

Certification Test Report

Report Number: ESS-7001-CTR-01

ES&S EVS 6.0.0.0

Certification Test Report v1.0

April 6th, 2018

Prepared for:

Vendor Name	<i>Election Systems and Software (ES&S)</i>
Vendor System	<i>EVS 6.0.0.0</i>
EAC Application No.	<i>EVS6000</i>
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***Accredited by the Election
Assistance Commission (EAC) for
Selected Voting System Test
Methods or Services***

Revision History

Date	Version	Author	Revision Summary
April 6 th , 2018	1.0	M. Santos	Initial Draft

Disclaimer

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Opinions and Interpretations

Any opinions or interpretations included in this report shall be marked as such, starting with “It is SLI’s opinion/interpretation...”

There are no opinions or interpretations included in this report, except as noted under Recommendations.

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1 INTRODUCTION

SLI Compliance is submitting this test report as a summary of the certification testing efforts for the **ES&S EVS 6.0.0.0** voting system, as detailed in the section System Identification. The purpose of this document is to provide an overview of the certification testing effort and the findings of the testing effort for the **ES&S EVS 6.0.0.0** voting system.

This effort included documentation review of the Technical Data Package, source code review, and testing of the **ES&S EVS 6.0.0.0** voting system. Testing consisted of the development of a test plan, managing system configurations, component and system level tests prepared by SLI, and analysis of results. The review and testing was performed at SLI's Denver, Colorado facility.

1.1 Certification Test Report Attachments

The following attachments apply to this Certification Test Report:

- Attachment A – ES&S EVS6000 Attestation Letter
- Attachment B – ES&S EVS6000 Trusted Build Record
- Attachment C1-11 – ES&S EVS6000 PCA Summary
- Attachment D - ES&S EVSSYS_6'0'0'0_DocumentationListing
- Attachment E – ES&S EVS6000 Implementation Statement
- Attachment F – List of Source Code Reviewed and Results
- Attachment G – ES&S EVS6000 Validations
- Attachment H1-H2 – Accredited Hardware Test Lab Certification
 - Attachment H1 - Elec_NTS_Longmont_A2LA_0214-43_053118
 - Attachment H2 - ENV_NTS_Longmont_A2LA_0214-44_053118
- Attachment I1-I4 – Hardware Test Plans
 - Attachment I1 - ES&S EV6000 Electrical Hardware Test Plan v2.4
 - Attachment I2 - ES&S EV6000 Environmental Hardware Test Plan v2.3
 - Attachment I3 - ES&S EVS6000 ExpressVote 2.1.2.0 ELEC. HW Test Plan v1.0
 - Attachment I4 - ES&S EVS6000 ExpressVote 2.1.2.0 ENV. HW Test Plan v1.0
- Attachment J1-J3 – Hardware Testing Results from Hardware Test Laboratories
 - Attachment J1 – ES&S EVS6000 Emissions Reports.zip
 - Attachment J2 – ES&S EVS6000 Immunity Reports.zip
 - Attachment J3 – ES&S EVS6000 Environmental Reports.zip

- Attachment K - ES&S EVS6000 Safety Reports.zip
- Attachment L – ES&S EVS6000 As Run Test Plan

1.2 References

The following key documents were used in preparing this test plan.

1. Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG), Version 1.0 Volumes I and II.
2. NIST Handbook 150: 2016.
3. NIST Handbook 150-22: 2017.
4. EAC Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 2.0, May 2015
5. SLI VSTL Quality System Manual, 2.3, prepared by SLI, dated January 20, 2017.

1.3 System Identification

This section provides a description of the scope of **ES&S EVS 6.0.0.0** voting system and components.

The **ES&S EVS 6.0.0.0** voting system is composed of software applications, central count location devices and polling place devices with accompanying firmware, and COTS hardware and software.

In addition to the voting system components, this documentation references ancillary products that are not required to be part of the certified system; however, these components were used to facilitate testing and demonstrate system interoperability.

1.3.1 Electionware®

Electionware election management software is an end-to-end election management software application that provides election definition creation, ballot formation, equipment configuration, result consolidation, adjudication and report creation. **Electionware** is composed of five software groups: Define, Design, Deliver, Results and Manage.

1.3.2 ExpressVote XL™

ExpressVote XL is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit.

1.3.3 ExpressTouch®

ExpressTouch Electronic Universal Voting System (ExpressTouch) is a DRE voting system which supports electronic vote capture for all individuals at the polling place.

1.3.4 ExpressVote® Hardware 1.0

ExpressVote Universal Voting System Hardware 1.0 (ExpressVote HW1.0) is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, to be scanned for tabulation in any one of the ES&S precinct or central tabulators.

1.3.5 ExpressVote® Hardware 2.1

ExpressVote Universal Voting System Hardware 2.1 (ExpressVote HW2.1) is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit. **ExpressVote HW2.1** is capable of operating in either marker or tabulator mode.

1.3.6 DS200®

DS200 is a polling place paper-based voting system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR).

