



THE POSSIBILITIES ARE INFINITE

**SPC BENCHMARK 1™
FULL DISCLOSURE REPORT**

**FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS
ETERNUS6000 MODEL 1100**

SPC-1 V1.8

Submitted for Review: October 20, 2004

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Notes

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

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

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AUDIT CERTIFICATION



C. A. (Sandy) Wilson
Fujitsu Limited
1250 East Arques Avenue
P.O. Box 3470
Sunnyvale, CA 94088

October 20, 2004

The SPC Benchmark 1™ results listed below for the Fujitsu Storage Systems ETERNUS6000 Model 1100 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 ETERNUS6000 Model 1100	
Metric	Reported Result
SPC-1 IOPS™	100,242.23
SPC-1 Price-Performance	\$13.39/SPC-1 IOPS™
Total ASU Capacity	11,377.366 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	\$1,342.738

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).

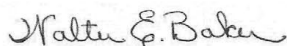
Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
AuditService@storageperformance.org
650.556.9384

- 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

Storage Performance Council
643 Bair Island Road, Suite 103
Redwood City, CA 94062
AuditService@storageperformance.org
650.556.9384

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



From: Fujitsu Limited, Test Sponsor

Submitted by: Kouichi Ueda
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 ETERNUS6000 Model 1100

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: Kouichi Ueda Date: 10/08/04

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
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu Computer Systems Corp. Kun Katsumata Kun.Katsumata@us.fujitsu.com 1250 East Arques Ave. PO Box 3470 Sunnyvale, CA 94088-3470 Phone (408) 746-6415
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Kouichi Ueda ueda@jp.fujitsu.com Kanagawa-ken, Kawasaki-shi, Nakahara-ku, Kamikodanaka 4-1-1 Japan 211-8588 Phone: 044- 754-3651
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@storageperformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

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	October 20, 2004
Date FDR was submitted to the SPC	October 20, 2004
Date the TSC will be available for shipment to customers	December 28, 2004
Date the TSC completed audit certification	October 20, 2004

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS6000 Model 1100	
Metric	Reported Result
SPC-1 IOPS™	100,242.23
SPC-1 Price-Performance	\$13.39/SPC-1 IOPS™
Total ASU Capacity	11,377.366 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	\$1,342,738

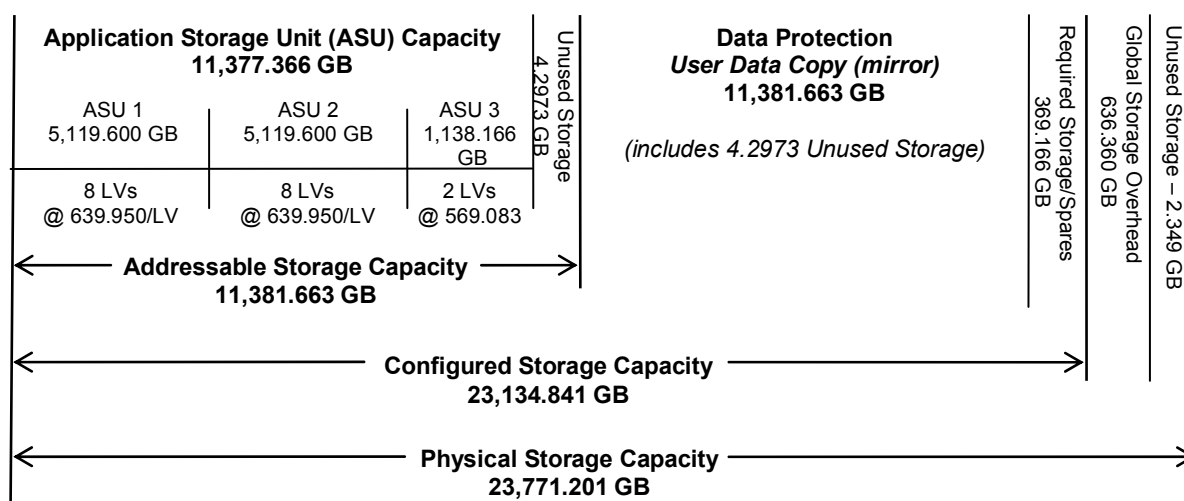
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

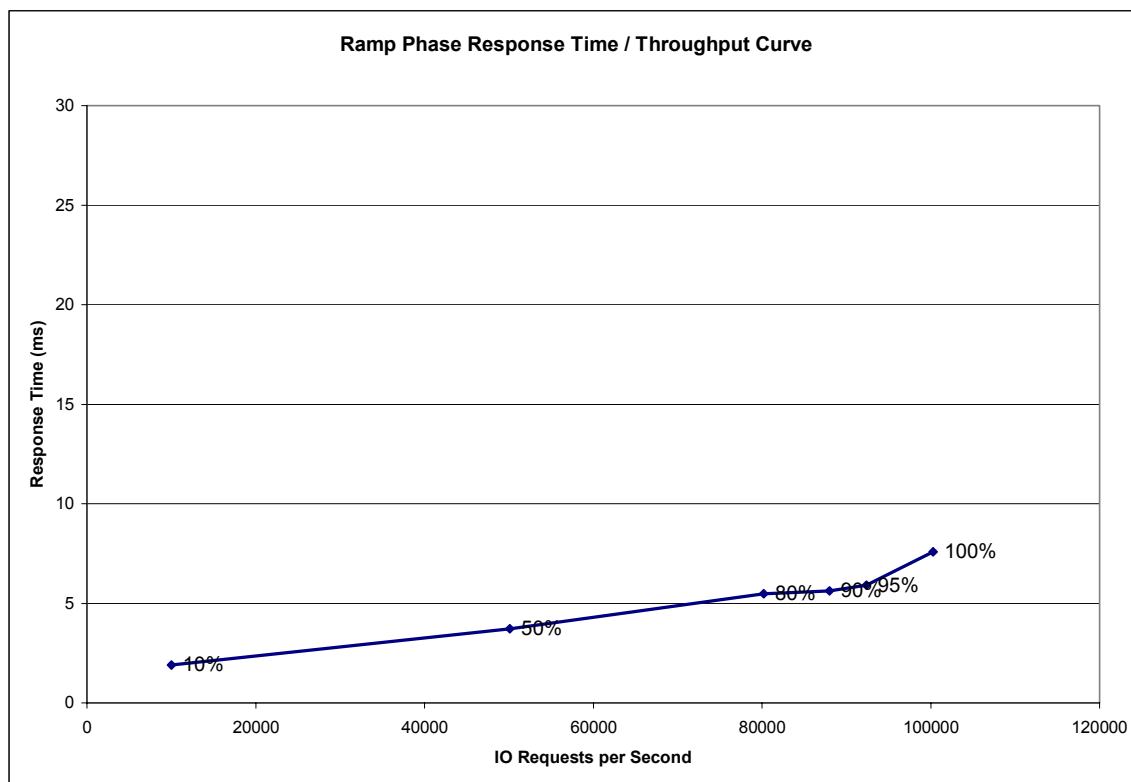
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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	9,998.70	50,098.95	80,196.03	87,989.60	92,386.76	100,242.23
Average Response Time (ms):						
All ASUs	1.90	3.72	5.49	5.62	5.90	7.59
ASU-1	2.40	4.36	6.30	6.55	6.87	8.58
ASU-2	1.85	3.62	5.58	5.82	6.16	7.96
ASU-3	0.86	2.40	3.73	3.59	3.73	5.33
Reads	3.59	5.86	8.32	8.91	9.40	11.30
Writes	0.79	2.33	3.64	3.49	3.63	5.17

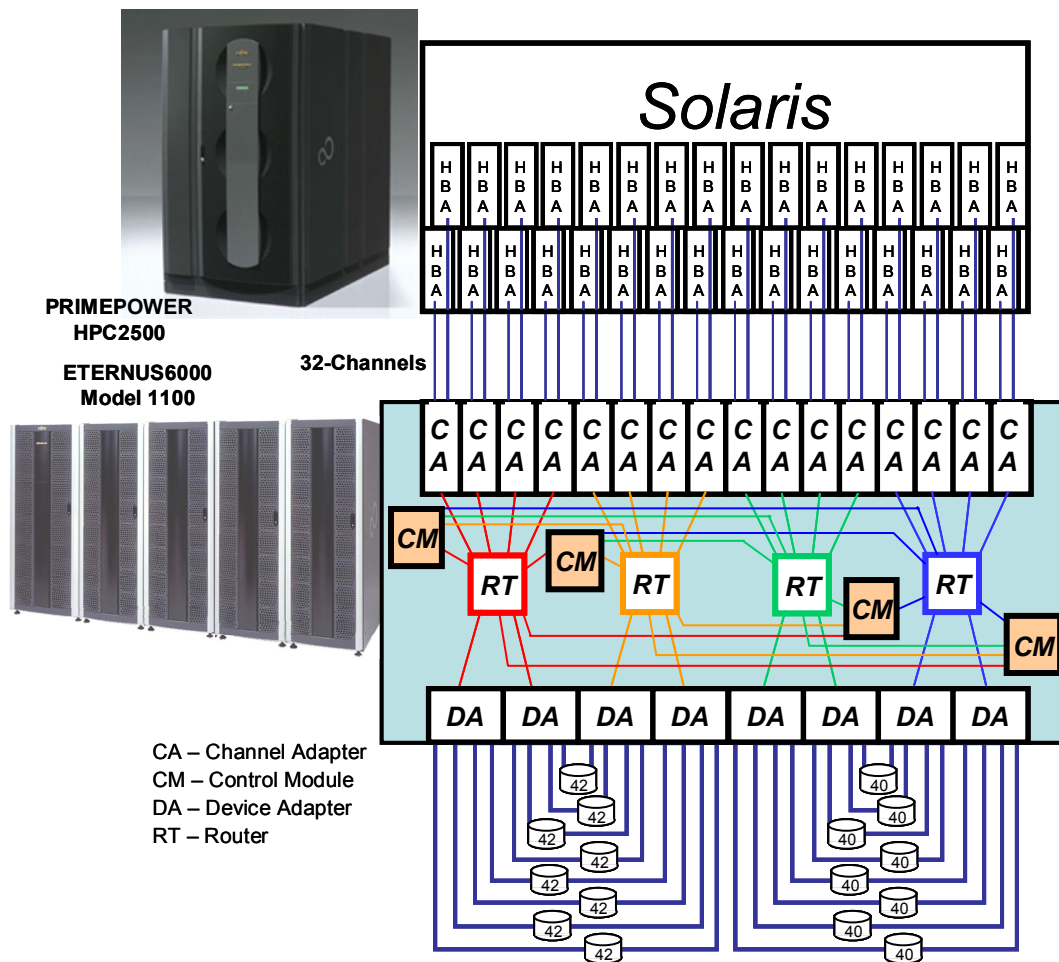
Tested Storage Configuration Pricing (*Priced Storage Configuration*)

Item	Product Id	Description	Qty	Unit \$	Extd \$
1	E6B0S01AU	ETERNUS6000 Model 1100 Base Unit (with door) including Controller Enclosure, 4x Controllers (CM), 4x Interface Units (RT), 8x Drive Interface (DA), 4x power supplie units, 6x battery units, 24x drive enclosures (DE), 8x 36GB System disk drives, 1x Base 1800mm (36U) rack, 2x Expansion 1800mm (36U) rack, 8x power distribution (200VAC), rack mount kit, ETERNUSmgr & drivers slots for up to 360 disk drives	1	\$341,149	\$341,149
2	E600CR3U	ETERNUS6000 Expansion Rack (with door) including Expansion 1800mm (36U) rack 2x power distribution (200 VAC)	2	\$7,450	\$14,900
3	E600CE21U	Drive Enclosure (4x DE) with slots for up to 60 disk drives	6	\$37,944	\$227,664
4	E600CM45	Additional cache memory (4x 8GB)	1	\$123,520	\$123,520
5	E600CM47	Additional cache memory (4x 16GB)	1	\$247,040	\$247,040
6	E600CH14	Fibre Channel Host Interface (dual port) x2	8	\$7,180	\$57,440
7	E600CC2L	36GB/15krpm Disk Drives RAID(4+4)	80	\$7,782	\$622,560
8	E600CA2L	36GB/15krpm Disk Drive (Hot Spare)	8	\$973	\$7,782
9	CBL-MLLB15	Fibre Channel Cable	32	\$290	\$9,280
10	LP9002L	Emulex LP9802 HBA	32	\$1,862	\$59,584
11		Enhanced Plus ETERNUS6000 Model 1100 Base Unit Phone 24x7, On-site 24x7, maintenance service with 4 hour response - 3 year Warranty Uplift w/ 24 DEs	1	\$128,621	\$128,621
12		Enhanced Plus ETERNUS6000 Model 1100 additional DE Set Phone 24x7, On-site 24x7, maintenance service with 4 hour response - 3 year Warranty Uplift per DE set	6	\$26,928	\$161,568
Total Product List Price					\$1,710,919
Product Discount				30%	
Net Product Price					\$1,197,643
Total Service List Price					\$290,189
Service Discount				50%	
Net Service Price					\$145,094
Total Sell Price, including 3 years Service					\$1,342,738

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

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

Benchmark Configuration/Tested Storage Configuration Diagram



Host Systems:	Tested Storage Configuration (TSC):
UID=HS-1	32 – Emulex LP9802 FC HBAs (2 Gbit)
Fujitsu PRIMEPOWER 2500	UID=SC-1:
128 - SPARC64 V (1.3 GHz) CPUs, each with: 128 KB L1 instruction cache, 128 KB L1 data cache, and 2 MB L2 cache	Fujitsu ETERNUS6000 Model 1100
512 GB main memory	4 – Controller Modules (CM), each with 24 GB cache
Solaris 9	16 – Channel Adapter Modules
PCI	8 – Device Adapter Modules
WG	4 – Router Modules
	32 – Front side fibre channels – 2 Gbit each
	32 – Drive side fibre channel switched FC-AL loops – 2 Gbit each
	656 – 36 GB 15K RPM disk drives
	48 – 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 51 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 54 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 90.

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)	11,377.366
Addressable Storage Capacity	Gigabytes (GB)	11,381.663
Configured Storage Capacity	Gigabytes (GB)	23,134.841
Physical Storage Capacity	Gigabytes (GB)	23,771.201
Data Protection Overhead (mirror)	Gigabytes (GB)	11,381.663
Required Storage	Gigabytes (GB)	369.166
Global Storage Overhead	Gigabytes (GB)	636.360
Total Unused Storage	Gigabytes (GB)	10.943

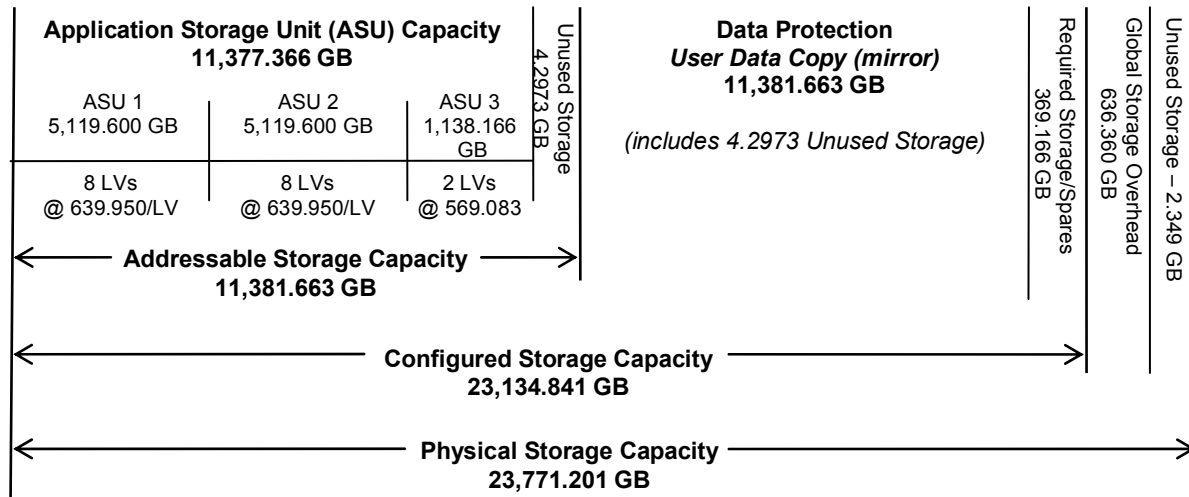
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	Configured Storage Capacity	Physical Storage Capacity
Total ASU Capacity	99.96%	49.18%	47.86%
Required for Data Protection (Mirroring)		49.20%	47.88%
Addressable Storage Capacity		49.20%	47.88%
Required Storage		1.60%	1.55%
Configured Storage Capacity			97.32%
Global Storage Overhead			2.68%
Unused Storage:			
Addressable	0.038%		
Configured		0.000%	
Physical			0.010%

The Physical Storage Capacity consisted of 23,771.201 GB distributed over 656 disk drives each with a formatted capacity of 36.260 TB. There was 2.349 GB (0.01%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 636.360 GB (2.68%) of Physical Storage Capacity. There was 0.000 GB (0.00%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 99.96% of the Addressable Storage Capacity resulting in 4.297 GB (0.038%) 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 (5,119.600 GB)	ASU-2 (5,119.600 GB)	ASU-3 (1,138.166 GB)
8 Logical Volumes 640.2185 GB per Logical Volume (639.9500 GB used/Logical Volume)	8 Logical Volumes 640.2185 GB per Logical Volume (639.9500 GB used/Logical Volume)	2 Logical Volume 569.0831 GB per Logical Volume (569.0830 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 80 RAID Group Assignments are RAID0+1(4+4) sets, each divided into 18 Logical Volumes, for a total of 1440 LVs. These are grouped into thirty-two separate sets of LUNs, using Host Affinity grouping, each with 45 LUNs.

