SPC BENCHMARK 1™
FULL DISCLOSURE REPORT

HITACHI DATA SYSTEMS CORPORATION
HITACHI ADAPTABLE MODULAR STORAGE 2500

SPC-1 V1.10.1

Submitted for Review: March 24, 2009
Submission Identifier: A00078

First Edition – March 2009

Trademarks

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AUDIT CERTIFICATION

Mel Boksenbaum
Hitachi Data Systems Corporation
750 Central Expressway M/S 3275
Santa Clara, CA 95050

March 24, 2009

The SPC Benchmark 1™ results listed below for the Hitachi Adaptable Modular Storage 2500 were produced in compliance with the SPC Benchmark 1™ V1.10.1 Onsite Audit requirements.

SPC Benchmark 1™ V1.10.1 Results	
Tested Storage Configuration (TSC) Name: Hitachi Adaptable Modular Storage 2500	
Metric	**Reported Result**
SPC-1 IOPS™	89,491.81
SPC-1 Price-Performance	$6.71/SPC-1 IOPS™
Total ASU Capacity	15,900.00 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$600,581

The following SPC Benchmark 1™ Onsite Audit requirements were reviewed and found compliant with V1.10.1 of the SPC Benchmark 1™ specification:

- A Letter of Good Faith, signed by a senior executive.
- The following Data Repository storage items were verified by physical inspection and information supplied by Hitachi Data Systems Corporation:
  - ✓ Physical Storage Capacity and requirements.
  - ✓ Configured Storage Capacity and requirements.
  - ✓ Addressable Storage Capacity and requirements.
  - ✓ Capacity of each Logical Volume and requirements.
  - ✓ Capacity of each Application Storage Unit (ASU) and requirements.
- An appropriate diagram of the Benchmark Configuration (BC)/Tested Storage Configuration (TSC).
- Physical verification of the components to mach the above diagram.

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Redwood City, CA 94062
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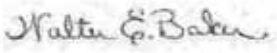
AUDIT CERTIFICATION *(CONT.)*

- Listings and commands to configure the Benchmark Configuration/Tested Storage Configuration, including customer tunable parameters that were changed from default values.
- SPC-1 Workload Generator commands and parameters used for the audited SPC Test Runs.
- The following Host System requirements were verified by physical inspection and information supplied by Hitachi Data Systems Corporation:
  - ✓ The type of Host System including the number of processors and main memory.
  - ✓ The presence and version number of the SPC-1 Workload Generator on the Host System.
  - ✓ The TSC boundary within the Host System.
- The execution of each Test, Test Phase, and Test Run was observed and found compliant with all of the requirements and constraints of Clauses 4 and 5 of the SPC-1 Benchmark Specification.
- The Test Results Files and resultant Summary Results Files received from Hitachi Data Systems Corporation 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 submitted pricing information 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.
- This successfully audited SPC measurement is not subject to an SPC Confidential Review.

Audit Notes:

SPC Auditor approval was granted to reorder the required execution sequence of SPC Tests to better utilize the time spent for onsite audit activities. The following execution sequence was used: Persistence Test Run 1, required TSC power cycle, and uninterrupted execution of Persistence Test Run 2, the Primary Metrics Test *(Sustainability Test Phase, IOP Test Phase, and Response Time Ramp Test Phase)*, and the Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)*.

Respectfully,



Walter E. Baker
SPC Auditor

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LETTER OF GOOD FAITH

HITACHI
Inspire the Next

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February 20, 2009

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

Subject: SPC-1 Letter of Good Faith for the Hitachi Adaptable Modular Storage 2500

Hitachi Data Systems 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 Version 1.10.1 of the SPC-1 benchmark specification.

Our disclosure of the Benchmark configuration and execution of the benchmark includes all items that, to the best of our knowledge and belief, materially affect the reported results regardless of whether such items are explicitly required to be disclosed by the SPC-1 benchmark specifications.

Regards,

Alan Cade,
Vice President
Technical Operations

Partner Beyond Technology

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Hitachi Data Systems Corporation – http://www.hds.com Alan Davey – alan.davey@hds.com 750 Central Expressway M/S U710 Santa Clara, CA 95050 Phone (425) 427-8858 FAX: (425) 642-8055
Test Sponsor Alternate Contact	Hitachi Data Systems Corporation – http://www.hds.com Mel Boksenbaum – mel.boksenbaum@hds.com 750 Central Expressway M/S 3275 Santa Clara, CA 95050 Phone (408) 970-7922 FAX: (408) 327-3066
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	V1.10.1
SPC-1 Workload Generator revision number	V2.00.04a
Date Results were first used publicly	March 24, 2009
Date the FDR was submitted to the SPC	March 24, 2009
Date the TSC is available for shipment to customers	currently available
Date the TSC completed audit certification	March 23, 2009

Tested Storage Product (TSP) Description

The best performance available in a model that scales to 480 disk drives. Ideal for large and enterprise businesses, Hitachi Adaptable Modular Storage 2500 is a highly reliable, flexible and scalable storage system for Microsoft® Exchange Server, VMware, databases and other business applications. It also provides an optimal choice for tiered and standalone storage, consolidation, business continuity, data replication, backup and archiving.

Summary of Results

SPC-1 Results	
Tested Storage Configuration (TSC) Name: Hitachi Adaptable Modular Storage 2500	
Metric	**Reported Result**
SPC-1 IOPS™	89,491.81
SPC-1 Price-Performance	$6.71/SPC-1 IOPS™
Total ASU Capacity	15,900.000 GB
Data Protection Level	Mirroring
Total TSC Price (including three-year maintenance)	$600,581

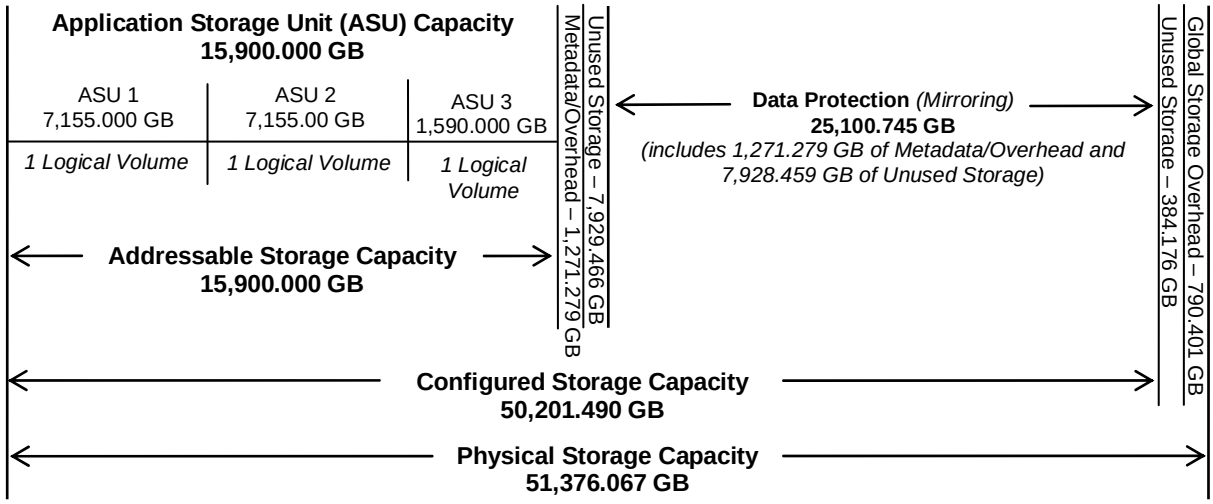
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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

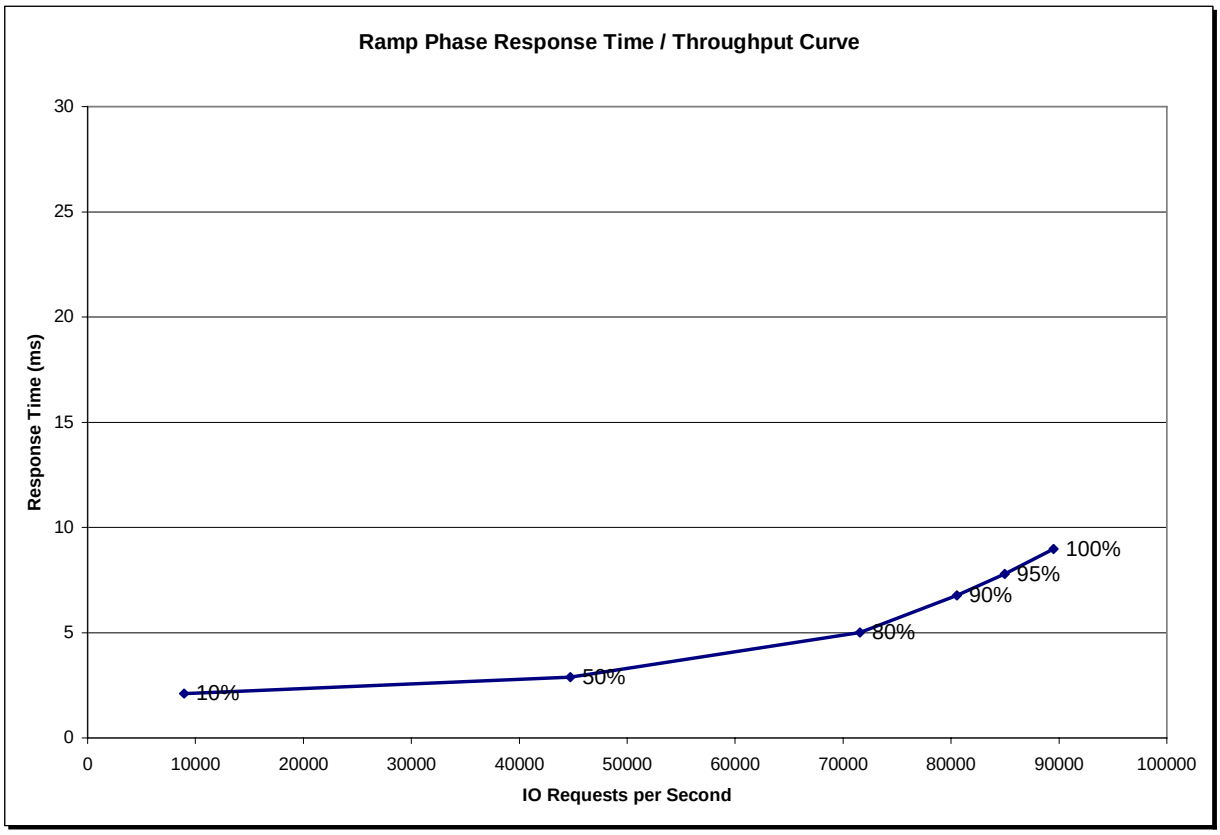
The following diagram documents the various storage capacities, used in this benchmark, and their relationships.



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	8,950.38	44,746.89	71,582.41	80,545.19	85,003.80	89,491.81
Average Response Time (ms):						
All ASUs	2.10	2.88	5.02	6.77	7.78	8.98
ASU-1	2.89	3.70	6.14	8.04	9.09	10.33
ASU-2	2.31	3.71	6.92	10.87	13.23	15.65
ASU-3	0.33	0.79	1.80	2.27	2.61	3.19
Reads	4.84	6.15	9.98	13.66	15.73	17.95
Writes	0.31	0.76	1.79	2.27	2.61	3.14

Tested Storage Configuration Pricing *(Priced Storage Configuration)*

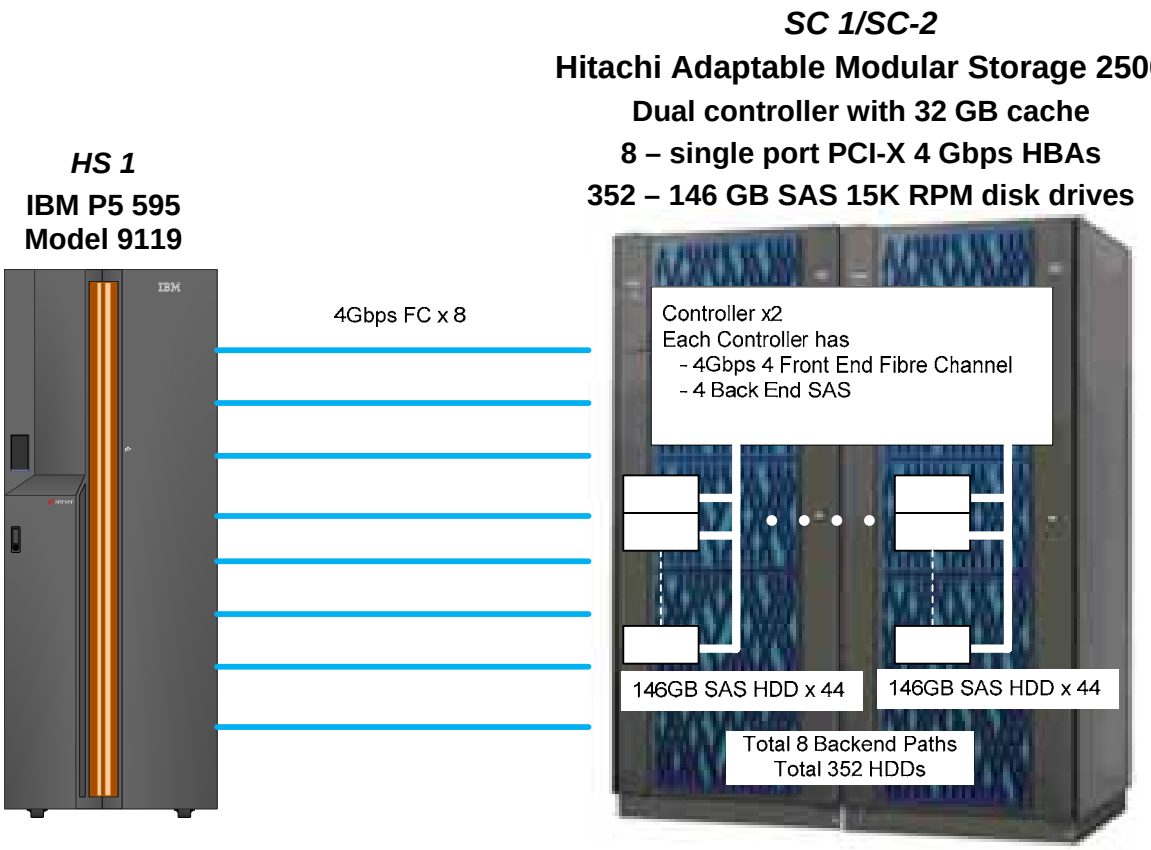
Description	Qty	List	List EXT	List MMC	List MMC Ext
AMS2500 Rack Mount System	1				
AMS2500 Svc Warranty 1 Mo Yr 1-3	36	$ -	$ -	$ -	$ -
AMS2500 Svc Uplift to Standard 1Mo	36	$ -	$ -	$ 182.00	$ 6,552.00
AMS2000 Svc RKAK Warranty 1 Mo Yr 1-3	864	$ -	$ -	$ -	$ -
AMS2000 Svc RKAK Uplift to Standard 1Mo	864	$ -	$ -	$ 45.00	$ 38,880.00
AMS2500 Service Installation	1	$ -	$ 2,750.00	$ -	$ -
Dummy drive for DF600/DF700/DF800/RAID 600	8	$ -	$ -	$ -	$ -
42U AMS2000 Rack 1050mm Deep w/30amp Nema PDU (4)	2	$ 5,295.00	$ 10,590.00	$ -	$ -
AMS2000 146GB SAS 15K RPM HDD	352	$ 610.00	$ 214,720.00	$ -	$ -
AMS2000 Series 4GB Cache Module	8	$ 6,260.00	$ 50,080.00	$ -	$ -
AMS2300/2500 FC Interface Adapter 4x4Gbps FC Intf	4	$ 2,950.00	$ 11,800.00	$ -	$ -
AMS2000 ENC Cable 5m	8	$ 730.00	$ 5,840.00	$ -	$ -
AMS2000 SAS/SATA Storage Expansion Tray	24	$ 8,840.00	$ 212,160.00	$ -	$ -
AMS2500 Chassis	1	$ 32,460.00	$ 32,460.00	$ -	$ -
AMS2500 Storage Software Sales	1				
Storage Navigator Modular 2, AMS 2500 Family	1	$ 6,100.00	$ 6,100.00	$ -	$ -
SVC Mo Storage Navigator Modular 2, AMS 2500 Family	12	$ -	$ -	$ 76.25	$ 915.00
ezLINE™ LC/LC Uniboot® Jumper, OFNP, 10-ft (50/125) Aqua	8	$ 18.45	$ 147.60		
IBM DS4000 1-pt PCI-X 4 Gbps HBA	8	$ 948.24	$ 7,585.92		
Total			**$ 554,233.52**		**$ 46,347.00**
Grand Total					**$ 600,581**

The above hardware maintenance and software support pricing components provides acknowledgement of new and existing problems within four (4) hours. In addition, the priced components provide onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration that can be remedied by repair or replacement of a Priced Storage Configuration component.

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

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

Benchmark Configuration/Tested Storage Configuration Diagram



Benchmark Configuration/Tested Storage Configuration Components

Host System:	Tested Storage Configuration (TSC):
UID=HS-1 IBM P5 595 Model 9119	8 – 9199-5758 IBM DS4000 1-pt PCI-X 4 Gbps HBA
12 - 1.65 GHz CPUs – 2 CPUs/POWER5 chip 32 KB L1 cache, 960 KB L2 cache, and 18 MB L3 cache per CPU	***UID=SC-1/SC-2:*** Hitachi Adaptable Modular Storage 2500 Dual controller with 32 GB cache 8 – FC front-end ports per controller *(16 total ports)* 4 – backend SAS interfaces per controller 44 drives per interface *(8 total interfaces)*
46 GB main memory	
AIX 5.3 ML6 SP4	Cache Partition Manager
PCI-X/RIO	4 – AMS2300/2500 FC Interface Adapters 4x4Gbps
AIX Logical Volume Manager	24 – AMS2000 SAS/SATA Storage Expansion Trays
WG	2 – 42U AMS2000 Racks w/30amp Nema PDU *(4)*
	352 – 146 GB SAS 15K RPM disk drives

In each of the following sections of this document, the appropriate Full Disclosure Report requirement, from the SPC-1 benchmark specification, is stated in italics followed by the information to fulfill the stated requirement.

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 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

Storage Network Configuration

Clause 9.2.4.4.1

…

5. *If the TSC contains network storage, the diagram will include the network configuration. If a single diagram is not sufficient to illustrate both the Benchmark Configuration and network configuration in sufficient detail, the Benchmark Configuration diagram will include a high-level network illustration as shown in Figure 9-8. In that case, a separate, detailed network configuration diagram will also be included as described in Clause 9.2.4.4.2.*

Clause 9.2.4.4.2

If a storage network was configured as a part of the Tested Storage Configuration and the Benchmark Configuration diagram described in Clause 9.2.4.4.1 contains a high-level illustration of the network configuration, the Executive Summary will contain a one page topology diagram of the storage network as illustrated in Figure 9-9.

The Benchmark Configuration (BC)/Tested Storage Configuration (TSC), including the network configuration, is illustrated on page 14 *(Benchmark Configuration/Tested Storage Configuration Diagram).*

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 14 *(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. If the parameter name is not self-explanatory to a knowledgeable practitioner, a brief description of the parameter's use must also be included in the FDR entry.

"Appendix B: Customer Tunable Parameters and Options" on page 58 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 BC Configuration Diagram in Clause 9.2.4.4.1 and/or 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.*
- *Listings of scripts used to create the logical representation of the TSC.*
- *If scripts were not used, a description of the process used with sufficient detail to recreate the logical representation of the TSC.*

"Appendix C: Tested Storage Configuration (TSC) Creation" on page 70 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 D: SPC-1 Workload Generator Storage Commands and Parameters" on page 85.

SPC-1 DATA REPOSITORY

This portion of the Full Disclosure Report presents the detailed information that fully documents the various SPC-1 storage capacities and mappings used in the Tested Storage Configuration. "SPC-1 Data Repository Definitions" on page 54 contains definitions of terms specific to the SPC-1 Data Repository.

Storage Capacities and Relationships

Clause 9.2.4.6.1

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)	15,900.000
Addressable Storage Capacity	Gigabytes (GB)	15,900.000
Configured Storage Capacity	Gigabytes (GB)	50,201.490
Physical Storage Capacity	Gigabytes (GB)	51,376.067
Data Protection *(Mirroring)*	Gigabytes (GB)	25,100.745
Required Storage	Gigabytes (GB)	2,542.558
Global Storage Overhead	Gigabytes (GB)	790.401
Total Unused Storage	Gigabytes (GB)	16,243.107

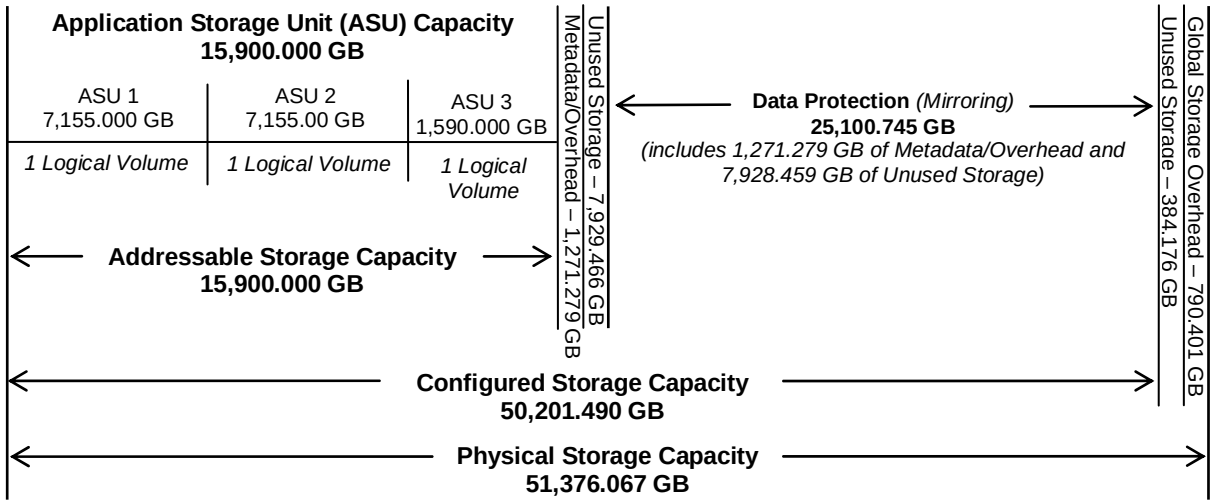
SPC-1 Storage Hierarchy Ratios

	Addressable Storage Capacity	**Configured Storage Capacity**	**Physical Storage Capacity**
Total ASU Capacity	100.00%	31.67%	30.95%
Required for Data Protection *(Mirrored)*		50.00%	48.86%
Addressable Storage Capacity		31.67%	30.95%
Required Storage		5.06%	4.95%
Configured Storage Capacity			97.71%
Global Storage Overhead			1.54%
Unused Storage:			
Addressable	0.00%		
Configured		31.59%	
Physical			0.75%

The Physical Storage Capacity consisted of 51,376.067 GB distributed over 352 disk drives each with a formatted capacity of 145.955 GB. There was 384.176 GB (0.75%) of Unused Storage within the Physical Storage Capacity. Global Storage Overhead consisted of 790.401 GB (1.54%) of Physical Storage Capacity. There was 15,858.932 GB (31.59%) of Unused Storage within the Configured Storage Capacity. The Total ASU Capacity utilized 100.00% of the Addressable Storage Capacity resulting in 0.000 GB (0.00%) 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 (7,155.000 GB)	**ASU-2 (7,155.000 GB)**	**ASU-3 (1,590.000 GB)**
5 Logical Volume 1,431.000 GB per Logical Volume 1,431.000(GB used per Logical Volume)	5 Logical Volume 1,431.000 GB per Logical Volume (1,431.000 GB used per Logical Volume)	1 Logical Volume 1,590.000 GB per Logical Volume (1,590.000 GB used per Logical Volume)

The Data Protection Level used for all Logical Volumes was “Mirrored” as described on page 11. See “ASU Configuration” in the **IOPS Test Results File** for more detailed configuration information.

SPC-1 BENCHMARK EXECUTION RESULTS

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs. "SPC-1 Test Execution Definitions" on page 55 contains definitions of terms specific to the SPC-1 Tests, Test Phases, and Test Runs.

Clause 5.4.3

The Tests must be executed in the following sequence: Primary Metrics, Repeatability, and Data Persistence. That required sequence must be uninterrupted from the start of Primary Metrics to the completion of Persistence Test Run 1. Uninterrupted means the Benchmark Configuration shall not be power cycled, restarted, disturbed, altered, or adjusted during the above measurement sequence. If the required sequence is interrupted other than for the Host System/TSC power cycle between the two Persistence Test Runs, the measurement is invalid.

SPC-1 Tests, Test Phases, and Test Runs

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

- **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
- **Data Persistence Test**
  - Data Persistence Test Run 1
  - Data Persistence Test Run 2

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 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 5.4.4.1.1

The Sustainability Test Phase has exactly one Test Run and shall demonstrate the maximum sustainable I/O Request Throughput within at least a continuous three (3) hour Measurement Interval. This Test Phase also serves to insure that the TSC has reached Steady State prior to reporting the final maximum I/O Request Throughput result (SPC-1 IOPS™).

Clause 5.4.4.1.2

The computed I/O Request Throughput of the Sustainability Test must be within 5% of the reported SPC-1 IOPS™ result.

Clause 5.4.4.1.4

The Average Response Time, as defined in Clause 5.1.1, will be computed and reported for the Sustainability Test Run and cannot exceed 30 milliseconds. If the Average Response time exceeds that 30-milliseconds constraint, the measurement is invalid.

Clause 9.2.4.7.1

For the Sustainability Test Phase the FDR shall contain:

1. *A Data Rate Distribution graph and data table.*
2. *I/O Request Throughput Distribution graph and data table.*
3. *A Response Time Frequency Distribution graph and table.*
4. *An Average Response Time Distribution graph and table.*
5. *The human readable Test Run Results File produced by the Workload Generator (may be included in an appendix).*
6. *A listing or screen image of all input parameters supplied to the Workload Generator (may be included in an appendix).*
7. *The Measured Intensity Multiplier for each I/O stream.*
8. *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, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 86.