1.3.7 DS450®

DS450 is a high-throughput central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR).

1.3.8 DS850®

DS850 is a high-speed central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR).

1.3.9 Event Log Service (ELS)

Event Log Service (ELS) monitors and logs users' interactions with the Election Management System. Events that happen when a connection to the database is not available are logged to the Windows Operating System log through the **ELS**.

1.3.10 Removable Media Service (RMS)

Removable Media Service (RMS) is a utility that runs in the background of the Windows operating system. RMS reads specific information from any attached USB devices so that **ES&S** applications such as **Electionware** can use that information for media validation purposes.

1.4 Configurations

The **ES&S EVS 6.0.0.0** voting system is composed of the components detailed in section “System Overview”.

Within the scope of the **ES&S EVS 6.0.0.0** voting system, three unique configurations are supported, in order to accommodate limitations of components with the **ES&S EVS 6.0.0.0** voting system.

1.4.1 Test Configuration A

ES&S EVS 6.0.0.0: Test Configuration A encompasses all functionality of the voting system with the exceptions noted below. This configuration is comprised of the entire suite of voting system products listed in the “System Overview” section listed below.

Included configuration:

- Electionware
- ExpressVote Marker (HW 1.0)
- ExpressVote Marker/Tabulator (HW 2.1)
- ExpressVote XL
- ExpressTouch
- DS200
- DS450
- DS850

Excluded hardware:

- None

Excluded functionality:

- Open Primary
- Reviewer or Judges Initials boxes
- Multi-card ballot support
- Massachusetts Group Vote
- Universal Primary Contest
- Multiple Target Cross Endorsement
- Punjabi and Gujarati foreign language support

1.4.2 Test Configuration B

ES&S EVS 6.0.0.0: Test Configuration B encompasses all functionality of the voting system with the exceptions noted below. This configuration is comprised of the entire suite of voting system products listed in the “System Overview” section, with the exceptions noted below.

Included configuration:

- Electionware
- ExpressVote Marker (HW 1.0)
- ExpressVote Marker/Tabulator (HW 2.1)
- DS200
- DS450
- DS850

Excluded hardware:

- ExpressTouch
- ExpressVote XL

Excluded functionality:

- Punjabi and Gujarati foreign language support

1.4.3 Test Configuration C

ES&S EVS 6.0.0.0: Test Configuration C encompasses all functionality of the voting system with the exceptions noted below. This configuration is comprised of a subset of the voting system products with the specific purpose of demonstrating **ES&S EVS 6.0.0.0's** support for the Punjabi and Gujarati foreign languages, which are required for the **ExpressVote XL** system. This configuration only includes **Electionware** and the **ExpressVote XL**.

Included configuration:

- Electionware
- ExpressVote XL

Excluded hardware:

- ExpressVote Marker (HW 1.0)
- ExpressVote Marker/Tabulator (HW 2.1)
- ExpressTouch
- DS200
- DS450
- DS850

Excluded functionality:

- Open Primary
- Reviewer or Judges Initials boxes
- Multi-card ballot support

- Massachusetts Group Vote
- Universal Primary Contest
- Multiple Target Cross Endorsement