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

G07-5-1 Configuration using 640 drives in 80 groups with high activity portions in the middle of the drives.

Drive:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	DA-Lp
00	SY	SY														DA0-0
01	SY	SY														DA0-1
02	SY	SY														DA0-2
03	SY	SY	RG01	RG02	RG03	RG04	RG05	RG06	RG07	RG08	RG09	RG10	RG11	RG12	RG00	DA0-3
04	HS	HS														DA1-0
05	HS	HS														DA1-1
06	HS	HS														DA1-2
07	HS	HS														DA1-3
08																DA2-0
09																DA2-1
0a																DA2-2
0b	RG13	RG14	RG15	RG16	RG17	RG18	RG19	RG20	RG21	RG22	RG23	RG24	RG25	RG26	RG83	DA2-3
0c																DA3-0
0d																DA3-1
0e																DA3-2
0f																DA3-3
10																DA0-0
11																DA0-1
12																DA0-2
13	RG27	RG28	RG29	RG30	RG31	RG32	RG33	RG34	RG35	RG36	RG37	RG38	RG39	RG40	RG84	DA0-3
14																DA1-0
15																DA1-1
16																DA1-2
17																DA1-3
18																DA2-0
19																DA2-1
1a																DA2-2
1b	RG41	RG42	RG43	RG44	RG45	RG46	RG47	RG48	RG49	RG50	RG51	RG52	RG53	RG54	RG85	DA2-3
1c																DA3-0
1d																DA3-1
1e																DA3-2
1f																DA3-3
20																DA0-0
21																DA0-1
22																DA0-2
23	RG55	RG56	RG57	RG58	RG59	RG60	RG61	RG62	RG63	RG64	RG65	RG66				DA0-3
24																DA1-0
25																DA1-1
26																DA1-2
27																DA1-3
28																DA2-0
29																DA2-1
2a																DA2-2
2b	RG69	RG70	RG71	RG72	RG73	RG74	RG75	RG76	RG77	RG78						DA2-3
2c																DA3-0
2d																DA3-1
2e																DA3-2
2f																DA3-3

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 RAID0+1 configurations. In this configuration, all of the RAID Groups are 4+4 arrangements.

There are eight (8) of the drives reserved exclusively for system use, and eight (8) Hot Spare drives have been included in the configuration. There are sixty-four (64) empty drive slots in this configuration, as well.

The LUNs, seen through the thirty-two HBAs by Solaris, are grouped into Solaris Volume Groups, and used with 8 MB stripe unit depths across the sets. Eight Logical Volumes, each with 80 LUNs are used for ASU1 and another eight for ASU2, while two Volumes, also each with 80 LUNs are used for ASU3. The sizes are reflected in the ASU Logical Volume Mapping chart.

Two optional facilities in the ETERNUS6000 (GRPM and Trace), which are used for collection information during operation, were turned off during this benchmark run. They are normally not enabled during operations. Two secondary enhanced reliability features (Patrol and sampled Read after Write compare), which may be optionally enabled by a customer, were turned off during this benchmark run. Although the PRIMEPOWER HPC2500 was equipped with 128 CPUs, for this I/O dominated benchmark, only 64 were active, with the other 64 set off-line, during this benchmark run.

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 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 SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are documented in “Appendix D: SPC-1 Workload Generator Input Parameters” on Page 91.

Sustainability Test Results File

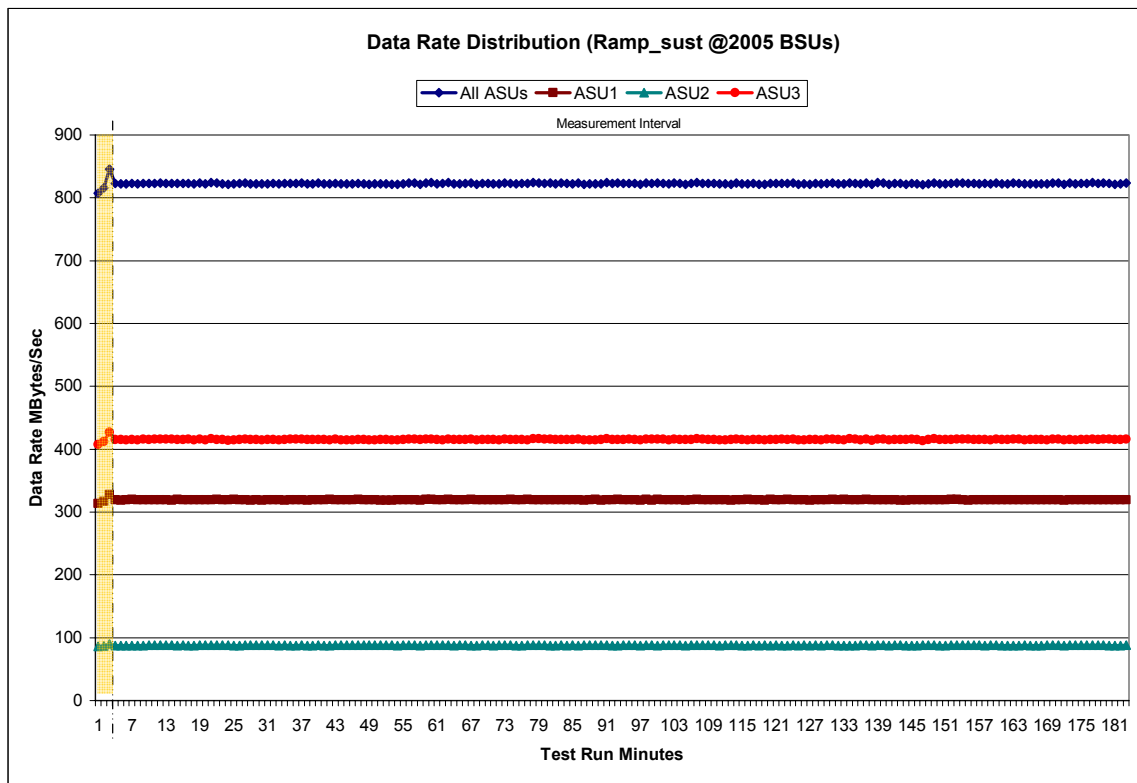
A link to the test results file generated from the Sustainability Test Run is listed below.

[Sustainability Test Results File](#)

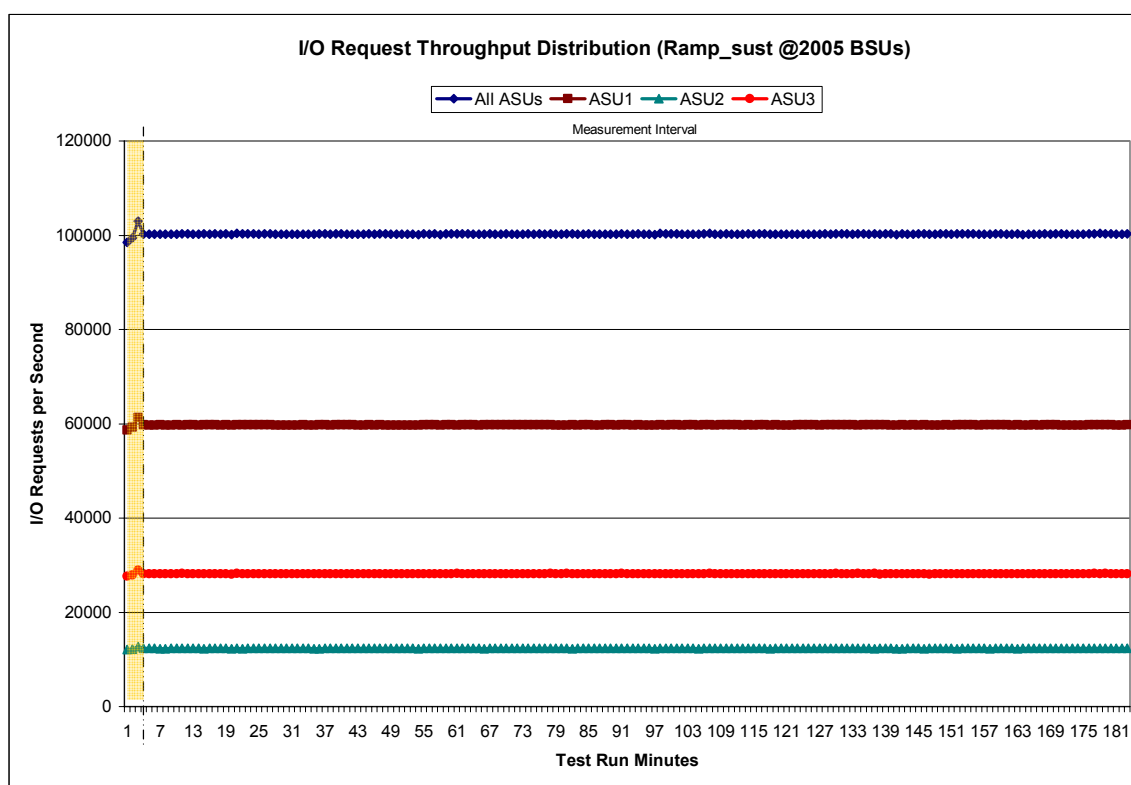
Sustainability – Data Rate Distribution Data (MB/second)

Ramp-Up/Start-Up		Start	Stop	Interval	Duration										
Measurement Interval		11:13:49	11:16:49	0-2	0:03:00										
		11:16:49	14:16:49	3-182	3:00:00										
Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	
0	807.38	313.49	86.26	407.62	63	822.53	319.73	87.70	415.10	126	821.73	318.98	87.65	415.09	
1	815.85	316.72	86.85	412.28	64	822.29	319.41	87.82	415.06	127	822.83	319.51	87.90	415.42	
2	845.53	328.15	90.19	427.19	65	822.90	319.49	87.84	415.57	128	822.14	319.60	87.73	414.80	
3	822.70	319.33	87.76	415.61	66	823.64	319.86	87.67	416.11	129	823.19	319.44	87.82	415.93	
4	822.03	318.91	87.68	415.43	67	821.88	319.31	87.68	414.88	130	823.37	319.83	87.84	415.69	
5	822.18	319.46	87.73	414.99	68	822.92	319.56	87.97	415.39	131	822.36	319.48	87.74	415.15	
6	822.82	320.10	87.54	415.18	69	823.01	319.36	88.11	415.54	132	822.37	319.78	87.65	414.94	
7	822.07	319.53	87.74	414.80	70	822.53	319.70	87.75	415.08	133	823.23	319.20	87.51	416.52	
8	822.92	319.41	87.66	415.85	71	822.15	319.26	87.92	414.97	134	822.98	319.25	87.73	416.00	
9	823.01	319.55	88.08	415.38	72	823.80	319.52	88.03	416.25	135	822.36	319.63	88.06	414.67	
10	823.07	319.41	87.86	415.80	73	822.99	319.93	87.85	415.21	136	823.68	319.89	87.85	415.94	
11	823.33	319.43	88.01	415.89	74	822.48	319.42	87.75	415.31	137	821.33	319.45	87.73	414.16	
12	823.03	319.24	87.87	415.92	75	822.79	319.71	87.78	415.31	138	823.89	319.44	88.19	416.26	
13	822.98	319.04	87.99	415.96	76	822.63	319.79	87.86	414.98	139	823.57	319.23	88.36	415.98	
14	822.82	319.78	87.70	415.34	77	824.21	319.55	87.89	416.77	140	821.85	319.44	87.63	414.78	
15	822.59	319.45	87.87	415.28	78	823.73	319.38	87.97	416.38	141	822.85	319.45	87.82	415.58	
16	823.07	319.67	87.68	415.72	79	822.88	319.31	87.85	415.72	142	822.58	319.03	87.94	415.61	
17	822.01	319.39	87.70	414.92	80	823.22	319.59	87.71	415.91	143	821.88	318.95	87.66	415.26	
18	823.33	319.51	88.04	415.78	81	822.26	319.44	87.73	415.09	144	823.15	319.52	87.68	415.95	
19	822.10	319.48	87.98	414.64	82	823.36	319.54	88.26	415.57	145	822.26	319.37	87.67	415.22	
20	824.36	319.66	88.05	416.65	83	822.90	319.72	87.70	415.48	146	821.03	319.39	87.92	413.71	
21	823.43	319.95	88.15	415.33	84	822.48	319.51	87.82	415.16	147	822.51	319.39	87.93	415.19	
22	822.29	319.34	87.85	415.10	85	823.22	319.41	87.79	416.02	148	823.39	319.22	87.80	416.36	
23	821.45	319.31	87.87	414.27	86	821.64	318.92	87.82	414.90	149	822.30	319.55	87.62	415.13	
24	822.27	319.79	87.75	414.73	87	822.38	319.46	87.94	414.98	150	822.26	319.21	87.59	415.46	
25	822.87	319.76	87.72	415.40	88	822.37	319.85	87.83	414.69	151	823.12	319.89	87.85	415.38	
26	823.26	319.43	87.94	415.89	89	822.31	319.10	87.89	415.31	152	823.58	319.85	88.02	415.71	
27	822.13	319.00	87.88	415.24	90	824.02	319.51	88.08	416.42	153	823.26	319.37	87.99	415.89	
28	822.33	319.12	87.87	415.34	91	822.79	319.45	87.76	415.57	154	822.85	318.92	88.18	415.75	
29	821.99	318.98	88.20	414.81	92	823.31	320.19	87.54	415.58	155	822.63	319.26	88.18	415.19	
30	822.50	319.40	87.96	415.15	93	823.11	319.72	87.87	415.52	156	822.55	319.36	88.01	415.19	
31	822.60	319.18	87.94	415.47	94	823.20	319.20	88.00	416.00	157	822.59	319.42	87.59	415.57	
32	822.06	319.61	87.68	414.76	95	822.70	319.37	87.95	415.38	158	822.31	319.41	87.94	414.96	
33	822.81	319.09	88.16	415.56	96	821.44	319.10	87.66	414.68	159	823.83	319.66	88.06	416.12	
34	823.04	319.55	87.65	415.84	97	823.81	320.08	88.00	415.73	160	822.56	319.54	87.66	415.37	
35	823.09	319.56	87.76	415.77	98	822.98	319.01	88.23	415.74	161	822.10	319.25	87.70	415.16	
36	823.44	319.44	88.05	415.95	99	823.57	320.00	87.79	415.77	162	823.59	319.67	87.77	416.15	
37	822.05	318.84	87.74	415.47	100	822.82	319.33	87.82	415.67	163	822.68	319.23	87.55	415.90	
38	822.22	319.29	87.64	415.30	101	822.21	319.27	88.25	414.69	164	822.21	319.29	88.05	414.87	
39	823.27	319.74	88.06	415.48	102	823.28	319.57	87.82	415.88	165	822.47	319.64	87.72	415.11	
40	822.25	319.40	87.73	415.13	103	822.69	319.14	88.02	415.53	166	822.37	319.16	87.76	415.46	
41	822.51	319.85	87.76	414.90	104	821.81	319.03	87.56	415.21	167	822.46	319.54	87.77	415.16	
42	823.01	319.31	87.91	415.79	105	823.14	319.75	87.84	415.55	168	822.38	319.42	88.21	414.75	
43	822.17	319.23	88.13	414.81	106	824.17	319.79	87.97	416.41	169	823.51	319.40	88.21	415.90	
44	822.56	319.69	87.89	414.99	107	822.73	319.21	87.84	415.67	170	823.44	319.68	88.00	415.76	
45	822.51	319.60	87.91	415.00	108	822.81	319.73	87.93	415.15	171	821.66	318.99	87.73	414.94	
46	823.08	319.84	87.92	415.33	109	822.87	319.52	87.97	415.38	172	823.33	319.56	88.17	415.61	
47	822.51	319.30	87.95	415.27	110	822.15	319.64	87.63	414.88	173	822.30	319.44	87.96	414.90	
48	821.91	319.24	87.85	414.81	111	822.25	319.45	87.84	414.96	174	822.80	319.45	87.93	415.42	
49	822.03	319.39	87.82	414.82	112	821.92	319.10	87.81	415.01	175	822.62	319.51	87.92	415.19	
50	822.51	319.11	88.06	415.34	113	823.35	319.61	87.87	415.87	176	824.16	319.74	88.12	416.30	
51	822.23	318.84	87.87	415.52	114	822.20	319.31	87.78	415.11	177	822.97	319.66	88.18	415.13	
52	821.44	318.95	87.88	414.61	115	822.48	320.01	87.75	414.72	178	823.37	319.43	87.98	415.96	
53	821.51	319.30	87.54	414.67	116	822.87	319.63	87.87	415.36	179	823.13	319.42	87.71	415.99	
54	822.42	319.40	87.86	415.17	117	821.72	319.12	87.37	415.24	180	821.85	319.13	87.50	415.21	
55	823.53	319.59	88.05	415.89	118	821.80	319.07	87.93	414.80	181	822.04	319.13	87.75	415.16	
56	823.37	319.23	88.11	416.03	119	822.98	319.91	87.76	415.31	182	823.62	319.41	87.92	416.30	
57	821.79	318.83	87.70	415.26	120	822.83	319.36	87.90	415.57						
58	823.43	319.90	87.86	415.66	121	823.11	319.58	87.68	415.85						
59	824.33	320.05	88.20	416.07	122	822.91	319.86	87.76	415.29						
60	822.49	319.12	87.83	415.54	123	823.23	319.61	87.88	415.74						
61	822.61	319.59	88.04	414.98	124	821.49	319.19	87.72	414.58						
62	824.27	319.95	88.01	416.31	125	822.22	319.15	88.09	414.98						