Sustainability Test Results File

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

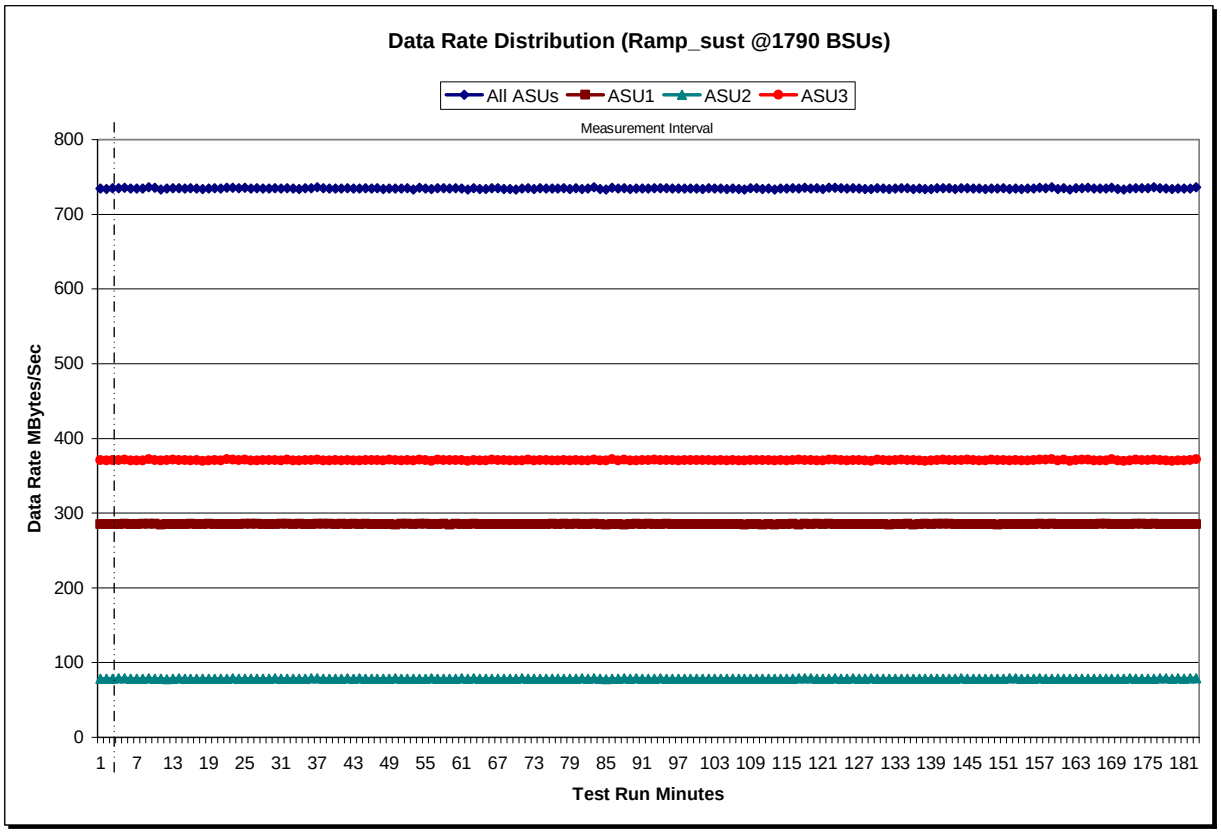
Sustainability Test Results File

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

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:50:36	20:53:36	0-2	0:03:00
Measurement Interval	20:53:36	23:53:36	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	734.46	285.18	78.34	370.95	63	733.73	284.98	78.31	370.44	126	734.34	285.07	78.56	370.72
1	733.78	285.09	78.44	370.25	64	733.52	285.09	78.30	370.13	127	733.75	285.22	78.36	370.17
2	734.68	285.23	78.39	371.05	65	735.04	285.07	78.36	371.61	128	733.98	285.30	78.92	369.76
3	735.11	285.29	78.64	371.18	66	734.83	285.35	78.50	370.98	129	735.20	285.15	78.49	371.56
4	735.45	285.39	78.64	371.42	67	733.79	284.86	78.24	370.69	130	734.16	285.02	78.49	370.65
5	734.23	285.20	78.48	370.55	68	734.05	285.27	78.44	370.33	131	733.56	284.63	78.41	370.51
6	734.08	285.27	78.25	370.55	69	733.45	285.10	78.22	370.13	132	734.06	284.88	78.19	370.98
7	734.22	285.54	78.33	370.35	70	734.25	285.18	78.63	370.44	133	734.89	285.32	78.36	371.21
8	735.90	285.42	78.64	371.83	71	734.97	285.26	78.37	371.33	134	734.79	285.55	78.41	370.84
9	735.51	285.79	78.53	371.19	72	733.96	285.09	78.41	370.47	135	734.05	284.78	78.47	370.81
10	733.30	284.62	78.12	370.56	73	734.77	285.05	78.54	371.17	136	734.31	285.34	78.49	370.48
11	734.38	285.37	78.04	370.97	74	734.55	285.20	78.48	370.88	137	733.66	285.64	78.11	369.91
12	734.93	285.34	78.18	371.41	75	734.25	285.39	78.51	370.35	138	734.03	285.14	78.54	370.35
13	734.88	285.19	78.70	370.99	76	734.07	285.16	78.34	370.57	139	734.92	285.41	78.31	371.20
14	734.51	285.20	78.54	370.78	77	734.71	285.58	78.36	370.76	140	734.95	285.52	78.08	371.35
15	734.66	285.69	78.54	370.43	78	733.85	285.04	78.40	370.41	141	735.05	285.43	78.56	371.05
16	734.48	285.36	78.32	370.80	79	735.01	285.73	78.48	370.80	142	733.99	285.03	78.27	370.69
17	733.54	285.22	78.36	369.96	80	733.80	284.82	78.75	370.22	143	734.74	285.05	78.70	371.00
18	734.26	285.49	78.42	370.36	81	734.11	285.36	78.31	370.44	144	734.96	285.05	78.60	371.32
19	734.73	285.16	78.42	371.15	82	735.80	285.41	78.90	371.49	145	734.35	285.32	78.14	370.90
20	734.21	285.34	78.34	370.52	83	733.77	285.14	78.55	370.09	146	734.12	285.26	78.40	370.47
21	735.44	284.87	78.47	372.10	84	733.37	284.77	77.99	370.61	147	734.01	285.17	78.22	370.62
22	735.51	285.12	78.73	371.66	85	735.72	285.23	78.57	371.93	148	734.46	284.86	78.37	371.22
23	734.75	285.33	78.46	370.97	86	734.22	285.24	78.48	370.49	149	734.07	284.80	78.28	371.00
24	735.21	285.46	78.38	371.37	87	734.93	284.62	78.65	371.67	150	734.78	285.31	78.56	370.90
25	734.58	285.66	78.50	370.42	88	733.75	285.16	78.48	370.11	151	733.96	285.26	78.63	370.07
26	734.65	285.50	78.55	370.60	89	734.29	285.42	78.75	370.12	152	734.43	285.03	78.62	370.77
27	734.46	285.08	78.59	370.79	90	734.40	285.15	78.22	371.04	153	733.92	285.21	78.59	370.12
28	734.25	284.89	78.24	371.11	91	734.51	285.40	78.24	370.88	154	734.43	285.28	78.59	370.57
29	735.12	285.26	78.98	370.88	92	734.97	285.06	78.36	371.55	155	734.43	285.01	78.23	371.19
30	734.18	285.63	78.30	370.25	93	734.74	285.13	78.75	370.86	156	735.44	285.50	78.66	371.28
31	735.06	285.51	78.20	371.35	94	734.83	285.44	78.35	371.04	157	735.11	285.23	78.46	371.43
32	734.30	285.34	78.49	370.47	95	734.07	284.97	78.07	371.03	158	735.81	285.56	78.42	371.83
33	733.98	285.56	78.30	370.12	96	734.10	285.29	78.18	370.63	159	733.96	285.25	78.37	370.34
34	734.76	285.38	78.47	370.92	97	734.26	285.21	78.41	370.64	160	734.98	285.21	78.49	371.28
35	734.73	285.08	78.70	370.95	98	734.31	285.24	78.27	370.80	161	733.40	285.12	78.35	369.93
36	735.81	285.66	78.74	371.42	99	734.60	285.31	78.57	370.72	162	734.90	285.25	78.52	371.13
37	734.74	285.52	78.60	370.62	100	733.86	284.85	78.21	370.80	163	734.86	285.27	78.25	371.34
38	734.11	285.53	78.31	370.27	101	734.90	285.38	78.58	370.94	164	735.40	285.33	78.61	371.46
39	734.10	285.11	78.24	370.74	102	734.06	285.17	78.49	370.40	165	734.09	285.11	78.59	370.39
40	734.08	285.39	78.38	370.31	103	734.39	285.35	78.09	370.95	166	734.24	285.41	78.37	370.46
41	734.77	285.34	78.69	370.73	104	733.76	285.21	78.34	370.21	167	734.51	285.75	78.49	370.27
42	734.56	285.58	78.54	370.45	105	734.57	285.08	78.46	371.03	168	735.43	285.36	78.27	371.81
43	734.20	284.96	78.71	370.52	106	733.67	285.10	78.21	370.36	169	734.01	285.13	78.37	370.50
44	735.14	285.58	78.59	370.96	107	733.42	284.71	78.10	370.60	170	733.24	285.23	78.43	369.58
45	734.40	285.28	78.40	370.71	108	734.73	285.17	78.50	371.06	171	734.28	285.26	78.69	370.33
46	734.65	285.24	78.49	370.92	109	734.66	285.29	78.31	371.06	172	735.07	285.57	78.23	371.27
47	733.66	285.30	78.26	370.11	110	733.87	284.59	78.26	371.01	173	735.00	285.48	78.51	371.02
48	734.58	285.14	78.13	371.32	111	734.16	284.93	78.51	370.72	174	734.80	285.17	78.52	371.11
49	734.25	284.79	78.69	370.77	112	733.42	284.73	78.31	370.39	175	735.82	285.77	78.33	371.71
50	734.34	285.46	78.50	370.38	113	734.17	284.88	78.35	370.95	176	734.98	285.24	78.63	371.11
51	734.70	285.46	78.45	370.79	114	734.14	285.30	78.44	370.40	177	734.17	284.90	78.88	370.40
52	733.41	284.90	78.34	370.17	115	735.08	285.41	78.51	371.15	178	733.95	285.34	78.60	370.01
53	735.50	285.48	78.46	371.56	116	734.57	284.50	78.69	371.38	179	734.23	285.19	78.74	370.30
54	734.60	285.39	78.45	370.76	117	735.39	285.42	78.88	371.10	180	734.20	285.11	78.61	370.48
55	733.82	285.15	78.64	370.02	118	734.60	285.01	78.73	370.86	181	734.39	285.12	78.62	370.65
56	734.80	285.09	78.49	371.22	119	734.87	285.80	78.50	370.57	182	736.04	285.16	78.68	372.20
57	734.85	285.43	78.24	371.19	120	733.95	285.17	78.51	370.27					
58	734.40	284.80	78.59	371.01	121	735.38	285.51	78.32	371.54					
59	734.68	285.59	78.30	370.79	122	735.72	285.35	78.63	371.75					
60	734.19	284.86	78.63	370.70	123	734.74	285.17	78.39	371.18					
61	733.25	285.15	78.49	369.60	124	734.39	285.22	78.58	370.59					
62	735.02	285.42	78.65	370.95	125	734.79	284.90	78.88	371.01					

Sustainability – Data Rate Distribution Graph

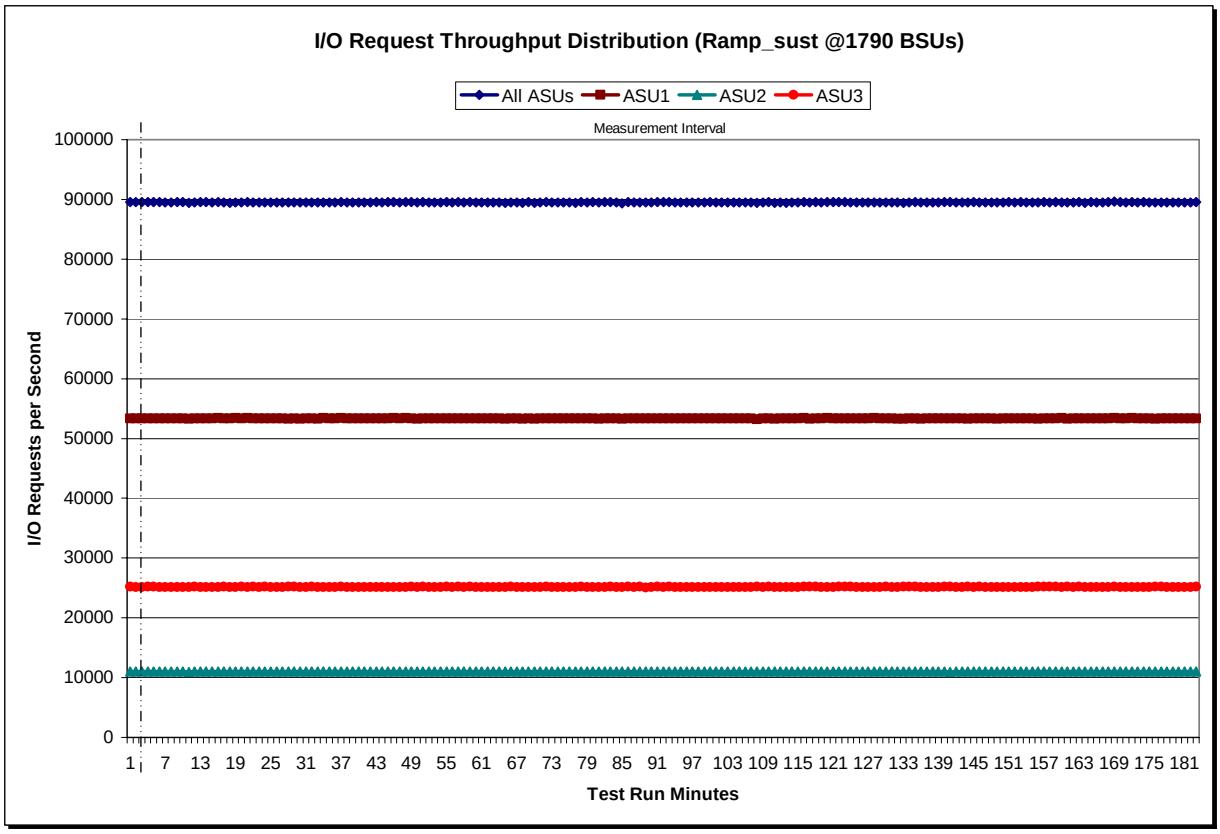


Sustainability – I/O Request Throughput Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:50:36	20:53:36	0-2	0:03:00
Measurement Interval	20:53:36	23:53:36	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	89,537.22	53,358.23	11,009.30	25,169.68	63	89,456.95	53,322.72	10,992.35	25,141.88	126	89,499.05	53,341.08	11,015.37	25,142.60
1	89,527.93	53,354.37	11,019.28	25,154.28	64	89,438.58	53,305.00	11,020.45	25,113.13	127	89,518.62	53,396.48	10,998.85	25,123.28
2	89,543.10	53,372.52	11,011.23	25,159.35	65	89,490.38	53,322.82	10,997.40	25,170.17	128	89,500.37	53,345.10	11,033.17	25,122.10
3	89,564.25	53,341.20	11,031.12	25,191.93	66	89,524.45	53,344.62	11,023.50	25,156.33	129	89,507.60	53,336.27	11,005.52	25,165.82
4	89,541.60	53,353.65	11,018.25	25,169.70	67	89,412.03	53,295.98	10,996.02	25,120.03	130	89,462.57	53,316.03	11,016.53	25,130.00
5	89,526.25	53,367.13	11,017.35	25,141.77	68	89,527.72	53,352.70	11,028.90	25,146.12	131	89,457.67	53,300.75	11,010.60	25,146.32
6	89,454.03	53,323.92	10,996.58	25,133.53	69	89,430.00	53,301.07	11,017.02	25,111.92	132	89,443.40	53,290.08	10,985.00	25,168.32
7	89,518.72	53,370.03	11,018.27	25,130.42	70	89,482.87	53,337.40	11,010.98	25,134.48	133	89,509.22	53,344.15	11,000.57	25,164.50
8	89,543.17	53,365.27	11,020.78	25,157.12	71	89,528.07	53,348.97	11,001.63	25,177.47	134	89,526.00	53,362.52	10,997.75	25,165.73
9	89,536.95	53,383.30	11,007.92	25,145.73	72	89,494.10	53,343.88	10,999.47	25,150.75	135	89,477.85	53,311.48	11,018.32	25,148.05
10	89,406.80	53,276.10	10,969.20	25,161.50	73	89,492.12	53,339.87	11,002.38	25,149.87	136	89,506.28	53,366.30	10,993.93	25,146.05
11	89,519.62	53,359.43	10,988.27	25,171.92	74	89,476.63	53,328.87	11,022.33	25,125.43	137	89,467.67	53,376.98	10,992.97	25,097.72
12	89,535.53	53,363.92	11,012.33	25,159.28	75	89,475.55	53,330.55	11,020.70	25,124.30	138	89,488.67	53,359.42	11,009.73	25,119.52
13	89,556.73	53,370.73	11,036.95	25,149.05	76	89,446.80	53,318.52	10,988.13	25,140.15	139	89,549.28	53,356.27	11,007.00	25,186.02
14	89,496.40	53,323.18	11,026.52	25,146.70	77	89,535.77	53,355.80	11,011.55	25,168.42	140	89,533.10	53,377.13	10,977.80	25,178.17
15	89,565.33	53,387.63	11,017.15	25,160.55	78	89,472.53	53,340.25	11,022.65	25,109.63	141	89,494.47	53,358.87	11,003.55	25,132.05
16	89,519.77	53,364.53	10,989.60	25,165.63	79	89,534.20	53,363.87	11,022.35	25,147.98	142	89,478.53	53,325.67	11,013.25	25,139.62
17	89,429.05	53,316.15	10,986.58	25,126.32	80	89,455.25	53,299.48	11,019.90	25,135.87	143	89,494.22	53,307.17	11,023.37	25,163.68
18	89,514.68	53,384.75	10,986.05	25,143.88	81	89,525.95	53,365.35	11,011.85	25,148.75	144	89,534.88	53,348.90	11,024.58	25,161.40
19	89,515.35	53,331.05	11,009.78	25,174.52	82	89,561.17	53,348.08	11,022.15	25,190.93	145	89,495.70	53,342.27	10,985.05	25,168.38
20	89,525.62	53,393.70	11,004.93	25,126.98	83	89,490.97	53,351.15	11,000.72	25,139.10	146	89,471.52	53,323.32	11,013.47	25,134.73
21	89,519.70	53,339.55	10,998.73	25,181.42	84	89,378.65	53,273.60	10,984.98	25,120.07	147	89,495.47	53,355.33	11,005.38	25,134.75
22	89,494.08	53,327.45	11,019.67	25,146.97	85	89,565.42	53,382.53	10,998.23	25,184.65	148	89,459.35	53,310.37	10,992.80	25,156.18
23	89,515.75	53,322.18	11,023.58	25,169.98	86	89,503.75	53,339.28	11,016.50	25,147.97	149	89,501.67	53,341.48	11,013.98	25,146.20
24	89,490.57	53,348.15	10,981.12	25,161.30	87	89,511.72	53,314.97	11,006.82	25,189.93	150	89,530.12	53,375.68	10,998.97	25,155.47
25	89,490.08	53,338.20	11,004.32	25,147.57	88	89,474.62	53,377.08	11,009.33	25,088.20	151	89,470.23	53,354.10	11,018.17	25,097.97
26	89,523.37	53,370.78	11,008.80	25,143.78	89	89,462.23	53,340.12	11,020.95	25,101.17	152	89,527.50	53,342.22	11,029.55	25,155.73
27	89,491.60	53,302.53	11,026.43	25,162.63	90	89,582.28	53,374.53	11,010.65	25,197.10	153	89,499.50	53,342.07	11,011.13	25,146.30
28	89,490.42	53,320.15	11,004.58	25,165.68	91	89,529.48	53,380.15	10,990.47	25,158.87	154	89,511.60	53,335.93	11,031.58	25,144.08
29	89,461.10	53,295.45	11,033.40	25,132.25	92	89,533.32	53,350.38	11,004.97	25,177.97	155	89,495.13	53,302.22	11,024.72	25,168.20
30	89,478.95	53,359.87	11,006.03	25,113.05	93	89,513.87	53,355.65	11,017.23	25,140.98	156	89,549.87	53,366.55	11,019.00	25,164.32
31	89,503.03	53,336.05	10,995.13	25,171.85	94	89,501.63	53,366.43	10,997.80	25,137.40	157	89,518.58	53,326.28	11,017.52	25,174.78
32	89,478.77	53,309.62	11,014.57	25,154.58	95	89,461.87	53,339.32	10,979.60	25,142.95	158	89,552.40	53,340.45	11,020.67	25,191.28
33	89,490.35	53,397.35	10,982.60	25,110.40	96	89,496.67	53,326.18	11,012.62	25,157.87	159	89,510.27	53,394.10	10,995.93	25,120.23
34	89,457.17	53,314.73	11,002.13	25,140.30	97	89,519.70	53,348.43	11,014.52	25,156.75	160	89,487.55	53,309.58	11,009.97	25,168.00
35	89,498.13	53,340.22	11,025.70	25,132.22	98	89,503.17	53,342.62	11,006.00	25,154.55	161	89,482.17	53,331.08	10,992.17	25,158.92
36	89,586.83	53,386.32	11,014.55	25,185.97	99	89,553.98	53,369.83	11,035.38	25,148.77	162	89,591.48	53,380.48	11,032.95	25,178.05
37	89,522.90	53,374.07	11,013.37	25,135.47	100	89,495.55	53,357.70	10,992.77	25,145.08	163	89,446.58	53,319.43	11,013.05	25,114.10
38	89,475.47	53,347.33	10,989.02	25,139.12	101	89,519.15	53,355.30	11,002.10	25,161.75	164	89,537.60	53,342.13	11,037.68	25,157.78
39	89,522.10	53,356.35	11,013.68	25,152.07	102	89,517.07	53,349.98	11,016.12	25,150.97	165	89,486.47	53,328.87	11,025.17	25,132.43
40	89,521.65	53,370.55	11,017.63	25,133.47	103	89,486.03	53,349.18	10,990.80	25,146.05	166	89,473.15	53,349.00	10,999.08	25,125.07
41	89,467.17	53,335.17	10,989.38	25,142.62	104	89,470.35	53,344.00	11,019.98	25,106.37	167	89,529.40	53,362.22	11,014.33	25,152.85
42	89,564.90	53,379.28	11,024.98	25,160.63	105	89,478.00	53,331.92	10,996.83	25,149.25	168	89,608.82	53,406.65	11,004.28	25,197.88
43	89,482.70	53,363.18	11,016.37	25,103.15	106	89,500.58	53,359.53	10,987.67	25,153.38	169	89,534.42	53,369.63	11,019.58	25,145.20
44	89,540.20	53,373.48	11,015.32	25,151.40	107	89,395.80	53,238.00	10,991.82	25,165.98	170	89,477.43	53,352.98	10,981.40	25,143.05
45	89,547.43	53,391.58	11,031.23	25,124.62	108	89,484.05	53,332.98	11,003.95	25,147.12	171	89,552.53	53,392.25	11,022.17	25,138.12
46	89,467.27	53,312.50	11,007.03	25,147.73	109	89,539.52	53,379.67	10,984.93	25,174.92	172	89,495.58	53,331.00	11,004.42	25,160.17
47	89,557.92	53,391.70	11,008.70	25,157.52	110	89,424.88	53,267.02	11,002.78	25,155.08	173	89,539.33	53,378.92	11,020.90	25,139.52
48	89,525.05	53,337.13	11,020.13	25,167.78	111	89,499.42	53,335.58	11,015.30	25,148.53	174	89,477.88	53,332.67	11,005.17	25,140.05
49	89,474.52	53,298.35	11,027.77	25,148.40	112	89,447.25	53,315.08	10,998.32	25,133.85	175	89,474.82	53,309.23	10,988.60	25,176.98
50	89,549.82	53,383.67	11,004.12	25,162.03	113	89,468.43	53,315.07	10,996.53	25,156.83	176	89,514.72	53,321.78	11,021.47	25,171.47
51	89,520.20	53,353.68	11,015.47	25,151.05	114	89,467.83	53,327.62	11,019.40	25,120.82	177	89,523.07	53,358.22	11,037.47	25,127.38
52	89,491.17	53,331.07	11,010.68	25,149.42	115	89,564.38	53,386.40	11,000.18	25,177.80	178	89,471.78	53,348.97	11,015.95	25,106.87
53	89,511.23	53,366.07	10,999.85	25,145.32	116	89,484.48	53,288.55	11,015.12	25,180.82	179	89,520.25	53,351.05	11,014.33	25,154.87
54	89,546.87	53,360.98	11,018.58	25,167.30	117	89,557.28	53,344.28	11,047.77	25,165.23	180	89,475.05	53,325.95	11,031.37	25,117.73
55	89,489.77	53,322.97	11,011.55	25,155.25	118	89,492.87	53,332.87	11,020.00	25,140.00	181	89,505.67	53,360.88	11,004.38	25,140.40
56	89,534.22	53,368.98	10,995.97	25,169.27	119	89,556.55	53,384.85	11,014.17	25,157.53	182	89,552.93	53,344.98	11,016.12	25,191.83
57	89,520.42	53,373.27	11,002.53	25,144.62	120	89,532.13	53,360.75	11,033.72	25,137.67	Average	89,503.83	53,344.25	11,009.79	25,149.79
58	89,528.73	53,340.15	11,016.65	25,171.93	121	89,557.80	53,357.27	11,008.08	25,192.45					
59	89,474.65	53,336.42	11,001.97	25,136.27	122	89,546.20	53,328.72	11,028.48	25,189.00					
60	89,470.07	53,332.50	11,010.82	25,126.75	123	89,508.33	53,323.52	11,003.02	25,181.80					
61	89,505.05	53,360.05	11,002.60	25,142.40	124	89,475.53	53,314.88	11,014.00	25,146.65					
62	89,512.02	53,339.47	11,023.53	25,149.02	125	89,515.50	53,320.85	11,033.93	25,160.72					

Sustainability – I/O Request Throughput Distribution Graph

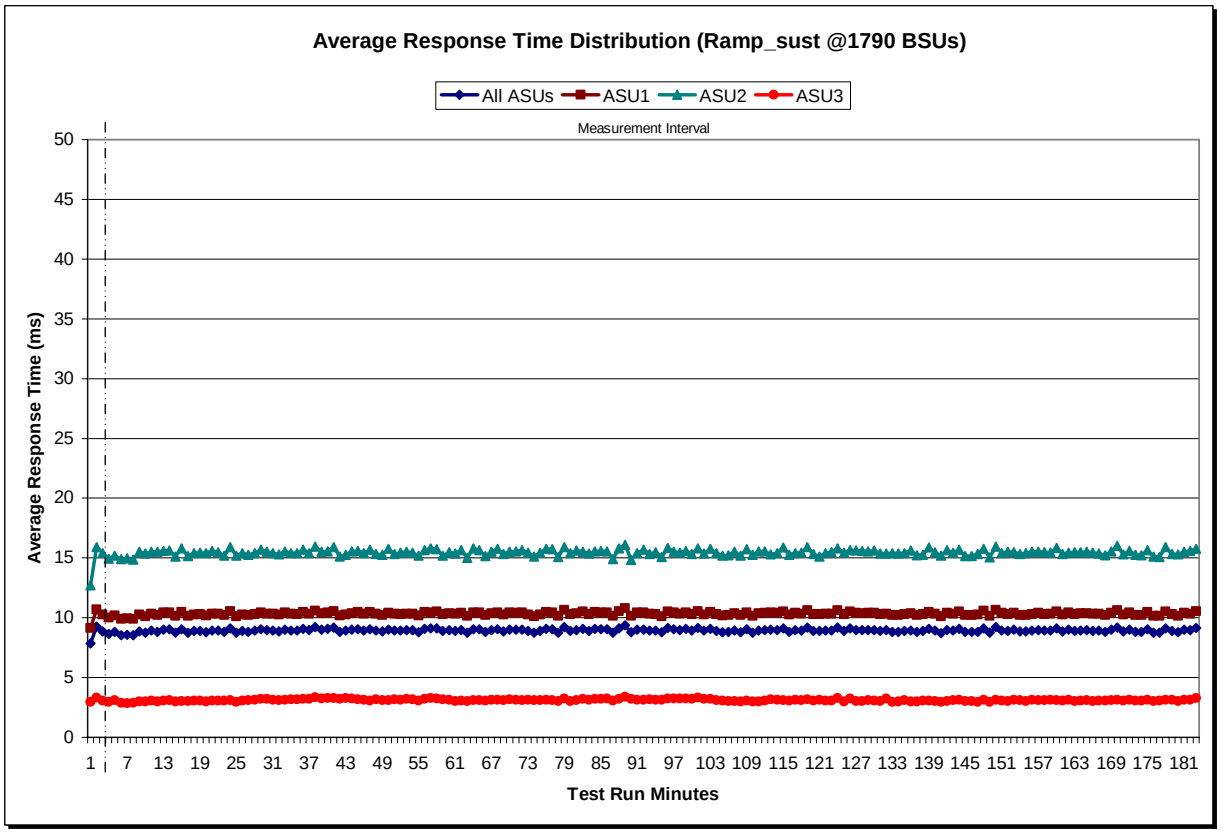


Sustainability – Average Response Time (ms) Distribution Data

	Start	Stop	Interval	Duration
Ramp-Up/Start-Up	20:50:36	20:53:36	0-2	0:03:00
Measurement Interval	20:53:36	23:53:36	3-182	3:00:00

Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3	Interval	All ASUs	ASU1	ASU2	ASU3
0	7.84	9.14	12.71	2.95	63	9.03	10.43	15.80	3.11	126	8.96	10.39	15.62	3.01
1	9.26	10.69	15.90	3.32	64	9.02	10.43	15.67	3.10	127	8.96	10.38	15.59	3.03
2	8.87	10.26	15.39	3.08	65	8.82	10.23	15.16	3.06	128	8.98	10.39	15.55	3.09
3	8.62	10.00	14.93	2.95	66	8.97	10.37	15.51	3.13	129	8.98	10.40	15.63	3.05
4	8.82	10.20	15.19	3.09	67	9.04	10.44	15.75	3.13	130	8.88	10.30	15.37	3.01
5	8.55	9.91	14.89	2.89	68	8.86	10.24	15.32	3.10	131	8.97	10.35	15.39	3.23
6	8.57	9.95	14.97	2.86	69	9.02	10.43	15.52	3.16	132	8.82	10.24	15.39	2.95
7	8.54	9.90	14.85	2.88	70	8.99	10.39	15.55	3.14	133	8.83	10.23	15.37	3.00
8	8.86	10.26	15.51	2.98	71	9.01	10.43	15.66	3.11	134	8.90	10.30	15.42	3.08
9	8.75	10.11	15.36	2.97	72	8.90	10.27	15.44	3.13	135	8.93	10.36	15.63	2.98
10	8.91	10.32	15.53	3.04	73	8.75	10.12	15.11	3.08	136	8.80	10.23	15.23	2.98
11	8.83	10.22	15.50	2.99	74	8.89	10.27	15.43	3.08	137	8.88	10.30	15.27	3.06
12	8.99	10.42	15.59	3.05	75	9.07	10.49	15.78	3.13	138	9.06	10.49	15.89	3.05
13	9.02	10.44	15.62	3.09	76	9.03	10.45	15.74	3.10	139	8.92	10.34	15.49	3.03
14	8.76	10.16	15.12	2.99	77	8.75	10.15	15.10	3.02	140	8.72	10.11	15.19	2.96
15	9.03	10.47	15.79	3.04	78	9.22	10.65	15.90	3.25	141	8.98	10.40	15.67	3.03
16	8.76	10.16	15.14	3.01	79	8.88	10.30	15.40	3.02	142	8.92	10.32	15.43	3.08
17	8.87	10.27	15.40	3.05	80	8.97	10.37	15.64	3.10	143	9.08	10.52	15.70	3.11
18	8.90	10.29	15.46	3.06	81	9.07	10.50	15.53	3.20	144	8.81	10.24	15.15	3.02
19	8.80	10.19	15.40	2.98	82	8.90	10.28	15.38	3.15	145	8.81	10.23	15.14	3.03
20	8.93	10.33	15.59	3.05	83	9.06	10.47	15.57	3.20	146	8.83	10.25	15.35	2.96
21	8.92	10.35	15.48	3.04	84	9.03	10.43	15.60	3.20	147	9.12	10.57	15.78	3.13
22	8.82	10.22	15.21	3.05	85	9.05	10.45	15.56	3.23	148	8.73	10.16	15.04	2.97
23	9.11	10.54	15.92	3.11	86	8.74	10.14	14.91	3.08	149	9.20	10.67	15.95	3.14
24	8.74	10.12	15.21	2.97	87	9.12	10.54	15.82	3.19	150	8.94	10.39	15.40	3.06
25	8.87	10.28	15.40	3.05	88	9.36	10.78	16.08	3.38	151	8.90	10.30	15.50	3.03
26	8.83	10.21	15.27	3.08	89	8.78	10.16	14.84	3.20	152	8.99	10.41	15.48	3.12
27	8.91	10.30	15.41	3.13	90	9.00	10.43	15.41	3.15	153	8.85	10.23	15.33	3.08
28	9.04	10.43	15.70	3.20	91	9.02	10.42	15.68	3.12	154	8.85	10.24	15.42	3.02
29	8.98	10.35	15.51	3.20	92	8.92	10.32	15.35	3.16	155	8.92	10.30	15.53	3.12
30	8.94	10.33	15.42	3.14	93	8.92	10.30	15.46	3.12	156	8.97	10.40	15.52	3.09
31	8.86	10.25	15.31	3.11	94	8.77	10.13	15.09	3.11	157	8.92	10.31	15.47	3.10
32	9.01	10.42	15.54	3.15	95	9.13	10.52	15.85	3.24	158	8.93	10.33	15.46	3.13
33	8.94	10.32	15.40	3.16	96	9.04	10.44	15.52	3.24	159	9.09	10.53	15.84	3.09
34	8.92	10.30	15.42	3.16	97	8.97	10.34	15.45	3.24	160	8.86	10.26	15.32	3.08
35	9.08	10.48	15.68	3.22	98	9.06	10.45	15.58	3.25	161	9.00	10.44	15.46	3.12
36	8.95	10.33	15.39	3.22	99	8.94	10.31	15.35	3.22	162	8.89	10.30	15.47	3.03
37	9.20	10.58	15.95	3.34	100	9.15	10.54	15.79	3.29	163	8.93	10.35	15.50	3.04
38	9.00	10.36	15.53	3.25	101	8.91	10.27	15.36	3.21	164	8.97	10.38	15.52	3.10
39	9.06	10.44	15.56	3.28	102	9.09	10.48	15.77	3.19	165	8.89	10.32	15.43	3.01
40	9.17	10.55	15.91	3.28	103	8.90	10.31	15.39	3.08	166	8.91	10.33	15.37	3.07
41	8.83	10.19	15.13	3.20	104	8.80	10.19	15.18	3.05	167	8.83	10.24	15.24	3.05
42	8.92	10.27	15.27	3.28	105	8.82	10.23	15.21	3.02	168	8.98	10.41	15.57	3.09
43	9.00	10.37	15.54	3.23	106	8.93	10.36	15.51	3.03	169	9.17	10.60	16.00	3.14
44	9.04	10.46	15.59	3.16	107	8.79	10.22	15.20	2.99	170	8.84	10.24	15.29	3.05
45	8.93	10.33	15.42	3.12	108	9.02	10.45	15.73	3.05	171	9.01	10.43	15.57	3.12
46	9.03	10.46	15.68	3.08	109	8.76	10.15	15.26	2.98	172	8.84	10.24	15.25	3.06
47	8.93	10.32	15.35	3.18	110	8.93	10.36	15.56	3.00	173	8.82	10.22	15.22	3.06
48	8.84	10.23	15.28	3.09	111	8.97	10.41	15.54	3.05	174	9.05	10.48	15.64	3.14
49	9.01	10.41	15.76	3.10	112	8.99	10.43	15.28	3.17	175	8.75	10.13	15.12	3.03
50	8.93	10.33	15.35	3.15	113	8.97	10.41	15.40	3.12	176	8.75	10.14	15.09	3.05
51	8.92	10.31	15.44	3.13	114	9.10	10.53	15.87	3.10	177	9.12	10.52	15.91	3.14
52	8.96	10.34	15.50	3.20	115	8.84	10.25	15.25	3.04	178	8.91	10.30	15.33	3.13
53	8.95	10.34	15.43	3.18	116	8.98	10.42	15.42	3.11	179	8.79	10.16	15.30	3.04
54	8.79	10.17	15.20	3.06	117	8.92	10.32	15.43	3.11	180	8.98	10.39	15.50	3.15
55	9.08	10.48	15.65	3.22	118	9.18	10.62	15.92	3.16	181	8.96	10.34	15.59	3.13
56	9.09	10.46	15.80	3.27	119	8.88	10.29	15.32	3.06	182	9.16	10.56	15.76	3.29
57	9.12	10.52	15.73	3.25	120	8.88	10.29	15.12	3.14	Average	8.94	10.34	15.46	3.10
58	8.89	10.28	15.21	3.16	121	8.91	10.33	15.39	3.06					
59	8.96	10.37	15.49	3.12	122	8.92	10.33	15.48	3.06					
60	8.90	10.33	15.37	3.03	123	9.19	10.63	15.80	3.28					
61	8.98	10.39	15.65	3.05	124	8.88	10.31	15.44	3.00					
62	8.74	10.13	15.02	3.02	125	9.09	10.49	15.67	3.24					

Sustainability – Average Response Time (ms) Distribution Graph



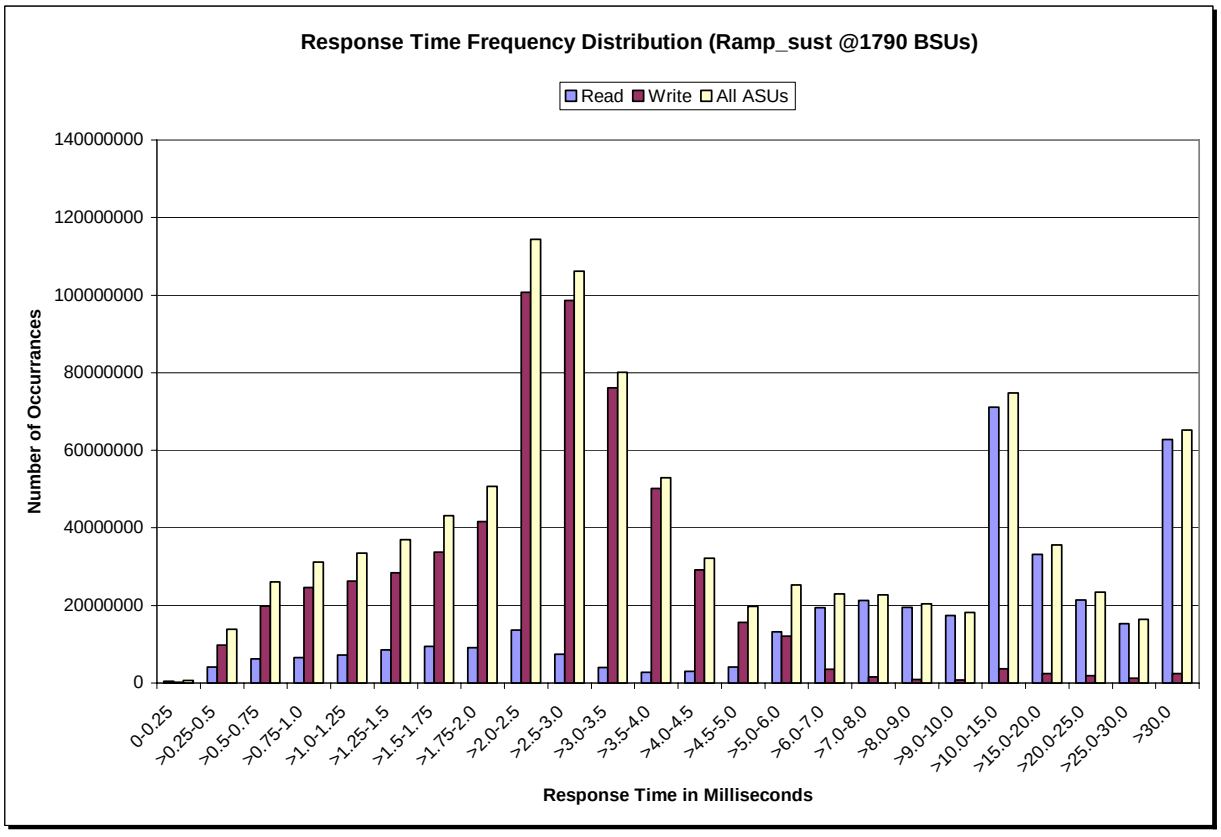
Sustainability – Response Time Frequency Distribution Data

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	427,641	4,058,866	6,199,061	6,528,924	7,205,800	8,557,105	9,457,903	9,124,174
Write	222,934	9,781,966	19,854,647	24,658,378	26,328,157	28,408,391	33,671,458	41,589,961
All ASUs	650,575	13,840,832	26,053,708	31,187,302	33,533,957	36,965,496	43,129,361	50,714,135
ASU1	463,477	8,001,392	14,019,968	16,203,627	17,364,483	19,352,595	22,436,210	25,656,410
ASU2	104,976	1,879,128	3,321,019	3,852,295	4,132,466	4,610,679	5,347,777	6,115,915
ASU3	82,122	3,960,312	8,712,721	11,131,380	12,037,008	13,002,222	15,345,374	18,941,810

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	13,691,437	7,473,606	4,002,688	2,820,455	3,026,238	4,086,727	13,164,626	19,408,206
Write	100,731,469	98,647,471	76,125,761	50,108,546	29,190,975	15,605,711	12,117,907	3,533,316
All ASUs	114,422,906	106,121,077	80,128,449	52,929,001	32,217,213	19,692,438	25,282,533	22,941,522
ASU1	54,978,777	48,421,197	35,579,130	23,523,444	15,016,341	10,429,343	17,723,358	19,751,153
ASU2	13,092,833	11,514,706	8,388,016	5,379,810	3,139,657	1,762,985	1,833,058	1,620,710
ASU3	46,351,296	46,185,174	36,161,303	24,025,747	14,061,215	7,500,110	5,726,117	1,569,659

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	21,278,055	19,490,307	17,383,799	71,159,997	33,173,056	21,444,967	15,260,628	62,803,377
Write	1,501,609	931,679	756,746	3,663,101	2,425,810	1,925,274	1,173,814	2,457,766
All ASUs	22,779,664	20,421,986	18,140,545	74,823,098	35,598,866	23,370,241	16,434,442	65,261,143
ASU1	20,164,340	17,915,759	15,683,564	63,390,341	29,839,642	19,233,121	13,439,714	47,529,890
ASU2	2,002,177	2,142,232	2,157,526	9,866,007	4,678,322	3,211,686	2,381,458	16,370,093
ASU3	613,147	363,995	299,455	1,566,750	1,080,902	925,434	613,270	1,361,160

Sustainability – Response Time Frequency Distribution Graph



Sustainability – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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.*

Clauses 5.1.0 and 5.3.13.2

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%.*

Clause 5.3.13.3

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

	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	0.002	0.001	0.003	0.002	0.002	0.001

Primary Metrics Test – IOPS Test Phase

Clause 5.4.2.2

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

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

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

Clause 9.2.4.7.2

For the IOPS Test Phase the FDR shall contain:

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

SPC-1 Workload Generator Input Parameters

The SPC-1 Workload Generator input parameters for the Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 86.

IOPS Test Results File

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

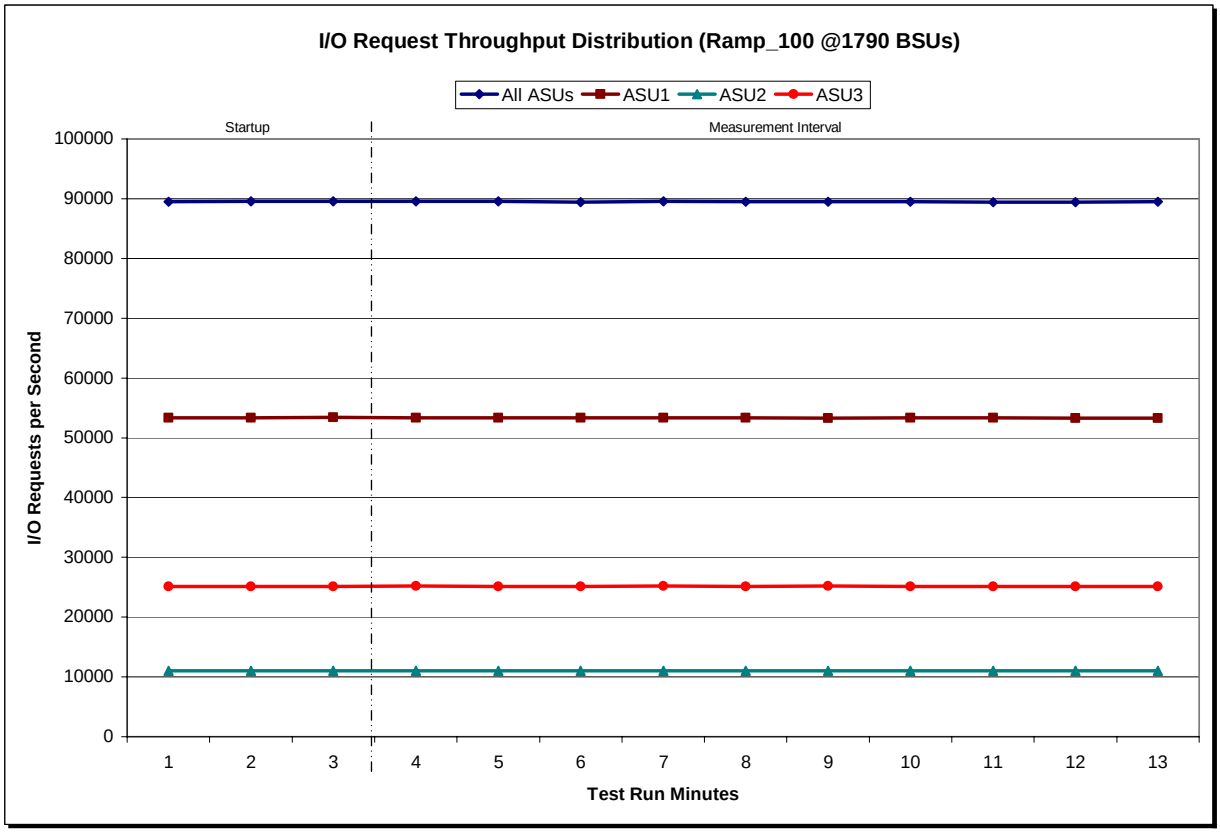
IOPS Test Results File

IOPS Test Run – I/O Request Throughput Distribution Data

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:54:13	23:57:14	0-2	0:03:01
Measurement Interval	23:57:14	0:07:14	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	89,521.47	53,357.02	11,008.15	25,156.30
1	89,533.77	53,367.67	11,010.92	25,155.18
2	89,536.58	53,391.65	11,009.15	25,135.78
3	89,555.55	53,357.95	11,003.22	25,194.38
4	89,532.92	53,366.93	11,012.02	25,153.97
5	89,446.05	53,313.83	11,011.28	25,120.93
6	89,526.48	53,335.85	11,010.53	25,180.10
7	89,519.17	53,335.13	11,022.12	25,161.92
8	89,472.70	53,307.82	10,997.42	25,167.47
9	89,524.60	53,370.95	10,995.52	25,158.13
10	89,429.92	53,312.18	10,979.70	25,138.03
11	89,451.60	53,311.28	11,016.63	25,123.68
12	89,459.15	53,296.63	11,034.00	25,128.52
Average	89,491.81	53,330.86	11,008.24	25,152.71

IOPS Test Run – I/O Request Throughput Distribution Graph

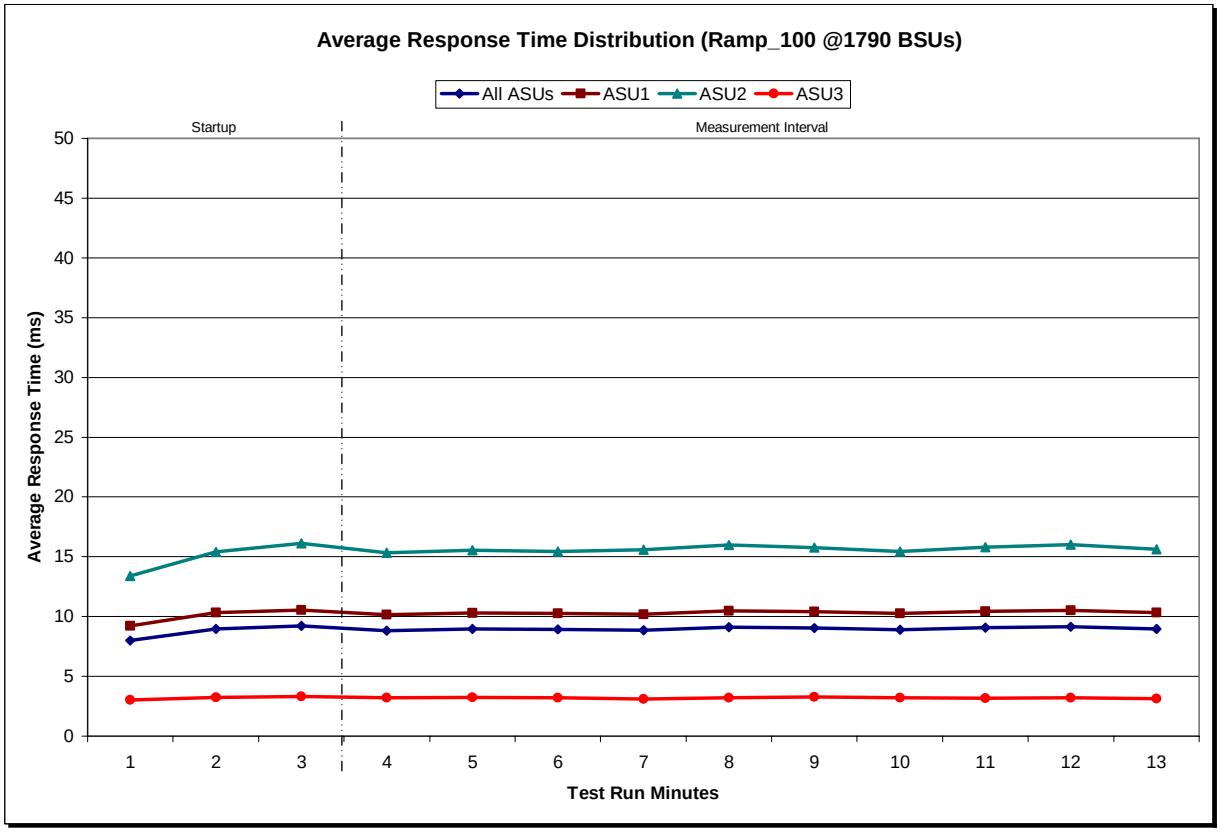


IOPS Test Run – Average Response Time (ms) Distribution Data

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:54:13	23:57:14	0-2	0:03:01
Measurement Interval	23:57:14	0:07:14	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	7.98	9.21	13.40	3.02
1	8.96	10.32	15.42	3.25
2	9.20	10.54	16.13	3.32
3	8.84	10.16	15.32	3.20
4	8.95	10.28	15.55	3.25
5	8.92	10.26	15.43	3.21
6	8.87	10.20	15.59	3.10
7	9.10	10.46	15.99	3.20
8	9.05	10.40	15.77	3.26
9	8.91	10.25	15.45	3.19
10	9.06	10.45	15.81	3.17
11	9.14	10.52	16.02	3.21
12	8.96	10.33	15.61	3.14
Average	8.98	10.33	15.65	3.19

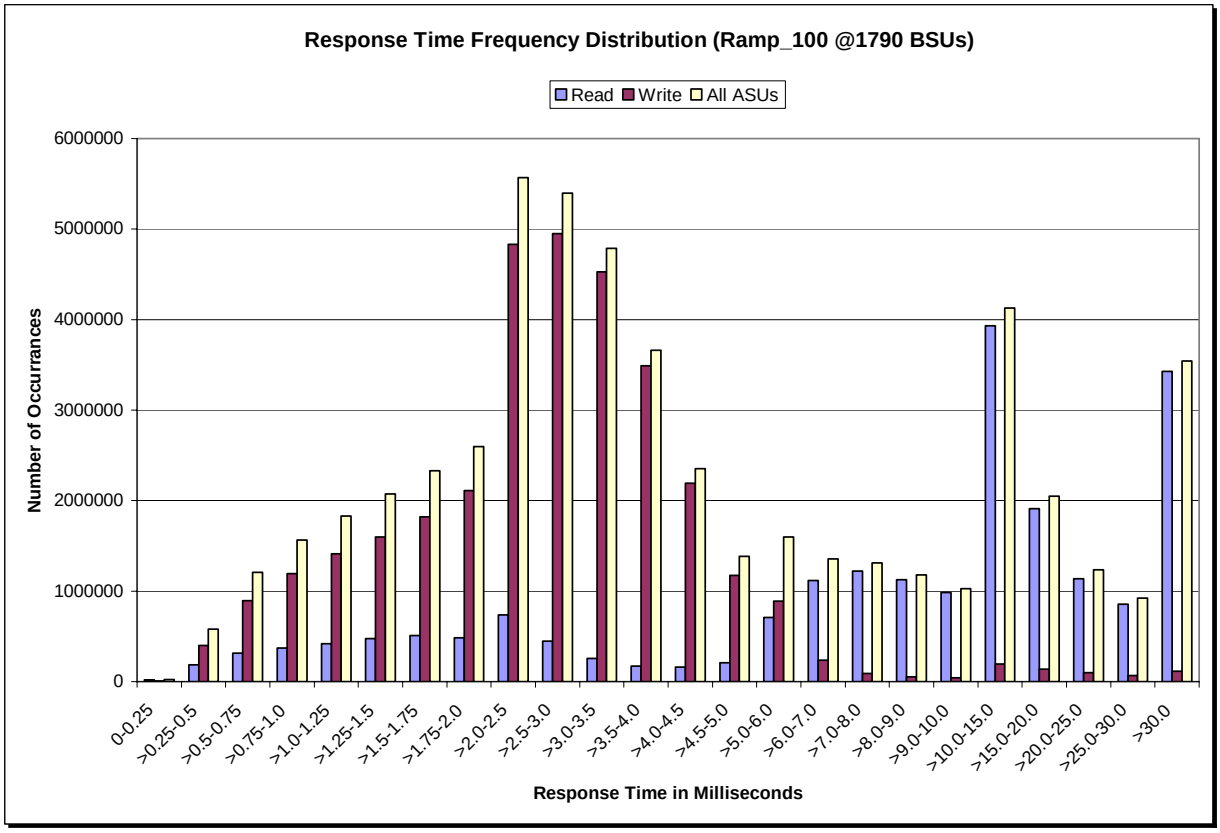
IOPS Test Run – Average Response Time (ms) Distribution Graph



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	17,363	183,875	312,501	369,590	416,579	475,347	508,729	482,855
Write	4,567	397,251	892,840	1,194,564	1,413,617	1,596,350	1,822,056	2,111,423
All ASUs	21,930	581,126	1,205,341	1,564,154	1,830,196	2,071,697	2,330,785	2,594,278
ASU1	16,688	343,211	661,978	835,614	964,928	1,089,723	1,216,330	1,319,979
ASU2	3,555	79,170	153,614	194,083	224,422	254,546	283,054	309,131
ASU3	1,687	158,745	389,749	534,457	640,846	727,428	831,401	965,168
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	738,965	448,882	258,697	170,918	160,208	208,184	709,476	1,115,270
Write	4,829,987	4,947,478	4,527,768	3,490,767	2,194,087	1,175,870	889,026	238,339
All ASUs	5,568,952	5,396,360	4,786,465	3,661,685	2,354,295	1,384,054	1,598,502	1,353,609
ASU1	2,706,307	2,498,602	2,149,598	1,626,055	1,067,178	689,477	1,054,398	1,151,258
ASU2	636,547	589,030	506,079	374,948	232,994	128,754	122,470	95,653
ASU3	2,226,098	2,308,728	2,130,788	1,660,682	1,054,123	565,823	421,634	106,698
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	1,222,292	1,126,657	984,757	3,931,469	1,911,625	1,134,049	855,112	3,426,283
Write	92,133	53,432	41,934	192,974	136,914	99,979	64,899	116,399
All ASUs	1,314,425	1,180,089	1,026,691	4,124,443	2,048,539	1,234,028	920,011	3,542,682
ASU1	1,159,654	1,032,338	884,502	3,480,615	1,710,587	1,011,278	749,996	2,577,699
ASU2	117,177	126,581	125,133	560,330	277,007	173,751	136,292	900,484
ASU3	37,594	21,170	17,056	83,498	60,945	48,999	33,723	64,499

IOPS Test Run –Response Time Frequency 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
53,694,337	50,151,655	3,542,682

IOPS Test Run – Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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.*

Clauses 5.1.0 and 5.3.13.2

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%.*

Clause 5.3.13.3

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

	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	0.2099	0.0180	0.0700	0.0350	0.2811
COV	0.002	0.001	0.002	0.001	0.003	0.002	0.003	0.001

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 12.