1.4.4 Block Diagrams

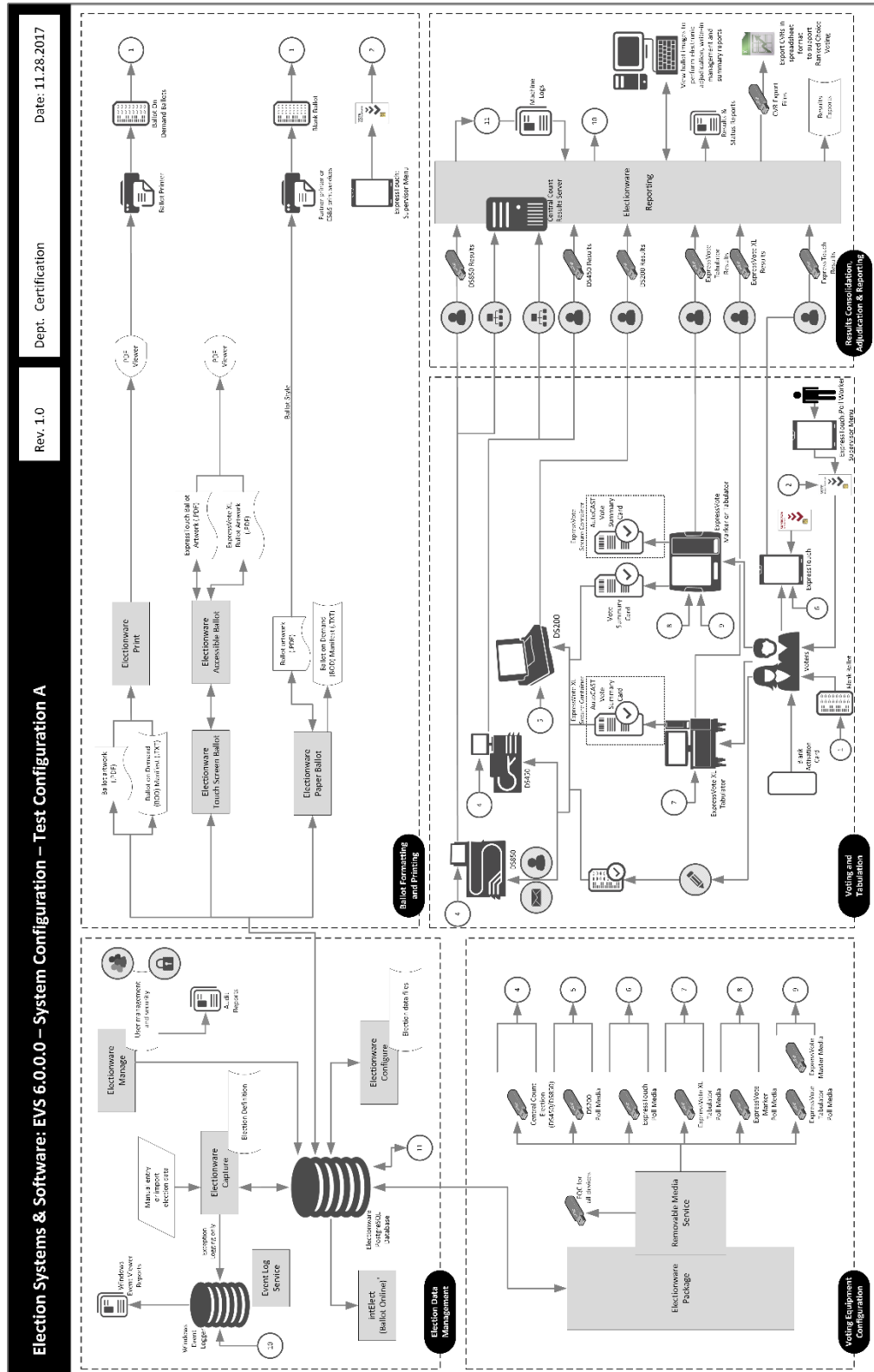


Figure 1: Voting System Overview – Test Configuration A

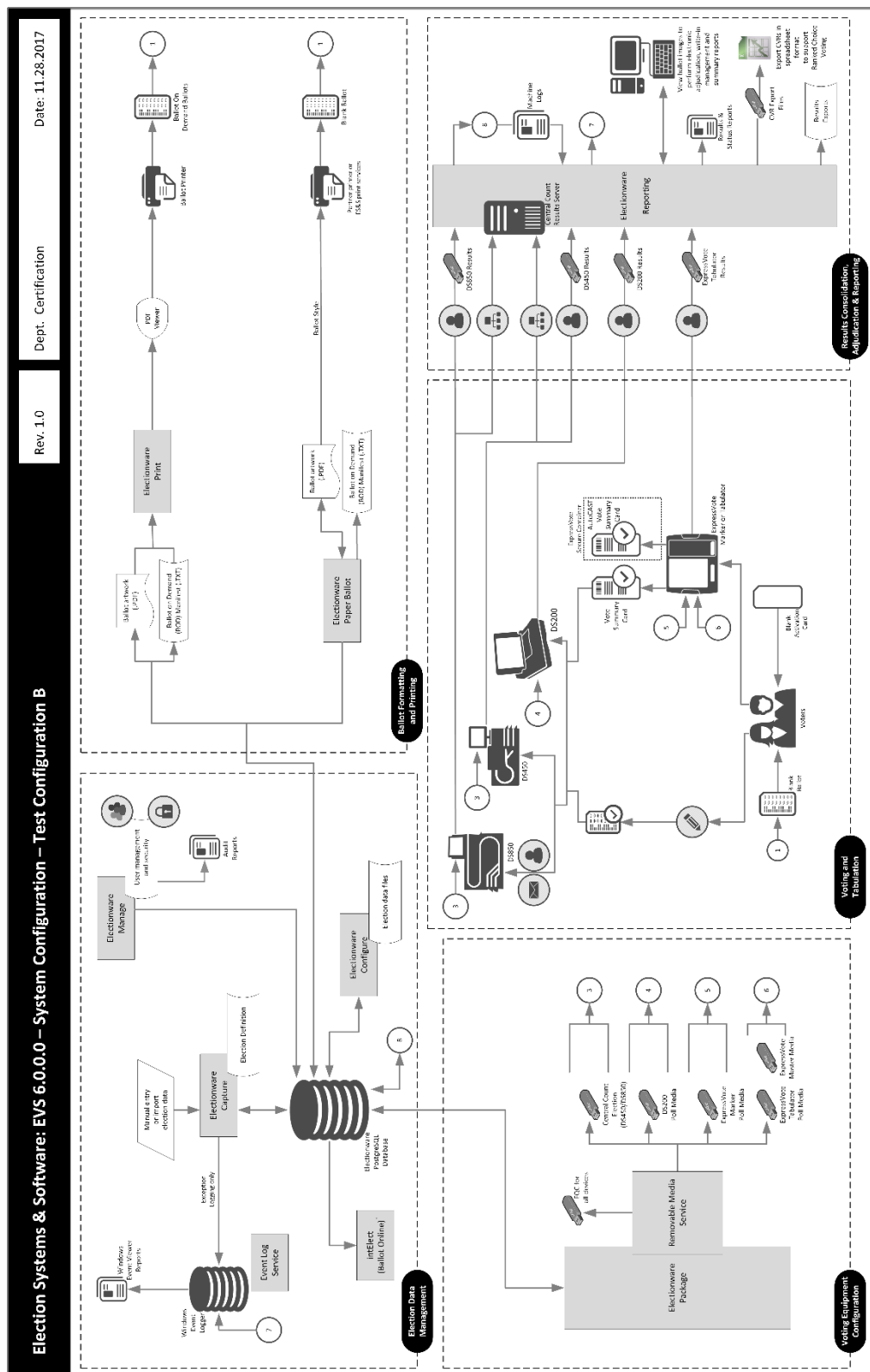


Figure 2: Voting System Overview – Test Configuration B

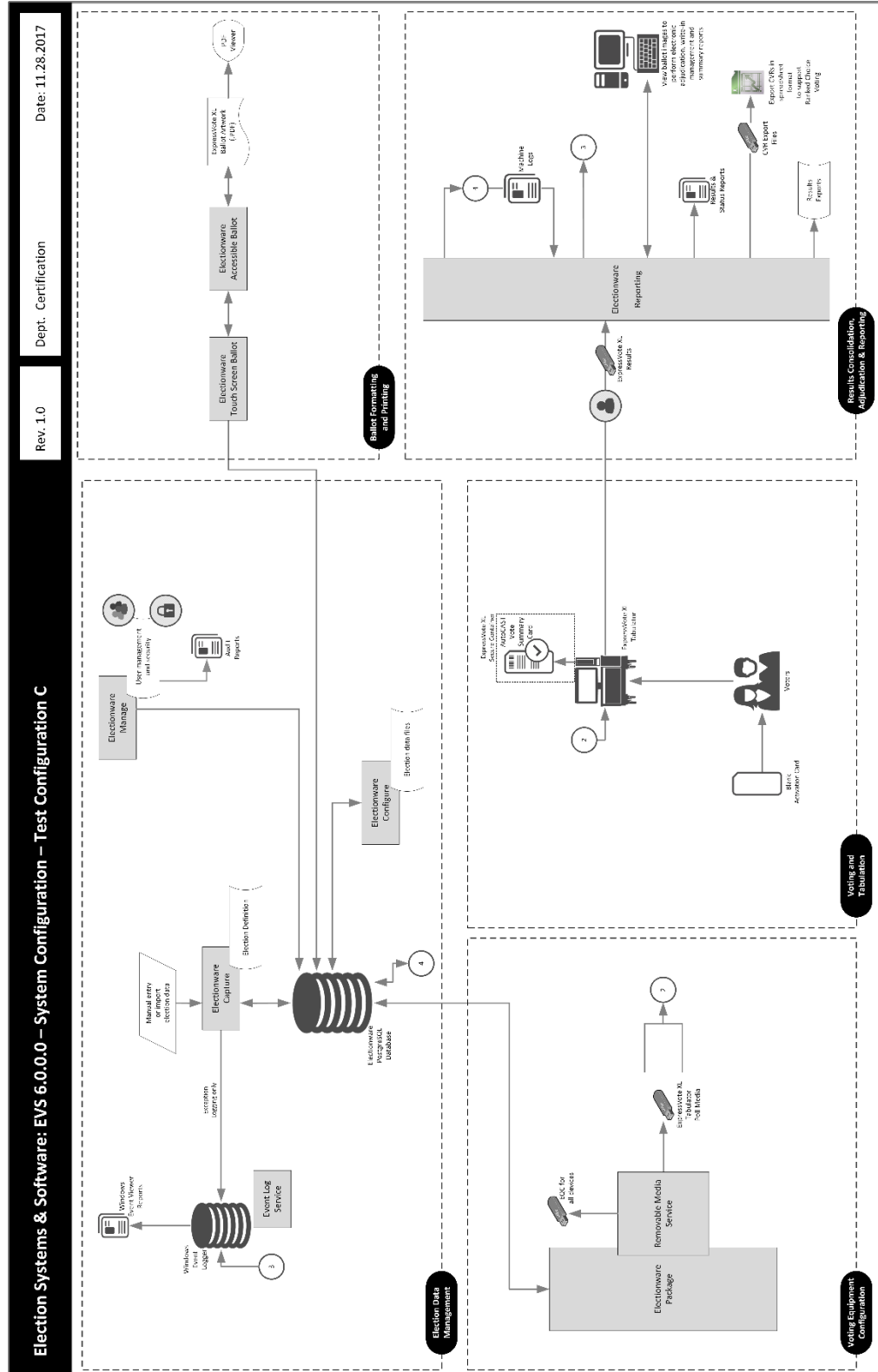


Figure 3: Voting System Overview – Test Configuration C

1.5 Software and Firmware

Any and all software/firmware that is to be used by the declared voting system whether directly or indirectly, in a production environment, must be validated during the certification process.