Sustainability – Data Rate Distribution Graph



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	0.002	0.001	0.001	0.001	0.003	0.002	0.002	0.001

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

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

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

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 to the Workload Generator.*
- 6. The total number of I/O Requests completed in the Measurement Interval as well as the number of I/O Requests with a Response Time less than or equal to 30 milliseconds and the number of I/O Requests with a Response Time greater than 30 milliseconds.*

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are documented in “Appendix D: SPC-1 Workload Generator Input Parameters” on Page 91.

IOPS Test Results File

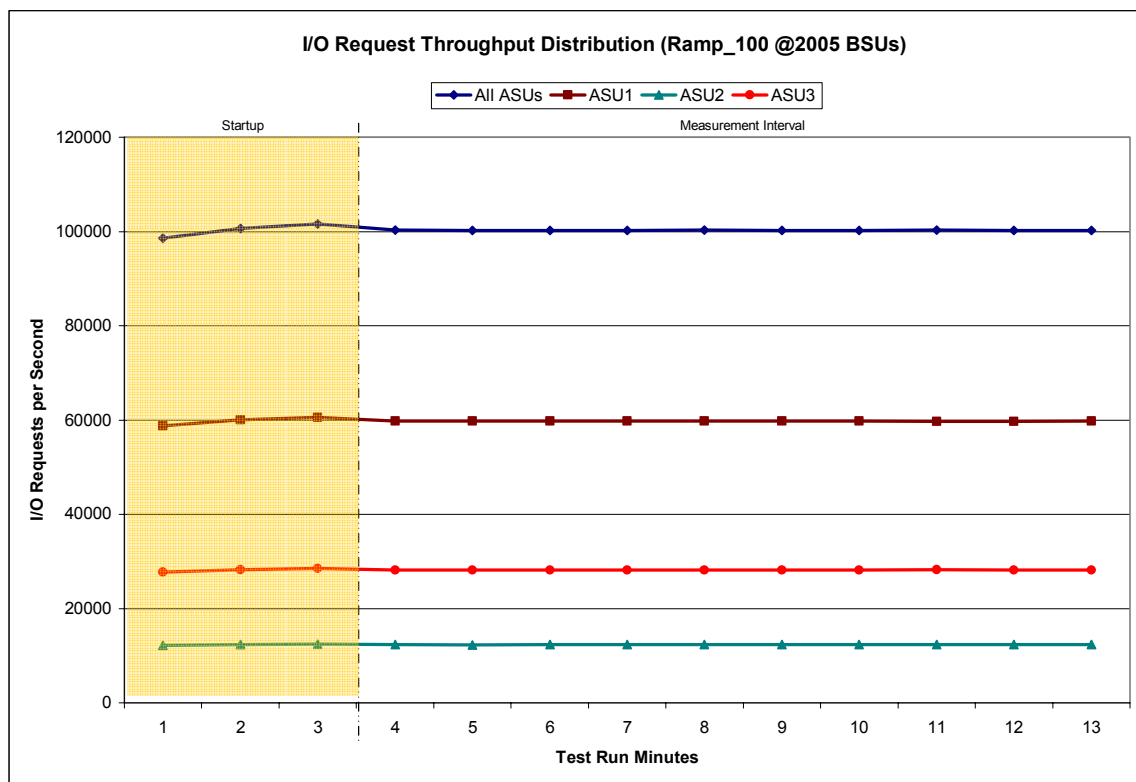
A link to the test results file generated from the IOPS Test Run is listed below.

[IOPS Test Results File](#)

IOPS Test Run – I/O Request Throughput Distribution Data

2005 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	14:18:13	14:21:14	0-2	0:03:01
<i>Measurement Interval</i>	14:21:14	14:31:14	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	98,583.62	58,729.93	12,147.88	27,705.80
1	100,656.13	60,005.53	12,363.52	28,287.08
2	101,563.43	60,535.78	12,477.82	28,549.83
3	100,262.57	59,771.35	12,328.18	28,163.03
4	100,222.08	59,743.63	12,304.63	28,173.82
5	100,236.00	59,744.82	12,347.25	28,143.93
6	100,245.73	59,756.85	12,333.70	28,155.18
7	100,278.12	59,763.90	12,330.53	28,183.68
8	100,236.67	59,755.03	12,330.12	28,151.52
9	100,246.32	59,743.97	12,323.92	28,178.43
10	100,281.85	59,725.20	12,336.72	28,219.93
11	100,194.88	59,715.50	12,341.38	28,138.00
12	100,218.03	59,746.22	12,326.23	28,145.58
Average	100,242.23	59,746.65	12,330.27	28,165.31

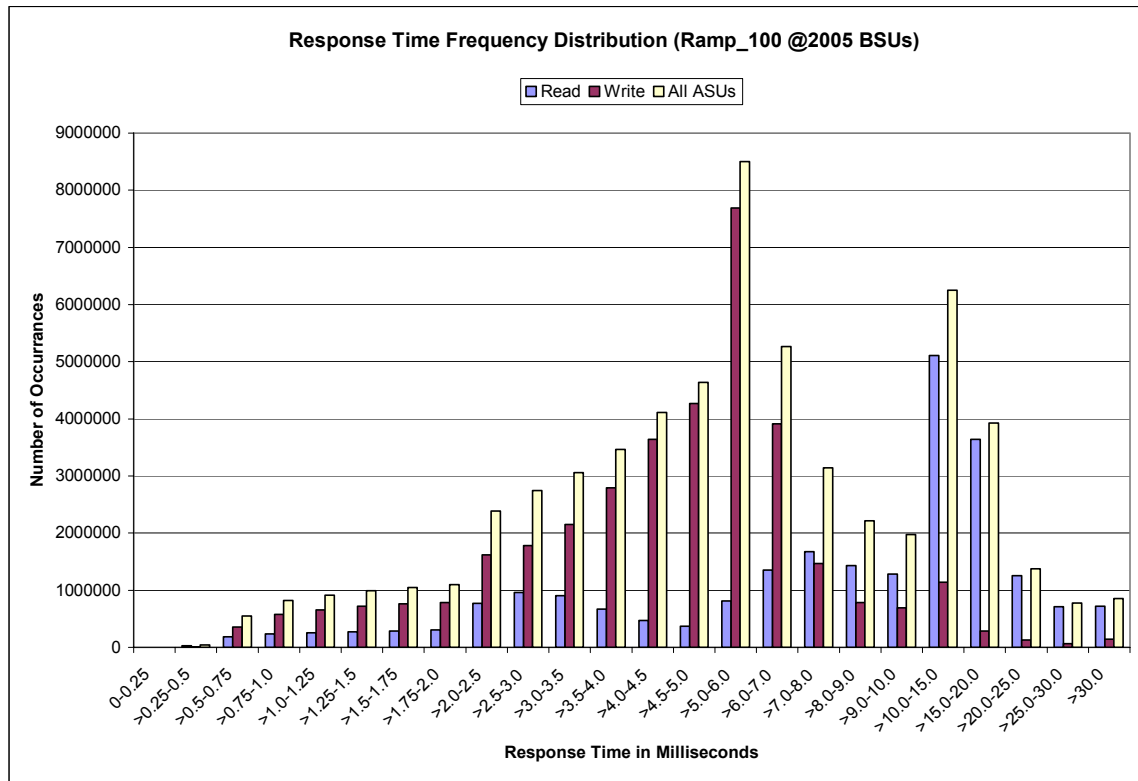
IOPS Test Run – I/O Request Throughput Distribution Graph



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	0	30,957	187,885	235,499	259,668	272,445	284,061	309,948
Write	0	9,022	357,620	580,631	652,380	717,707	764,834	785,770
All ASUs	0	39,979	545,505	816,130	912,048	990,152	1,048,895	1,095,718
ASU1	0	28,355	324,049	452,375	495,732	529,447	555,480	580,964
ASU2	0	8,862	94,158	129,323	141,108	150,522	157,860	164,799
ASU3	0	2,762	127,298	234,432	275,208	310,183	335,555	349,955
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	773,080	963,005	905,789	672,259	471,753	370,110	809,008	1,351,025
Write	1,617,415	1,779,789	2,150,982	2,790,858	3,638,810	4,271,934	7,692,341	3,915,290
All ASUs	2,390,495	2,742,794	3,056,771	3,463,117	4,110,563	4,642,044	8,501,349	5,266,315
ASU1	1,290,386	1,504,942	1,630,817	1,750,256	1,983,077	2,185,680	4,019,646	2,838,609
ASU2	373,055	438,080	463,079	465,945	491,892	513,731	863,098	482,280
ASU3	727,054	799,772	962,875	1,246,916	1,635,594	1,942,633	3,618,605	1,945,426
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	1,676,700	1,430,241	1,284,570	5,109,070	3,641,465	1,250,730	713,625	717,786
Write	1,468,242	785,638	690,281	1,140,806	286,569	124,975	62,008	139,844
All ASUs	3,144,942	2,215,879	1,974,851	6,249,876	3,928,034	1,375,705	775,633	857,630
ASU1	2,098,181	1,599,656	1,427,552	4,973,364	3,267,216	1,110,461	609,010	592,141
ASU2	296,000	228,476	205,714	688,465	510,944	200,894	135,447	194,296
ASU3	750,761	387,747	341,585	588,047	149,874	64,350	31,176	71,193

IOPS Test Run – Response Time Frequency Distribution Graph

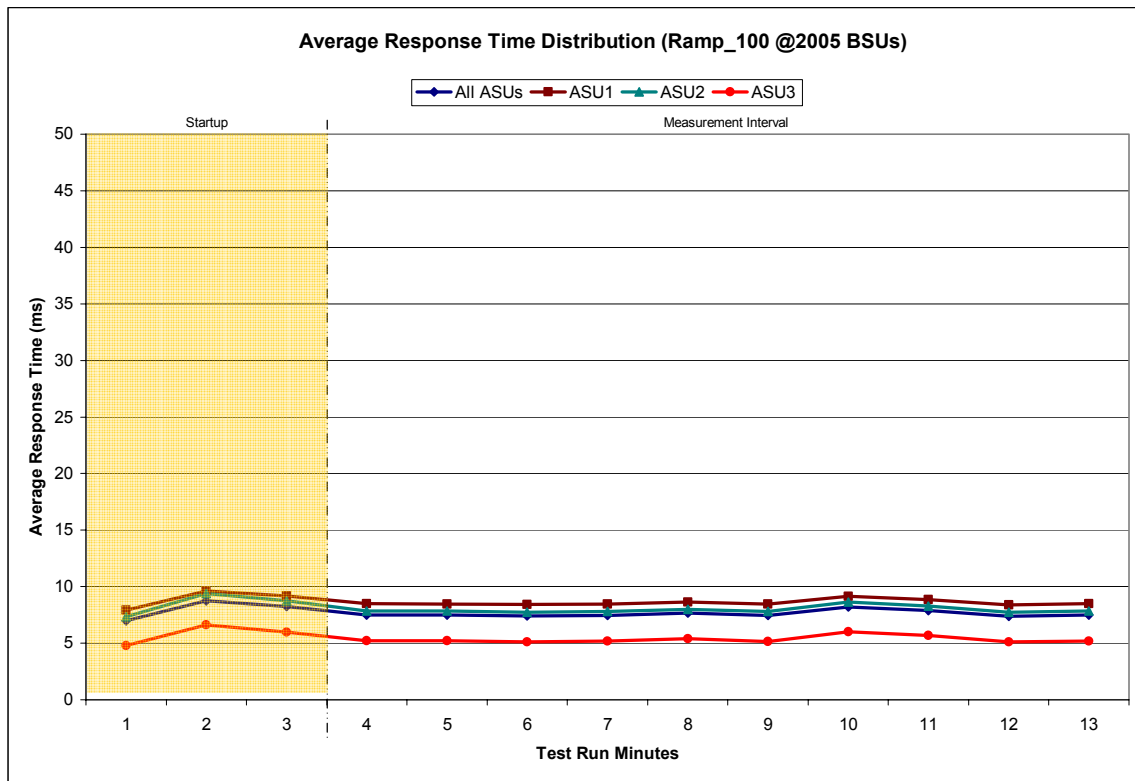


IOPS Test Run – Average Response Time (ms) Distribution Data

2005 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	14:18:13	14:21:14	0-2	0:03:01
<i>Measurement Interval</i>	14:21:14	14:31:14	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	6.97	7.91	7.35	4.80
1	8.75	9.62	9.40	6.62
2	8.24	9.20	8.74	5.99
3	7.49	8.49	7.84	5.22
4	7.47	8.46	7.83	5.21
5	7.40	8.41	7.74	5.11
6	7.46	8.46	7.81	5.19
7	7.65	8.65	8.00	5.40
8	7.44	8.45	7.82	5.16
9	8.20	9.14	8.65	6.01
10	7.89	8.84	8.29	5.68
11	7.39	8.40	7.72	5.10
12	7.49	8.49	7.85	5.19
Average	7.59	8.58	7.96	5.33

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
60,144,425	59,286,795	857,630

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	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.001	0.002	0.001	0.003	0.002	0.003	0.001

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

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

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

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 SPC-1 Workload Generator input parameters for the Sustainability, IOPS, and Response Time Ramp Test Runs are documented in “Appendix D: SPC-1 Workload Generator Input Parameters” on Page 91.