In addition, the Average Response Time measured during the 10% Test Run is the value for the SPC-1 LRT™ 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, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 86.

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 - 1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	23:54:13	23:57:14	0-4	0:03:01
Measurement Interval	23:57:14	0:07:14	5-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	89,521.47	53,357.02	11,008.15	25,156.30
1	89,533.77	53,367.67	11,010.92	25,155.18
2	89,536.58	53,391.65	11,009.15	25,135.78
3	89,555.55	53,357.95	11,003.22	25,194.38
4	89,532.92	53,366.93	11,012.02	25,153.97
5	89,446.05	53,313.83	11,011.28	25,120.93
6	89,526.48	53,335.85	11,010.53	25,180.10
7	89,519.17	53,335.13	11,022.12	25,161.92
8	89,472.70	53,307.82	10,997.42	25,167.47
9	89,524.60	53,370.95	10,995.52	25,158.13
10	89,429.92	53,312.18	10,979.70	25,138.03
11	89,451.60	53,311.28	11,016.63	25,123.68
12	89,459.15	53,296.63	11,034.00	25,128.52
Average	89,491.81	53,330.86	11,008.24	25,152.71

95% Load Level - 1700 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:07:37	0:10:38	0-4	0:03:01
Measurement Interval	0:10:38	0:20:38	5-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	85,037.63	50,685.83	10,467.07	23,884.73
1	85,001.88	50,676.28	10,438.15	23,887.45
2	84,939.90	50,622.87	10,453.63	23,863.40
3	85,091.63	50,729.92	10,462.65	23,899.07
4	84,983.78	50,652.08	10,460.07	23,871.63
5	85,028.02	50,680.18	10,458.87	23,888.97
6	84,978.47	50,633.47	10,447.50	23,897.50
7	85,074.42	50,705.13	10,467.70	23,901.58
8	84,960.42	50,640.37	10,441.20	23,878.85
9	84,985.77	50,648.93	10,476.82	23,860.02
10	84,933.80	50,615.50	10,457.38	23,860.92
11	85,011.20	50,669.27	10,455.93	23,886.00
12	84,990.52	50,658.75	10,461.15	23,870.62
Average	85,003.80	50,663.36	10,458.93	23,881.52

90% Load Level - 1611 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:21:01	0:24:02	0-4	0:03:01
Measurement Interval	0:24:02	0:34:02	5-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	80,588.75	48,040.25	9,924.33	22,624.17
1	80,585.80	48,051.97	9,901.82	22,632.02
2	80,524.30	48,006.15	9,898.98	22,619.17
3	80,584.90	48,021.02	9,911.98	22,651.90
4	80,574.87	48,003.93	9,920.42	22,650.52
5	80,481.37	47,995.30	9,918.42	22,567.65
6	80,492.62	47,943.25	9,908.47	22,640.90
7	80,608.23	48,035.75	9,914.17	22,658.32
8	80,541.50	48,009.08	9,889.30	22,643.12
9	80,579.68	48,021.92	9,919.83	22,637.93
10	80,543.42	48,028.90	9,885.02	22,629.50
11	80,560.98	48,025.97	9,914.35	22,620.67
12	80,484.32	47,987.80	9,886.78	22,609.73
Average	80,545.19	48,007.29	9,906.87	22,631.02

80% Load Level - 1432 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:34:24	0:37:25	0-4	0:03:01
Measurement Interval	0:37:25	0:47:25	5-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	71,612.00	42,684.18	8,805.15	20,122.67
1	71,595.97	42,636.15	8,815.05	20,144.77
2	71,535.75	42,640.50	8,819.05	20,076.20
3	71,601.45	42,689.42	8,795.78	20,116.25
4	71,616.65	42,653.62	8,811.55	20,151.48
5	71,610.42	42,662.30	8,831.12	20,117.00
6	71,599.88	42,697.80	8,792.28	20,109.80
7	71,596.77	42,683.58	8,814.13	20,099.05
8	71,633.12	42,690.95	8,816.30	20,125.87
9	71,564.75	42,631.73	8,828.52	20,104.50
10	71,549.40	42,663.52	8,805.60	20,080.28
11	71,518.50	42,633.67	8,803.78	20,081.05
12	71,533.15	42,602.65	8,819.95	20,110.55
Average	71,582.41	42,660.92	8,811.90	20,109.58

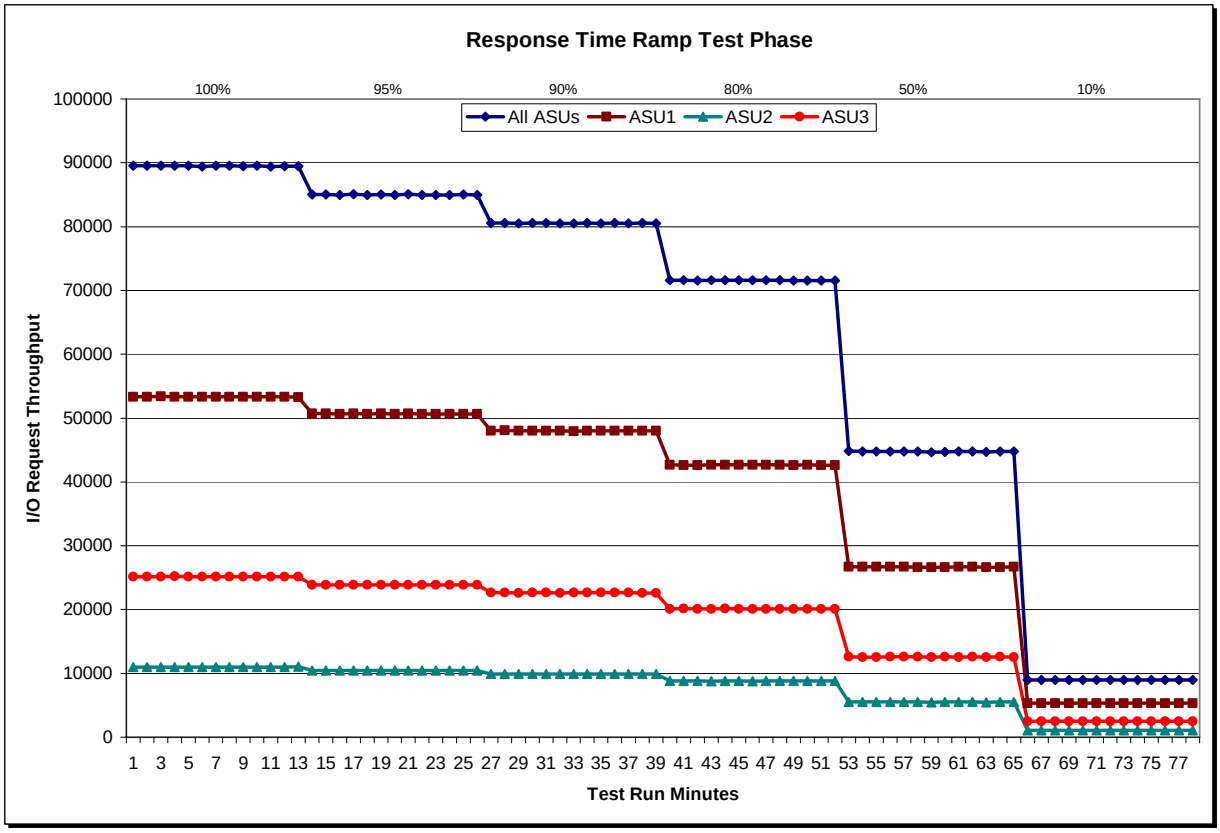
50% Load Level - 895 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	0:47:44	0:50:45	0-4	0:03:01
Measurement Interval	0:50:45	1:00:45	5-12	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	44,829.98	26,707.42	5,518.92	12,603.65
1	44,744.43	26,699.95	5,506.12	12,538.37
2	44,749.88	26,680.23	5,504.53	12,565.12
3	44,778.97	26,675.13	5,504.33	12,599.50
4	44,756.38	26,675.42	5,499.37	12,581.60
5	44,748.75	26,656.30	5,498.88	12,593.57
6	44,672.27	26,634.82	5,489.92	12,547.53
7	44,719.27	26,629.00	5,509.93	12,580.33
8	44,771.10	26,682.77	5,514.57	12,573.77
9	44,771.78	26,683.63	5,501.42	12,586.73
10	44,708.20	26,656.33	5,493.48	12,558.38
11	44,762.43	26,668.43	5,517.50	12,576.50
12	44,779.73	26,713.68	5,501.35	12,564.70
Average	44,746.89	26,667.55	5,503.08	12,576.26

10% Load Level - 179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:01:00	1:04:01	0-4	0:03:01
Measurement Interval	1:04:01	1:14:01	5-14	0:10:00

(60 second intervals)	All ASUs	ASU-1	ASU-2	ASU-3
0	8,956.92	5,338.67	1,105.17	2,513.08
1	8,958.40	5,341.65	1,101.95	2,514.80
2	8,969.63	5,349.28	1,099.97	2,520.38
3	8,950.52	5,340.65	1,097.67	2,512.20
4	8,937.93	5,329.80	1,100.03	2,508.10
5	8,946.08	5,320.87	1,105.40	2,519.82
6	8,956.85	5,331.97	1,110.65	2,514.23
7	8,961.50	5,352.75	1,094.92	2,513.83
8	8,954.67	5,339.67	1,097.80	2,517.20
9	8,950.93	5,337.47	1,102.02	2,511.45
10	8,946.35	5,332.18	1,104.90	2,509.27
11	8,952.40	5,335.00	1,102.90	2,514.50
12	8,946.55	5,332.95	1,098.60	2,515.00
Average	8,950.38	5,335.33	1,101.49	2,513.56

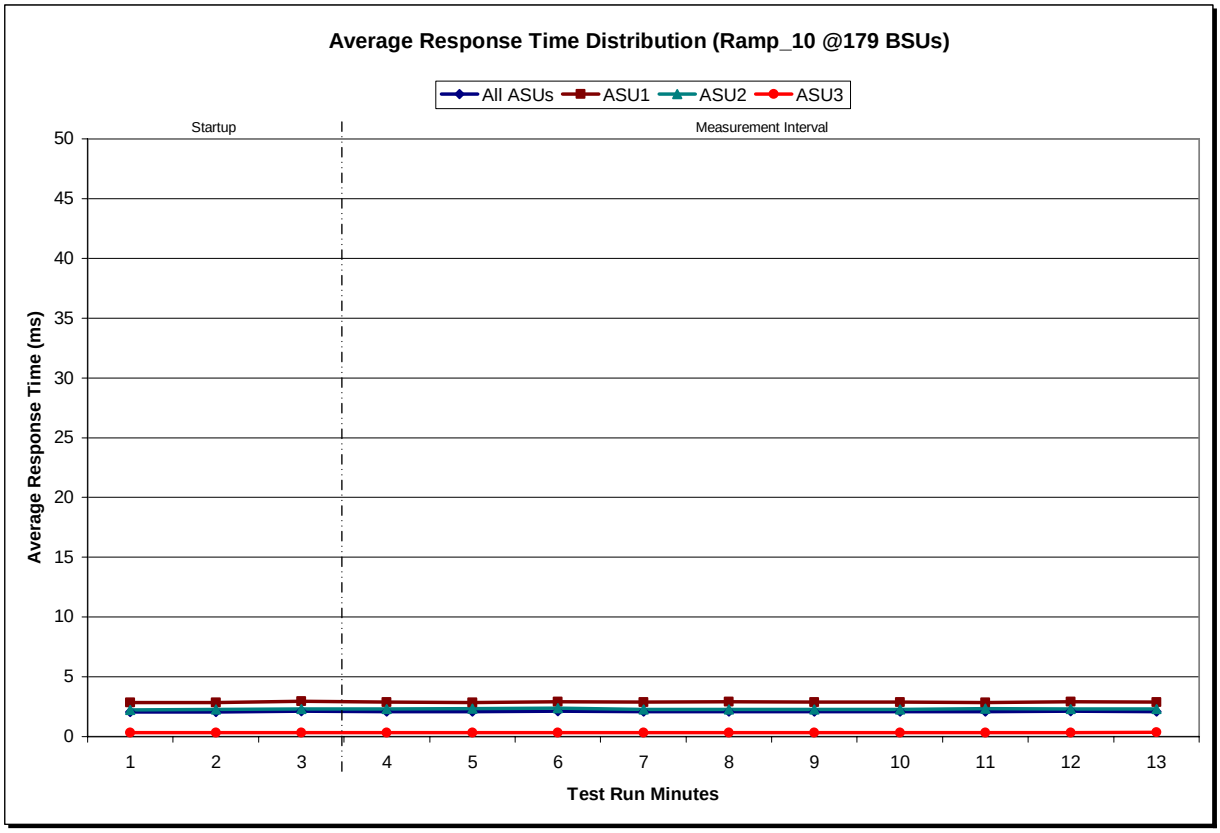
Response Time Ramp Distribution (IOPS) Graph



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

179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:01:00	1:04:01	0-4	0:03:01
Measurement Interval	1:04:01	1:14:01	5-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.05	2.83	2.23	0.33
1	2.06	2.84	2.25	0.33
2	2.12	2.94	2.29	0.33
3	2.09	2.88	2.32	0.33
4	2.09	2.86	2.35	0.34
5	2.13	2.93	2.36	0.34
6	2.09	2.88	2.25	0.33
7	2.11	2.90	2.28	0.33
8	2.09	2.89	2.27	0.32
9	2.08	2.86	2.28	0.33
10	2.09	2.86	2.33	0.34
11	2.11	2.91	2.32	0.33
12	2.10	2.89	2.30	0.34
Average	2.10	2.89	2.31	0.33

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



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

Clause 3.4.3

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.*

Clauses 5.1.0 and 5.3.13.2

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%.*

Clause 5.3.13.3

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

	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	0.0701	0.2101	0.0180	0.0701	0.0349	0.2808
COV	0.008	0.002	0.005	0.002	0.008	0.007	0.009	0.001

Repeatability Test

Clause 5.4.5

The Repeatability Test demonstrates the repeatability and reproducibility of the SPC-1 IOPS™ primary metric and SPC-1 LRT™ metric 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™ metric. Each Average Response Time value must be less than the SPC-1 LRT™ 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 9.2.4.7.4

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 Repeatability Test.*
2. *An I/O Request Throughput Distribution graph and table.*
3. *An Average Response Time Distribution graph and table.*
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 Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 86.

Repeatability Test Results File

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

	SPC-1 IOPS™
Primary Metrics	***89,492.81***
Repeatability Test Phase 1	89,476.79
Repeatability Test Phase 2	89,508.75

The SPC-1 IOPS™ values in the above table were generated using 100% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 IOPS™ must greater than 95% of the reported SPC-1 IOPS™ Primary Metric.

	SPC-1 LRT™
Primary Metrics	***2.10 ms***
Repeatability Test Phase 1	2.08 ms
Repeatability Test Phase 2	2.10 ms

The average response time values in the SPC-1 LRT™ column were generated using 10% of the specified Business Scaling Unit (BSU) load level. Each of the Repeatability Test Phase values for SPC-1 LRT™ must be less than 105% of the reported SPC-1 LRT™ Primary Metric.

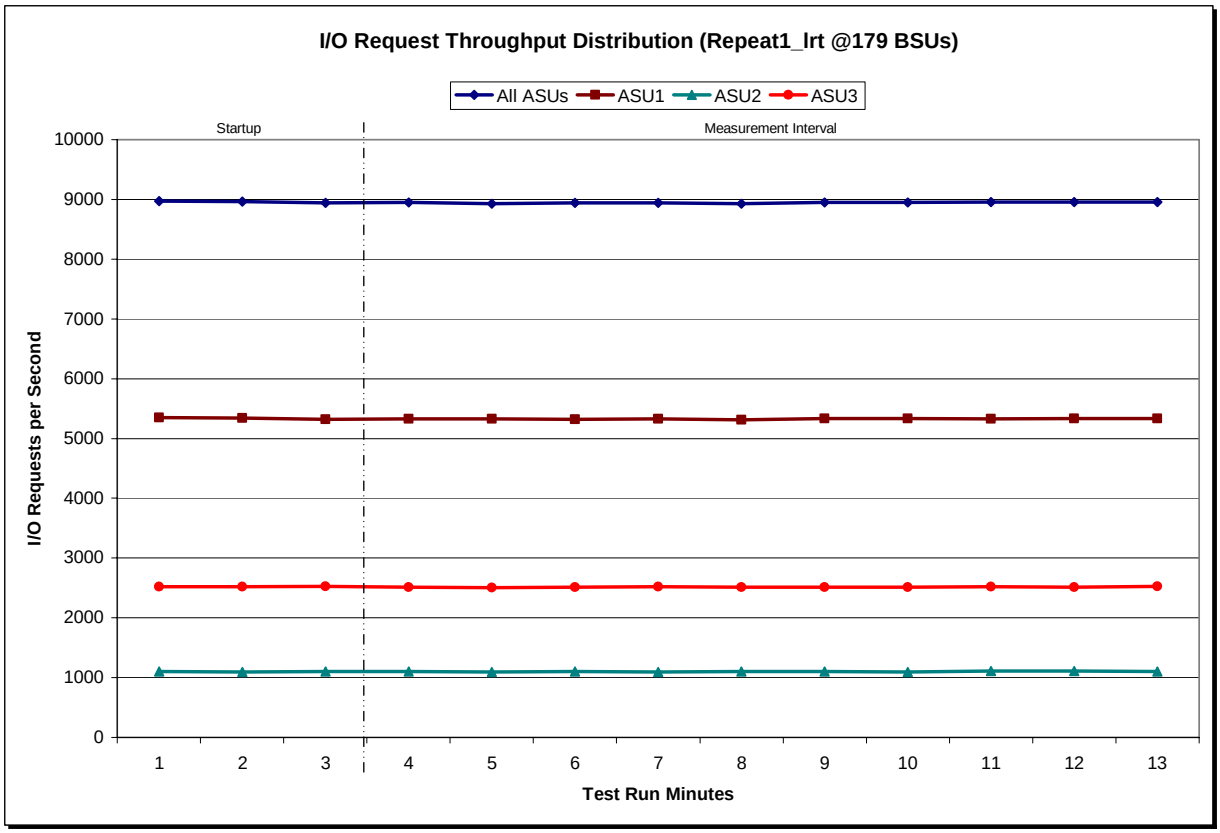
A link to the test result file generated from each Repeatability Test Run is listed below.

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

179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:14:35	1:17:35	0-2	0:03:00
Measurement Interval	1:17:35	1:27:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	8,973.42	5,350.27	1,101.67	2,521.48
1	8,960.58	5,341.43	1,097.72	2,521.43
2	8,941.43	5,318.85	1,098.53	2,524.05
3	8,946.05	5,328.38	1,102.30	2,515.37
4	8,926.43	5,324.33	1,094.62	2,507.48
5	8,943.27	5,323.92	1,103.30	2,516.05
6	8,942.53	5,327.80	1,097.23	2,517.50
7	8,928.38	5,313.80	1,098.93	2,515.65
8	8,951.97	5,337.82	1,099.38	2,514.77
9	8,951.52	5,337.88	1,097.78	2,515.85
10	8,954.62	5,330.23	1,105.67	2,518.72
11	8,956.13	5,333.78	1,110.43	2,511.92
12	8,959.57	5,333.93	1,101.58	2,524.05
Average	8,946.05	5,329.19	1,101.12	2,515.74

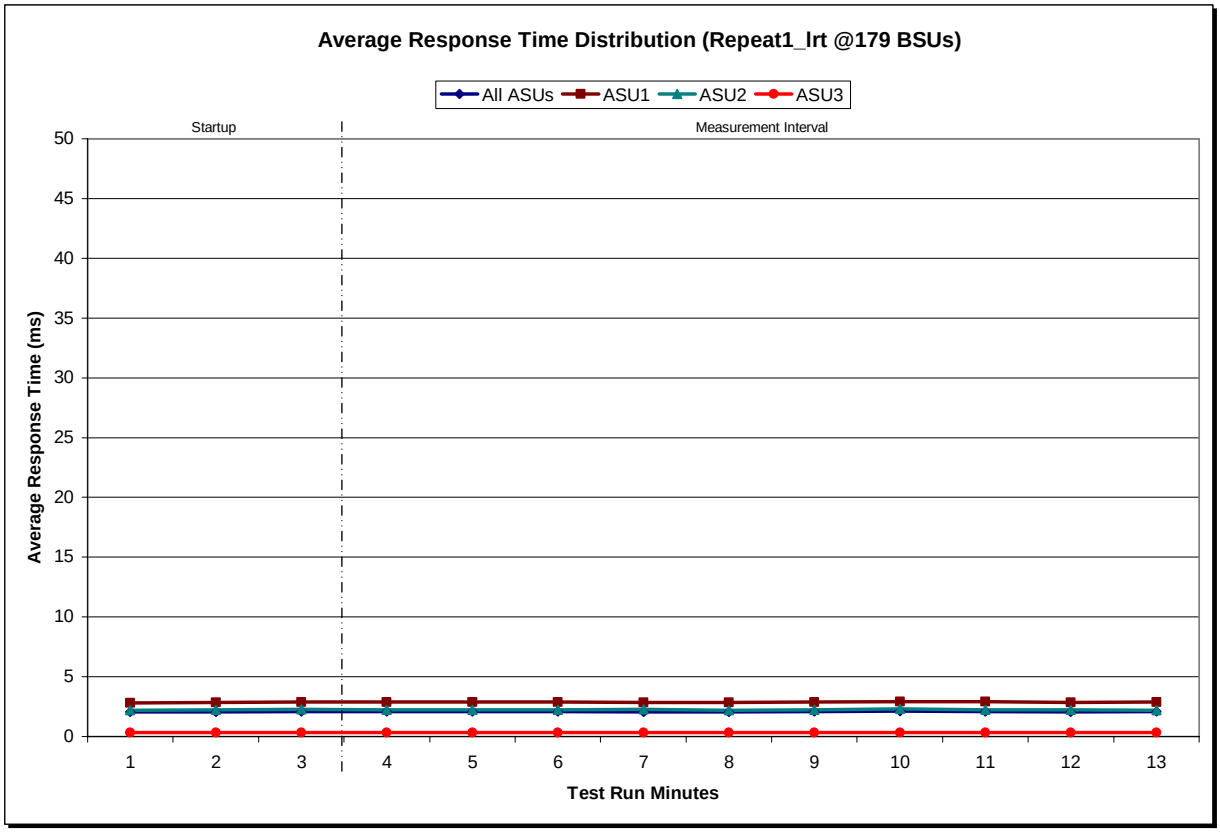
Repeatability 1 LRT – I/O Request Throughput Distribution Graph



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

179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:14:35	1:17:35	0-2	0:03:00
Measurement Interval	1:17:35	1:27:35	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.04	2.82	2.18	0.32
1	2.07	2.86	2.24	0.33
2	2.09	2.89	2.28	0.32
3	2.09	2.89	2.22	0.33
4	2.09	2.88	2.25	0.33
5	2.09	2.89	2.24	0.32
6	2.07	2.84	2.27	0.33
7	2.06	2.85	2.19	0.33
8	2.07	2.87	2.22	0.32
9	2.11	2.91	2.29	0.33
10	2.10	2.90	2.24	0.32
11	2.07	2.86	2.22	0.33
12	2.08	2.89	2.20	0.32
Average	2.08	2.88	2.23	0.32

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

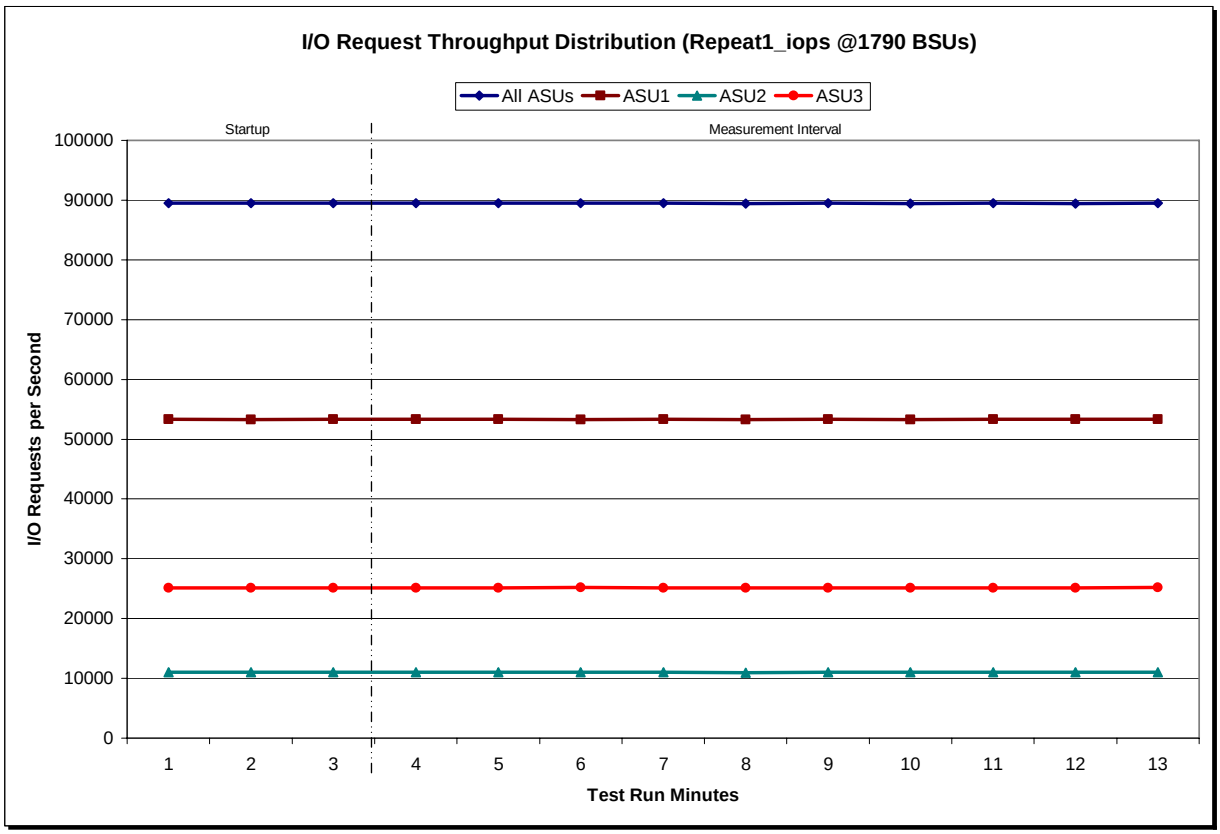


Repeatability 1 IOPS – I/O Request Throughput Distribution Data

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:28:00	1:31:01	0-2	0:03:01
Measurement Interval	1:31:01	1:41:01	3-12	0:10:00