The software and firmware employed by **ES&S EVS 6.0.0.0** consists of two types, custom and commercial off the shelf (COTS). COTS applications were verified to be pristine, or were subjected to source code review for analysis of any modifications and verification of meeting the pertinent standards.

1.5.1 Manufacturer Software/Firmware

The **ES&S EVS 6.0.0.0** voting system consists of the following software and firmware components:

- **Electionware** Election database creation, media programming and tally/reporting software
- **DS450** Central Tabulator firmware, Central Count scanner and tabulator
- **DS850** Central Tabulator firmware, Central Count scanner and tabulator
- **DS200** Precinct Tabulator firmware, Precinct scanner and tabulator
- **ExpressVote HW1.0** Universal Voting System (UVS) firmware, Precinct Universal Voting System as a marker
- **ExpressVote HW2.1** UVS firmware, Precinct Universal Voting System as a marker and/or tabulator
- **ExpressVote HW1.0 Previewer** ballot preview software
- **ExpressVote HW2.1 Previewer** ballot preview software
- **ExpressVote XL** UVS firmware, Precinct Universal Voting System and tabulator
- **ExpressTouch** Electronic Universal Voting System firmware, Precinct Universal Voting System
- **ELS** software service monitoring user's interactions with the Election Management System
- **RMS** software service supporting election media programming

Table 4 – ES&S EVS 6.0.0.0 Software/Firmware

Application	Version
Electionware – Client/Server	5.0.0.0
Event Log Service	1.6.0.0
Removable Media Service	1.5.0.0
ExpressVote HW1.0	1.5.0.0
ExpressVote HW1.0 Previewer	1.5.0.0
ExpressVote HW2.1	2.4.0.0
ExpressVote HW2.1 Previewer	2.4.0.0

Application	Version
DS200	2.17.0.0
DS850	3.1.0.0
DS450	3.1.0.0
ExpressVote XL	1.0.0.0
ExpressTouch	1.0.0.0

1.5.2 COTS Software/Firmware

This section details the COTS software and firmware utilized within the **ES&S EVS 6.0.0.0** voting system.

Table 5 – COTS Software/Firmware

Manufacturer	Application	Version
Microsoft Corporation	Window 7 Professional	SP-1 (64-bit)
Microsoft Corporation	Windows Server 2008	R2, SP-1 (64-bit)
Microsoft Corporation	WSUS Microsoft Windows Offline Update Utility	11.1.1
Symantec	Symantec Endpoint Protection	14.0.1 (64-bit)
Symantec	Symantec Endpoint Protection Intelligent Updater (File-Based Protection)	20180116-002-core3sds5i64.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Network-Based Protection)	20180115-040-IPS_IU_SEP_14RU1.exe
Symantec	Symantec Endpoint Protection Intelligent Updater (Behavior-Based Protection)	20180108-003-SONAR_IU_SEP.exe
Cerberus	Cerberus FTP Server – Enterprise	9.0.3.1 (64-bit)
Adobe	Adobe Acrobat Standard	XI
Microsoft Corporation	Visual C++ Redistributable	vc_redist.x86.exe (86-bit)

1.6 Equipment

The following equipment is required for the execution of the hardware, software, telecommunications, and security tests. This includes system hardware, general purpose data processing and communications equipment, and any test instrumentation required.

1.6.1 ES&S EVS 6.0.0.0 Equipment

The following manufacturer equipment was used in testing:

Table 6 – ES&S EVS 6.0.0.0 Equipment

Hardware	HW Revision	Model
ExpressVote Universal Voting System	1.0	N/A
ExpressVote Universal Voting System	2.1, 2.1.2	N/A
DS200 Precinct-based Scanner and Tabulator	1.2, 1.3	N/A
DS450 High-Throughput Scanner and Tabulator	1.0	N/A
DS850 High-Speed Scanner and Tabulator	1.0	N/A
ExpressVote XL Full-Faced Universal Voting System	1.0	N/A
ExpressTouch Electronic Universal Voting System	1.0	N/A
ExpressVote Rolling Kiosk	1.0	98-00049
ExpressVote Voting Booth	N/A	87001
ExpressVote Single Table	N/A	87033
ExpressVote Double Table	N/A	87032
ExpressVote ADA Table	N/A	87031
DS200 Collapsible Ballot Box	1.0	98-00009
DS200 Plastic Ballot Box	1.2, 1.3, 1.4, 1.5	57521
DS200 Metal Ballot Box	1.0, 1.1, 1.2	76245
DS200 Tote Bin	1.0	00074
DS450 Cart	N/A	3002
DS850 Cart	N/A	6823
Universal Voting Console	1.0	98-00077
Tabletop Easel	N/A	14040
ExpressTouch Voting Booth	N/A	98-00081