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](#)

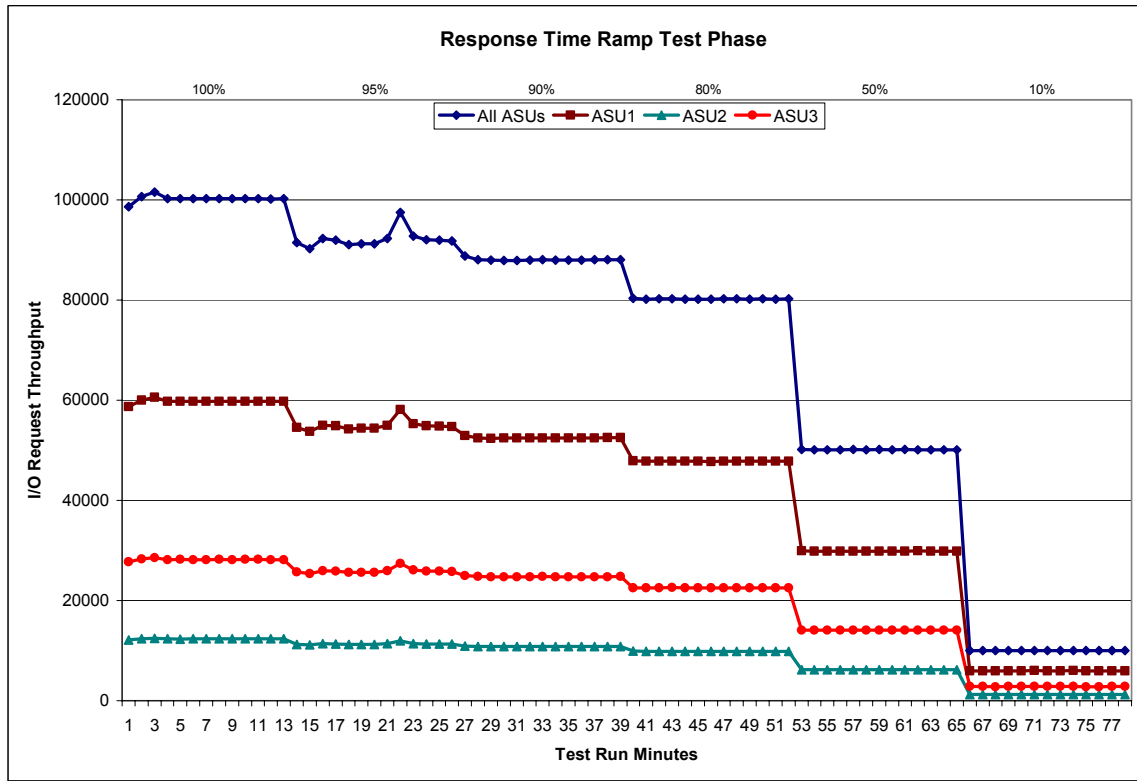
[10% Load Level](#)

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 - 2005 BSUs					95% Load Level - 1904 BSUs				
	Start	Stop	Interval	Duration		Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:18:13	14:21:14	0-2	0:03:01	Start-Up/Ramp-Up	14:32:08	14:35:09	0-2	0:03:01
Measurement Interval	14:21:14	14:31:14	3-12	0:10:00	Measurement Interval	14:35:09	14:45:09	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	98,583.62	58,729.93	12,147.88	27,705.80	0	91,488.60	54,531.48	11,253.02	25,704.10
1	100,656.13	60,005.53	12,363.52	28,287.08	1	90,214.47	53,758.02	11,110.93	25,345.52
2	101,563.43	60,535.78	12,477.82	28,549.83	2	92,241.17	54,980.83	11,343.28	25,917.05
3	100,262.57	59,771.35	12,328.18	28,163.03	3	91,986.50	54,848.65	11,305.02	25,832.83
4	100,222.08	59,743.63	12,304.63	28,173.82	4	91,021.35	54,233.05	11,196.25	25,592.05
5	100,236.00	59,744.82	12,347.25	28,143.93	5	91,240.88	54,401.70	11,215.05	25,624.13
6	100,245.73	59,756.85	12,333.70	28,155.18	6	91,249.08	54,379.45	11,223.00	25,646.63
7	100,278.12	59,743.63	12,330.53	28,183.68	7	92,292.03	54,986.30	11,363.25	25,942.48
8	100,236.67	59,755.03	12,330.12	28,151.52	8	97,505.10	58,115.62	11,988.58	27,400.90
9	100,246.32	59,743.97	12,323.92	28,178.43	9	92,765.47	55,291.22	11,405.85	26,068.40
10	100,281.85	59,725.20	12,336.72	28,219.93	10	92,011.78	54,848.93	11,312.87	25,849.98
11	100,194.88	59,715.50	12,341.38	28,138.00	11	91,981.50	54,824.32	11,287.75	25,869.43
12	100,218.03	59,746.22	12,326.23	28,145.58	12	91,813.93	54,721.57	11,303.77	25,788.60
Average	100,242.23	59,746.65	12,330.27	28,165.31	Average	92,386.76	55,065.08	11,360.14	25,961.55
90% Load Level - 1804 BSUs					80% Load Level - 1604 BSUs				
	Start	Stop	Interval	Duration		Start	Stop	Interval	Duration
Start-Up/Ramp-Up	14:46:01	14:49:02	0-2	0:03:01	Start-Up/Ramp-Up	14:59:56	15:02:57	0-2	0:03:01
Measurement Interval	14:49:02	14:59:02	3-12	0:10:00	Measurement Interval	15:02:57	15:12:57	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	88,787.33	52,930.75	10,909.67	24,946.92	0	80,310.47	47,858.68	9,895.40	22,556.38
1	88,014.43	52,430.80	10,826.98	24,756.65	1	80,156.58	47,772.22	9,870.82	22,513.55
2	87,928.50	52,381.93	10,847.67	24,698.90	2	80,213.88	47,809.40	9,870.08	22,534.40
3	87,919.87	52,414.83	10,810.53	24,694.50	3	80,220.98	47,784.43	9,875.53	22,561.02
4	87,925.80	52,436.33	10,793.07	24,696.40	4	80,162.00	47,784.58	9,868.02	22,509.40
5	87,955.92	52,399.43	10,850.97	24,705.52	5	80,181.72	47,818.78	9,858.92	22,504.02
6	88,026.22	52,427.37	10,833.87	24,764.98	6	80,158.72	47,758.18	9,868.62	22,531.92
7	87,945.20	52,415.48	10,819.60	24,710.12	7	80,219.18	47,803.70	9,860.78	22,554.70
8	87,983.43	52,438.28	10,826.33	24,718.82	8	80,223.38	47,823.90	9,851.58	22,547.90
9	87,989.62	52,427.45	10,817.40	24,744.77	9	80,180.42	47,774.87	9,860.48	22,545.07
10	88,023.53	52,470.78	10,826.77	24,725.98	10	80,206.05	47,794.52	9,856.32	22,555.22
11	88,039.52	52,499.28	10,829.12	24,711.12	11	80,182.62	47,790.82	9,856.47	22,535.33
12	88,086.92	52,499.25	10,831.23	24,756.43	12	80,225.27	47,813.40	9,877.47	22,534.40
Average	87,989.60	52,442.85	10,823.89	24,722.86	Average	80,196.03	47,794.72	9,863.42	22,537.90
50% Load Level - 1002 BSUs					10% Load Level - 200 BSUs				
	Start	Stop	Interval	Duration		Start	Stop	Interval	Duration
Start-Up/Ramp-Up	15:13:50	15:16:51	0-2	0:03:01	Start-Up/Ramp-Up	15:27:45	15:30:46	0-2	0:03:01
Measurement Interval	15:16:51	15:26:51	3-12	0:10:00	Measurement Interval	15:30:46	15:40:46	3-12	0:10:00
(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3	(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	50,136.15	29,884.53	6,171.22	14,080.40	0	9,999.55	5,953.38	1,231.57	2,814.60
1	50,081.72	29,846.25	6,159.88	14,075.58	1	9,993.90	5,958.07	1,230.10	2,805.73
2	50,095.75	29,839.03	6,163.10	14,093.62	2	9,988.70	5,952.55	1,231.47	2,804.68
3	50,096.87	29,855.87	6,153.67	14,087.33	3	9,998.23	5,950.70	1,231.65	2,815.88
4	50,132.03	29,877.65	6,162.78	14,091.60	4	9,976.40	5,938.12	1,228.40	2,809.88
5	50,067.83	29,832.73	6,173.35	14,061.75	5	10,015.62	5,979.88	1,225.57	2,810.17
6	50,130.07	29,864.63	6,167.47	14,097.97	6	9,986.82	5,950.90	1,223.52	2,812.40
7	50,083.00	29,845.05	6,147.25	14,090.70	7	9,993.98	5,950.53	1,230.37	2,813.08
8	50,128.45	29,857.68	6,169.27	14,101.50	8	10,017.08	5,975.65	1,227.35	2,814.08
9	50,119.32	29,897.03	6,156.00	14,066.28	9	9,987.55	5,960.30	1,223.52	2,803.73
10	50,068.28	29,848.02	6,148.72	14,071.55	10	9,998.45	5,968.93	1,234.40	2,795.12
11	50,052.63	29,849.98	6,140.48	14,062.17	11	9,987.25	5,952.78	1,225.28	2,809.18
12	50,110.97	29,855.67	6,167.05	14,088.25	12	10,025.57	5,974.02	1,234.95	2,816.60
Average	50,098.95	29,858.43	6,158.60	14,081.91	Average	9,998.70	5,960.18	1,228.50	2,810.01

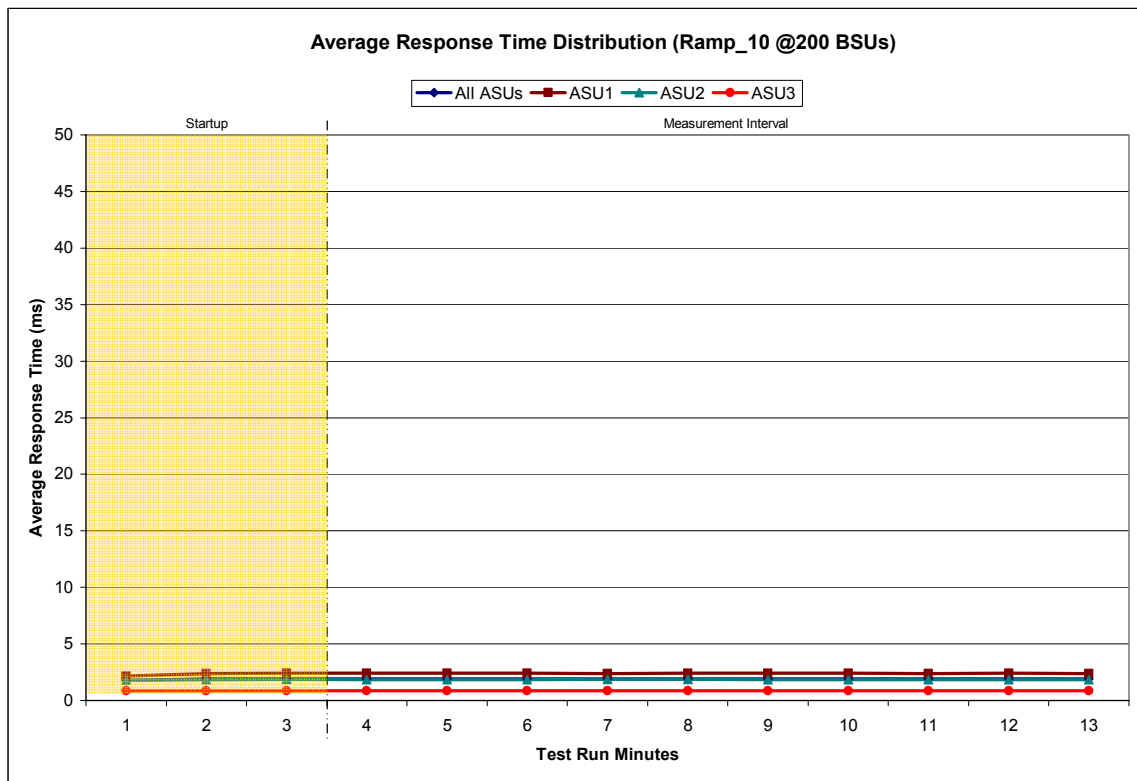
Response Time Ramp Distribution (IOPS) Graph



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

200 BSUs Start-Up/Ramp-Up Measurement Interval	Start	Stop	Interval	Duration
	15:27:45	15:30:46	0-2	0:03:01
	15:30:46	15:40:46	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.75	2.17	1.80	0.85
1	1.89	2.39	1.84	0.86
2	1.91	2.42	1.86	0.86
3	1.90	2.41	1.84	0.86
4	1.90	2.41	1.84	0.86
5	1.90	2.40	1.84	0.86
6	1.89	2.39	1.86	0.86
7	1.90	2.41	1.86	0.86
8	1.90	2.40	1.85	0.86
9	1.90	2.40	1.84	0.86
10	1.89	2.39	1.83	0.86
11	1.90	2.40	1.85	0.86
12	1.89	2.39	1.84	0.86
Average	1.90	2.40	1.85	0.86

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
<i>IM</i>	0.0350	0.2810	0.0700	0.2100	0.0180	0.0700	0.0350	0.2810
<i>MIM</i>	0.0350	0.2809	0.0701	0.2101	0.0180	0.0700	0.0349	0.2810
<i>COV</i>	0.008	0.002	0.005	0.003	0.009	0.005	0.005	0.002

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

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

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

Repeatability Test

Clause 5.4.3

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

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

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

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

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

Clause 9.2.4.7.3

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

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Repeatability Test Runs are documented in “Appendix D: SPC-1 Workload Generator Input Parameters” on Page 91.

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	100,242.23	1.90
Repeatability Test Phase 1	100,266.06	1.90
Repeatability Test Phase 2	100,296.50	1.90

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 \(IOPS\)](#)

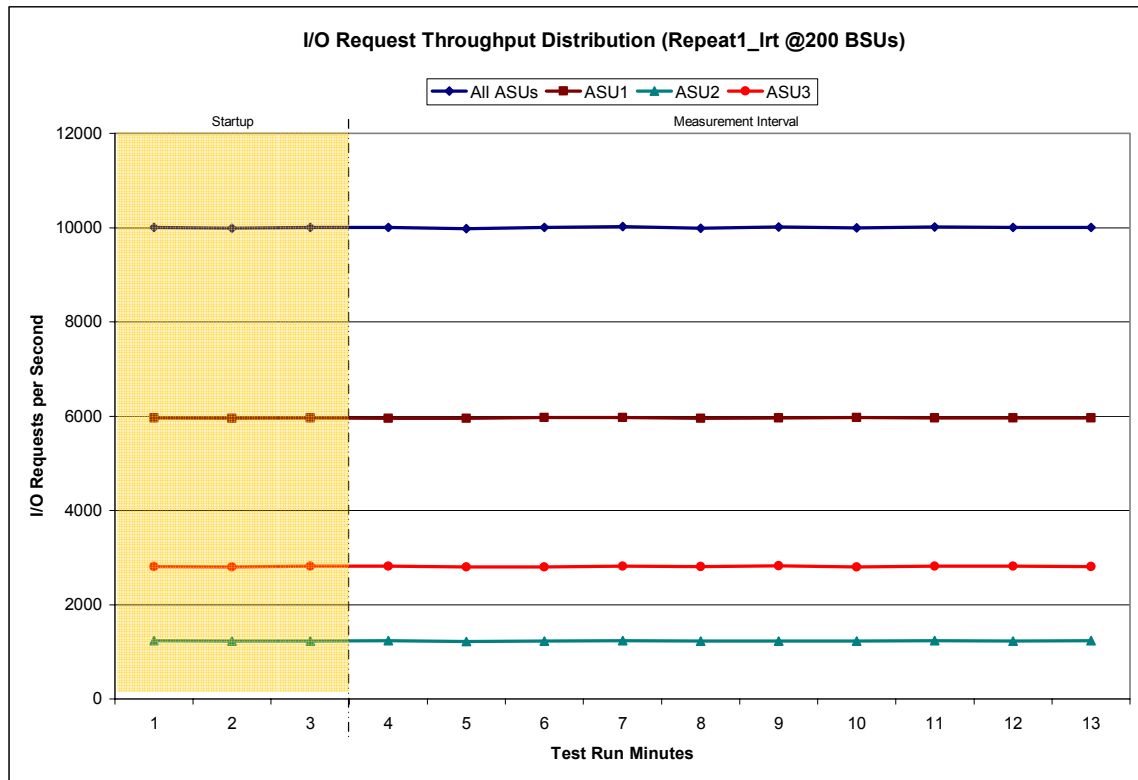
[Repeatability Test Phase 2, Test Run 1 \(LRT\)](#)