60 second intervals	All ASUs	ASU1	ASU2	ASU3
0	89,481.77	53,332.85	11,021.48	25,127.43
1	89,457.18	53,276.82	11,025.33	25,155.03
2	89,486.20	53,329.83	11,008.82	25,147.55
3	89,501.48	53,359.62	11,004.35	25,137.52
4	89,513.28	53,373.57	10,998.88	25,140.83
5	89,511.35	53,305.80	11,038.17	25,167.38
6	89,490.72	53,350.30	10,995.60	25,144.82
7	89,389.32	53,266.25	10,977.03	25,146.03
8	89,470.85	53,325.18	10,989.53	25,156.13
9	89,441.93	53,300.88	11,024.08	25,116.97
10	89,488.47	53,349.68	11,008.82	25,129.97
11	89,442.83	53,316.15	10,990.83	25,135.85
12	89,517.68	53,352.20	10,981.33	25,184.15
Average	89,476.79	53,329.96	11,000.86	25,145.97

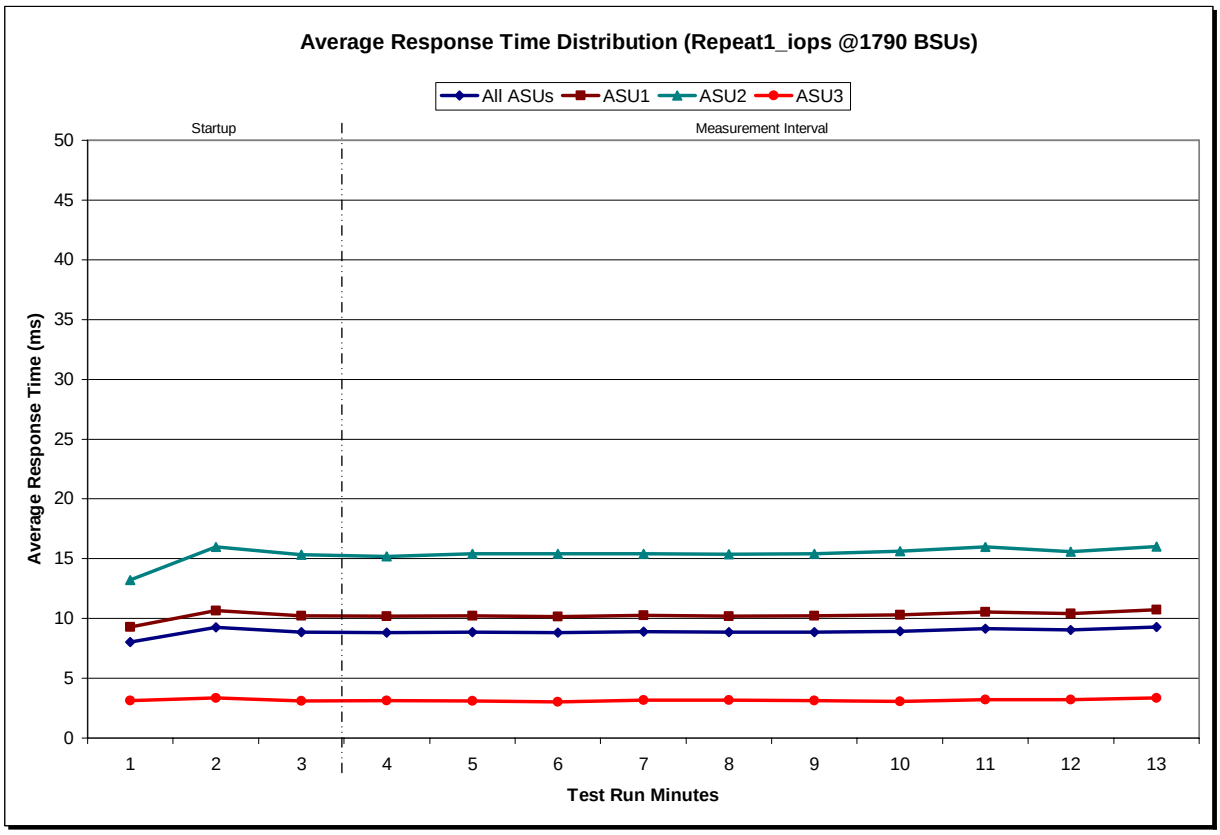
Repeatability 1 IOPS – I/O Request Throughput Distribution Graph



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

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:28:00	1:31:01	0-2	0:03:01
Measurement Interval	1:31:01	1:41:01	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	8.03	9.27	13.20	3.13
1	9.25	10.66	16.00	3.33
2	8.86	10.23	15.34	3.11
3	8.82	10.18	15.20	3.13
4	8.86	10.23	15.39	3.10
5	8.81	10.17	15.41	3.03
6	8.89	10.25	15.42	3.16
7	8.84	10.18	15.38	3.16
8	8.86	10.21	15.41	3.12
9	8.92	10.29	15.62	3.07
10	9.15	10.55	15.97	3.21
11	9.02	10.42	15.59	3.20
12	9.29	10.72	16.01	3.33
Average	8.95	10.32	15.54	3.15

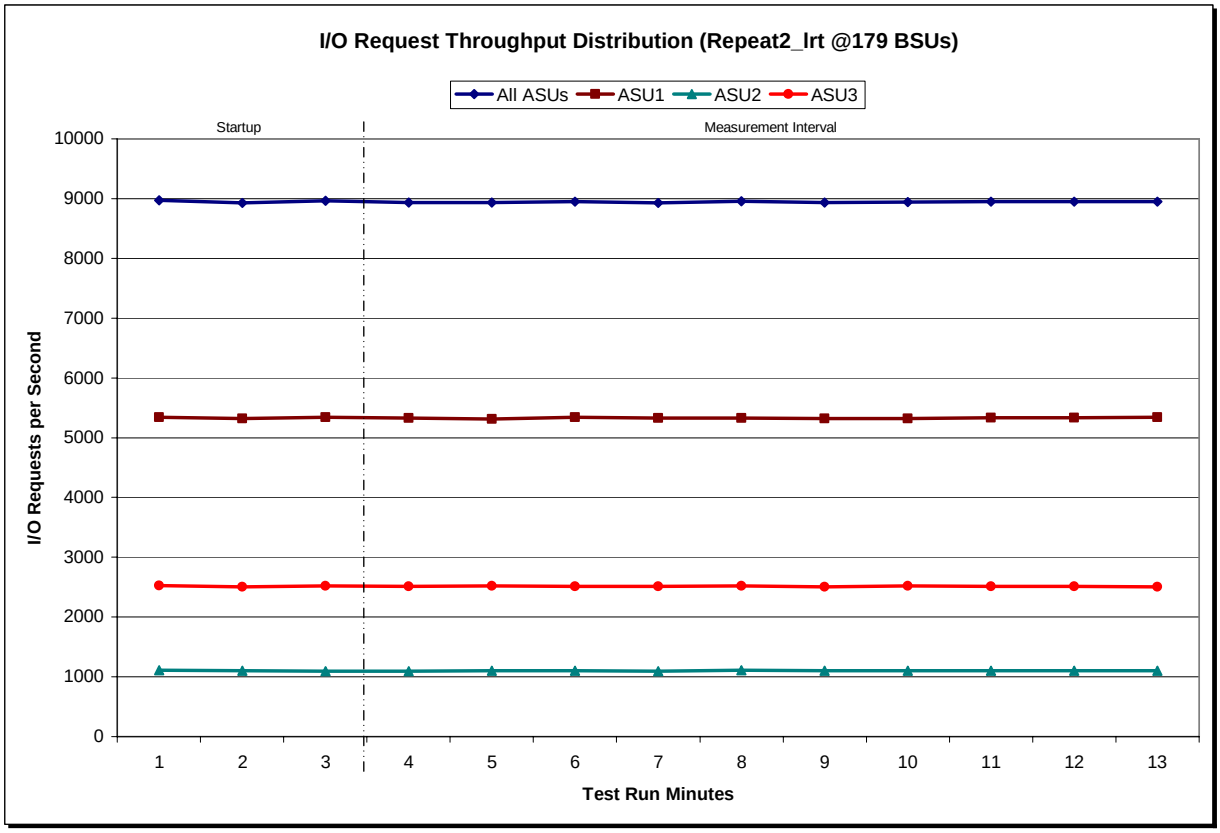
Repeatability 1 IOPS –Average Response Time (ms) Distribution Graph



Repeatability 2 LRT – I/O Request Throughput Distribution Data

179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:41:34	1:44:34	0-2	0:03:00
Measurement Interval	1:44:34	1:54:34	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	8,970.13	5,339.05	1,106.32	2,524.77
1	8,930.12	5,319.43	1,102.62	2,508.07
2	8,964.42	5,344.90	1,096.93	2,522.58
3	8,933.52	5,324.63	1,094.98	2,513.90
4	8,935.65	5,316.47	1,099.45	2,519.73
5	8,949.50	5,339.40	1,100.20	2,509.90
6	8,929.12	5,325.63	1,092.68	2,510.80
7	8,955.93	5,325.42	1,108.98	2,521.53
8	8,932.05	5,322.95	1,102.17	2,506.93
9	8,940.62	5,322.87	1,098.42	2,519.33
10	8,949.82	5,334.02	1,100.07	2,515.73
11	8,947.42	5,333.43	1,100.35	2,513.63
12	8,949.22	5,339.48	1,102.42	2,507.32
Average	8,942.28	5,328.43	1,099.97	2,513.88

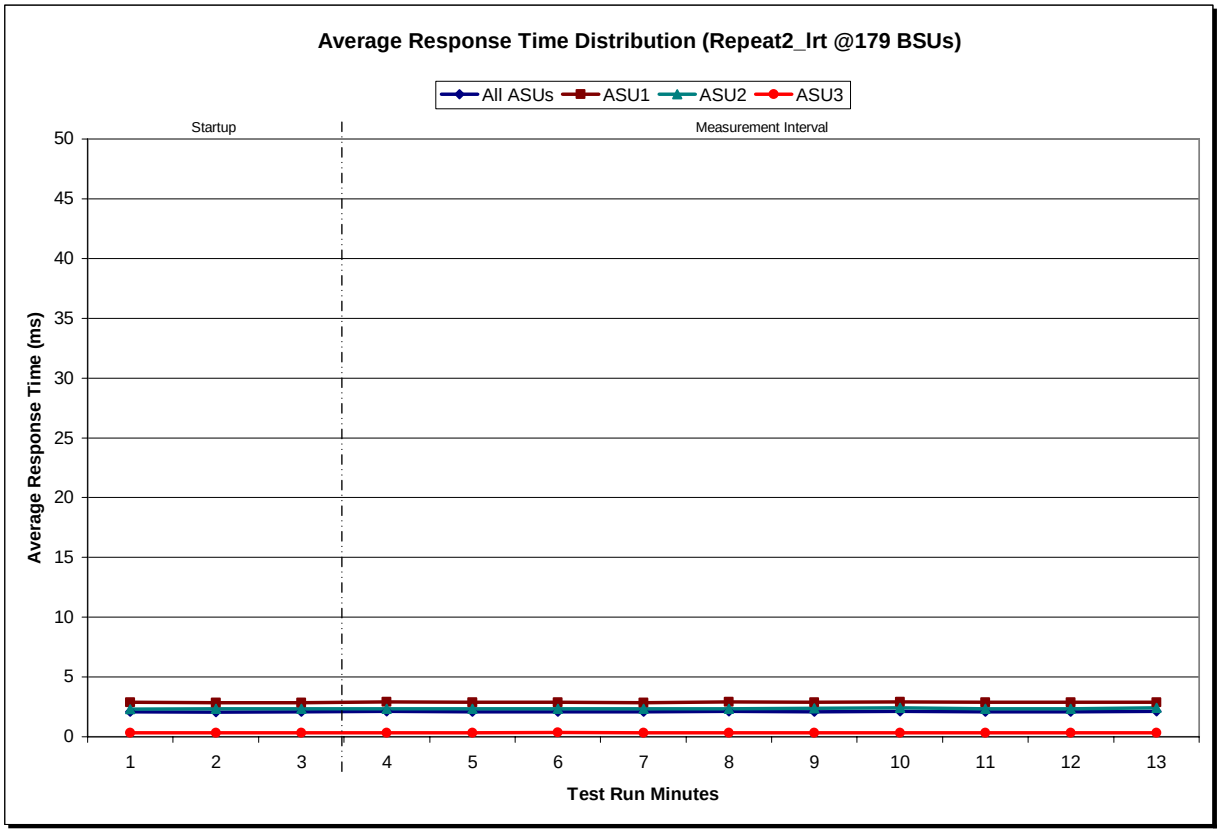
Repeatability 2 LRT – I/O Request Throughput Distribution Graph



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

179 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:41:34	1:44:34	0-2	0:03:00
Measurement Interval	1:44:34	1:54:34	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	2.08	2.87	2.29	0.33
1	2.07	2.83	2.34	0.33
2	2.08	2.86	2.32	0.33
3	2.11	2.90	2.35	0.33
4	2.09	2.88	2.32	0.33
5	2.10	2.88	2.35	0.35
6	2.08	2.85	2.35	0.33
7	2.11	2.91	2.34	0.33
8	2.10	2.87	2.36	0.34
9	2.12	2.92	2.39	0.33
10	2.10	2.88	2.35	0.34
11	2.09	2.88	2.35	0.32
12	2.12	2.90	2.40	0.33
Average	2.10	2.89	2.36	0.33

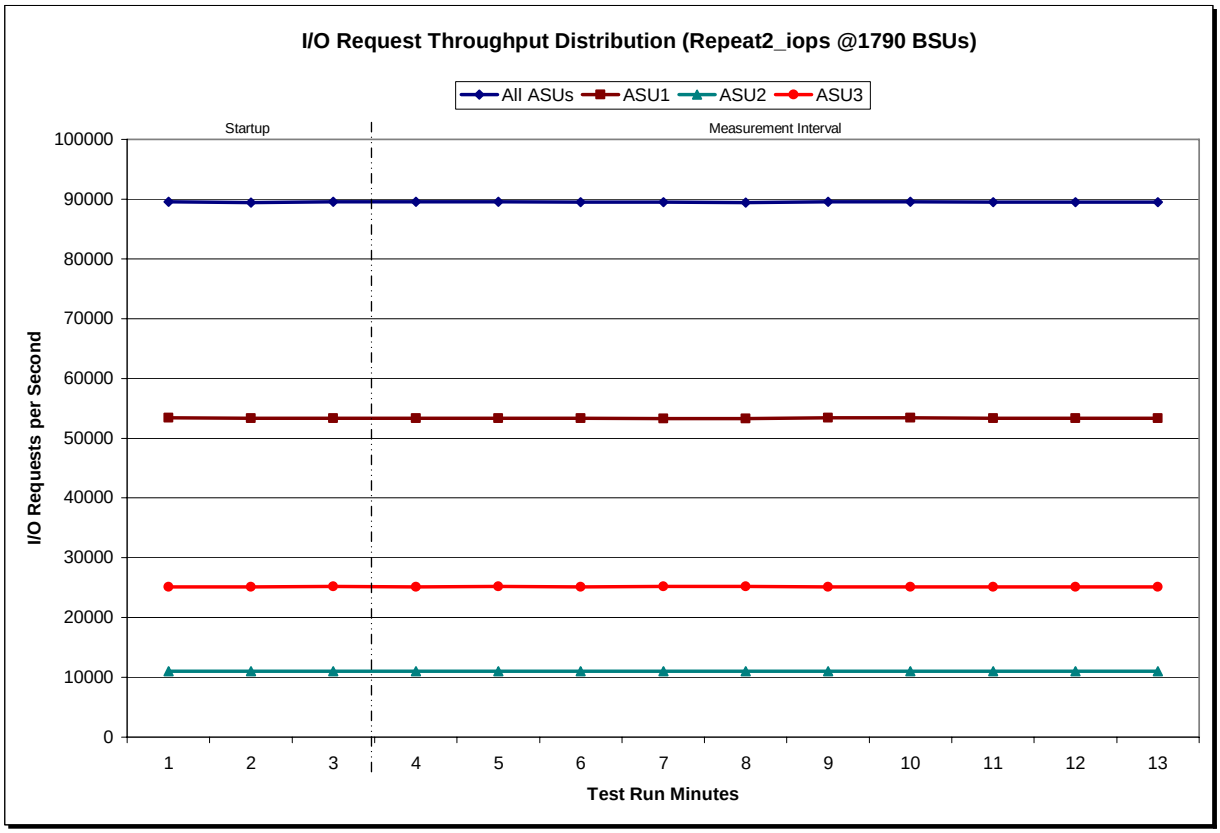
Repeatability 2 LRT –Average Response Time (ms) Distribution Graph



Repeatability 2 IOPS – I/O Request Throughput Distribution Data

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:55:00	1:58:01	0-2	0:03:01
Measurement Interval	1:58:01	2:08:01	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	89,557.12	53,384.83	11,014.30	25,157.98
1	89,439.80	53,319.28	10,996.38	25,124.13
2	89,536.55	53,360.48	11,009.02	25,167.05
3	89,537.00	53,380.82	10,997.12	25,159.07
4	89,527.22	53,349.95	11,009.42	25,167.85
5	89,456.12	53,336.68	10,979.78	25,139.65
6	89,522.55	53,298.47	11,017.77	25,206.32
7	89,447.47	53,263.98	11,008.62	25,174.87
8	89,555.68	53,391.58	11,027.17	25,136.93
9	89,527.83	53,388.27	10,980.13	25,159.43
10	89,513.73	53,355.87	10,998.08	25,159.78
11	89,496.28	53,345.85	11,018.37	25,132.07
12	89,503.62	53,328.75	11,019.50	25,155.37
Average	89,508.75	53,344.02	11,005.60	25,159.13

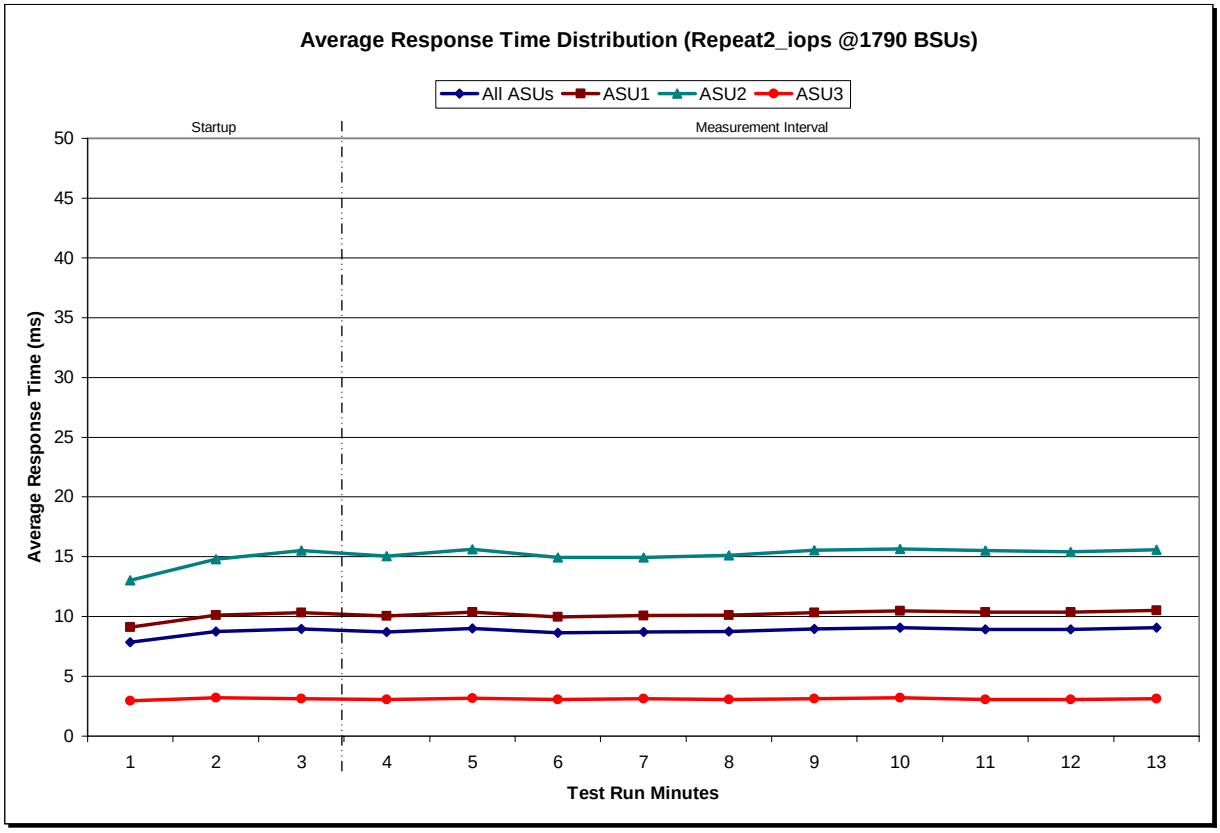
Repeatability 2 IOPS – I/O Request Throughput Distribution Graph



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

1790 BSUs	Start	Stop	Interval	Duration
Start-Up/Ramp-Up	1:55:00	1:58:01	0-2	0:03:01
Measurement Interval	1:58:01	2:08:01	3-12	0:10:00
60 second intervals	**All ASUs**	**ASU1**	**ASU2**	**ASU3**
0	7.86	9.11	13.03	2.95
1	8.75	10.11	14.81	3.21
2	8.95	10.34	15.51	3.13
3	8.70	10.06	15.05	3.05
4	8.99	10.38	15.60	3.16
5	8.65	9.99	14.95	3.06
6	8.72	10.08	14.95	3.12
7	8.75	10.12	15.12	3.07
8	8.95	10.34	15.56	3.12
9	9.06	10.46	15.65	3.19
10	8.94	10.36	15.50	3.05
11	8.94	10.38	15.41	3.04
12	9.07	10.52	15.59	3.14
Average	8.88	10.27	15.34	3.10

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



Repeatability 1 (LRT)
Measured Intensity Multiplier and Coefficient of Variation

Clause 3.4.3

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.*

Clauses 5.1.0 and 5.3.13.2

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%.*

Clause 5.3.13.3

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

	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	0.2807	0.0700	0.2100	0.0180	0.0700	0.0351	0.2812
COV	0.008	0.002	0.004	0.003	0.09	0.005	0.005	0.001

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	0.0699	0.0350	0.2810
COV	0.002	0.001	0.002	0.001	0.003	0.002	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	0.2811	0.0700	0.2098	0.0180	0.0700	0.0350	0.2811
COV	0.006	0.001	0.007	0.002	0.007	0.005	0.005	0.002

Repeatability 2 (IOPS)
Measured Intensity Multiplier and Coefficient of Variation

	ASU1-1	ASU1-2	ASU1-3	ASU1-4	ASU2-1	ASU2-2	ASU2-3	ASU3-1
IM	***0.0350***	***0.2810***	***0.0700***	***0.2100***	***0.0180***	***0.0700***	***0.0350***	***0.2810***
MIM	0.0350	0.2810	0.0701	0.2099	0.0180	0.0700	0.0350	0.2811
COV	0.003	0.001	0.001	0.001	0.003	0.001	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 Sustainability, IOPS, Response Time Ramp, Repeatability, and Persistence Test Runs are documented in "Appendix E: SPC-1 Workload Generator Input Parameters" on Page 86.

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	180,107,952
Total Number of Logical Blocks Verified	128,463,472
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 Hitachi Adaptable Modular Storage 2500 as documented in this Full Disclosure Report is currently available for customer purchase and shipment.

PRICING INFORMATION

Clause 9.2.4.11

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

Clause 9.2.4.11.3

A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration must be included.

Pricing information may found in the Tested Storage Configuration Pricing section on page 13. A list of all differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration may be found in the Executive Summary portion of this document on page 13.

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.

SPC Auditor approval was granted to reorder to required execution sequence of SPC Tests to better utilize the time spent for onsite audit activities. The following execution sequence was used: Persistence Test Run 1, required TSC power cycle, and uninterrupted execution of Persistence Test Run 2, the Primary Metrics Test *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)*, and Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)*.

APPENDIX A: SPC-1 GLOSSARY

"Decimal" *(powers of ten)* Measurement Units

In the storage industry, the terms "kilo", "mega", "giga", "tera", "peta", and "exa" are commonly used prefixes for computing performance and capacity. For the purposes of the SPC workload definitions, all of the following terms are defined in "powers of ten" measurement units.

- A kilobyte (KB) is equal to 1,000 (10^3) bytes.
- A megabyte (MB) is equal to 1,000,000 (10^6) bytes.
- A gigabyte (GB) is equal to 1,000,000,000 (10^9) bytes.
- A terabyte (TB) is equal to 1,000,000,000,000 (10^{12}) bytes.
- A petabyte (PB) is equal to 1,000,000,000,000,000 (10^{15}) bytes
- An exabyte (EB) is equal to 1,000,000,000,000,000,000 (10^{18}) bytes

"Binary" *(powers of two)* Measurement Units

The sizes reported by many operating system components use "powers of two" measurement units rather than "power of ten" units. The following standardized definitions and terms are also valid and may be used in this document.

- A kibibyte (KiB) is equal to 1,024 (2^{10}) bytes.
- A mebibyte (MiB) is equal to 1,048,576 (2^{20}) bytes.
- A gigibyte (GiB) is equal to 1,073,741,824 (2^{30}) bytes.
- A tebibyte (TiB) is equal to 1,099,511,627,776 (2^{40}) bytes.
- A pebibyte (PiB) is equal to 1,125,899,906,842,624 (2^{50}) bytes.
- An exbibyte (EiB) is equal to 1,152,921,504,606,846,967 (2^{60}) bytes.

SPC-1 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 selected level of 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.

SPC-1 Data Protection Levels

RAID5: User data is distributed across the disks in the array. Check data corresponding to user data is distributed across multiple disks in the form of bit-by-bit parity.

Mirroring: Two or more identical copies of user data are maintained on separate disks.

Other Protection Level: Any data protection other than **RAID5** or **Mirroring**.

Unprotected: There is no data protection provided.

SPC-1 Test Execution 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.

Completed I/O Request: An I/O Request with a Start Time and a Completion Time (see "I/O Completion Types" below).

Completion Time: The time recorded by the Workload Generator when an I/O Request is satisfied by the TSC as signaled by System Software.

Data Rate: The data transferred in all Measured I/O Requests in an SPC-1 Test Run divided by the length of the Test Run in seconds.

Expected I/O Count: For any given I/O Stream and Test Phase, the product of 50 times the BSU level, the duration of the Test Phase in seconds, and the Intensity Multiplier for that I/O Stream.

Failed I/O Request: Any I/O Request issued by the Workload Generator that could not be completed or was signaled as failed by System Software. A Failed I/O Request has no Completion Time (see "I/O Completion Types" below).

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.

In-Flight I/O Request: An I/O Request issued by the I/O Command Generator to the TSC that has a recorded Start Time, but does not complete within the Measurement Interval (see "I/O Completion Types" below).

Measured I/O Request: A Completed I/O Request with a Completion Time occurring within the Measurement Interval (see "I/O Completion Types" below).

Measured Intensity Multiplier: The percentage of all Measured I/O Requests that were issued by a given I/O Stream.

Measurement Interval: The finite and contiguous time period, after the 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.

Ramp-Up: The time required for the Benchmark Configuration (BC) to produce Steady State throughput after the Workload Generator begins submitting I/O Requests to the TSC for execution.