COTS Equipment

The following COTS equipment was used in testing:

Table 7 – COTS Equipment

Manufacturer	Hardware	Model	Operating System
Innodisk	USB EDC H 2SE (1GB)	DEEUH 1-01GI72AC1SB (for ExpressVote HW1.0)	N/A
Innodisk	USB EDC H 2SE (16GB)	DEUH1-16GI72AC1SB (for ExpressVote HW2.1)	N/A
Delkin Devices	USB Embedded 2.0 Module (16GB)	MY16MGFSY-RA000-D	N/A
Symbol	Scanner (External)	DS9208	N/A
Zebra Technologies	Scanner (Integrated)	DS457-SR20009	N/A
OKI	Audit Printer	Microline 420	N/A
Dell	Report Printer	S2810dn	N/A

Manufacturer	Hardware	Model	Operating System
OKI	Report Printer	B431DN B431D	N/A
Tripp Lite	Spike Cube	SPIKECUBE	N/A
APC	Backup power supply (Uninterruptible Power Supply)	Back-UPS Pro 1500 Back-UPS RS 1500	N/A
Various (EMS Networked or Standalone configuration)	• Processor: Dual Core • RAM: 4 GB, 8 GB recommended • Hard Disk: 150 GB • Keyboard • Mouse • Monitor: 1280x800 resolution • Monitor – ExpressVote XL (Monitor needed for programming election for ExpressVote XL) 1920x1080p resolution • CD/DVD reader: 16x min • 2 USB ports: 2.0 min • Report Printer: w/printer control language driver	N/A	Windows 7 Professional, SP-1 (64-bit)
Various (EMS Networked server configuration)	• Processor: Dual Core or Quad Core • RAM: 4 GB, 8 GB recommended • Hard Disk: 150 GB or 320 GB • Keyboard • Mouse • Monitor: 1280x800 resolution • Monitor – ExpressVote XL (Monitor needed for programming election for ExpressVote XL) 1920x1080p resolution • CD/DVD reader: 16x min • 2 USB ports: 2.0 min • Report Printer: Network		Windows Server 2008 R2, SP-1 (64-bit)

Manufacturer	Hardware	Model	Operating System
	printer w/printer control language driver • Ethernet Port • Backup power supply: 865 Watts / 1500 VA output capacity • Network Switch: 1 GB throughput		
Delkin	USB Flash Drive: 512 MB, 1 GB, 2 GB, 4 GB, 8 GB	N/A	N/A
AVID	Headphones	86002	N/A
Seiko Instruments	Thermal Printer	LTPD-347B	N/A
NCR / Nashua	Paper Roll	2320	N/A
Delkin	Compact Flash Memory Card: 1 GB max	N/A	N/A
Delkin	Compact Flash Memory Card Reader/Writer	6381	N/A
Delkin	CFAST Card, 2GB, 4GB	N/A	N/A
Lexar	CFAST Card Reader/Writer	LRWCR1TBNA	N/A
CardLogix	Smart Card	CLXSU128KC7 / AED C7	N/A
SCM Microsystems	Smart Card Writer	SCR3310	N/A
Fujitsu	Thermal Printer	FTP-62GDSL001FTP-63GMCL153	N/A

1.7 Test Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, test ballot cards and control cards, standard and optional output data report formats, and any other materials used in testing.

- Ballots and blank ballot grade paper
- Activation cards
- Smart cards
- Ballot pens
- Printer paper rolls

1.8 ES&S EVS 6.0.0.0 Documentation

The documents that are a part of the **ES&S EVS 6.0.0.0** voting system are detailed in “Attachment D – Documentation Listing”, with listings of Full listing, Configuration A listing, Configuration B listing and Configuration C listing.

2 Certification Test Background

This section provides a brief overview of the EAC Certification Program and the activities involved in order for a voting system to be considered for certification against the EAC VVSG and the EAC program manual.

2.1 Revision History

Please see the Revision History on pg. 2.

2.2 Implementation Statement

The **ES&S EVS 6.0.0.0** voting system incorporates all software and hardware, as well as supporting documentation, as declared in the **ES&S's** implementation statement, as provided to the EAC.

2.3 Terms and Abbreviations

The following terms and abbreviations will be used throughout this document:

Table 1 – Terms and Abbreviations

Term	Abbreviation	Description
American Association for Laboratory Accreditation	A2LA	A nonprofit, non-governmental, public service, membership society whose mission is to provide comprehensive services in laboratory accreditation and laboratory-related training.
Ballot Marking Device	BMD	An accessible computer-based voting system that produces a marked ballot (usually paper) that is the result of voter interaction with visual or audio prompts.
Cast Vote Record	CVR	Permanent record of all votes produced by a single voter whether in electronic, paper or other form. Also referred to as ballot image when used to refer to electronic ballots.
Central Count Scanner	CCS	High Speed Optical Scanner is a mark sense-based ballot and vote counting device typically located at a central count facility and is operated by an automated multi-sheet feeding capability.
Compact Flash card	CF	This is a type of flash memory card in a standardized enclosure often used in voting systems to store ballot and/or vote results data.