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

Repeatability 1 LRT – I/O Request Throughput Distribution Data

200 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	15:42:30	15:45:30	0-2	0:03:00
<i>Measurement Interval</i>	15:45:30	15:55:30	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10,002.77	5,958.47	1,235.33	2,808.97
1	9,985.27	5,953.32	1,229.48	2,802.47
2	10,005.28	5,959.75	1,227.22	2,818.32
3	10,003.85	5,956.78	1,234.20	2,812.87
4	9,982.10	5,956.72	1,221.98	2,803.40
5	10,002.43	5,971.97	1,227.75	2,802.72
6	10,018.18	5,966.33	1,233.68	2,818.17
7	9,988.22	5,952.82	1,226.45	2,808.95
8	10,013.72	5,963.33	1,228.08	2,822.30
9	9,995.17	5,965.65	1,227.03	2,802.48
10	10,013.30	5,957.27	1,238.87	2,817.17
11	10,005.53	5,962.02	1,227.05	2,816.47
12	10,001.68	5,958.00	1,233.43	2,810.25
Average	10,002.42	5,961.09	1,229.85	2,811.48

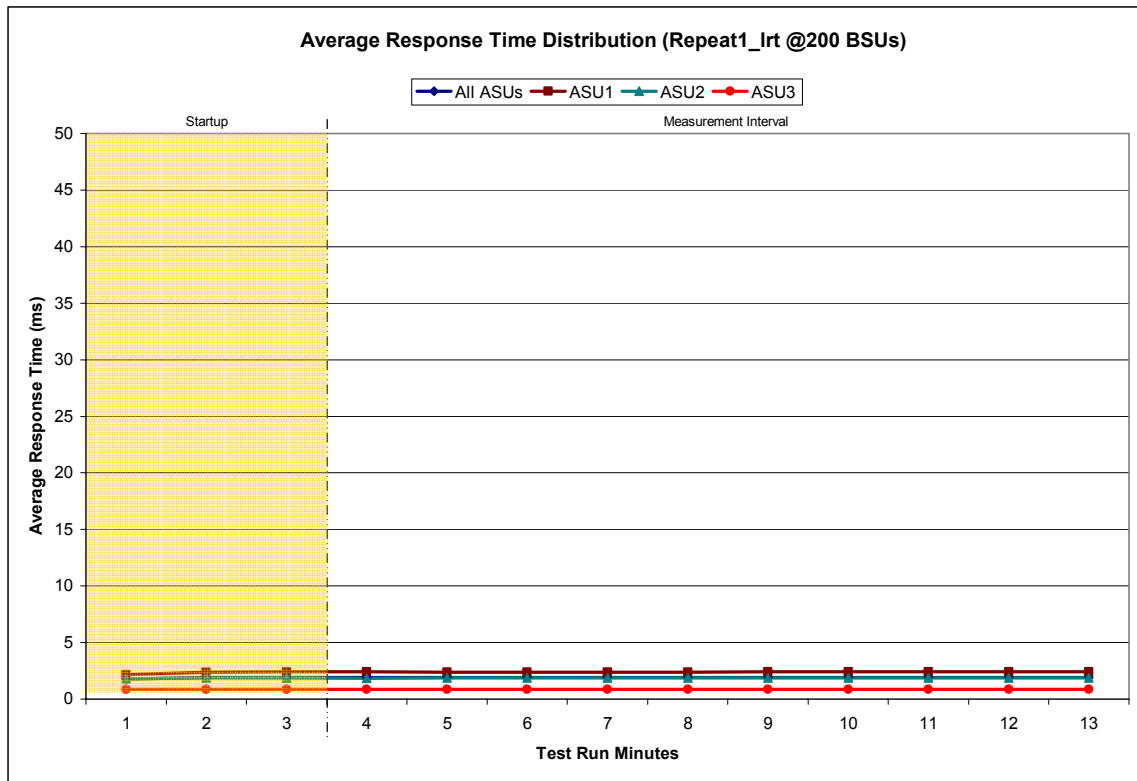
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

200 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	15:42:30	15:45:30	0-2	0:03:00
<i>Measurement Interval</i>	15:45:30	15:55:30	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.76	2.17	1.81	0.86
1	1.89	2.38	1.87	0.87
2	1.90	2.40	1.86	0.87
3	1.90	2.40	1.85	0.87
4	1.90	2.39	1.86	0.86
5	1.90	2.39	1.88	0.86
6	1.89	2.39	1.86	0.87
7	1.89	2.39	1.86	0.87
8	1.90	2.40	1.87	0.87
9	1.90	2.39	1.88	0.87
10	1.90	2.39	1.85	0.87
11	1.90	2.40	1.85	0.87
12	1.90	2.39	1.85	0.86
Average	1.90	2.39	1.86	0.87

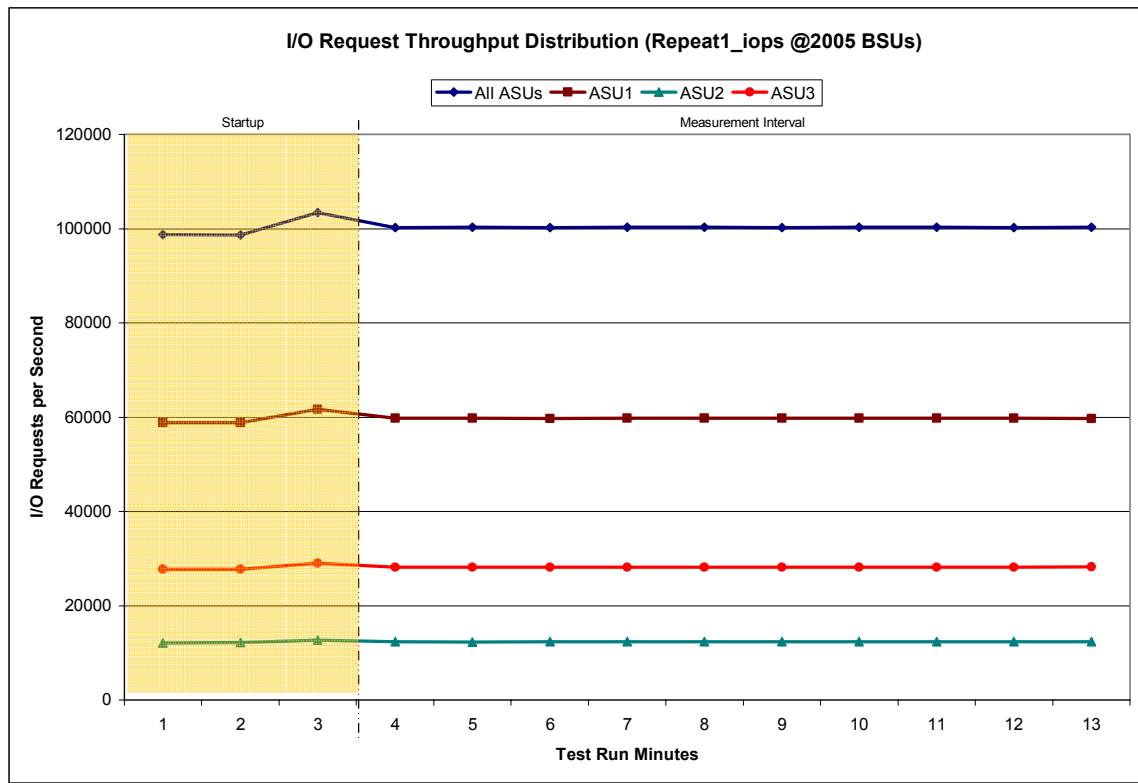
Repeatability 1 LRT –Average Response Time (ms) Distribution Graph



Repeatability 1 IOPS – I/O Request Throughput Distribution Data

2005 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	15:56:34	15:59:35	0-2	0:03:01
<i>Measurement Interval</i>	15:59:35	16:09:35	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	98,710.42	58,834.95	12,123.88	27,751.58
1	98,675.22	58,802.42	12,138.53	27,734.27
2	103,438.35	61,652.10	12,718.13	29,068.12
3	100,216.72	59,752.22	12,328.67	28,135.83
4	100,290.03	59,799.17	12,306.58	28,184.28
5	100,245.67	59,740.63	12,347.77	28,157.27
6	100,263.80	59,758.05	12,343.57	28,162.18
7	100,269.35	59,747.88	12,318.03	28,203.43
8	100,232.65	59,750.17	12,318.08	28,164.40
9	100,297.98	59,790.47	12,334.47	28,173.05
10	100,313.42	59,768.68	12,353.25	28,191.48
11	100,257.20	59,774.88	12,324.58	28,157.73
12	100,273.80	59,740.65	12,317.95	28,215.20
Average	100,266.06	59,762.28	12,329.30	28,174.49

Repeatability 1 IOPS – I/O Request Throughput Distribution Graph

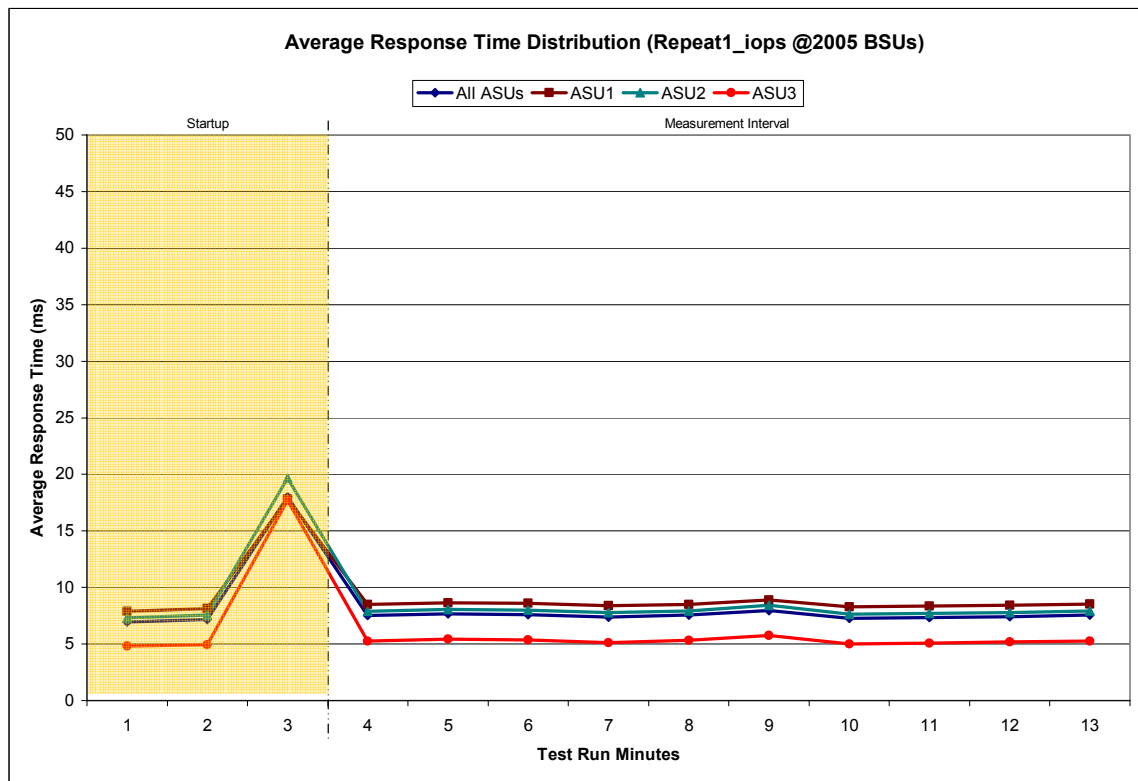


Repeatability 1 IOPS –Average Response Time (ms) Distribution Data

2005 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	15:56:34	15:59:35	0-2	0:03:01
<i>Measurement Interval</i>	15:59:35	16:09:35	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	6.96	7.89	7.32	4.84
1	7.17	8.14	7.55	4.95
2	18.01	17.80	19.67	17.71
3	7.52	8.50	7.89	5.27
4	7.66	8.62	8.06	5.43
5	7.61	8.59	7.98	5.36
6	7.39	8.38	7.79	5.12
7	7.55	8.51	7.94	5.33
8	7.96	8.91	8.41	5.75
9	7.28	8.28	7.62	5.00
10	7.34	8.34	7.70	5.07
11	7.43	8.42	7.79	5.17
12	7.55	8.55	7.92	5.27
Average	7.53	8.51	7.91	5.28

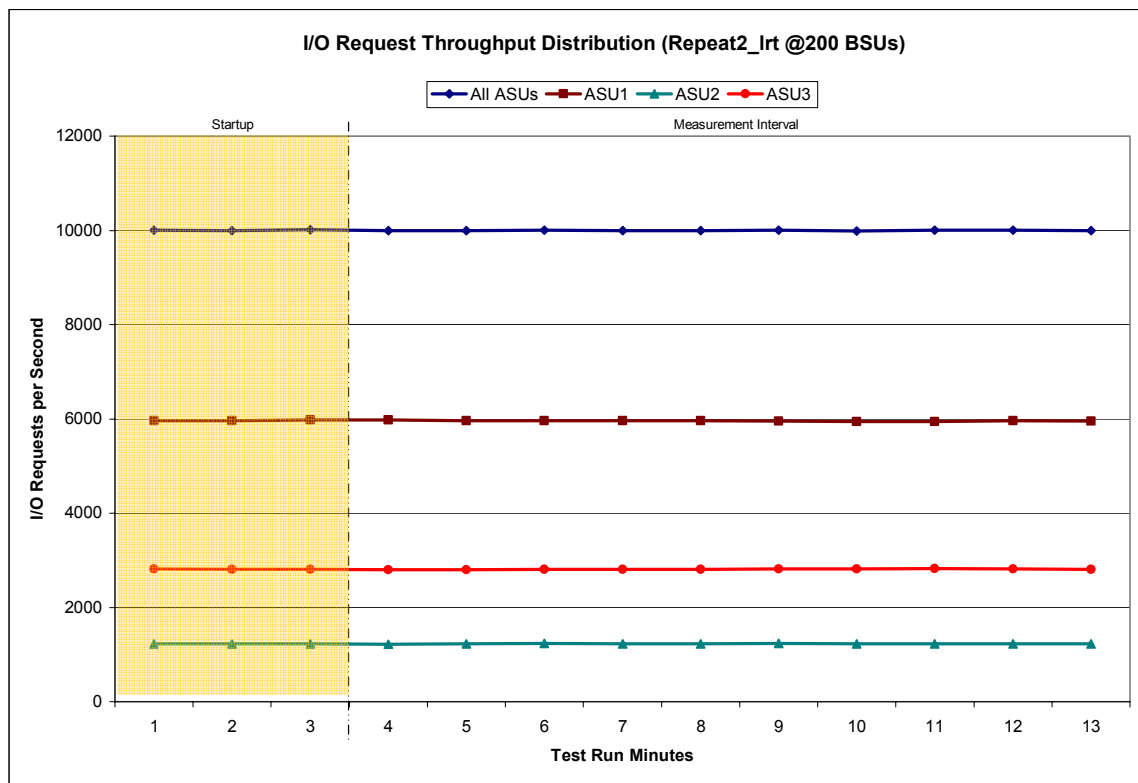
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

200 BSUs				
	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	16:11:15	16:14:15	0-2	0:03:00
<i>Measurement Interval</i>	16:14:15	16:24:15	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	10,008.48	5,964.45	1,227.55	2,816.48
1	9,997.30	5,961.30	1,225.22	2,810.78
2	10,013.25	5,979.90	1,229.27	2,804.08
3	9,994.58	5,975.43	1,218.75	2,800.40
4	9,996.08	5,964.12	1,228.58	2,803.38
5	10,001.18	5,962.90	1,232.98	2,805.30
6	9,997.60	5,960.37	1,227.28	2,809.95
7	9,994.20	5,957.82	1,226.43	2,809.95
8	10,004.45	5,954.93	1,236.32	2,813.20
9	9,988.67	5,943.93	1,229.13	2,815.60
10	10,000.77	5,948.02	1,225.53	2,827.22
11	10,000.40	5,957.43	1,229.35	2,813.62
12	9,998.07	5,955.60	1,230.75	2,811.72
Average	9,997.60	5,958.06	1,228.51	2,811.03

