0: (interlace: 256 blocks)

Device	Start Block	Dbase	Reloc
c3t0d4s0	0	No	Yes
c4t0d4s0	0	No	Yes
c3t0d9s0	0	No	Yes
c4t0d9s0	0	No	Yes
c3t0d14s0	0	No	Yes
c4t0d14s0	0	No	Yes
c3t0d19s0	0	No	Yes
c4t0d19s0	0	No	Yes
c3t0d24s0	0	No	Yes
c4t0d24s0	0	No	Yes
c3t0d29s0	0	No	Yes
c4t0d29s0	0	No	Yes
c3t0d34s0	0	No	Yes
c4t0d34s0	0	No	Yes
c3t0d39s0	0	No	Yes

d2: Concat/Stripe
Size: 246497280 blocks (117 GB)
Stripe 0: (interlace: 256 blocks)

Device	Start Block	Dbase	Reloc
c3t0d0s0	0	No	Yes
c4t0d0s0	0	No	Yes
c3t0d5s0	0	No	Yes
c4t0d5s0	0	No	Yes
c3t0d10s0	0	No	Yes
c4t0d10s0	0	No	Yes
c3t0d15s0	0	No	Yes
c4t0d15s0	0	No	Yes
c3t0d20s0	0	No	Yes
c4t0d20s0	0	No	Yes
c3t0d25s0	0	No	Yes
c4t0d25s0	0	No	Yes
c3t0d30s0	0	No	Yes
c4t0d30s0	0	No	Yes
c3t0d35s0	0	No	Yes

d1: Concat/Stripe
Size: 246497280 blocks (117 GB)
Stripe 0: (interlace: 256 blocks)

Device	Start Block	Dbase	Reloc
c3t0d3s0	0	No	Yes
c4t0d3s0	0	No	Yes
c3t0d8s0	0	No	Yes
c4t0d8s0	0	No	Yes
c3t0d13s0	0	No	Yes
c4t0d13s0	0	No	Yes
c3t0d18s0	0	No	Yes
c4t0d18s0	0	No	Yes
c3t0d23s0	0	No	Yes
c4t0d23s0	0	No	Yes
c3t0d28s0	0	No	Yes
c4t0d28s0	0	No	Yes
c3t0d33s0	0	No	Yes
c4t0d33s0	0	No	Yes
c3t0d38s0	0	No	Yes