Term	Abbreviation	Description
Commercial Off the Shelf	COTS	Term used to designate computer software, hardware or accessories that are ready-made and available for sale, lease, or license to the general public.
Direct Recording Electronic	DRE	Voting systems that, using touch screen or other user interfaces, directly record the voter's selections in each race or contest on the ballot in electronic form.
Election Assistance Commission	EAC	An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program.
Election Management System	EMS	Typically a database management system used to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to layout the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Electromagnetic Compatibility	EMC	The goal of EMC is to validate the correct functioning of different equipment in the same environment and the avoidance of any interference effects between them.
Functional Configuration Audit	FCA	The testing activities associated with the functional testing of the system.
National Institute of Standards and Technology	NIST	A non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
National Voluntary Laboratory Accreditation Program	NVLAP	A division of NIST that provides third-party accreditation to testing and calibration laboratories.
Physical Configuration Audit	PCA	Confirms that the documentation submitted meets the national certification requirements. Includes Trusted Build activities.
Precinct Count Scanner	PCS	A precinct-count optical scanner is a mark sense-based ballot and vote counting device located at a precinct and is typically operated by scanning one ballot at a time.

Term	Abbreviation	Description
Request For Information	RFI	A means used by testing laboratories and manufacturers to request that the EAC provide an interpretation of a technical issue related to testing of voting systems.
Technical Data Package	TDP	The data package supplied by the vendor, which includes Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of a voting system.
Universal Voting System	UVS	A device designed for all voters.
Voluntary Voting System Guidelines	VVSG	A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all of the basic functionality, accessibility and security capabilities required for EAC certification.
Voting System Test Lab	VSTL	An independent testing organization accredited by NVLAP and the EAC to conduct voting system testing for EAC certification.
Voting Test Specialist	VTs	An SLI employee within the Compliance division who has been qualified to perform EAC voting system certification testing.

2.4 PCA - Document and Source Code Reviews

The Physical Configuration Audit (PCA) review of the **ES&S EVS 6.0.0.0** voting system documentation, submitted in the requisite Technical Data Package (TDP), was performed in order to verify conformance with the Election Assistance Commission Voluntary Voting System Guidelines 1.0 (EAC VVSG 1.0). Source code was reviewed for each software and firmware application declared within the **ES&S EVS 6.0.0.0** voting system.

All PCA reviews were conducted in accordance with *Volume 2 Section 2* of the EAC VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA documentation review can be found in section 5.2 of this Certification Test Report. Inconsistencies or errors in documentation were identified to **ES&S** for resolution or comment. Additional details of the PCA documentation review can be found in “Attachments F1-11”.

All PCA source code reviews were conducted in accordance with *Volume 1 Section 5.2 and Volume 2 Section 5* of the EAC VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA source code reviews can be found in “Attachment G – List of Source Code Reviewed and Results”. Inconsistencies or errors in the source code were identified to **ES&S** for resolution.

2.5 FCA - Functional & System Testing and Sampling

The Functional Configuration Audit (FCA) review of the test documentation submitted by **ES&S** in the TDP was executed in order to verify testing of the voting system requirements defined in *Volume 1 Sections 2, 6, 7, and 9* of the EAC VVSG 1.0.

SLI's standard Test Suites were customized for the **ES&S EVS 6.0.0.0** voting system and conducted in accordance with *Volume 2 Section 6*, in conjunction with the functional testing. Simulations of elections were conducted to demonstrate a beginning-to-end business use case process for the **ES&S EVS 6.0.0.0** voting system.

2.5.1 Test Methods

All test methods employed are within the scope of SLI's VSTL accreditation.

The following validated test methods were employed during this test campaign:

Table 2 – Test Methods

SLI VSTL Test Method Name
TM_Accessibility v1.0.doc
TM_Accuracy v1.1.doc
TM_Audit_Record_Data v1.0.doc
TM_Ballot_and_Program_Installation_and_Control v1.0.doc
TM_Ballot_Box v1.1.doc
TM_Ballot_Counter v1.0.doc
TM_Ballot_Formatting_and_Production v1.0.doc
TM_Ballot_Rotation v 1.0.doc
TM_Basic_Election_Components v1.0.doc
TM_Blanket_Open_Primary_Creation v 1.0.doc
TM_Closed_Primary_Election_Creation v 1.0.doc
TM_Closing_the_Polls v 1.0.doc
TM_Error Message and Recovery v1.2.doc
TM_HW_Integrity v1.0.doc
TM_Maintainability v1.0.doc
TM_Non-Partisan v1.0.doc
TM_Partisan Offices v1.0.doc
TM_Performance v1.0.doc
TM_Pre-Voting_Capabilities v1.0.doc
TM_Provisional or Challenged Ballots v1.0.doc
TM_Ranked_Order_Voting v1.0.doc
TM_Readiness v1.0.doc
TM_Security_Access_Control v1.0.doc
TM_Security_Access_Control_Measures v1.0.doc
TM_Security_Physical_Security_Measures v1.0.doc
TM_Security_Software_Security v1.0.doc