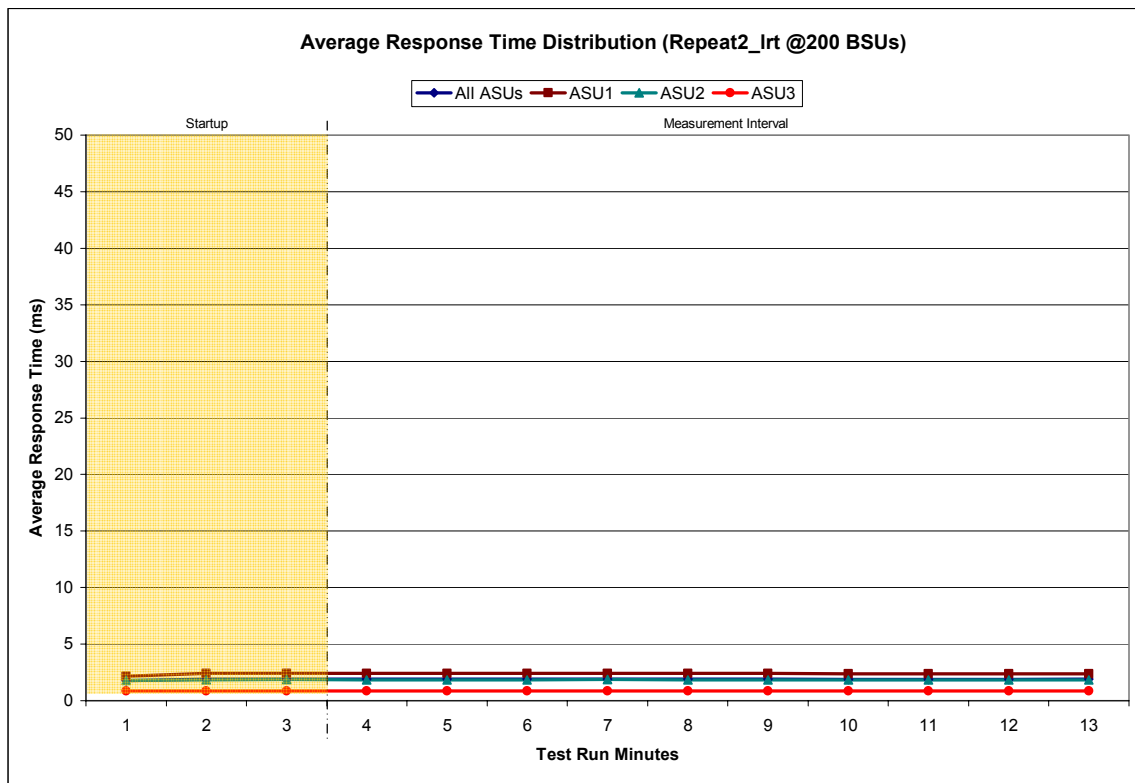
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

200 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	16:11:15	16:14:15	0-2	0:03:00
<i>Measurement Interval</i>	16:14:15	16:24:15	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	1.75	2.17	1.79	0.86
1	1.90	2.40	1.84	0.86
2	1.91	2.41	1.85	0.86
3	1.91	2.41	1.85	0.86
4	1.90	2.40	1.83	0.86
5	1.90	2.40	1.85	0.86
6	1.90	2.40	1.86	0.86
7	1.90	2.39	1.85	0.86
8	1.89	2.39	1.84	0.86
9	1.89	2.38	1.85	0.86
10	1.89	2.39	1.84	0.85
11	1.89	2.39	1.84	0.86
12	1.89	2.39	1.85	0.86
Average	1.90	2.39	1.85	0.86

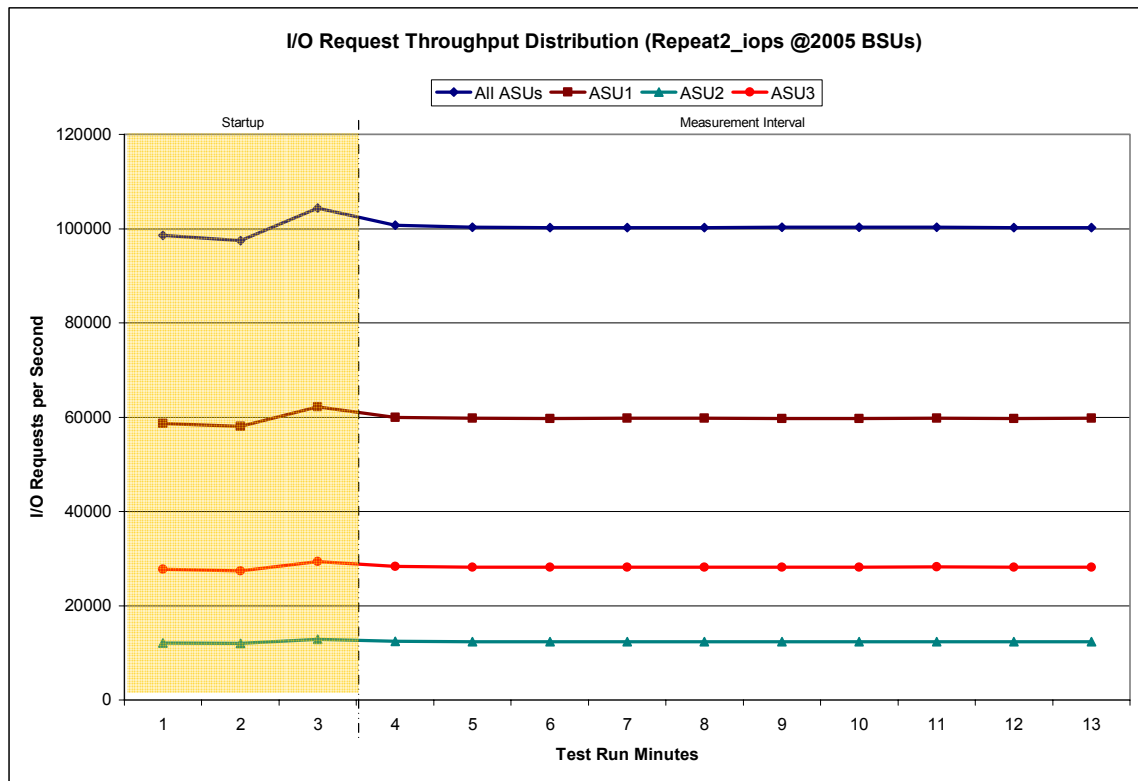
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

2005 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	16:25:18	16:28:19	0-2	0:03:01
Measurement Interval	16:28:19	16:38:19	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	98,537.95	58,686.12	12,130.32	27,721.52
1	97,453.07	58,089.28	12,007.78	27,356.00
2	104,385.65	62,192.98	12,837.18	29,355.48
3	100,732.23	59,998.70	12,402.82	28,330.72
4	100,316.45	59,800.55	12,331.90	28,184.00
5	100,185.45	59,697.40	12,327.32	28,160.73
6	100,243.38	59,741.78	12,335.35	28,166.25
7	100,204.72	59,741.40	12,331.72	28,131.60
8	100,264.63	59,736.45	12,337.27	28,190.92
9	100,266.18	59,737.93	12,330.00	28,198.25
10	100,319.47	59,756.92	12,352.97	28,209.58
11	100,216.62	59,720.75	12,323.13	28,172.73
12	100,215.82	59,768.67	12,323.58	28,123.57
Average	100,296.50	59,770.06	12,339.61	28,186.84

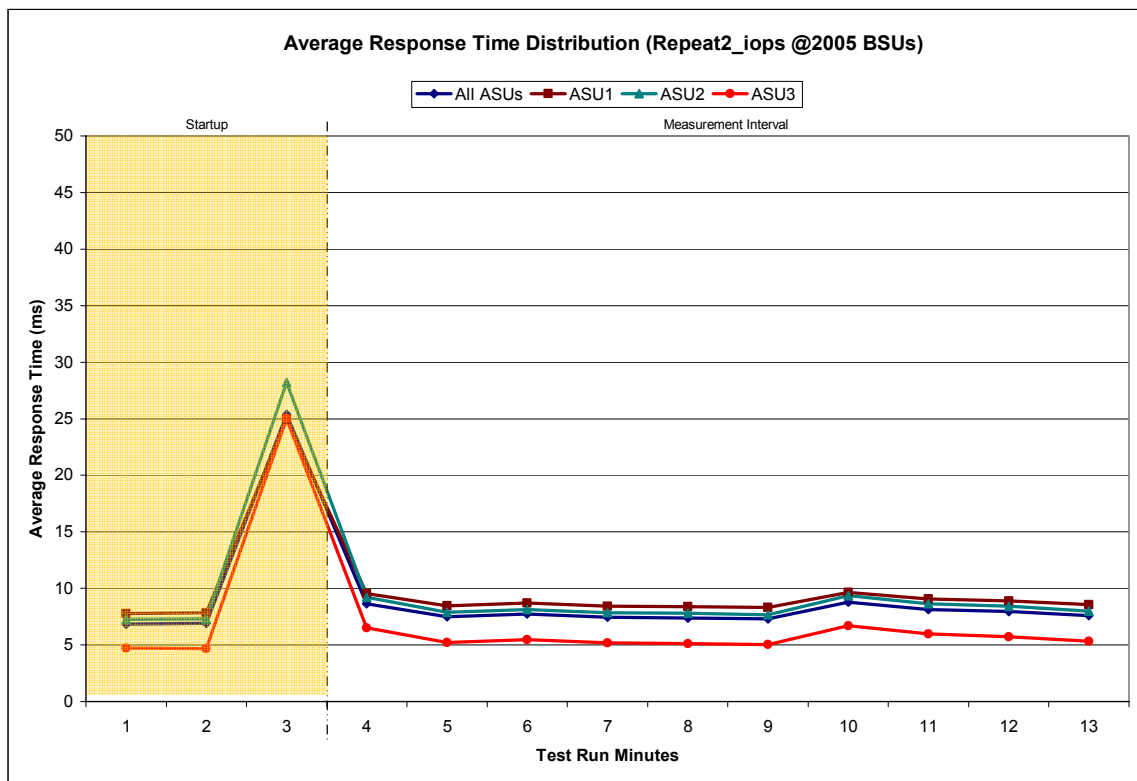
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

2005 BSUs	Start	Stop	Interval	Duration
<i>Start-Up/Ramp-Up</i>	16:25:18	16:28:19	0-2	0:03:01
<i>Measurement Interval</i>	16:28:19	16:38:19	3-12	0:10:00
60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	6.85	7.77	7.28	4.71
1	6.90	7.85	7.32	4.67
2	25.37	24.96	28.24	25.01
3	8.65	9.54	9.21	6.51
4	7.48	8.47	7.89	5.21
5	7.72	8.70	8.15	5.46
6	7.45	8.44	7.86	5.18
7	7.40	8.39	7.80	5.12
8	7.31	8.31	7.68	5.02
9	8.78	9.64	9.35	6.69
10	8.15	9.08	8.66	5.97
11	7.94	8.89	8.43	5.71
12	7.59	8.57	8.01	5.32
Average	7.85	8.80	8.30	5.62

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	0.0349	0.2811	0.0701	0.2099	0.0180	0.0700	0.0350	0.2811
COV	0.006	0.003	0.004	0.003	0.009	0.005	0.007	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.

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	0.2100	0.0180	0.0700	0.0350	0.2810
COV	0.003	0.000	0.001	0.001	0.005	0.001	0.003	0.001

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	0.0350	0.2809	0.0699	0.2101	0.0180	0.0699	0.0350	0.2812
COV	0.005	0.002	0.005	0.003	0.009	0.005	0.005	0.003

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	0.2811	0.0700	0.2099	0.0180	0.0701	0.0350	0.2810
COV	0.001	0.001	0.001	0.001	0.003	0.000	0.002	0.001

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 SPC-1 Workload Generator input parameters for the Persistence Test Runs are documented in “Appendix D: SPC-1 Workload Generator Input Parameters” on Page 91.

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	62,021,072
Total Number of Logical Blocks Verified	54,473,824
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 ETERNUS6000 Model 1100, as documented in this Full Disclosure Report will become available for customer purchase and shipment on December 28, 2004.

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 ETERNUS6000 Model 1100.

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 PRIMEPOWER2500:

```
*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)
forceload:   drv/se
forceload:   drv/fjmse

* 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 disable_memscrub = 1
```

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 ETERNUS6000 Model 1100 Storage System:

```
# 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;

# lun-queue-depth: the default value lpfc will use to limit
# the number of outstanding commands per FCP LUN. This value is
# global, affecting each LUN recognized by the driver, but may be
# overridden on a per-LUN basis (see below). RAID arrays may want
# to be configured using the per-LUN tunable throttles.
lun-queue-depth=10;

# 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=45;

# Set loop mode if you want to run as an NL_Port.
topology=4;
```

APPENDIX B: TESTED STORAGE CONFIGURATION (TSC) CREATION

HBA to LUN Access – *Entries in “sd.conf”*

The following entries in sd.conf were defined to enable the Emulex HBAs for accessing the LUNs defined in the ETERNUS6000 Model 1100.

```
# Copyright (c) 1992, by Sun Microsystems, Inc.
#
#ident"@(#)sd.conf      1.9      98/01/11 SMI"

name="sd" class="scsi" class_prop="atapi"
    target=0 lun=0;

name="sd" class="scsi" class_prop="atapi"
    target=1 lun=0;

name="sd" class="scsi" class_prop="atapi"
    target=2 lun=0;

name="sd" class="scsi" class_prop="atapi"
    target=3 lun=0;

name="sd" class="scsi"
    target=4 lun=0;

name="sd" class="scsi"
    target=16 lun=0;

name="sd" class="scsi"
    target=17 lun=0;

name="sd" class="scsi"
    target=18 lun=0;

name="sd" class="scsi"
    target=19 lun=0;

# Start lpfc auto-generated configuration -- do NOT alter or delete this line
# WARNING: anything you put within this auto-generated section will
# be DELETED if you execute pkgm to remove the lpfc driver package.
# You may need to add additional lines to probe for additional LUNs
# or targets. You SHOULD delete any lines that represent lpfc targets
# or LUNs that are not used.
# You should add any new entries between this line
# and the End lpfc auto generated configuration line
# name="sd" parent="lpfc" target=16 lun=0;
# name="sd" parent="lpfc" target=16 lun=0;
# A small number of LUNs for a RAID array
# name="sd" parent="lpfc" target=16 lun=1;
# name="sd" parent="lpfc" target=16 lun=2;
# name="sd" parent="lpfc" target=16 lun=3;
name="sd" parent="lpfc" target=16 lun=0;
name="sd" parent="lpfc" target=16 lun=1;
name="sd" parent="lpfc" target=16 lun=2;
name="sd" parent="lpfc" target=16 lun=3;
name="sd" parent="lpfc" target=16 lun=4;
name="sd" parent="lpfc" target=16 lun=5;
name="sd" parent="lpfc" target=16 lun=6;
name="sd" parent="lpfc" target=16 lun=7;
```

```
name="sd" parent="lpfc" target=16 lun=8;
name="sd" parent="lpfc" target=16 lun=9;
name="sd" parent="lpfc" target=16 lun=10;
name="sd" parent="lpfc" target=16 lun=11;
name="sd" parent="lpfc" target=16 lun=12;
name="sd" parent="lpfc" target=16 lun=13;
name="sd" parent="lpfc" target=16 lun=14;
name="sd" parent="lpfc" target=16 lun=15;
name="sd" parent="lpfc" target=16 lun=16;
name="sd" parent="lpfc" target=16 lun=17;
name="sd" parent="lpfc" target=16 lun=18;
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name="sd" parent="lpfc" target=17 lun=14;
name="sd" parent="lpfc" target=17 lun=15;
name="sd" parent="lpfc" target=17 lun=16;
name="sd" parent="lpfc" target=17 lun=17;
name="sd" parent="lpfc" target=17 lun=18;
name="sd" parent="lpfc" target=17 lun=19;
```

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



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

```
name="sd" parent="lpfc" target=19 lun=44;  
name="sd" parent="lpfc" target=19 lun=45;  
name="sd" parent="lpfc" target=19 lun=46;  
name="sd" parent="lpfc" target=19 lun=47;  
name="sd" parent="lpfc" target=19 lun=48;  
name="sd" parent="lpfc" target=19 lun=49;  
# End lpfc auto-generated configuration -- do NOT alter or delete this line
```

Scripts and Commands to Configure Storage

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 700 Storage system.