Ramp-Down: The time required for the BC to complete all I/O Requests issued by the Workload Generator. The Ramp-Down period begins when the Workload Generator ceases to issue new I/O Requests to the TSC.

Response Time: The Response Time of a Measured I/O Request is its Completion Time minus its Start Time.

Start Time: The time recorded by the Workload Generator when an I/O Request is submitted, by the Workload Generator, to the System Software for execution on the Tested Storage Configuration (TSC).

Start-Up: The period that begins after the Workload Generator starts to submit I/O requests to the TSC and ends at the beginning of the Measurement Interval.

Shut-Down: The period between the end of the Measurement Interval and the time when all I/O Requests issued by the Workload Generator have completed or failed.

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.

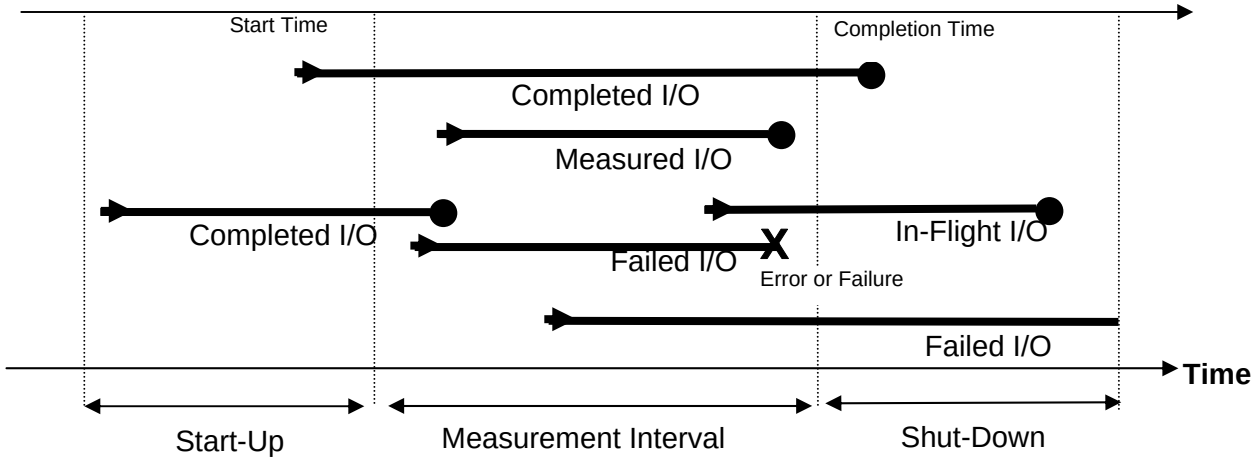
Test: A collection of Test Phases and or Test Runs sharing a common objective.

Test Run: The execution of SPC-1 for the purpose of producing or supporting an SPC-1 test result. SPC-1 Test Runs may have a finite and measured Ramp-Up period, Start-Up

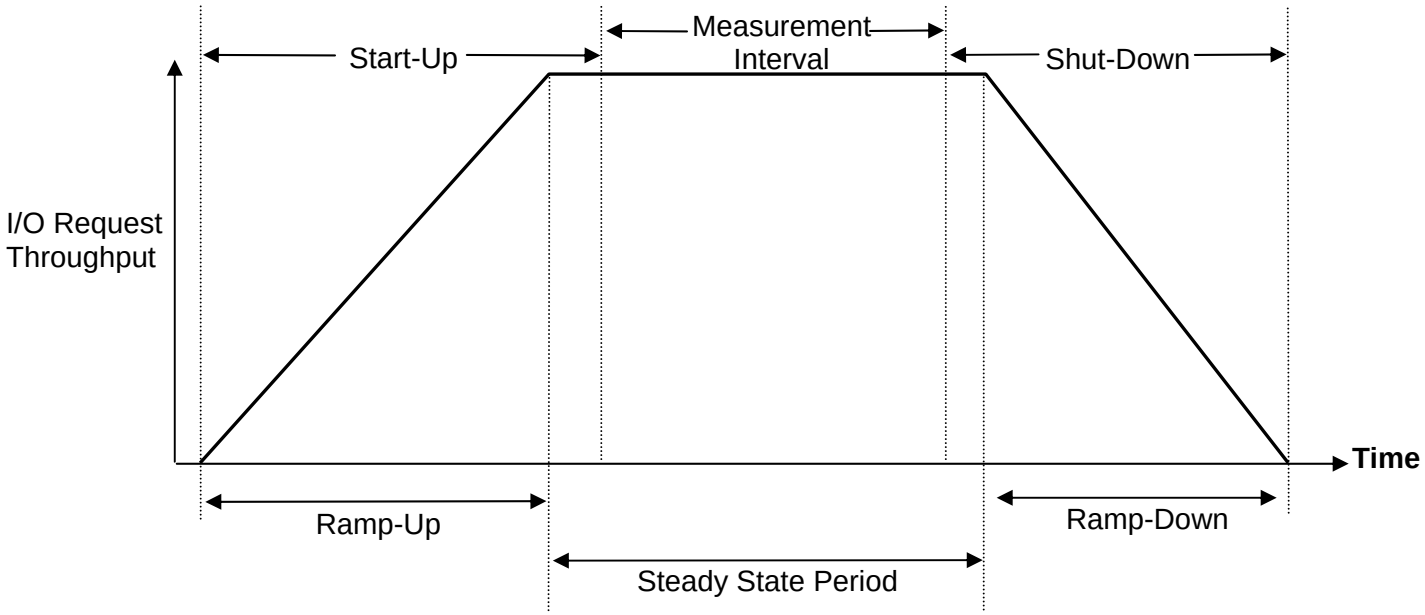
period, Shut-Down period, and Ramp-Down period as illustrated in the "SPC-1 Test Run Components" below. All SPC-1 Test Runs shall have a Steady State period and a Measurement Interval.

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.

I/O Completion Types



SPC-1 Test Run Components



APPENDIX B: CUSTOMER TUNABLE PARAMETERS AND OPTIONS

1. Change Queue Depth

Change the "hdisk" ***queue depth*** from default 8 to 32 in AIX.

2. Turn off trace, online verify test and monitoring information

Set ***Detailed Trace Mode*** from default "ON" to "OFF".

Set ***Online Verify Test*** from default "Yes" to "No".

Set following performance monitoring parameters from default "Start" to "Stop"

Monitoring items	Default	New
Port Information	Start	Stop
RAID Group/Logical Unit Information	Start	Stop
Cache Information	Start	Stop
Processor Information	Start	Stop
Drive Information	Start	Stop
Drive Operating Information	Start	Stop
Back-end Information	Start	Stop

3. Change cache management strategy

Change the cache configuration as illustrated below.

Partition #	Default		New	
	Partition size[MB]	Segment size[KB]	Partition size[MB]	Segment size[KB]
Partition 0	7210	16	4210	16
Partition 1	7210	16	4210	16
Partition 2	-	-	3000	16
Partition 3	-	-	3000	16

Change the cache de-staging parameter settings as illustrated below.

Parameter	Default	New
Dirty Data Opportunity	5	20
Dirty Data Stop Opportunity	5	10

Change each Logical Unit's (LU) pre-fetch parameters for multi-stream I/O as illustrated below.

LU #	Default					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
All LU	Read	Enable	Base	256	128	3

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 0	Read	Enable	Base	256	128	0
LU 1	Read	Disable	Fixed	128	128	1
LU 2	Read	Disable	Fixed	128	128	1
LU 3	Read	Enable	Base	256	128	0
LU 4	Read	Enable	Base	256	128	0
LU 5	Read	Enable	Base	256	128	0
LU 6	Read	Disable	Fixed	128	128	1
LU 7	Read	Enable	Base	256	128	0
LU 8	Read	Enable	Base	256	128	0
LU 9	Read	Enable	Base	256	128	0
LU 10	Read	Enable	Base	256	128	0
LU 11	Read	Disable	Fixed	128	128	1
LU 12	Read	Disable	Fixed	128	128	1
LU 13	Read	Enable	Base	256	128	0
LU 14	Read	Enable	Base	256	128	0
LU 15	Read	Enable	Base	256	128	0
LU 16	Read	Disable	Fixed	128	128	1
LU 17	Read	Enable	Base	256	128	0
LU 18	Read	Enable	Base	256	128	0
LU 19	Read	Enable	Base	256	128	0
LU 20	Read	Enable	Base	256	128	0
LU 21	Read	Disable	Fixed	128	128	1
LU 22	Read	Disable	Fixed	128	128	1
LU 23	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 24	Read	Enable	Base	256	128	0
LU 25	Read	Enable	Base	256	128	0
LU 26	Read	Disable	Fixed	128	128	1
LU 27	Read	Enable	Base	256	128	0
LU 28	Read	Enable	Base	256	128	0
LU 29	Read	Enable	Base	256	128	0
LU 30	Read	Enable	Base	256	128	0
LU 31	Read	Disable	Fixed	128	128	1
LU 32	Read	Disable	Fixed	128	128	1
LU 33	Read	Enable	Base	256	128	0
LU 34	Read	Enable	Base	256	128	0
LU 35	Read	Enable	Base	256	128	0
LU 36	Read	Disable	Fixed	128	128	1
LU 37	Read	Enable	Base	256	128	0
LU 38	Read	Enable	Base	256	128	0
LU 39	Read	Enable	Base	256	128	0
LU 40	Read	Enable	Base	256	128	0
LU 41	Read	Disable	Fixed	128	128	1
LU 42	Read	Disable	Fixed	128	128	1
LU 43	Read	Enable	Base	256	128	0
LU 44	Read	Enable	Base	256	128	0
LU 45	Read	Enable	Base	256	128	0
LU 46	Read	Disable	Fixed	128	128	1
LU 47	Read	Enable	Base	256	128	0
LU 48	Read	Enable	Base	256	128	0
LU 49	Read	Enable	Base	256	128	0
LU 50	Read	Enable	Base	256	128	0
LU 51	Read	Disable	Fixed	128	128	1
LU 52	Read	Disable	Fixed	128	128	1
LU 53	Read	Enable	Base	256	128	0
LU 54	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 55	Read	Enable	Base	256	128	0
LU 56	Read	Disable	Fixed	128	128	1
LU 57	Read	Enable	Base	256	128	0
LU 58	Read	Enable	Base	256	128	0
LU 59	Read	Enable	Base	256	128	0
LU 60	Read	Enable	Base	256	128	0
LU 61	Read	Disable	Fixed	128	128	1
LU 62	Read	Disable	Fixed	128	128	1
LU 63	Read	Enable	Base	256	128	0
LU 64	Read	Enable	Base	256	128	0
LU 65	Read	Enable	Base	256	128	0
LU 66	Read	Disable	Fixed	128	128	1
LU 67	Read	Enable	Base	256	128	0
LU 68	Read	Enable	Base	256	128	0
LU 69	Read	Enable	Base	256	128	0
LU 70	Read	Enable	Base	256	128	0
LU 71	Read	Disable	Fixed	128	128	1
LU 72	Read	Disable	Fixed	128	128	1
LU 73	Read	Enable	Base	256	128	0
LU 74	Read	Enable	Base	256	128	0
LU 75	Read	Enable	Base	256	128	0
LU 76	Read	Disable	Fixed	128	128	1
LU 77	Read	Enable	Base	256	128	0
LU 78	Read	Enable	Base	256	128	0
LU 79	Read	Enable	Base	256	128	0
LU 80	Read	Enable	Base	256	128	0
LU 81	Read	Disable	Fixed	128	128	1
LU 82	Read	Disable	Fixed	128	128	1
LU 83	Read	Enable	Base	256	128	0
LU 84	Read	Enable	Base	256	128	0
LU 85	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 86	Read	Disable	Fixed	128	128	1
LU 87	Read	Enable	Base	256	128	0
LU 88	Read	Enable	Base	256	128	0
LU 89	Read	Enable	Base	256	128	0
LU 90	Read	Enable	Base	256	128	0
LU 91	Read	Disable	Fixed	128	128	1
LU 92	Read	Disable	Fixed	128	128	1
LU 93	Read	Enable	Base	256	128	0
LU 94	Read	Enable	Base	256	128	0
LU 95	Read	Enable	Base	256	128	0
LU 96	Read	Disable	Fixed	128	128	1
LU 97	Read	Enable	Base	256	128	0
LU 98	Read	Enable	Base	256	128	0
LU 99	Read	Enable	Base	256	128	0
LU 100	Read	Enable	Base	256	128	0
LU 101	Read	Disable	Fixed	128	128	1
LU 102	Read	Disable	Fixed	128	128	1
LU 103	Read	Enable	Base	256	128	0
LU 104	Read	Enable	Base	256	128	0
LU 105	Read	Enable	Base	256	128	0
LU 106	Read	Disable	Fixed	128	128	1
LU 107	Read	Enable	Base	256	128	0
LU 108	Read	Enable	Base	256	128	0
LU 109	Read	Enable	Base	256	128	0
LU 110	Read	Enable	Base	256	128	0
LU 111	Read	Disable	Fixed	128	128	1
LU 112	Read	Disable	Fixed	128	128	1
LU 113	Read	Enable	Base	256	128	0
LU 114	Read	Enable	Base	256	128	0
LU 115	Read	Enable	Base	256	128	0
LU 116	Read	Disable	Fixed	128	128	1

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 117	Read	Enable	Base	256	128	0
LU 118	Read	Enable	Base	256	128	0
LU 119	Read	Enable	Base	256	128	0
LU 120	Read	Enable	Base	256	128	0
LU 121	Read	Disable	Fixed	128	128	1
LU 122	Read	Disable	Fixed	128	128	1
LU 123	Read	Enable	Base	256	128	0
LU 124	Read	Enable	Base	256	128	0
LU 125	Read	Enable	Base	256	128	0
LU 126	Read	Disable	Fixed	128	128	1
LU 127	Read	Enable	Base	256	128	0
LU 128	Read	Enable	Base	256	128	0
LU 129	Read	Enable	Base	256	128	0
LU 130	Read	Enable	Base	256	128	0
LU 131	Read	Disable	Fixed	128	128	1
LU 132	Read	Disable	Fixed	128	128	1
LU 133	Read	Enable	Base	256	128	0
LU 134	Read	Enable	Base	256	128	0
LU 135	Read	Enable	Base	256	128	0
LU 136	Read	Disable	Fixed	128	128	1
LU 137	Read	Enable	Base	256	128	0
LU 138	Read	Enable	Base	256	128	0
LU 139	Read	Enable	Base	256	128	0
LU 140	Read	Enable	Base	256	128	0
LU 141	Read	Disable	Fixed	128	128	1
LU 142	Read	Disable	Fixed	128	128	1
LU 143	Read	Enable	Base	256	128	0
LU 144	Read	Enable	Base	256	128	0
LU 145	Read	Enable	Base	256	128	0
LU 146	Read	Disable	Fixed	128	128	1
LU 147	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 148	Read	Enable	Base	256	128	0
LU 149	Read	Enable	Base	256	128	0
LU 150	Read	Enable	Base	256	128	0
LU 151	Read	Disable	Fixed	128	128	1
LU 152	Read	Disable	Fixed	128	128	1
LU 153	Read	Enable	Base	256	128	0
LU 154	Read	Enable	Base	256	128	0
LU 155	Read	Enable	Base	256	128	0
LU 156	Read	Disable	Fixed	128	128	1
LU 157	Read	Enable	Base	256	128	0
LU 158	Read	Enable	Base	256	128	0
LU 159	Read	Enable	Base	256	128	0
LU 160	Read	Enable	Base	256	128	0
LU 161	Read	Disable	Fixed	128	128	1
LU 162	Read	Disable	Fixed	128	128	1
LU 163	Read	Enable	Base	256	128	0
LU 164	Read	Enable	Base	256	128	0
LU 165	Read	Enable	Base	256	128	0
LU 166	Read	Disable	Fixed	128	128	1
LU 167	Read	Enable	Base	256	128	0
LU 168	Read	Enable	Base	256	128	0
LU 169	Read	Enable	Base	256	128	0
LU 170	Read	Enable	Base	256	128	0
LU 171	Read	Disable	Fixed	128	128	1
LU 172	Read	Disable	Fixed	128	128	1
LU 173	Read	Enable	Base	256	128	0
LU 174	Read	Enable	Base	256	128	0
LU 175	Read	Enable	Base	256	128	0
LU 176	Read	Disable	Fixed	128	128	1
LU 177	Read	Enable	Base	256	128	0
LU 178	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 179	Read	Enable	Base	256	128	0
LU 180	Read	Enable	Base	256	128	0
LU 181	Read	Disable	Fixed	128	128	1
LU 182	Read	Disable	Fixed	128	128	1
LU 183	Read	Enable	Base	256	128	0
LU 184	Read	Enable	Base	256	128	0
LU 185	Read	Enable	Base	256	128	0
LU 186	Read	Disable	Fixed	128	128	1
LU 187	Read	Enable	Base	256	128	0
LU 188	Read	Enable	Base	256	128	0
LU 189	Read	Enable	Base	256	128	0
LU 190	Read	Enable	Base	256	128	0
LU 191	Read	Disable	Fixed	128	128	1
LU 192	Read	Disable	Fixed	128	128	1
LU 193	Read	Enable	Base	256	128	0
LU 194	Read	Enable	Base	256	128	0
LU 195	Read	Enable	Base	256	128	0
LU 196	Read	Disable	Fixed	128	128	1
LU 197	Read	Enable	Base	256	128	0
LU 198	Read	Enable	Base	256	128	0
LU 199	Read	Enable	Base	256	128	0
LU 200	Read	Enable	Base	256	128	0
LU 201	Read	Disable	Fixed	128	128	1
LU 202	Read	Disable	Fixed	128	128	1
LU 203	Read	Enable	Base	256	128	0
LU 204	Read	Enable	Base	256	128	0
LU 205	Read	Enable	Base	256	128	0
LU 206	Read	Disable	Fixed	128	128	1
LU 207	Read	Enable	Base	256	128	0
LU 208	Read	Enable	Base	256	128	0
LU 209	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 210	Read	Enable	Base	256	128	0
LU 211	Read	Disable	Fixed	128	128	1
LU 212	Read	Disable	Fixed	128	128	1
LU 213	Read	Enable	Base	256	128	0
LU 214	Read	Enable	Base	256	128	0
LU 215	Read	Enable	Base	256	128	0
LU 216	Read	Disable	Fixed	128	128	1
LU 217	Read	Enable	Base	256	128	0
LU 218	Read	Enable	Base	256	128	0
LU 219	Read	Enable	Base	256	128	0
LU 220	Read	Enable	Base	256	128	0
LU 221	Read	Disable	Fixed	128	128	1
LU 222	Read	Disable	Fixed	128	128	1
LU 223	Read	Enable	Base	256	128	0
LU 224	Read	Enable	Base	256	128	0
LU 225	Read	Enable	Base	256	128	0
LU 226	Read	Disable	Fixed	128	128	1
LU 227	Read	Enable	Base	256	128	0
LU 228	Read	Enable	Base	256	128	0
LU 229	Read	Enable	Base	256	128	0
LU 230	Read	Enable	Base	256	128	0
LU 231	Read	Disable	Fixed	128	128	1
LU 232	Read	Disable	Fixed	128	128	1
LU 233	Read	Enable	Base	256	128	0
LU 234	Read	Enable	Base	256	128	0
LU 235	Read	Enable	Base	256	128	0
LU 236	Read	Disable	Fixed	128	128	1
LU 237	Read	Enable	Base	256	128	0
LU 238	Read	Enable	Base	256	128	0
LU 239	Read	Enable	Base	256	128	0
LU 240	Read	Enable	Base	256	128	0

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 241	Read	Disable	Fixed	128	128	1
LU 242	Read	Disable	Fixed	128	128	1
LU 243	Read	Enable	Base	256	128	0
LU 244	Read	Enable	Base	256	128	0
LU 245	Read	Enable	Base	256	128	0
LU 246	Read	Disable	Fixed	128	128	1
LU 247	Read	Enable	Base	256	128	0
LU 248	Read	Enable	Base	256	128	0
LU 249	Read	Enable	Base	256	128	0
LU 250	Read	Enable	Base	256	128	0
LU 251	Read	Disable	Fixed	128	128	1
LU 252	Read	Disable	Fixed	128	128	1
LU 253	Read	Enable	Base	256	128	0
LU 254	Read	Enable	Base	256	128	0
LU 255	Read	Enable	Base	256	128	0
LU 256	Read	Disable	Fixed	128	128	1
LU 257	Read	Enable	Base	256	128	0
LU 258	Read	Enable	Base	256	128	0
LU 259	Read	Enable	Base	256	128	0
LU 260	Read	Enable	Base	256	128	0
LU 261	Read	Disable	Fixed	128	128	1
LU 262	Read	Disable	Fixed	128	128	1
LU 263	Read	Enable	Base	256	128	0
LU 264	Read	Enable	Base	256	128	0
LU 265	Read	Enable	Base	256	128	0
LU 266	Read	Disable	Fixed	128	128	1
LU 267	Read	Enable	Base	256	128	0
LU 268	Read	Enable	Base	256	128	0
LU 269	Read	Enable	Base	256	128	0
LU 270	Read	Enable	Base	256	128	0
LU 271	Read	Disable	Fixed	128	128	1

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 272	Read	Disable	Fixed	128	128	1
LU 273	Read	Enable	Base	256	128	0
LU 274	Read	Enable	Base	256	128	0
LU 275	Read	Enable	Base	256	128	0
LU 276	Read	Disable	Fixed	128	128	1
LU 277	Read	Enable	Base	256	128	0
LU 278	Read	Enable	Base	256	128	0
LU 279	Read	Enable	Base	256	128	0
LU 280	Read	Enable	Base	256	128	0
LU 281	Read	Disable	Fixed	128	128	1
LU 282	Read	Disable	Fixed	128	128	1
LU 283	Read	Enable	Base	256	128	0
LU 284	Read	Enable	Base	256	128	0
LU 285	Read	Enable	Base	256	128	0
LU 286	Read	Disable	Fixed	128	128	1
LU 287	Read	Enable	Base	256	128	0
LU 288	Read	Enable	Base	256	128	0
LU 289	Read	Enable	Base	256	128	0
LU 290	Read	Enable	Base	256	128	0
LU 291	Read	Disable	Fixed	128	128	1
LU 292	Read	Disable	Fixed	128	128	1
LU 293	Read	Enable	Base	256	128	0
LU 294	Read	Enable	Base	256	128	0
LU 295	Read	Enable	Base	256	128	0
LU 296	Read	Disable	Fixed	128	128	1
LU 297	Read	Enable	Base	256	128	0
LU 298	Read	Enable	Base	256	128	0
LU 299	Read	Enable	Base	256	128	0
LU 300	Read	Enable	Base	256	128	0
LU 301	Read	Disable	Fixed	128	128	1
LU 302	Read	Disable	Fixed	128	128	1

LU #	New					
	Mode	Prefetch Next	Prefetch Criteria	Fixed	Base	Count of Judgment Sequential
LU 303	Read	Enable	Base	256	128	0
LU 304	Read	Enable	Base	256	128	0
LU 305	Read	Enable	Base	256	128	0
LU 306	Read	Disable	Fixed	128	128	1
LU 307	Read	Enable	Base	256	128	0
LU 308	Read	Enable	Base	256	128	0
LU 309	Read	Enable	Base	256	128	0
LU 310	Read	Enable	Base	256	128	0
LU 311	Read	Disable	Fixed	128	128	1
LU 312	Read	Disable	Fixed	128	128	1
LU 313	Read	Enable	Base	256	128	0
LU 314	Read	Enable	Base	256	128	0
LU 315	Read	Enable	Base	256	128	0
LU 316	Read	Disable	Fixed	128	128	1
LU 317	Read	Enable	Base	256	128	0
LU 318	Read	Enable	Base	256	128	0
LU 319	Read	Enable	Base	256	128	0
LU 320	Read/Write	Enable	Base	256	128	1
LU 321	Read/Write	Enable	Base	256	128	1
LU 322	Read/Write	Enable	Base	256	128	1
LU 323	Read/Write	Enable	Base	256	128	1
LU 324	Read/Write	Enable	Base	256	128	1
LU 325	Read/Write	Enable	Base	256	128	1
LU 326	Read/Write	Enable	Base	256	128	1
LU 327	Read/Write	Enable	Base	256	128	1

APPENDIX C: TESTED STORAGE CONFIGURATION (TSC) CREATION

The following Storage Navigator Modular2 (SNM2) scripts/commands were used to create and configure the Tested Storage Configuration (TSC).

1. Registration of the unit

The AMS2500 was registered by using the following command:

```
set UNAME=(Your Unit Name)
auunitadd  -unit %UNAME%  -LAN -ctl0  (IP address of controller0) –ctl1 (IP
address of controller1)
```

2. Cache Partition Configuration

The AMS2500 cache was divided into four (4) partitions. “Partition 0” and “Partition 1” were used for ASU-1 and ASU-2. “Partition 2” and “Partition 3” were used for ASU-3. After each command, SNM2 will request a reboot of the AMS2500, but a reboot is only needed after the last command to enable the newly configured cache partitioning.

```
set ASU1_2size=421
set ASU3size=300
set segsize=16

aucachept -unit %UNAME% -chg -pt 0 -ptsize %ASU1_2size%
aucachept -unit %UNAME% -chg -pt 1 -ptsize %ASU1_2size%
aucachept -unit %UNAME% -add -ptsize %ASU3size% -segsize %segsize% -ctl0
aucachept -unit %UNAME% -add -ptsize %ASU3size% -segsize %segsize% -ctl1
```

3. RAID Group (RG) Creation

Thirty-two (32) RAID Groups *(0-31, 5D+5D, RAID1+0)* were created and used for ASU-1 and ASU-2. Eight (8) RAID Groups *(32-39, 2D+2D, RAID1+0)* were created and used for ASU-3. The RAID Groups were created using the following commands:

```
aurgadd -unit %UNAME% -rg 0 -RAID10 -drive 0.0-0.9 -pnum 1
aurgadd -unit %UNAME% -rg 1 -RAID10 -drive 1.0-1.9 -pnum 1
aurgadd -unit %UNAME% -rg 2 -RAID10 -drive 2.0-2.9 -pnum 1
aurgadd -unit %UNAME% -rg 3 -RAID10 -drive 3.0-3.9 -pnum 1
aurgadd -unit %UNAME% -rg 4 -RAID10 -drive 0.10-0.14 4.0-4.4 -pnum 1
aurgadd -unit %UNAME% -rg 5 -RAID10 -drive 1.10-1.14 5.0-5.4 -pnum 1
aurgadd -unit %UNAME% -rg 6 -RAID10 -drive 2.10-2.14 6.0-6.4 -pnum 1
aurgadd -unit %UNAME% -rg 7 -RAID10 -drive 3.10-3.14 7.0-7.4 -pnum 1
aurgadd -unit %UNAME% -rg 8 -RAID10 -drive 4.5-4.14 -pnum 1
aurgadd -unit %UNAME% -rg 9 -RAID10 -drive 5.5-5.14 -pnum 1
aurgadd -unit %UNAME% -rg 10 -RAID10 -drive 6.5-6.14 -pnum 1
aurgadd -unit %UNAME% -rg 11 -RAID10 -drive 7.5-7.14 -pnum 1
aurgadd -unit %UNAME% -rg 12 -RAID10 -drive 8.0-8.9 -pnum 1
aurgadd -unit %UNAME% -rg 13 -RAID10 -drive 9.0-9.9 -pnum 1
aurgadd -unit %UNAME% -rg 14 -RAID10 -drive 10.0-10.9 -pnum 1
aurgadd -unit %UNAME% -rg 15 -RAID10 -drive 11.0-11.9 -pnum 1
aurgadd -unit %UNAME% -rg 16 -RAID10 -drive 8.10-8.14 12.0-12.4 -pnum 1
aurgadd -unit %UNAME% -rg 17 -RAID10 -drive 9.10-9.14 13.0-13.4 -pnum 1
aurgadd -unit %UNAME% -rg 18 -RAID10 -drive 10.10-10.14 14.0-14.4 -pnum 1
aurgadd -unit %UNAME% -rg 19 -RAID10 -drive 11.10-11.14 15.0-15.4 -pnum 1
```

```
aurgadd -unit %UNAME% -rg 20 -RAID10 -drive 12.5-12.14 -pnum 1
aurgadd -unit %UNAME% -rg 21 -RAID10 -drive 13.5-13.14 -pnum 1
aurgadd -unit %UNAME% -rg 22 -RAID10 -drive 14.5-14.14 -pnum 1
aurgadd -unit %UNAME% -rg 23 -RAID10 -drive 15.5-15.14 -pnum 1
aurgadd -unit %UNAME% -rg 24 -RAID10 -drive 16.0-16.9 -pnum 1
aurgadd -unit %UNAME% -rg 25 -RAID10 -drive 17.0-17.9 -pnum 1
aurgadd -unit %UNAME% -rg 26 -RAID10 -drive 18.0-18.9 -pnum 1
aurgadd -unit %UNAME% -rg 27 -RAID10 -drive 19.0-19.9 -pnum 1
aurgadd -unit %UNAME% -rg 28 -RAID10 -drive 16.10-16.14 20.0-20.4 -pnum 1
aurgadd -unit %UNAME% -rg 29 -RAID10 -drive 17.10-17.14 21.0-21.4 -pnum 1
aurgadd -unit %UNAME% -rg 30 -RAID10 -drive 18.10-18.14 22.0-22.4 -pnum 1
aurgadd -unit %UNAME% -rg 31 -RAID10 -drive 19.10-19.14 23.0-23.4 -pnum 1
aurgadd -unit %UNAME% -rg 32 -RAID10 -drive 20.5-20.8 -pnum 1
aurgadd -unit %UNAME% -rg 33 -RAID10 -drive 21.5-21.8 -pnum 1
aurgadd -unit %UNAME% -rg 34 -RAID10 -drive 22.5-22.8 -pnum 1
aurgadd -unit %UNAME% -rg 35 -RAID10 -drive 23.5-23.8 -pnum 1
aurgadd -unit %UNAME% -rg 36 -RAID10 -drive 20.9-20.12 -pnum 1
aurgadd -unit %UNAME% -rg 37 -RAID10 -drive 21.9-21.12 -pnum 1
aurgadd -unit %UNAME% -rg 38 -RAID10 -drive 22.9-22.12 -pnum 1
aurgadd -unit %UNAME% -rg 39 -RAID10 -drive 23.9-23.12 -pnum 1
```

4. Logical Unit (LU) Creation

There were 160 logical devices (Logical Unit, LU) created on RAID Groups 0-31 for ASU-1. A second set of 160 LUs were also created the same RAID Groups for ASU-2. Eight (8) LUs were created on RAID Groups 32-39 for ASU-3.