d0: Concat/Stripe
Size: 246497280 blocks (117 GB)

```
Stripe 0: (interlace: 256 blocks)
    Device      Start Block  Dbase        Reloc
    c3t0d1s0          0      No     Yes
    c4t0d1s0          0      No     Yes
    c3t0d6s0          0      No     Yes
    c4t0d6s0          0      No     Yes
    c3t0d11s0         0      No     Yes
    c4t0d11s0         0      No     Yes
    c3t0d16s0         0      No     Yes
    c4t0d16s0         0      No     Yes
    c3t0d21s0         0      No     Yes
    c4t0d21s0         0      No     Yes
    c3t0d26s0         0      No     Yes
    c4t0d26s0         0      No     Yes
    c3t0d31s0         0      No     Yes
    c4t0d31s0         0      No     Yes
    c3t0d36s0         0      No     Yes

  Device Relocation Information:
  Device   Reloc Device ID
  c3t0d2   Yes   id1,sd@w46554a4954535520333030303030313730303032
  c4t0d2   Yes   id1,sd@w46554a4954535520333030303030313730303037
  c3t0d7   Yes   id1,sd@w46554a4954535520333030303030313730303043
  c4t0d7   Yes   id1,sd@w46554a4954535520333030303030313730303131
  c3t0d12  Yes   id1,sd@w46554a4954535520333030303030313730303136
  c4t0d12  Yes   id1,sd@w46554a4954535520333030303030313730303142
  c3t0d17  Yes   id1,sd@w46554a4954535520333030303030313730303230
  c4t0d17  Yes   id1,sd@w46554a4954535520333030303030313730303235
  c3t0d22  Yes   id1,sd@w46554a4954535520333030303030313730303241
  c4t0d22  Yes   id1,sd@w46554a4954535520333030303030313730303246
  c3t0d27  Yes   id1,sd@w46554a4954535520333030303030313730303334
  c4t0d27  Yes   id1,sd@w46554a4954535520333030303030313730303339
  c3t0d32  Yes   id1,sd@w46554a4954535520333030303030313730303345
  c4t0d32  Yes   id1,sd@w46554a4954535520333030303030313730303433
  c3t0d37  Yes   id1,sd@w46554a4954535520333030303030313730303438
  c3t0d4   Yes   id1,sd@w46554a4954535520333030303030313730303034
  c4t0d4   Yes   id1,sd@w46554a4954535520333030303030313730303039
  c3t0d9   Yes   id1,sd@w46554a4954535520333030303030313730303045
  c4t0d9   Yes   id1,sd@w46554a4954535520333030303030313730303133
  c3t0d14  Yes   id1,sd@w46554a4954535520333030303030313730303138
  c4t0d14  Yes   id1,sd@w46554a4954535520333030303030313730303144
  c3t0d19  Yes   id1,sd@w46554a4954535520333030303030313730303232
  c4t0d19  Yes   id1,sd@w46554a4954535520333030303030313730303237
  c3t0d24  Yes   id1,sd@w46554a4954535520333030303030313730303243
  c4t0d24  Yes   id1,sd@w46554a4954535520333030303030313730303331
  c3t0d29  Yes   id1,sd@w46554a4954535520333030303030313730303336
  c4t0d29  Yes   id1,sd@w46554a4954535520333030303030313730303342
  c3t0d34  Yes   id1,sd@w46554a4954535520333030303030313730303430
  c4t0d34  Yes   id1,sd@w46554a4954535520333030303030313730303435
  c3t0d39  Yes   id1,sd@w46554a4954535520333030303030313730303441
  c3t0d0   Yes   id1,sd@w46554a4954535520333030303030313730303030
  c4t0d0   Yes   id1,sd@w46554a4954535520333030303030313730303035
  c3t0d5   Yes   id1,sd@w46554a4954535520333030303030313730303041
  c4t0d5   Yes   id1,sd@w46554a4954535520333030303030313730303046
  c3t0d10  Yes   id1,sd@w46554a4954535520333030303030313730303134
  c4t0d10  Yes   id1,sd@w46554a4954535520333030303030313730303139
  c3t0d15  Yes   id1,sd@w46554a4954535520333030303030313730303145
  c4t0d15  Yes   id1,sd@w46554a4954535520333030303030313730303233
  c3t0d20  Yes   id1,sd@w46554a4954535520333030303030313730303238
  c4t0d20  Yes   id1,sd@w46554a4954535520333030303030313730303244
  c3t0d25  Yes   id1,sd@w46554a4954535520333030303030313730303332
  c4t0d25  Yes   id1,sd@w46554a4954535520333030303030313730303337
```

```
c3t0d30   Yes  id1,sd@w46554a4954535520333030303030313730303343
c4t0d30   Yes  id1,sd@w46554a4954535520333030303030313730303431
c3t0d35   Yes  id1,sd@w46554a4954535520333030303030313730303436
c3t0d3    Yes  id1,sd@w46554a4954535520333030303030313730303033
c4t0d3    Yes  id1,sd@w46554a4954535520333030303030313730303038
c3t0d8    Yes  id1,sd@w46554a4954535520333030303030313730303044
c4t0d8    Yes  id1,sd@w46554a4954535520333030303030313730303132
c3t0d13   Yes  id1,sd@w46554a4954535520333030303030313730303137
c4t0d13   Yes  id1,sd@w46554a4954535520333030303030313730303143
c3t0d18   Yes  id1,sd@w46554a4954535520333030303030313730303231
c4t0d18   Yes  id1,sd@w46554a4954535520333030303030313730303236
c3t0d23   Yes  id1,sd@w46554a4954535520333030303030313730303242
c4t0d23   Yes  id1,sd@w46554a4954535520333030303030313730303330
c3t0d28   Yes  id1,sd@w46554a4954535520333030303030313730303335
c4t0d28   Yes  id1,sd@w46554a4954535520333030303030313730303341
c3t0d33   Yes  id1,sd@w46554a4954535520333030303030313730303346
c4t0d33   Yes  id1,sd@w46554a4954535520333030303030313730303434
c3t0d38   Yes  id1,sd@w46554a4954535520333030303030313730303439
c3t0d1    Yes  id1,sd@w46554a4954535520333030303030313730303031
c4t0d1    Yes  id1,sd@w46554a4954535520333030303030313730303036
c3t0d6    Yes  id1,sd@w46554a4954535520333030303030313730303042
c4t0d6    Yes  id1,sd@w46554a4954535520333030303030313730303130
c3t0d11   Yes  id1,sd@w46554a4954535520333030303030313730303135
c4t0d11   Yes  id1,sd@w46554a4954535520333030303030313730303141
c3t0d16   Yes  id1,sd@w46554a4954535520333030303030313730303146
c4t0d16   Yes  id1,sd@w46554a4954535520333030303030313730303234
c3t0d21   Yes  id1,sd@w46554a4954535520333030303030313730303239
c4t0d21   Yes  id1,sd@w46554a4954535520333030303030313730303245
c3t0d26   Yes  id1,sd@w46554a4954535520333030303030313730303333
c4t0d26   Yes  id1,sd@w46554a4954535520333030303030313730303338
c3t0d31   Yes  id1,sd@w46554a4954535520333030303030313730303344
c4t0d31   Yes  id1,sd@w46554a4954535520333030303030313730303432
c3t0d36   Yes  id1,sd@w46554a4954535520333030303030313730303437
```

APPENDIX C: SPC-1 WORKLOAD GENERATOR STORAGE COMMANDS AND PARAMETERS

The contents of the SPC-1 Workload Generator command and parameter file is listed below.

```
sd=asu1_1,lun=/dev/md/rdsk/d0,size=126.2g
sd=asu1_2,lun=/dev/md/rdsk/d1,size=126.2g
sd=asu2_1,lun=/dev/md/rdsk/d2,size=126.2g
sd=asu2_2,lun=/dev/md/rdsk/d3,size=126.2g
sd=asu3_1,lun=/dev/md/rdsk/d4,size=56.1g
```