1. makesol

The **makesol** script is used to create the Solaris Volume Manager (SVM) logical volumes based on a configuration description file, **E6000M110_8M_G07-5-1_svmake.txt**. This script is called by:

```
./makesol E6000M110_8M_G07-5-1_svmake.txt
```

2. E6000M110_8M_G07-5-1_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.

The details 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 $2 }'`
                sec cyl=`prtvtoc /dev/dsk/$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=$secCount*$sec cyl ))
                        fs=$sec cyl
                        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
                fi
            done
        done
    done
}

```

```

                                done
                                fi
                                echo "$1 $2 $3 $4 $5 $6" >> $LABELFILE
                                tmp=`fmthard -s $LABELFILE /dev/rdisk/$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"
                fi
            *)
                ;;
        esac
    done
}
```

```
        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
    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
```



```
fi
tmp=`/usr/sbin/metastat -p > $STATFILE`
checkConfig
delGroups
setVtoc
makevol
```

E6000M110 8M G07-5-1 svmake.txt

```
DELETE_ALL
VOLUME_GROUP: asu1-1 (d0)
STRIPE 8m
VOLUME 1
c96t16d4
c112t16d4
c104t16d4
c120t16d4
c98t17d4
c114t17d4
c106t17d4
c122t17d4
c100t18d4
c116t18d4
c108t18d4
c124t18d4
c102t19d4
c118t19d4
c110t19d4
c126t19d4
c96t16d13
c112t16d13
c104t16d13
c120t16d13
c98t17d13
c114t17d13
c106t17d13
c122t17d13
c100t18d13
c116t18d13
c108t18d13
c124t18d13
c102t19d13
c118t19d13
c110t19d13
c126t19d13
c96t16d22
c112t16d22
c104t16d22
c120t16d22
c98t17d22
c114t17d22
c106t17d22
c122t17d22
c100t18d22
c116t18d22
c108t18d22
c124t18d22
c102t19d22
c118t19d22
```

c110t19d22
c126t19d22
c96t16d31
c112t16d31
c104t16d31
c120t16d31
c98t17d31
c114t17d31
c106t17d31
c122t17d31
c100t18d31
c116t18d31
c108t18d31
c124t18d31
c102t19d31
c118t19d31
c110t19d31
c126t19d31
c96t16d40
c112t16d40
c104t16d40
c120t16d40
c98t17d40
c114t17d40
c106t17d40
c122t17d40
c100t18d40
c116t18d40
c108t18d40
c124t18d40
c102t19d40
c118t19d40
c110t19d40
c126t19d40
END

VOLUME_GROUP: asu1-2 (d1)

STRIPE 8m

VOLUME 1

c96t16d5
c112t16d5
c104t16d5
c120t16d5
c98t17d5
c114t17d5
c106t17d5
c122t17d5
c100t18d5
c116t18d5
c108t18d5
c124t18d5
c102t19d5
c118t19d5
c110t19d5
c126t19d5
c96t16d14
c112t16d14
c104t16d14
c120t16d14
c98t17d14
c114t17d14
c106t17d14
c122t17d14

c100t18d14
c116t18d14
c108t18d14
c124t18d14
c102t19d14
c118t19d14
c110t19d14
c126t19d14
c96t16d23
c112t16d23
c104t16d23
c120t16d23
c98t17d23
c114t17d23
c106t17d23
c122t17d23
c100t18d23
c116t18d23
c108t18d23
c124t18d23
c102t19d23
c118t19d23
c110t19d23
c126t19d23
c96t16d32
c112t16d32
c104t16d32
c120t16d32
c98t17d32
c114t17d32
c106t17d32
c122t17d32
c100t18d32
c116t18d32
c108t18d32
c124t18d32
c102t19d32
c118t19d32
c110t19d32
c126t19d32
c96t16d41
c112t16d41
c104t16d41
c120t16d41
c98t17d41
c114t17d41
c106t17d41
c122t17d41
c100t18d41
c116t18d41
c108t18d41
c124t18d41
c102t19d41
c118t19d41
c110t19d41
c126t19d41
END

VOLUME_GROUP: asu1-3 (d2)
STRIPE 8m
VOLUME 1
c96t16d6
c112t16d6

c104t16d6
c120t16d6
c98t17d6
c114t17d6
c106t17d6
c122t17d6
c100t18d6
c116t18d6
c108t18d6
c124t18d6
c102t19d6
c118t19d6
c110t19d6
c126t19d6
c96t16d15
c112t16d15
c104t16d15
c120t16d15
c98t17d15
c114t17d15
c106t17d15
c122t17d15
c100t18d15
c116t18d15
c108t18d15
c124t18d15
c102t19d15
c118t19d15
c110t19d15
c126t19d15
c96t16d24
c112t16d24
c104t16d24
c120t16d24
c98t17d24
c114t17d24
c106t17d24
c122t17d24
c100t18d24
c116t18d24
c108t18d24
c124t18d24
c102t19d24
c118t19d24
c110t19d24
c126t19d24
c96t16d33
c112t16d33
c104t16d33
c120t16d33
c98t17d33
c114t17d33
c106t17d33
c122t17d33
c100t18d33
c116t18d33
c108t18d33
c124t18d33
c102t19d33
c118t19d33
c110t19d33
c126t19d33

c96t16d42
c112t16d42
c104t16d42
c120t16d42
c98t17d42
c114t17d42
c106t17d42
c122t17d42
c100t18d42
c116t18d42
c108t18d42
c124t18d42
c102t19d42
c118t19d42
c110t19d42
c126t19d42
END
VOLUME_GROUP: asu1-4 (d3)
STRIPE 8m
VOLUME 1
c96t16d7
c112t16d7
c104t16d7
c120t16d7
c98t17d7
c114t17d7
c106t17d7
c122t17d7
c100t18d7
c116t18d7
c108t18d7
c124t18d7
c102t19d7
c118t19d7
c110t19d7
c126t19d7
c96t16d16
c112t16d16
c104t16d16
c120t16d16
c98t17d16
c114t17d16
c106t17d16
c122t17d16
c100t18d16
c116t18d16
c108t18d16
c124t18d16
c102t19d16
c118t19d16
c110t19d16
c126t19d16
c96t16d25
c112t16d25
c104t16d25
c120t16d25
c98t17d25
c114t17d25
c106t17d25
c122t17d25
c100t18d25
c116t18d25

c108t18d25
c124t18d25
c102t19d25
c118t19d25
c110t19d25
c126t19d25
c96t16d34
c112t16d34
c104t16d34
c120t16d34
c98t17d34
c114t17d34
c106t17d34
c122t17d34
c100t18d34
c116t18d34
c108t18d34
c124t18d34
c102t19d34
c118t19d34
c110t19d34
c126t19d34
c96t16d43
c112t16d43
c104t16d43
c120t16d43
c98t17d43
c114t17d43
c106t17d43
c122t17d43
c100t18d43
c116t18d43
c108t18d43
c124t18d43
c102t19d43
c118t19d43
c110t19d43
c126t19d43
END

VOLUME_GROUP: asu1-5 (d4)

STRIPE 8m

VOLUME 1

c97t16d1
c113t16d1
c105t16d1
c121t16d1
c99t17d1
c115t17d1
c107t17d1
c123t17d1
c101t18d1
c117t18d1
c109t18d1
c125t18d1
c103t19d1
c119t19d1
c111t19d1
c127t19d1
c97t16d10
c113t16d10
c105t16d10
c121t16d10

c99t17d10
c115t17d10
c107t17d10
c123t17d10
c101t18d10
c117t18d10
c109t18d10
c125t18d10
c103t19d10
c119t19d10
c111t19d10
c127t19d10
c97t16d19
c113t16d19
c105t16d19
c121t16d19
c99t17d19
c115t17d19
c107t17d19
c123t17d19
c101t18d19
c117t18d19
c109t18d19
c125t18d19
c103t19d19
c119t19d19
c111t19d19
c127t19d19
c97t16d28
c113t16d28
c105t16d28
c121t16d28
c99t17d28
c115t17d28
c107t17d28
c123t17d28
c101t18d28
c117t18d28
c109t18d28
c125t18d28
c103t19d28
c119t19d28
c111t19d28
c127t19d28
c97t16d37
c113t16d37
c105t16d37
c121t16d37
c99t17d37
c115t17d37
c107t17d37
c123t17d37
c101t18d37
c117t18d37
c109t18d37
c125t18d37
c103t19d37
c119t19d37
c111t19d37
c127t19d37
END
VOLUME_GROUP: asu1-6 (d5)

STRIPE 8m
VOLUME 1
c97t16d2
c113t16d2
c105t16d2
c121t16d2
c99t17d2
c115t17d2
c107t17d2
c123t17d2
c101t18d2
c117t18d2
c109t18d2
c125t18d2
c103t19d2
c119t19d2
c111t19d2
c127t19d2
c97t16d11
c113t16d11
c105t16d11
c121t16d11
c99t17d11
c115t17d11
c107t17d11
c123t17d11
c101t18d11
c117t18d11
c109t18d11
c125t18d11
c103t19d11
c119t19d11
c111t19d11
c127t19d11
c97t16d20
c113t16d20
c105t16d20
c121t16d20
c99t17d20
c115t17d20
c107t17d20
c123t17d20
c101t18d20
c117t18d20
c109t18d20
c125t18d20
c103t19d20
c119t19d20
c111t19d20
c127t19d20
c97t16d29
c113t16d29
c105t16d29
c121t16d29
c99t17d29
c115t17d29
c107t17d29
c123t17d29
c101t18d29
c117t18d29
c109t18d29
c125t18d29


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c103t19d29
c119t19d29
c111t19d29
c127t19d29
c97t16d38
c113t16d38
c105t16d38
c121t16d38
c99t17d38
c115t17d38
c107t17d38
c123t17d38
c101t18d38
c117t18d38
c109t18d38
c125t18d38
c103t19d38
c119t19d38
c111t19d38
c127t19d38
END
VOLUME_GROUP: asu1-7 (d6)
STRIPE 8m
VOLUME 1
c97t16d3
c113t16d3
c105t16d3
c121t16d3
c99t17d3
c115t17d3
c107t17d3
c123t17d3
c101t18d3
c117t18d3
c109t18d3
c125t18d3
c103t19d3
c119t19d3
c111t19d3
c127t19d3
c97t16d12
c113t16d12
c105t16d12
c121t16d12
c99t17d12
c115t17d12
c107t17d12
c123t17d12
c101t18d12
c117t18d12
c109t18d12
c125t18d12
c103t19d12
c119t19d12
c111t19d12
c127t19d12
c97t16d21
c113t16d21
c105t16d21
c121t16d21
c99t17d21
c115t17d21
```

c107t17d21
c123t17d21
c101t18d21
c117t18d21
c109t18d21
c125t18d21
c103t19d21
c119t19d21
c111t19d21
c127t19d21
c97t16d30
c113t16d30
c105t16d30
c121t16d30
c99t17d30
c115t17d30
c107t17d30
c123t17d30
c101t18d30
c117t18d30
c109t18d30
c125t18d30
c103t19d30
c119t19d30
c111t19d30
c127t19d30
c97t16d39
c113t16d39
c105t16d39
c121t16d39
c99t17d39
c115t17d39
c107t17d39
c123t17d39
c101t18d39
c117t18d39
c109t18d39
c125t18d39
c103t19d39
c119t19d39
c111t19d39
c127t19d39
END

VOLUME_GROUP: asu1-8 (d7)

STRIPE 8m

VOLUME 1

c97t16d4
c113t16d4
c105t16d4
c121t16d4
c99t17d4
c115t17d4
c107t17d4
c123t17d4
c101t18d4
c117t18d4
c109t18d4
c125t18d4
c103t19d4
c119t19d4
c111t19d4
c127t19d4

c97t16d13
c113t16d13
c105t16d13
c121t16d13
c99t17d13
c115t17d13
c107t17d13
c123t17d13
c101t18d13
c117t18d13
c109t18d13
c125t18d13
c103t19d13
c119t19d13
c111t19d13
c127t19d13
c97t16d22
c113t16d22
c105t16d22
c121t16d22
c99t17d22
c115t17d22
c107t17d22
c123t17d22
c101t18d22
c117t18d22
c109t18d22
c125t18d22
c103t19d22
c119t19d22
c111t19d22
c127t19d22
c97t16d31
c113t16d31
c105t16d31
c121t16d31
c99t17d31
c115t17d31
c107t17d31
c123t17d31
c101t18d31
c117t18d31
c109t18d31
c125t18d31
c103t19d31
c119t19d31
c111t19d31
c127t19d31
c97t16d40
c113t16d40
c105t16d40
c121t16d40
c99t17d40
c115t17d40
c107t17d40
c123t17d40
c101t18d40
c117t18d40
c109t18d40
c125t18d40
c103t19d40
c119t19d40

```
c111t19d40
c127t19d40
END
VOLUME_GROUP: asu2-1 (d8)
STRIPE 8m
VOLUME 1
c96t16d0
c112t16d0
c104t16d0
c120t16d0
c98t17d0
c114t17d0
c106t17d0
c122t17d0
c100t18d0
c116t18d0
c108t18d0
c124t18d0
c102t19d0
c118t19d0
c110t19d0
c126t19d0
c96t16d9
c112t16d9
c104t16d9
c120t16d9
c98t17d9
c114t17d9
c106t17d9
c122t17d9
c100t18d9
c116t18d9
c108t18d9
c124t18d9
c102t19d9
c118t19d9
c110t19d9
c126t19d9
c96t16d18
c112t16d18
c104t16d18
c120t16d18
c98t17d18
c114t17d18
c106t17d18
c122t17d18
c100t18d18
c116t18d18
c108t18d18
c124t18d18
c102t19d18
c118t19d18
c110t19d18
c126t19d18
c96t16d27
c112t16d27
c104t16d27
c120t16d27
c98t17d27
c114t17d27
c106t17d27
c122t17d27
```

c100t18d27
c116t18d27
c108t18d27
c124t18d27
c102t19d27
c118t19d27
c110t19d27
c126t19d27
c96t16d36
c112t16d36
c104t16d36
c120t16d36
c98t17d36
c114t17d36
c106t17d36
c122t17d36
c100t18d36
c116t18d36
c108t18d36
c124t18d36
c102t19d36
c118t19d36
c110t19d36
c126t19d36
END
VOLUME_GROUP: asu2-2 (d9)
STRIPE 8m
VOLUME 1
c96t16d1
c112t16d1
c104t16d1
c120t16d1
c98t17d1
c114t17d1
c106t17d1
c122t17d1
c100t18d1
c116t18d1
c108t18d1
c124t18d1
c102t19d1
c118t19d1
c110t19d1
c126t19d1
c96t16d10
c112t16d10
c104t16d10
c120t16d10
c98t17d10
c114t17d10
c106t17d10
c122t17d10
c100t18d10
c116t18d10
c108t18d10
c124t18d10
c102t19d10
c118t19d10
c110t19d10
c126t19d10
c96t16d19
c112t16d19

c104t16d19
c120t16d19
c98t17d19
c114t17d19
c106t17d19
c122t17d19
c100t18d19
c116t18d19
c108t18d19
c124t18d19
c102t19d19
c118t19d19
c110t19d19
c126t19d19
c96t16d28
c112t16d28
c104t16d28
c120t16d28
c98t17d28
c114t17d28
c106t17d28
c122t17d28
c100t18d28
c116t18d28
c108t18d28
c124t18d28
c102t19d28
c118t19d28
c110t19d28
c126t19d28
c96t16d37
c112t16d37
c104t16d37
c120t16d37
c98t17d37
c114t17d37
c106t17d37
c122t17d37
c100t18d37
c116t18d37
c108t18d37
c124t18d37
c102t19d37
c118t19d37
c110t19d37
c126t19d37
END
VOLUME_GROUP: asu2-3 (d10)
STRIPE 8m
VOLUME 1
c96t16d2
c112t16d2
c104t16d2
c120t16d2
c98t17d2
c114t17d2
c106t17d2
c122t17d2
c100t18d2
c116t18d2
c108t18d2
c124t18d2

c102t19d2
c118t19d2
c110t19d2
c126t19d2
c96t16d11
c112t16d11
c104t16d11
c120t16d11
c98t17d11
c114t17d11
c106t17d11
c122t17d11
c100t18d11
c116t18d11
c108t18d11
c124t18d11
c102t19d11
c118t19d11
c110t19d11
c126t19d11
c96t16d20
c112t16d20
c104t16d20
c120t16d20
c98t17d20
c114t17d20
c106t17d20
c122t17d20
c100t18d20
c116t18d20
c108t18d20
c124t18d20
c102t19d20
c118t19d20
c110t19d20
c126t19d20
c96t16d29
c112t16d29
c104t16d29
c120t16d29
c98t17d29
c114t17d29
c106t17d29
c122t17d29
c100t18d29
c116t18d29
c108t18d29
c124t18d29
c102t19d29
c118t19d29
c110t19d29
c126t19d29
c96t16d38
c112t16d38
c104t16d38
c120t16d38
c98t17d38
c114t17d38
c106t17d38
c122t17d38
c100t18d38
c116t18d38