The following commands were used to create the LUs:

```
for /L %I IN ( 0, 1, 9) DO auluadd -unit %UNAME% -lu %I -rg 0 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (10, 1,19) DO auluadd -unit %UNAME% -lu %I -rg 1 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (20, 1,29) DO auluadd -unit %UNAME% -lu %I -rg 2 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (30, 1,39) DO auluadd -unit %UNAME% -lu %I -rg 3 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (40, 1,49) DO auluadd -unit %UNAME% -lu %I -rg 4 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (50, 1,59) DO auluadd -unit %UNAME% -lu %I -rg 5 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (60, 1,69) DO auluadd -unit %UNAME% -lu %I -rg 6 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (70, 1,79) DO auluadd -unit %UNAME% -lu %I -rg 7 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (80, 1,89) DO auluadd -unit %UNAME% -lu %I -rg 8 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (90, 1,99) DO auluadd -unit %UNAME% -lu %I -rg 9 -size 100663296 -
cachept 0 -noluformat
for /L %I IN (100, 1,109) DO auluadd -unit %UNAME% -lu %I -rg 10 -size 100663296
-cachept 0 -noluformat
for /L %I IN (110, 1,119) DO auluadd -unit %UNAME% -lu %I -rg 11 -size 100663296
-cachept 0 -noluformat
for /L %I IN (120, 1,129) DO auluadd -unit %UNAME% -lu %I -rg 12 -size 100663296
-cachept 0 -noluformat
for /L %I IN (130, 1,139) DO auluadd -unit %UNAME% -lu %I -rg 13 -size 100663296
-cachept 0 -noluformat
for /L %I IN (140, 1,149) DO auluadd -unit %UNAME% -lu %I -rg 14 -size 100663296
-cachept 0 -noluformat
for /L %I IN (150, 1,159) DO auluadd -unit %UNAME% -lu %I -rg 15 -size 100663296
-cachept 0 -noluformat
```

```
for /L %I IN (160, 1,169) DO auluadd -unit %UNAME% -lu %I -rg 16 -size 100663296
-cachept 1 -noluformat
for /L %I IN (170, 1,179) DO auluadd -unit %UNAME% -lu %I -rg 17 -size 100663296
-cachept 1 -noluformat
for /L %I IN (180, 1,189) DO auluadd -unit %UNAME% -lu %I -rg 18 -size 100663296
-cachept 1 -noluformat
for /L %I IN (190, 1,199) DO auluadd -unit %UNAME% -lu %I -rg 19 -size 100663296
-cachept 1 -noluformat
for /L %I IN (200, 1,209) DO auluadd -unit %UNAME% -lu %I -rg 20 -size 100663296
-cachept 1 -noluformat
for /L %I IN (210, 1,219) DO auluadd -unit %UNAME% -lu %I -rg 21 -size 100663296
-cachept 1 -noluformat
for /L %I IN (220, 1,229) DO auluadd -unit %UNAME% -lu %I -rg 22 -size 100663296
-cachept 1 -noluformat
for /L %I IN (230, 1,239) DO auluadd -unit %UNAME% -lu %I -rg 23 -size 100663296
-cachept 1 -noluformat
for /L %I IN (240, 1,249) DO auluadd -unit %UNAME% -lu %I -rg 24 -size 100663296
-cachept 1 -noluformat
for /L %I IN (250, 1,259) DO auluadd -unit %UNAME% -lu %I -rg 25 -size 100663296
-cachept 1 -noluformat
for /L %I IN (260, 1,269) DO auluadd -unit %UNAME% -lu %I -rg 26 -size 100663296
-cachept 1 -noluformat
for /L %I IN (270, 1,279) DO auluadd -unit %UNAME% -lu %I -rg 27 -size 100663296
-cachept 1 -noluformat
for /L %I IN (280, 1,289) DO auluadd -unit %UNAME% -lu %I -rg 28 -size 100663296
-cachept 1 -noluformat
for /L %I IN (290, 1,299) DO auluadd -unit %UNAME% -lu %I -rg 29 -size 100663296
-cachept 1 -noluformat
for /L %I IN (300, 1,309) DO auluadd -unit %UNAME% -lu %I -rg 30 -size 100663296
-cachept 1 -noluformat
for /L %I IN (310, 1,319) DO auluadd -unit %UNAME% -lu %I -rg 31 -size 100663296
-cachept 1 -noluformat
auluadd -unit %UNAME% -lu 320 -rg 32 -size 556793856 -stripesize 512 -cachept 2 -
noluformat
auluadd -unit %UNAME% -lu 321 -rg 33 -size 556793856 -stripesize 512 -cachept 2 -
noluformat
auluadd -unit %UNAME% -lu 322 -rg 34 -size 556793856 -stripesize 512 -cachept 2 -
noluformat
auluadd -unit %UNAME% -lu 323 -rg 35 -size 556793856 -stripesize 512 -cachept 2 -
noluformat
auluadd -unit %UNAME% -lu 324 -rg 36 -size 556793856 -stripesize 512 -cachept 3 -
noluformat
auluadd -unit %UNAME% -lu 325 -rg 37 -size 556793856 -stripesize 512 -cachept 3 -
noluformat
auluadd -unit %UNAME% -lu 326 -rg 38 -size 556793856 -stripesize 512 -cachept 3 -
noluformat
auluadd -unit %UNAME% -lu 327 -rg 39 -size 556793856 -stripesize 512 -cachept 3 -
noluformat

for /L %n in (0,1,9) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (40,1,49) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (80,1,89) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (120,1,129) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX

for /L %n in (10,1,19) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (50,1,59) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (90,1,99) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX
for /L %n in (130,1,139) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreX

for /L %n in (20,1,29) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (60,1,69) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (100,1,109) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (140,1,149) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
```

```
for /L %n in (30,1,39) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (70,1,79) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (110,1,119) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY
for /L %n in (150,1,159) DO autuningluown -unit %UNAME% -set -lu %n -ctl0 -coreY

for /L %n in (160,1,169) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (200,1,209) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (240,1,249) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (280,1,289) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX

for /L %n in (170,1,179) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (210,1,219) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (250,1,259) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX
for /L %n in (290,1,299) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreX

for /L %n in (180,1,189) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (220,1,229) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (260,1,269) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (300,1,309) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY

for /L %n in (190,1,199) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (230,1,239) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (270,1,279) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY
for /L %n in (310,1,319) DO autuningluown -unit %UNAME% -set -lu %n -ctl1 -coreY

autuningluown -unit %UNAME% -set -lu 320 -ctl0 -coreX
autuningluown -unit %UNAME% -set -lu 321 -ctl0 -coreX
autuningluown -unit %UNAME% -set -lu 322 -ctl0 -coreY
autuningluown -unit %UNAME% -set -lu 323 -ctl0 -coreY
autuningluown -unit %UNAME% -set -lu 324 -ctl1 -coreX
autuningluown -unit %UNAME% -set -lu 325 -ctl1 -coreX
autuningluown -unit %UNAME% -set -lu 326 -ctl1 -coreY
autuningluown -unit %UNAME% -set -lu 327 -ctl1 -coreY

for /L %I IN (320,  1,  327) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  0, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  1, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  2, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  3, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  4, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  5, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  6, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  7, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  8, 10,  319) DO auformat -unit %UNAME% -lu %I
for /L %I IN (  9, 10,  319) DO auformat -unit %UNAME% -lu %I
```

5. Map LUs to Front-End Ports

Each front-end port is assigned forty-one (41) LUs as follows: twenty (20) LUs for ASU-1, twenty (20) LUs for ASU-2, and one (1) LU for ASU-3.

The following commands were used to map each LU to the appropriate front-end port:

```
auhgmap -unit %UNAME% -MappingMode off
auhgmap -unit %UNAME% -MappingMode on

auhgmap -unit %UNAME% -add 0 A 0 0 0
auhgmap -unit %UNAME% -add 0 A 0 1 1
auhgmap -unit %UNAME% -add 0 A 0 2 2
auhgmap -unit %UNAME% -add 0 A 0 3 3
auhgmap -unit %UNAME% -add 0 A 0 4 4
auhgmap -unit %UNAME% -add 0 A 0 5 5
auhgmap -unit %UNAME% -add 0 A 0 6 6
auhgmap -unit %UNAME% -add 0 A 0 7 7
auhgmap -unit %UNAME% -add 0 A 0 8 8
auhgmap -unit %UNAME% -add 0 A 0 9 9
auhgmap -unit %UNAME% -add 0 A 0 10 40
auhgmap -unit %UNAME% -add 0 A 0 11 41
auhgmap -unit %UNAME% -add 0 A 0 12 42
auhgmap -unit %UNAME% -add 0 A 0 13 43
auhgmap -unit %UNAME% -add 0 A 0 14 44
auhgmap -unit %UNAME% -add 0 A 0 15 45
auhgmap -unit %UNAME% -add 0 A 0 16 46
auhgmap -unit %UNAME% -add 0 A 0 17 47
auhgmap -unit %UNAME% -add 0 A 0 18 48
auhgmap -unit %UNAME% -add 0 A 0 19 49
auhgmap -unit %UNAME% -add 0 A 0 20 80
auhgmap -unit %UNAME% -add 0 A 0 21 81
auhgmap -unit %UNAME% -add 0 A 0 22 82
auhgmap -unit %UNAME% -add 0 A 0 23 83
auhgmap -unit %UNAME% -add 0 A 0 24 84
auhgmap -unit %UNAME% -add 0 A 0 25 85
auhgmap -unit %UNAME% -add 0 A 0 26 86
auhgmap -unit %UNAME% -add 0 A 0 27 87
auhgmap -unit %UNAME% -add 0 A 0 28 88
auhgmap -unit %UNAME% -add 0 A 0 29 89
auhgmap -unit %UNAME% -add 0 A 0 30 120
auhgmap -unit %UNAME% -add 0 A 0 31 121
auhgmap -unit %UNAME% -add 0 A 0 32 122
auhgmap -unit %UNAME% -add 0 A 0 33 123
auhgmap -unit %UNAME% -add 0 A 0 34 124
auhgmap -unit %UNAME% -add 0 A 0 35 125
auhgmap -unit %UNAME% -add 0 A 0 36 126
auhgmap -unit %UNAME% -add 0 A 0 37 127
auhgmap -unit %UNAME% -add 0 A 0 38 128
auhgmap -unit %UNAME% -add 0 A 0 39 129

auhgmap -unit %UNAME% -add 0 C 0 0 10
auhgmap -unit %UNAME% -add 0 C 0 1 11
auhgmap -unit %UNAME% -add 0 C 0 2 12
auhgmap -unit %UNAME% -add 0 C 0 3 13
auhgmap -unit %UNAME% -add 0 C 0 4 14
auhgmap -unit %UNAME% -add 0 C 0 5 15
auhgmap -unit %UNAME% -add 0 C 0 6 16
auhgmap -unit %UNAME% -add 0 C 0 7 17
```

```
auhgmap -unit %UNAME% -add 0 C 0 8 18
auhgmap -unit %UNAME% -add 0 C 0 9 19
auhgmap -unit %UNAME% -add 0 C 0 10 50
auhgmap -unit %UNAME% -add 0 C 0 11 51
auhgmap -unit %UNAME% -add 0 C 0 12 52
auhgmap -unit %UNAME% -add 0 C 0 13 53
auhgmap -unit %UNAME% -add 0 C 0 14 54
auhgmap -unit %UNAME% -add 0 C 0 15 55
auhgmap -unit %UNAME% -add 0 C 0 16 56
auhgmap -unit %UNAME% -add 0 C 0 17 57
auhgmap -unit %UNAME% -add 0 C 0 18 58
auhgmap -unit %UNAME% -add 0 C 0 19 59
auhgmap -unit %UNAME% -add 0 C 0 20 90
auhgmap -unit %UNAME% -add 0 C 0 21 91
auhgmap -unit %UNAME% -add 0 C 0 22 92
auhgmap -unit %UNAME% -add 0 C 0 23 93
auhgmap -unit %UNAME% -add 0 C 0 24 94
auhgmap -unit %UNAME% -add 0 C 0 25 95
auhgmap -unit %UNAME% -add 0 C 0 26 96
auhgmap -unit %UNAME% -add 0 C 0 27 97
auhgmap -unit %UNAME% -add 0 C 0 28 98
auhgmap -unit %UNAME% -add 0 C 0 29 99
auhgmap -unit %UNAME% -add 0 C 0 30 130
auhgmap -unit %UNAME% -add 0 C 0 31 131
auhgmap -unit %UNAME% -add 0 C 0 32 132
auhgmap -unit %UNAME% -add 0 C 0 33 133
auhgmap -unit %UNAME% -add 0 C 0 34 134
auhgmap -unit %UNAME% -add 0 C 0 35 135
auhgmap -unit %UNAME% -add 0 C 0 36 136
auhgmap -unit %UNAME% -add 0 C 0 37 137
auhgmap -unit %UNAME% -add 0 C 0 38 138
auhgmap -unit %UNAME% -add 0 C 0 39 139

auhgmap -unit %UNAME% -add 0 E 0 0 20
auhgmap -unit %UNAME% -add 0 E 0 1 21
auhgmap -unit %UNAME% -add 0 E 0 2 22
auhgmap -unit %UNAME% -add 0 E 0 3 23
auhgmap -unit %UNAME% -add 0 E 0 4 24
auhgmap -unit %UNAME% -add 0 E 0 5 25
auhgmap -unit %UNAME% -add 0 E 0 6 26
auhgmap -unit %UNAME% -add 0 E 0 7 27
auhgmap -unit %UNAME% -add 0 E 0 8 28
auhgmap -unit %UNAME% -add 0 E 0 9 29
auhgmap -unit %UNAME% -add 0 E 0 10 60
auhgmap -unit %UNAME% -add 0 E 0 11 61
auhgmap -unit %UNAME% -add 0 E 0 12 62
auhgmap -unit %UNAME% -add 0 E 0 13 63
auhgmap -unit %UNAME% -add 0 E 0 14 64
auhgmap -unit %UNAME% -add 0 E 0 15 65
auhgmap -unit %UNAME% -add 0 E 0 16 66
auhgmap -unit %UNAME% -add 0 E 0 17 67
auhgmap -unit %UNAME% -add 0 E 0 18 68
auhgmap -unit %UNAME% -add 0 E 0 19 69
auhgmap -unit %UNAME% -add 0 E 0 20 100
auhgmap -unit %UNAME% -add 0 E 0 21 101
auhgmap -unit %UNAME% -add 0 E 0 22 102
auhgmap -unit %UNAME% -add 0 E 0 23 103
auhgmap -unit %UNAME% -add 0 E 0 24 104
auhgmap -unit %UNAME% -add 0 E 0 25 105
auhgmap -unit %UNAME% -add 0 E 0 26 106
auhgmap -unit %UNAME% -add 0 E 0 27 107
auhgmap -unit %UNAME% -add 0 E 0 28 108
auhgmap -unit %UNAME% -add 0 E 0 29 109
```

```
auhgmap -unit %UNAME% -add 0 E 0 30 140
auhgmap -unit %UNAME% -add 0 E 0 31 141
auhgmap -unit %UNAME% -add 0 E 0 32 142
auhgmap -unit %UNAME% -add 0 E 0 33 143
auhgmap -unit %UNAME% -add 0 E 0 34 144
auhgmap -unit %UNAME% -add 0 E 0 35 145
auhgmap -unit %UNAME% -add 0 E 0 36 146
auhgmap -unit %UNAME% -add 0 E 0 37 147
auhgmap -unit %UNAME% -add 0 E 0 38 148
auhgmap -unit %UNAME% -add 0 E 0 39 149

auhgmap -unit %UNAME% -add 0 G 0 0 30
auhgmap -unit %UNAME% -add 0 G 0 1 31
auhgmap -unit %UNAME% -add 0 G 0 2 32
auhgmap -unit %UNAME% -add 0 G 0 3 33
auhgmap -unit %UNAME% -add 0 G 0 4 34
auhgmap -unit %UNAME% -add 0 G 0 5 35
auhgmap -unit %UNAME% -add 0 G 0 6 36
auhgmap -unit %UNAME% -add 0 G 0 7 37
auhgmap -unit %UNAME% -add 0 G 0 8 38
auhgmap -unit %UNAME% -add 0 G 0 9 39
auhgmap -unit %UNAME% -add 0 G 0 10 70
auhgmap -unit %UNAME% -add 0 G 0 11 71
auhgmap -unit %UNAME% -add 0 G 0 12 72
auhgmap -unit %UNAME% -add 0 G 0 13 73
auhgmap -unit %UNAME% -add 0 G 0 14 74
auhgmap -unit %UNAME% -add 0 G 0 15 75
auhgmap -unit %UNAME% -add 0 G 0 16 76
auhgmap -unit %UNAME% -add 0 G 0 17 77
auhgmap -unit %UNAME% -add 0 G 0 18 78
auhgmap -unit %UNAME% -add 0 G 0 19 79
auhgmap -unit %UNAME% -add 0 G 0 20 110
auhgmap -unit %UNAME% -add 0 G 0 21 111
auhgmap -unit %UNAME% -add 0 G 0 22 112
auhgmap -unit %UNAME% -add 0 G 0 23 113
auhgmap -unit %UNAME% -add 0 G 0 24 114
auhgmap -unit %UNAME% -add 0 G 0 25 115
auhgmap -unit %UNAME% -add 0 G 0 26 116
auhgmap -unit %UNAME% -add 0 G 0 27 117
auhgmap -unit %UNAME% -add 0 G 0 28 118
auhgmap -unit %UNAME% -add 0 G 0 29 119
auhgmap -unit %UNAME% -add 0 G 0 30 150
auhgmap -unit %UNAME% -add 0 G 0 31 151
auhgmap -unit %UNAME% -add 0 G 0 32 152
auhgmap -unit %UNAME% -add 0 G 0 33 153
auhgmap -unit %UNAME% -add 0 G 0 34 154
auhgmap -unit %UNAME% -add 0 G 0 35 155
auhgmap -unit %UNAME% -add 0 G 0 36 156
auhgmap -unit %UNAME% -add 0 G 0 37 157
auhgmap -unit %UNAME% -add 0 G 0 38 158
auhgmap -unit %UNAME% -add 0 G 0 39 159

auhgmap -unit %UNAME% -add 1 A 0 0 160
auhgmap -unit %UNAME% -add 1 A 0 1 161
auhgmap -unit %UNAME% -add 1 A 0 2 162
auhgmap -unit %UNAME% -add 1 A 0 3 163
auhgmap -unit %UNAME% -add 1 A 0 4 164
auhgmap -unit %UNAME% -add 1 A 0 5 165
auhgmap -unit %UNAME% -add 1 A 0 6 166
auhgmap -unit %UNAME% -add 1 A 0 7 167
auhgmap -unit %UNAME% -add 1 A 0 8 168
auhgmap -unit %UNAME% -add 1 A 0 9 169
auhgmap -unit %UNAME% -add 1 A 0 10 200
```

```
auhgmap -unit %UNAME% -add 1 A 0 11 201
auhgmap -unit %UNAME% -add 1 A 0 12 202
auhgmap -unit %UNAME% -add 1 A 0 13 203
auhgmap -unit %UNAME% -add 1 A 0 14 204
auhgmap -unit %UNAME% -add 1 A 0 15 205
auhgmap -unit %UNAME% -add 1 A 0 16 206
auhgmap -unit %UNAME% -add 1 A 0 17 207
auhgmap -unit %UNAME% -add 1 A 0 18 208
auhgmap -unit %UNAME% -add 1 A 0 19 209
auhgmap -unit %UNAME% -add 1 A 0 20 240
auhgmap -unit %UNAME% -add 1 A 0 21 241
auhgmap -unit %UNAME% -add 1 A 0 22 242
auhgmap -unit %UNAME% -add 1 A 0 23 243
auhgmap -unit %UNAME% -add 1 A 0 24 244
auhgmap -unit %UNAME% -add 1 A 0 25 245
auhgmap -unit %UNAME% -add 1 A 0 26 246
auhgmap -unit %UNAME% -add 1 A 0 27 247
auhgmap -unit %UNAME% -add 1 A 0 28 248
auhgmap -unit %UNAME% -add 1 A 0 29 249
auhgmap -unit %UNAME% -add 1 A 0 30 280
auhgmap -unit %UNAME% -add 1 A 0 31 281
auhgmap -unit %UNAME% -add 1 A 0 32 282
auhgmap -unit %UNAME% -add 1 A 0 33 283
auhgmap -unit %UNAME% -add 1 A 0 34 284
auhgmap -unit %UNAME% -add 1 A 0 35 285
auhgmap -unit %UNAME% -add 1 A 0 36 286
auhgmap -unit %UNAME% -add 1 A 0 37 287
auhgmap -unit %UNAME% -add 1 A 0 38 288
auhgmap -unit %UNAME% -add 1 A 0 39 289

auhgmap -unit %UNAME% -add 1 C 0 0 170
auhgmap -unit %UNAME% -add 1 C 0 1 171
auhgmap -unit %UNAME% -add 1 C 0 2 172
auhgmap -unit %UNAME% -add 1 C 0 3 173
auhgmap -unit %UNAME% -add 1 C 0 4 174
auhgmap -unit %UNAME% -add 1 C 0 5 175
auhgmap -unit %UNAME% -add 1 C 0 6 176
auhgmap -unit %UNAME% -add 1 C 0 7 177
auhgmap -unit %UNAME% -add 1 C 0 8 178
auhgmap -unit %UNAME% -add 1 C 0 9 179
auhgmap -unit %UNAME% -add 1 C 0 10 210
auhgmap -unit %UNAME% -add 1 C 0 11 211
auhgmap -unit %UNAME% -add 1 C 0 12 212
auhgmap -unit %UNAME% -add 1 C 0 13 213
auhgmap -unit %UNAME% -add 1 C 0 14 214
auhgmap -unit %UNAME% -add 1 C 0 15 215
auhgmap -unit %UNAME% -add 1 C 0 16 216
auhgmap -unit %UNAME% -add 1 C 0 17 217
auhgmap -unit %UNAME% -add 1 C 0 18 218
auhgmap -unit %UNAME% -add 1 C 0 19 219
auhgmap -unit %UNAME% -add 1 C 0 20 250
auhgmap -unit %UNAME% -add 1 C 0 21 251
auhgmap -unit %UNAME% -add 1 C 0 22 252
auhgmap -unit %UNAME% -add 1 C 0 23 253
auhgmap -unit %UNAME% -add 1 C 0 24 254
auhgmap -unit %UNAME% -add 1 C 0 25 255
auhgmap -unit %UNAME% -add 1 C 0 26 256
auhgmap -unit %UNAME% -add 1 C 0 27 257
auhgmap -unit %UNAME% -add 1 C 0 28 258
auhgmap -unit %UNAME% -add 1 C 0 29 259
auhgmap -unit %UNAME% -add 1 C 0 30 290
auhgmap -unit %UNAME% -add 1 C 0 31 291
auhgmap -unit %UNAME% -add 1 C 0 32 292
```

```
auhgmap -unit %UNAME% -add 1 C 0 33 293
auhgmap -unit %UNAME% -add 1 C 0 34 294
auhgmap -unit %UNAME% -add 1 C 0 35 295
auhgmap -unit %UNAME% -add 1 C 0 36 296
auhgmap -unit %UNAME% -add 1 C 0 37 297
auhgmap -unit %UNAME% -add 1 C 0 38 298
auhgmap -unit %UNAME% -add 1 C 0 39 299

auhgmap -unit %UNAME% -add 1 E 0 0 180
auhgmap -unit %UNAME% -add 1 E 0 1 181
auhgmap -unit %UNAME% -add 1 E 0 2 182
auhgmap -unit %UNAME% -add 1 E 0 3 183
auhgmap -unit %UNAME% -add 1 E 0 4 184
auhgmap -unit %UNAME% -add 1 E 0 5 185
auhgmap -unit %UNAME% -add 1 E 0 6 186
auhgmap -unit %UNAME% -add 1 E 0 7 187
auhgmap -unit %UNAME% -add 1 E 0 8 188
auhgmap -unit %UNAME% -add 1 E 0 9 189
auhgmap -unit %UNAME% -add 1 E 0 10 220
auhgmap -unit %UNAME% -add 1 E 0 11 221
auhgmap -unit %UNAME% -add 1 E 0 12 222
auhgmap -unit %UNAME% -add 1 E 0 13 223
auhgmap -unit %UNAME% -add 1 E 0 14 224
auhgmap -unit %UNAME% -add 1 E 0 15 225
auhgmap -unit %UNAME% -add 1 E 0 16 226
auhgmap -unit %UNAME% -add 1 E 0 17 227
auhgmap -unit %UNAME% -add 1 E 0 18 228
auhgmap -unit %UNAME% -add 1 E 0 19 229
auhgmap -unit %UNAME% -add 1 E 0 20 260
auhgmap -unit %UNAME% -add 1 E 0 21 261
auhgmap -unit %UNAME% -add 1 E 0 22 262
auhgmap -unit %UNAME% -add 1 E 0 23 263
auhgmap -unit %UNAME% -add 1 E 0 24 264
auhgmap -unit %UNAME% -add 1 E 0 25 265
auhgmap -unit %UNAME% -add 1 E 0 26 266
auhgmap -unit %UNAME% -add 1 E 0 27 267
auhgmap -unit %UNAME% -add 1 E 0 28 268
auhgmap -unit %UNAME% -add 1 E 0 29 269
auhgmap -unit %UNAME% -add 1 E 0 30 300
auhgmap -unit %UNAME% -add 1 E 0 31 301
auhgmap -unit %UNAME% -add 1 E 0 32 302
auhgmap -unit %UNAME% -add 1 E 0 33 303
auhgmap -unit %UNAME% -add 1 E 0 34 304
auhgmap -unit %UNAME% -add 1 E 0 35 305
auhgmap -unit %UNAME% -add 1 E 0 36 306
auhgmap -unit %UNAME% -add 1 E 0 37 307
auhgmap -unit %UNAME% -add 1 E 0 38 308
auhgmap -unit %UNAME% -add 1 E 0 39 309

auhgmap -unit %UNAME% -add 1 G 0 0 190
auhgmap -unit %UNAME% -add 1 G 0 1 191
auhgmap -unit %UNAME% -add 1 G 0 2 192
auhgmap -unit %UNAME% -add 1 G 0 3 193
auhgmap -unit %UNAME% -add 1 G 0 4 194
auhgmap -unit %UNAME% -add 1 G 0 5 195
auhgmap -unit %UNAME% -add 1 G 0 6 196
auhgmap -unit %UNAME% -add 1 G 0 7 197
auhgmap -unit %UNAME% -add 1 G 0 8 198
auhgmap -unit %UNAME% -add 1 G 0 9 199
auhgmap -unit %UNAME% -add 1 G 0 10 230
auhgmap -unit %UNAME% -add 1 G 0 11 231
auhgmap -unit %UNAME% -add 1 G 0 12 232
auhgmap -unit %UNAME% -add 1 G 0 13 233
```

```
auhgmap -unit %UNAME% -add 1 G 0 14 234
auhgmap -unit %UNAME% -add 1 G 0 15 235
auhgmap -unit %UNAME% -add 1 G 0 16 236
auhgmap -unit %UNAME% -add 1 G 0 17 237
auhgmap -unit %UNAME% -add 1 G 0 18 238
auhgmap -unit %UNAME% -add 1 G 0 19 239
auhgmap -unit %UNAME% -add 1 G 0 20 270
auhgmap -unit %UNAME% -add 1 G 0 21 271
auhgmap -unit %UNAME% -add 1 G 0 22 272
auhgmap -unit %UNAME% -add 1 G 0 23 273
auhgmap -unit %UNAME% -add 1 G 0 24 274
auhgmap -unit %UNAME% -add 1 G 0 25 275
auhgmap -unit %UNAME% -add 1 G 0 26 276
auhgmap -unit %UNAME% -add 1 G 0 27 277
auhgmap -unit %UNAME% -add 1 G 0 28 278
auhgmap -unit %UNAME% -add 1 G 0 29 279
auhgmap -unit %UNAME% -add 1 G 0 30 310
auhgmap -unit %UNAME% -add 1 G 0 31 311
auhgmap -unit %UNAME% -add 1 G 0 32 312
auhgmap -unit %UNAME% -add 1 G 0 33 313
auhgmap -unit %UNAME% -add 1 G 0 34 314
auhgmap -unit %UNAME% -add 1 G 0 35 315
auhgmap -unit %UNAME% -add 1 G 0 36 316
auhgmap -unit %UNAME% -add 1 G 0 37 317
auhgmap -unit %UNAME% -add 1 G 0 38 318
auhgmap -unit %UNAME% -add 1 G 0 39 319

auhgmap -unit %UNAME% -add 0 A 0 100 320
auhgmap -unit %UNAME% -add 0 C 0 100 321
auhgmap -unit %UNAME% -add 0 E 0 100 322
auhgmap -unit %UNAME% -add 0 G 0 100 323

auhgmap -unit %UNAME% -add 1 A 0 100 324
auhgmap -unit %UNAME% -add 1 C 0 100 325
auhgmap -unit %UNAME% -add 1 E 0 100 326
auhgmap -unit %UNAME% -add 1 G 0 100 327
```