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c108t18d38
c124t18d38
c102t19d38
c118t19d38
c110t19d38
c126t19d38
END
VOLUME_GROUP: asu2-4 (d11)
STRIPE 8m
VOLUME 1
c96t16d3
c112t16d3
c104t16d3
c120t16d3
c98t17d3
c114t17d3
c106t17d3
c122t17d3
c100t18d3
c116t18d3
c108t18d3
c124t18d3
c102t19d3
c118t19d3
c110t19d3
c126t19d3
c96t16d12
c112t16d12
c104t16d12
c120t16d12
c98t17d12
c114t17d12
c106t17d12
c122t17d12
c100t18d12
c116t18d12
c108t18d12
c124t18d12
c102t19d12
c118t19d12
c110t19d12
c126t19d12
c96t16d21
c112t16d21
c104t16d21
c120t16d21
c98t17d21
c114t17d21
c106t17d21
c122t17d21
c100t18d21
c116t18d21
c108t18d21
c124t18d21
c102t19d21
c118t19d21
c110t19d21
c126t19d21
c96t16d30
c112t16d30
c104t16d30
c120t16d30
```



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c98t17d30
c114t17d30
c106t17d30
c122t17d30
c100t18d30
c116t18d30
c108t18d30
c124t18d30
c102t19d30
c118t19d30
c110t19d30
c126t19d30
c96t16d39
c112t16d39
c104t16d39
c120t16d39
c98t17d39
c114t17d39
c106t17d39
c122t17d39
c100t18d39
c116t18d39
c108t18d39
c124t18d39
c102t19d39
c118t19d39
c110t19d39
c126t19d39
END
VOLUME_GROUP: asu2-5 (d12)
STRIPE 8m
VOLUME 1
c97t16d5
c113t16d5
c105t16d5
c121t16d5
c99t17d5
c115t17d5
c107t17d5
c123t17d5
c101t18d5
c117t18d5
c109t18d5
c125t18d5
c103t19d5
c119t19d5
c111t19d5
c127t19d5
c97t16d14
c113t16d14
c105t16d14
c121t16d14
c99t17d14
c115t17d14
c107t17d14
c123t17d14
c101t18d14
c117t18d14
c109t18d14
c125t18d14
c103t19d14
c119t19d14
```

c111t19d14
c127t19d14
c97t16d23
c113t16d23
c105t16d23
c121t16d23
c99t17d23
c115t17d23
c107t17d23
c123t17d23
c101t18d23
c117t18d23
c109t18d23
c125t18d23
c103t19d23
c119t19d23
c111t19d23
c127t19d23
c97t16d32
c113t16d32
c105t16d32
c121t16d32
c99t17d32
c115t17d32
c107t17d32
c123t17d32
c101t18d32
c117t18d32
c109t18d32
c125t18d32
c103t19d32
c119t19d32
c111t19d32
c127t19d32
c97t16d41
c113t16d41
c105t16d41
c121t16d41
c99t17d41
c115t17d41
c107t17d41
c123t17d41
c101t18d41
c117t18d41
c109t18d41
c125t18d41
c103t19d41
c119t19d41
c111t19d41
c127t19d41
END
VOLUME_GROUP: asu2-6 (d13)
STRIPE 8m
VOLUME 1
c97t16d6
c113t16d6
c105t16d6
c121t16d6
c99t17d6
c115t17d6
c107t17d6
c123t17d6

c101t18d6
c117t18d6
c109t18d6
c125t18d6
c103t19d6
c119t19d6
c111t19d6
c127t19d6
c97t16d15
c113t16d15
c105t16d15
c121t16d15
c99t17d15
c115t17d15
c107t17d15
c123t17d15
c101t18d15
c117t18d15
c109t18d15
c125t18d15
c103t19d15
c119t19d15
c111t19d15
c127t19d15
c97t16d24
c113t16d24
c105t16d24
c121t16d24
c99t17d24
c115t17d24
c107t17d24
c123t17d24
c101t18d24
c117t18d24
c109t18d24
c125t18d24
c103t19d24
c119t19d24
c111t19d24
c127t19d24
c97t16d33
c113t16d33
c105t16d33
c121t16d33
c99t17d33
c115t17d33
c107t17d33
c123t17d33
c101t18d33
c117t18d33
c109t18d33
c125t18d33
c103t19d33
c119t19d33
c111t19d33
c127t19d33
c97t16d42
c113t16d42
c105t16d42
c121t16d42
c99t17d42
c115t17d42

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c107t17d42
c123t17d42
c101t18d42
c117t18d42
c109t18d42
c125t18d42
c103t19d42
c119t19d42
c111t19d42
c127t19d42
END
VOLUME_GROUP: asu2-7 (d14)
STRIPE 8m
VOLUME 1
c97t16d7
c113t16d7
c105t16d7
c121t16d7
c99t17d7
c115t17d7
c107t17d7
c123t17d7
c101t18d7
c117t18d7
c109t18d7
c125t18d7
c103t19d7
c119t19d7
c111t19d7
c127t19d7
c97t16d16
c113t16d16
c105t16d16
c121t16d16
c99t17d16
c115t17d16
c107t17d16
c123t17d16
c101t18d16
c117t18d16
c109t18d16
c125t18d16
c103t19d16
c119t19d16
c111t19d16
c127t19d16
c97t16d25
c113t16d25
c105t16d25
c121t16d25
c99t17d25
c115t17d25
c107t17d25
c123t17d25
c101t18d25
c117t18d25
c109t18d25
c125t18d25
c103t19d25
c119t19d25
c111t19d25
c127t19d25
```

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c97t16d34
c113t16d34
c105t16d34
c121t16d34
c99t17d34
c115t17d34
c107t17d34
c123t17d34
c101t18d34
c117t18d34
c109t18d34
c125t18d34
c103t19d34
c119t19d34
c111t19d34
c127t19d34
c97t16d43
c113t16d43
c105t16d43
c121t16d43
c99t17d43
c115t17d43
c107t17d43
c123t17d43
c101t18d43
c117t18d43
c109t18d43
c125t18d43
c103t19d43
c119t19d43
c111t19d43
c127t19d43
END
VOLUME_GROUP: asu2-8 (d15)
STRIPE 8m
VOLUME 1
c97t16d8
c113t16d8
c105t16d8
c121t16d8
c99t17d8
c115t17d8
c107t17d8
c123t17d8
c101t18d8
c117t18d8
c109t18d8
c125t18d8
c103t19d8
c119t19d8
c111t19d8
c127t19d8
c97t16d17
c113t16d17
c105t16d17
c121t16d17
c99t17d17
c115t17d17
c107t17d17
c123t17d17
c101t18d17
c117t18d17
```

c109t18d17
c125t18d17
c103t19d17
c119t19d17
c111t19d17
c127t19d17
c97t16d26
c113t16d26
c105t16d26
c121t16d26
c99t17d26
c115t17d26
c107t17d26
c123t17d26
c101t18d26
c117t18d26
c109t18d26
c125t18d26
c103t19d26
c119t19d26
c111t19d26
c127t19d26
c97t16d35
c113t16d35
c105t16d35
c121t16d35
c99t17d35
c115t17d35
c107t17d35
c123t17d35
c101t18d35
c117t18d35
c109t18d35
c125t18d35
c103t19d35
c119t19d35
c111t19d35
c127t19d35
c97t16d44
c113t16d44
c105t16d44
c121t16d44
c99t17d44
c115t17d44
c107t17d44
c123t17d44
c101t18d44
c117t18d44
c109t18d44
c125t18d44
c103t19d44
c119t19d44
c111t19d44
c127t19d44
END
VOLUME_GROUP: asu3-1 (d16)
STRIPE 8m
VOLUME 1
c96t16d8
c112t16d8
c104t16d8
c120t16d8

c98t17d8
c114t17d8
c106t17d8
c122t17d8
c100t18d8
c116t18d8
c108t18d8
c124t18d8
c102t19d8
c118t19d8
c110t19d8
c126t19d8
c96t16d17
c112t16d17
c104t16d17
c120t16d17
c98t17d17
c114t17d17
c106t17d17
c122t17d17
c100t18d17
c116t18d17
c108t18d17
c124t18d17
c102t19d17
c118t19d17
c110t19d17
c126t19d17
c96t16d26
c112t16d26
c104t16d26
c120t16d26
c98t17d26
c114t17d26
c106t17d26
c122t17d26
c100t18d26
c116t18d26
c108t18d26
c124t18d26
c102t19d26
c118t19d26
c110t19d26
c126t19d26
c96t16d35
c112t16d35
c104t16d35
c120t16d35
c98t17d35
c114t17d35
c106t17d35
c122t17d35
c100t18d35
c116t18d35
c108t18d35
c124t18d35
c102t19d35
c118t19d35
c110t19d35
c126t19d35
c96t16d44
c112t16d44

```
c104t16d44
c120t16d44
c98t17d44
c114t17d44
c106t17d44
c122t17d44
c100t18d44
c116t18d44
c108t18d44
c124t18d44
c102t19d44
c118t19d44
c110t19d44
c126t19d44
END
VOLUME_GROUP: asu3-2 (d17)
STRIPE 8m
VOLUME 1
c97t16d0
c113t16d0
c105t16d0
c121t16d0
c99t17d0
c115t17d0
c107t17d0
c123t17d0
c101t18d0
c117t18d0
c109t18d0
c125t18d0
c103t19d0
c119t19d0
c111t19d0
c127t19d0
c97t16d9
c113t16d9
c105t16d9
c121t16d9
c99t17d9
c115t17d9
c107t17d9
c123t17d9
c101t18d9
c117t18d9
c109t18d9
c125t18d9
c103t19d9
c119t19d9
c111t19d9
c127t19d9
c97t16d18
c113t16d18
c105t16d18
c121t16d18
c99t17d18
c115t17d18
c107t17d18
c123t17d18
c101t18d18
c117t18d18
c109t18d18
c125t18d18
```


c103t19d18
c119t19d18
c111t19d18
c127t19d18
c97t16d27
c113t16d27
c105t16d27
c121t16d27
c99t17d27
c115t17d27
c107t17d27
c123t17d27
c101t18d27
c117t18d27
c109t18d27
c125t18d27
c103t19d27
c119t19d27
c111t19d27
c127t19d27
c97t16d36
c113t16d36
c105t16d36
c121t16d36
c99t17d36
c115t17d36
c107t17d36
c123t17d36
c101t18d36
c117t18d36
c109t18d36
c125t18d36
c103t19d36
c119t19d36
c111t19d36
c127t19d36
END

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.

```
javaparms="-Xmx1024m -Xms1024m -Xss256k"  
sd=asu1_1,lun=/dev/md/rdisk/d0,size=639.95g  
sd=asu1_2,lun=/dev/md/rdisk/d1,size=639.95g  
sd=asu1_3,lun=/dev/md/rdisk/d2,size=639.95g  
sd=asu1_4,lun=/dev/md/rdisk/d3,size=639.95g  
sd=asu1_5,lun=/dev/md/rdisk/d4,size=639.95g  
sd=asu1_6,lun=/dev/md/rdisk/d5,size=639.95g  
sd=asu1_7,lun=/dev/md/rdisk/d6,size=639.95g  
sd=asu1_8,lun=/dev/md/rdisk/d7,size=639.95g  
sd=asu2_1,lun=/dev/md/rdisk/d8,size=639.95g  
sd=asu2_2,lun=/dev/md/rdisk/d9,size=639.95g  
sd=asu2_3,lun=/dev/md/rdisk/d10,size=639.95g  
sd=asu2_4,lun=/dev/md/rdisk/d11,size=639.95g  
sd=asu2_5,lun=/dev/md/rdisk/d12,size=639.95g  
sd=asu2_6,lun=/dev/md/rdisk/d13,size=639.95g  
sd=asu2_7,lun=/dev/md/rdisk/d14,size=639.95g  
sd=asu2_8,lun=/dev/md/rdisk/d15,size=639.95g  
sd=asu3_1,lun=/dev/md/rdisk/d16,size=569.083g  
sd=asu3_2,lun=/dev/md/rdisk/d17,size=569.083g
```

APPENDIX D: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Commands executed from the Command Line Interface:

```
java -Xmx1024m -Xms1024m -Xss512k persist1 -b 2005

java -Xmx1024m -Xms1024m -Xss512k persist2

./run_fdr.sh G07-5-1_BSU2005_FDR 2005
```

The content of the “run_fdr.sh” script is:

```
#!/usr/bin/sh
#
# run_fdr

case $# in
0) echo "Usage: $0 CONFIG BSU " 1>&2; exit 2 ;;
1) echo "Usage: $0 CONFIG BSU " 1>&2; exit 2 ;;
esac

CONFIG=$1
BSU=$2

echo "`date +%Y.%m.%d:%H:%M:%S` > SPC FDR TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED" >>
run_fdr.txt

echo "`date +%Y.%m.%d:%H:%M:%S` > METRICS TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED" >>
run_fdr.txt
echo "`date +%Y.%m.%d:%H:%M:%S` > METRICS TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED"

java -Xmx1024m -Xms1024m -Xss512k metrics -b $BSU

echo "`date +%Y.%m.%d:%H:%M:%S` > REPEAT1 TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED" >>
run_fdr.txt
echo "`date +%Y.%m.%d:%H:%M:%S` > REPEAT1 TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED"

java -Xmx1024m -Xms1024m -Xss512k repeat1 -b $BSU

echo "`date +%Y.%m.%d:%H:%M:%S` > REPEAT2 TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED" >>
run_fdr.txt
echo "`date +%Y.%m.%d:%H:%M:%S` > REPEAT2 TEST FOR CONFIG=$CONFIG BSU=$BSU STARTED"

java -Xmx1024m -Xms1024m -Xss512k repeat2 -b $BSU

echo "`date +%Y.%m.%d:%H:%M:%S` > SPC FDR TEST FOR CONFIG=$CONFIG BSU=$BSU ENDED " >>
run_fdr.txt
echo "`date +%Y.%m.%d:%H:%M:%S` > SPC FDR TEST FOR CONFIG=$CONFIG BSU=$BSU ENDED "
```

The content of the “run_fdr.txt” text file is:

```
2004.10.14:18:26:48 > SPC FDR TEST FOR CONFIG=G07-5-1_BSU2005_FDR BSU=2005 STARTED
2004.10.14:18:26:48 > METRICS TEST FOR CONFIG=G07-5-1_BSU2005_FDR BSU=2005 STARTED
2004.10.14:22:55:54 > REPEAT1 TEST FOR CONFIG=G07-5-1_BSU2005_FDR BSU=2005 STARTED
2004.10.14:23:24:39 > REPEAT2 TEST FOR CONFIG=G07-5-1_BSU2005_FDR BSU=2005 STARTED
2004.10.14:23:53:24 > SPC FDR TEST FOR CONFIG=G07-5-1_BSU2005_FDR BSU=2005 ENDED
```