6. Set Host Connection Option

Change the Host connection option settings for the AIX Host System using the following commands:

```
auhgopt -unit %uname% -set 0 A -gno 0  -NACA enable
auhgopt -unit %uname% -set 0 C -gno 0  -NACA enable
auhgopt -unit %uname% -set 0 E -gno 0  -NACA enable
auhgopt -unit %uname% -set 0 G -gno 0  -NACA enable
auhgopt -unit %uname% -set 1 A -gno 0  -NACA enable
auhgopt -unit %uname% -set 1 C -gno 0  -NACA enable
auhgopt -unit %uname% -set 1 E -gno 0  -NACA enable
auhgopt -unit %uname% -set 1 G -gno 0  -NACA enable
```

7. Turn Off Trace and Monitoring Information – AMS2500 Tuning Parameter

Turn off the collection of trace and performance monitor information to reduce CPU overhead using the following commands:

```
aupfmstatiscfg -unit %UNAME% -set -port stop -rglu stop -cache stop -processor
stop -drive stop -driveopr stop -backend stop
auonlineverify -unit %UNAME% -set -verify disable
ausystuning -unit %UNAME% -set -detailedtrace off
```

8. Change Cache Management Strategy – AMS2500 Tuning Parameter

Optimize the cache management strategy for multi-stream I/O by using the following commands:

```
ausystuning -unit %UNAME% -set -dtystart 20 -dtystop 10

autuningmultistream -unit %UNAME% -default
autuningmultistream -unit %UNAME% -set -scope lu -lu 0-327 -seqcount 0
for /L %I IN ( 1, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -seqcount 1 -next disable -criteria fixed
for /L %I IN ( 2, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -seqcount 1 -next disable -criteria fixed
for /L %I IN ( 6, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -seqcount 1 -next disable -criteria fixed
autuningmultistream -unit %UNAME% -set -scope lu -lu 320 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 321 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 322 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 323 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 324 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 325 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 326 -readwrite enable -
seqcount 1 -criteria base
autuningmultistream -unit %UNAME% -set -scope lu -lu 327 -readwrite enable -
seqcount 1 -criteria base

set PREF_SIZE=128
set PREB_SIZE=128
for /L %I IN ( 1, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -fixedsize %PREF_SIZE% -basesize %PREF_SIZE%
for /L %I IN ( 2, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -fixedsize %PREF_SIZE% -basesize %PREF_SIZE%
for /L %I IN ( 6, 10, 319) DO autuningmultistream -unit %UNAME% -set -scope lu -
lu %I -fixedsize %PREF_SIZE% -basesize %PREF_SIZE%
```

The following TSC creation/configuration steps result in the creation of the final SPC-1 Logical Volumes, which comprise ASU-1, ASU-2, and ASU-3. Those volumes are visible to accessible by the AIX Host System.

9. Discover LUNs

Use the AIX command, ***cfgmgr***, to discover the LUNs, followed by the AIX command ***lsdev –Cc disk*** to confirm that 328 "hdisks" exist.

10. Change "hdisk" Queue Depth Settings

Change the "hdisk" queue depth setting to thirty-two (32) using the following script:

```
#!/bin/sh

# Remove all attached Hitachi hdisks

hdisk_list=`lsdev -Cc disk | grep Hitachi | awk '{print $1}'`
for hd in $hdisk_list
do
  rmdev -dl $hd -R
done
lsdev -Cc disk

hdisk_list=`lsdev -Cc disk |  awk '{print $1}'`

for hd in $hdisk_list
do
  chdev -l $hd -a queue_depth='32'
done

for hd in $hdisk_list
do
queue_depth=`lsattr -l $hd -a queue_depth -E | awk '{print $2}'`
echo "$hd  $queue_depth"
done
```

11. Create Volume Groups and Logical Volumes for ASUs

Volume Groups are created using the native AIX Logical Volume Manager. The first step is to edit **env.cfg**. This file is used as an environment file which identifies the name of the Volume Group, the "hdisks" which belong to each Volume Group, the names of the Logical Volumes, the size of the Logical Volumes, and the number of logical partitions. After editing the environment file, **env.cfg**, execute the **mkvg.ksh** script to create the Volume Groups, and **mklv.ksh** to create the Logical Volumes.

The content of **env.cfg**, **mkvg.ksh**, and **mklv.ksh** are listed below.

env.cfg

```
# Volume Group Naming Stems & Logical Volume Naming Stems
ASU11FS=asu11
ASU12FS=asu12
ASU13FS=asu13
ASU14FS=asu14
ASU15FS=asu15
ASU21FS=asu21
ASU22FS=asu22
ASU23FS=asu23
ASU24FS=asu24
ASU25FS=asu25
ASU31FS=asu31

# List of hdisks to create logical volume.
ASU11DISK="hdisk4 hdisk14 hdisk24 hdisk34 hdisk45 hdisk55 hdisk65 hdisk75
hdisk86 hdisk96 hdisk106 hdisk116 hdisk127 hdisk137 hdisk147 hdisk157 hdisk168
hdisk178 hdisk188 hdisk198 hdisk209 hdisk219 hdisk229 hdisk239 hdisk250
hdisk260 hdisk270 hdisk280 hdisk291 hdisk301 hdisk311 hdisk321"
ASU12DISK="hdisk5 hdisk15 hdisk25 hdisk35 hdisk46 hdisk56 hdisk66 hdisk76
hdisk87 hdisk97 hdisk107 hdisk117 hdisk128 hdisk138 hdisk148 hdisk158 hdisk169
hdisk179 hdisk189 hdisk199 hdisk210 hdisk220 hdisk230 hdisk240 hdisk251
hdisk261 hdisk271 hdisk281 hdisk292 hdisk302 hdisk312 hdisk322"
ASU13DISK="hdisk6 hdisk16 hdisk26 hdisk36 hdisk47 hdisk57 hdisk67 hdisk77
hdisk88 hdisk98 hdisk108 hdisk118 hdisk129 hdisk139 hdisk149 hdisk159 hdisk170
hdisk180 hdisk190 hdisk200 hdisk211 hdisk221 hdisk231 hdisk241 hdisk252
hdisk262 hdisk272 hdisk282 hdisk293 hdisk303 hdisk313 hdisk323"
ASU14DISK="hdisk7 hdisk17 hdisk27 hdisk37 hdisk48 hdisk58 hdisk68 hdisk78
hdisk89 hdisk99 hdisk109 hdisk119 hdisk130 hdisk140 hdisk150 hdisk160 hdisk171
hdisk181 hdisk191 hdisk201 hdisk212 hdisk222 hdisk232 hdisk242 hdisk253
hdisk263 hdisk273 hdisk283 hdisk294 hdisk304 hdisk314 hdisk324"
ASU15DISK="hdisk8 hdisk18 hdisk28 hdisk38 hdisk49 hdisk59 hdisk69 hdisk79
hdisk90 hdisk100 hdisk110 hdisk120 hdisk131 hdisk141 hdisk151 hdisk161 hdisk172
hdisk182 hdisk192 hdisk202 hdisk213 hdisk223 hdisk233 hdisk243 hdisk254
hdisk264 hdisk274 hdisk284 hdisk295 hdisk305 hdisk315 hdisk325"
ASU21DISK="hdisk9 hdisk19 hdisk29 hdisk39 hdisk50 hdisk60 hdisk70 hdisk80
hdisk91 hdisk101 hdisk111 hdisk121 hdisk132 hdisk142 hdisk152 hdisk162 hdisk173
hdisk183 hdisk193 hdisk203 hdisk214 hdisk224 hdisk234 hdisk244 hdisk255
hdisk265 hdisk275 hdisk285 hdisk296 hdisk306 hdisk316 hdisk326"
ASU22DISK="hdisk10 hdisk20 hdisk30 hdisk40 hdisk51 hdisk61 hdisk71 hdisk81
hdisk92 hdisk102 hdisk112 hdisk122 hdisk133 hdisk143 hdisk153 hdisk163 hdisk174
hdisk184 hdisk194 hdisk204 hdisk215 hdisk225 hdisk235 hdisk245 hdisk256
hdisk266 hdisk276 hdisk286 hdisk297 hdisk307 hdisk317 hdisk327"
ASU23DISK="hdisk11 hdisk21 hdisk31 hdisk41 hdisk52 hdisk62 hdisk72 hdisk82
hdisk93 hdisk103 hdisk113 hdisk123 hdisk134 hdisk144 hdisk154 hdisk164 hdisk175
```

```
hdisk185 hdisk195 hdisk205 hdisk216 hdisk226 hdisk236 hdisk246 hdisk257
hdisk267 hdisk277 hdisk287 hdisk298 hdisk308 hdisk318 hdisk328"
ASU24DISK="hdisk12 hdisk22 hdisk32 hdisk42 hdisk53 hdisk63 hdisk73 hdisk83
hdisk94 hdisk104 hdisk114 hdisk124 hdisk135 hdisk145 hdisk155 hdisk165 hdisk176
hdisk186 hdisk196 hdisk206 hdisk217 hdisk227 hdisk237 hdisk247 hdisk258
hdisk268 hdisk278 hdisk288 hdisk299 hdisk309 hdisk319 hdisk329"
ASU25DISK="hdisk13 hdisk23 hdisk33 hdisk43 hdisk54 hdisk64 hdisk74 hdisk84
hdisk95 hdisk105 hdisk115 hdisk125 hdisk136 hdisk146 hdisk156 hdisk166 hdisk177
hdisk187 hdisk197 hdisk207 hdisk218 hdisk228 hdisk238 hdisk248 hdisk259
hdisk269 hdisk279 hdisk289 hdisk300 hdisk310 hdisk320 hdisk330"
ASU31DISK="hdisk44 hdisk85 hdisk126 hdisk167 hdisk208 hdisk249 hdisk290
hdisk331"

# Volume Group Name
ASU11VG=vg$ASU11FS
ASU12VG=vg$ASU12FS
ASU13VG=vg$ASU13FS
ASU14VG=vg$ASU14FS
ASU15VG=vg$ASU15FS
ASU21VG=vg$ASU21FS
ASU22VG=vg$ASU22FS
ASU23VG=vg$ASU23FS
ASU24VG=vg$ASU24FS
ASU25VG=vg$ASU25FS
ASU31VG=vg$ASU31FS

# Logical Volume Name
ASU11LV=lv$ASU11FS
ASU12LV=lv$ASU12FS
ASU13LV=lv$ASU13FS
ASU14LV=lv$ASU14FS
ASU15LV=lv$ASU15FS
ASU21LV=lv$ASU21FS
ASU22LV=lv$ASU22FS
ASU23LV=lv$ASU23FS
ASU24LV=lv$ASU24FS
ASU25LV=lv$ASU25FS
ASU31LV=lv$ASU31FS

# Logical Volume Size
ASU11LVSIZE=1431G
ASU12LVSIZE=1431G
ASU13LVSIZE=1431G
ASU14LVSIZE=1431G
ASU15LVSIZE=1431G
ASU21LVSIZE=1431G
ASU22LVSIZE=1431G
ASU23LVSIZE=1431G
ASU24LVSIZE=1431G
ASU25LVSIZE=1431G
ASU31LVSIZE=1590G

# Maximum Number of Logical Partitions
ASU1LP=32
ASU2LP=32
ASU3LP=8
```

mkvg.ksh

```
#!/bin/ksh

. /scripts/host/aix/spcbuild/env.cfg

# Create VGs
mkvg -f -y $ASU11VG -s '1024' $ASU11DISK
mkvg -f -y $ASU12VG -s '1024' $ASU12DISK
mkvg -f -y $ASU13VG -s '1024' $ASU13DISK
mkvg -f -y $ASU14VG -s '1024' $ASU14DISK
mkvg -f -y $ASU15VG -s '1024' $ASU15DISK
mkvg -f -y $ASU21VG -s '1024' $ASU21DISK
mkvg -f -y $ASU22VG -s '1024' $ASU22DISK
mkvg -f -y $ASU23VG -s '1024' $ASU23DISK
mkvg -f -y $ASU24VG -s '1024' $ASU24DISK
mkvg -f -y $ASU25VG -s '1024' $ASU25DISK
mkvg -f -y $ASU31VG -s '1024' $ASU31DISK
```

mklv.ksh

```
#!/bin/ksh

. /scripts/host/aix/spcbuild/env.cfg

mklv -y $ASU11LV -t 'rawio' -u $ASU1LP -w 'n' -S '4M' $ASU11VG $ASU11LVSIZE
$ASU11DISK
mklv -y $ASU12LV -t 'rawio' -u $ASU1LP -w 'n' -S '4M' $ASU12VG $ASU12LVSIZE
$ASU12DISK
mklv -y $ASU13LV -t 'rawio' -u $ASU1LP -w 'n' -S '4M' $ASU13VG $ASU13LVSIZE
$ASU13DISK
mklv -y $ASU14LV -t 'rawio' -u $ASU1LP -w 'n' -S '4M' $ASU14VG $ASU14LVSIZE
$ASU14DISK
mklv -y $ASU15LV -t 'rawio' -u $ASU1LP -w 'n' -S '4M' $ASU15VG $ASU15LVSIZE
$ASU15DISK
mklv -y $ASU21LV -t 'rawio' -u $ASU2LP -w 'n' -S '4M' $ASU21VG $ASU21LVSIZE
$ASU21DISK
mklv -y $ASU22LV -t 'rawio' -u $ASU2LP -w 'n' -S '4M' $ASU22VG $ASU22LVSIZE
$ASU22DISK
mklv -y $ASU23LV -t 'rawio' -u $ASU2LP -w 'n' -S '4M' $ASU23VG $ASU23LVSIZE
$ASU23DISK
mklv -y $ASU24LV -t 'rawio' -u $ASU2LP -w 'n' -S '4M' $ASU24VG $ASU24LVSIZE
$ASU24DISK
mklv -y $ASU25LV -t 'rawio' -u $ASU2LP -w 'n' -S '4M' $ASU25VG $ASU25LVSIZE
$ASU25DISK
mklv -y $ASU31LV -t 'rawio' -u $ASU3LP -w 'n' -S '4M' $ASU31VG $ASU31LVSIZE
$ASU31DISK
```

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

The content of SPC-1 Workload Generator command and parameter file, used in this benchmark, is listed below.

```
# SPC1 uses three different ASUs (Application Storage Unit)
# The storage definition must start with asu1, or asu2 or
# asu3.  Each of the asu luns will be concatenated together for
# for form 1 logical piece of storage.  The storage must be in the
# following proportion.
#     ASU1 = 45%
#     ASU2 = 45%
#     ASU3 = 10%

# The sd statement can have an optional size.  For example:
# Use only the first 30GMs of the storage for each LUN.
#     sd=asu1_1,lun=/dev/rdsk/c2t129d0s6,size=33g

javaparms="-Xms384m -Xmx768m -Xss128k -Xgcpolicy:optavgpause"

sd=asu1_1,lun=/dev/rlvasu11,size=1431g
sd=asu1_2,lun=/dev/rlvasu12,size=1431g
sd=asu1_3,lun=/dev/rlvasu13,size=1431g
sd=asu1_4,lun=/dev/rlvasu14,size=1431g
sd=asu1_5,lun=/dev/rlvasu15,size=1431g
sd=asu2_1,lun=/dev/rlvasu21,size=1431g
sd=asu2_2,lun=/dev/rlvasu22,size=1431g
sd=asu2_3,lun=/dev/rlvasu23,size=1431g
sd=asu2_4,lun=/dev/rlvasu24,size=1431g
sd=asu2_5,lun=/dev/rlvasu25,size=1431g
sd=asu3_1,lun=/dev/rlvasu31,size=1590g
```

APPENDIX E: SPC-1 WORKLOAD GENERATOR INPUT PARAMETERS

Persistence Test Run 1

The following script was used to execute Persistence Test Run 1.

```
#!/bin/ksh

# Logic when passing arguments from the command line.

if [ $# -ne 1 ];then
   echo "Usage: $0 [BSU]"
   exit 1
   else
   BSU=$1
fi

# Global Variable
DATE=`date +%y%m%d.%H%M`
SPCDIR=/home/benchmark/spc1
OUTDIR=$SPCDIR/output/$DATE.bsu$BSU

# Create Output Directory
mkdir -p $OUTDIR

# SPC Configruation Variable
# MEASURE:
#    Number of seconds for the measurement
#    interval of the Sustainability Test Phase.
# RAMP:
#    Number of seconds for the measurement
#    intervals for the Response Ramp Test Phase.
# STARTUP:
#    Number of seconds of startup time for each
#    measurement interval.
MEASURE=10800
RAMP=600
STARTUP=180

# Need to setup LD_LIBRARY_PATH in .kshrc
export LIBPATH=/home/benchmark/spc1/aix

# Path where java resides:
java=/usr/java14/jre/bin/java

# IBM Java Environment Setting
export CLASSPATH=.
export IBM_JAVADUMP_OUTOFMEMORY=false
export IBM_HEAPDUMP_OUTOFMEMORY=false

################################################################################
################################################################################

################################################################################
#
# Metric Test
# Metric Test Time: 4 Hours and 30 Minutes.
#
# It is recommened that you restart both the Benchmark Configuration
# and Tested Storage Configuration.  The metrics test actually consists
# of the sustainability test phase and the ramp test phase.
```

```
#
###############################################################################

# Run Metric Test
#java -Xoptionsfile=javaopts.cfg metrics -b $BSU
#java -Xoptionsfile=javaopts.cfg range -b $BSU -t $MEASURE

###############################################################################
#
# Repeatability Test
# Repeatability Test Time: 30 Minutes.
#
# The Repeatability Test may be run before or after the metrics and/or
# persistence test, but it is recommended that the Repeatability Test be
# executed following the Response Time Ramp Test Phase (Metrics).  The two
# Test Phases ('repeat1' and 'repeat2') that comprise the Repeatability Test
# must be executed in an uninterrupted sequence.
#
###############################################################################

# Run Repeatability 1 Test
#java -Xoptionsfile=javaopts.cfg repeat1 -b $BSU

# Run Repeatability 2 Test
#java -Xoptionsfile=javaopts.cfg repeat2 -b $BSU

###############################################################################
#
# Persistence Test
# Persistence Test Time: 30 Minutes + Time to power off system.
#
# It is recommended to run the Persistence Test as the
# first item of an Audit.  The first stage (persist1), pwer
# off/restart, and second stage (persist2) must be run
# in an uninterrupted sequence.
#
###############################################################################

# Run Persistence 1 Test
java -Xoptionsfile=javaopts.cfg persist1 -b $BSU

# It is now necessary to completely power off and restart
# both the Benchmark COnfiguration and the Tested Storage
# Configuration machine so that all caches are completely
# emptied.

# Run Persistence 2 Test
#java -Xoptionsfile=javaopts.cfg persist2

###############################################################################
#
# Clean up process
#
###############################################################################

cp $SPCDIR/SPC1.cfg $OUTDIR
mv $SPCDIR/SPC1.parm $OUTDIR
#mv $SPCDIR/*.jnl $OUTDIR
#mv $SPCDIR/*.map $OUTDIR
#mv $SPCDIR/metrics/ $OUTDIR
#mv $SPCDIR/repeatability1/ $OUTDIR
#mv $SPCDIR/repeatability2/ $OUTDIR
mv $SPCDIR/persistence1/ $OUTDIR
```

```
#mv $SPCDIR/persistence2/ $OUTDIR
mv $SPCDIR/SPCOut/ $OUTDIR
```

Persistence Test Run 2, Primary Metrics Test, and Repeatability Test

The following script was used to execute Persistence Test Run 2, the Primary Metrics Test *(Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase)*, and Repeatability Test *(Repeatability Test Phase 1 and Repeatability Test Phase 2)* in an uninterrupted sequence.

```
#!/bin/ksh

# Logic when passing arguments from the command line.

if [ $# -ne 1 ];then
   echo "Usage: $0 [BSU]"
   exit 1
   else
   BSU=$1
fi

# Global Variable
DATE=`date +%y%m%d.%H%M`
SPCDIR=/home/benchmark/spc1
OUTDIR=$SPCDIR/output/$DATE.bsu$BSU

# Create Output Directory
mkdir -p $OUTDIR

# SPC Configruation Variable
# MEASURE:
#    Number of seconds for the measurement
#    interval of the Sustainability Test Phase.
# RAMP:
#    Number of seconds for the measurement
#    intervals for the Response Ramp Test Phase.
# STARTUP:
#    Number of seconds of startup time for each
#    measurement interval.
MEASURE=10800
RAMP=600
STARTUP=180

# Need to setup LD_LIBRARY_PATH in .kshrc
export LIBPATH=/home/benchmark/spc1/aix

# Path where java resides:
java=/usr/java14/jre/bin/java

# IBM Java Environment Setting
export CLASSPATH=.
export IBM_JAVADUMP_OUTOFMEMORY=false
export IBM_HEAPDUMP_OUTOFMEMORY=false

################################################################################
################################################################################

# Run Persistence 2 Test
java -Xoptionsfile=javaopts.cfg persist2
```

```
###############################################################################
#
# Metric Test
# Metric Test Time: 4 Hours and 30 Minutes.
#
# It is recommened that you restart both the Benchmark Configuration
# and Tested Storage Configuration.  The metrics test actually consists
# of the sustainability test phase and the ramp test phase.
#
###############################################################################

# Run Metric Test
java -Xoptionsfile=javaopts.cfg metrics -b $BSU

###############################################################################
#
# Repeatability Test
# Repeatability Test Time: 30 Minutes.
#
# The Repeatability Test may be run before or after the metrics and/or
# persistence test, but it is recommended that the Repeatability Test be
# executed following the Response Time Ramp Test Phase (Metrics).  The two
# Test Phases ('repeat1' and 'repeat2') that comprise the Repeatability Test
# must be executed in an uninterrupted sequence.
#
###############################################################################

# Run Repeatability 1 Test
java -Xoptionsfile=javaopts.cfg repeat1 -b $BSU

# Run Repeatability 2 Test
java -Xoptionsfile=javaopts.cfg repeat2 -b $BSU

###############################################################################
#
# Persistence Test
# Persistence Test Time: 30 Minutes + Time to power off system.
#
# It is recommended to run the Persistence Test as the
# first item of an Audit.  The first stage (persist1), pwer
# off/restart, and second stage (persist2) must be run
# in an uninterrupted sequence.
#
###############################################################################

# Run Persistence 1 Test
#java -Xoptionsfile=javaopts.cfg persist1 -b $BSU

# It is now necessary to completely power off and restart
# both the Benchmark COnfiguration and the Tested Storage
# Configuration machine so that all caches are completely
# emptied.

# Run Persistence 2 Test
#java -Xoptionsfile=javaopts.cfg persist2

###############################################################################
#
# Clean up process
#
###############################################################################
```

```
cp $SPCDIR/SPC1.cfg $OUTDIR
mv $SPCDIR/SPC1.parm $OUTDIR
mv $SPCDIR/*.jnl $OUTDIR
mv $SPCDIR/*.map $OUTDIR
mv $SPCDIR/metrics/ $OUTDIR
mv $SPCDIR/repeatability1/ $OUTDIR
mv $SPCDIR/repeatability2/ $OUTDIR
mv $SPCDIR/persistence1/ $OUTDIR
mv $SPCDIR/persistence2/ $OUTDIR
mv $SPCDIR/SPCOut/ $OUTDIR
```