SLI VSTL Test Method Name
TM_Split_Precincts v1.0.doc
TM_Standard Open Primary Creation v1.0.doc
TM_Straight_Party_Voting v1.0.doc
TM_Stress v1.0.doc
TM_System_Audit v1.0.doc
TM_Tally_and_Reporting v1.0.doc
TM_Usability v1.1.doc
TM_Volume v1.0.doc
TM_Vote_for_N_of_M v1.0.doc
TM_Voting_Ballot_Rotation v1.0.doc
TM_Voting_Capabilities v1 1.doc
TM_Voting_Non-Partisan v1.0.doc
TM_Voting_Partisan_Offices v1.0.doc
TM_Voting_Precincts_and_Districts v1.0.doc
TM_Voting_Straight_Party v1.0.doc
TM_Voting_Vote_for_N_of_M v1.0.doc
TM_Voting_Write-In v1.0.doc
TM_Write-In v1.0.doc

The above listed test methods are implemented in a complementary fashion: modules are employed from various methods to form suites. Suites include a logical sequence of functionality that is used to validate the requirement addressed by each module within the suite. Please see the Terms and Abbreviations table for additional information about Test Modules and Test Suites.

2.5.1.1 Deviations from, additions to, or exclusions from the test methods

There were no deviations from, additions to, or exclusions from any of the test methods used in this certification test campaign.

2.5.2 Sampling of Manufacturer tests

SLI selected a subset of the **ES&S EVS 6.0.0.0** functionality for verification of **ES&S's** internal functional test execution. SLI performed a sampling of the **ES&S** internally implemented test cases.

2.5.2.1 3rd Party Hardware Testing

Hardware testing was conducted by 3rd Party certified hardware test laboratories to verify the voting system devices are in compliance with the EAC VVSG 1.0 hardware requirements.

Other Labs Performing Non-Core Hardware Testing

SLI Compliance is responsible for all core voting system tests as identified in the NIST NVLAP Handbook 150-22 (2017). Regarding non-core hardware testing for this

certification test campaign, this report contains data that were produced under subcontract by the following lab(s):

Table 3 – Labs Performing Hardware Testing

Laboratory	Address	Test(s)	Date(s)
NTS – EMI / EMC	1736 Vista View Drive Longmont, CO 80504	<u>EMC / EMI Tests:</u> Radiated Emissions, Conducted Emissions, ESD, Electromagnetic Susceptibility, Electrical Fast Transient, Lightning Surge, Conducted RF Immunity, Magnetic Fields Immunity, Electrical Power Disturbance	7/7/2017 – 9/12/2017 3/6/18 – 3/20/18
NTS – Environmental / Dynamic	1601 Dry Creek Drive Suite 200 Longmont, CO 80503	<u>MIL-STD-810D Tests:</u> Bench Handling, Vibration, Low Temperature, High Temperature, Humidity, Temperature/Power Variation, and Reliability	7/7/2017 – 1/19/2018 3/5/18 – 3/30/18

3 Certification Test Results Summary

3.1 Source Code Review Summary

SLI has reviewed the software source code for each application in the **ES&S EVS 6.0.0.0** voting system to determine the code's compliance with the EAC VVSG 1.0, Volume 1 Sections 5, 9 and Volume 2 Section 5.4 and for compliance with **ES&S's** internally developed coding standards. **ES&S EVS 6.0.0.0** is implemented with the C, C++, C#, Java, VB and VB.net languages. Results of the source code review are detailed in "Attachment G – List of Source Code Reviewed and Results".

The review was conducted for:

- **Software Integrity:** The module contains no self-modifying code. Software remains unchanged and retains its integrity. The module has defined array dimensions, which are positive constant integers (pointer variables, dynamic memory allocation and management are not applicable to Visual Basic.)
- **Modularity:** The modules have a specific testable function; performing a single function; is uniquely named; follows a standard format, has a single entry point; has a single exit point (or deviates in an acceptable manner); has error handling; and acceptable module size.

- **Control Constructs:** Logic flow utilizes standard constructs of the development language used; constructs are used consistently throughout the code; logic structure is not overly complex, and acceptable use of error handlers.
- **Naming Conventions:** Variable and Function names that clearly define the purpose of the variable or function. Use of standard notation for variables by type. Use of names that are unique for both global and local variables. Use of names that are unique for functions (except where it deviates in an accepted manner).
- **Coding Conventions:** Use of a standard methodology for the construction of a code module. This includes uniform calling sequences, parameter validation, a single executable statement per line, and status or error messages.
- **Comments Conventions:** Comment Header blocks for the module / function follows a standard format in its layout and content. In code comments are clearly delineated and readable.

Evaluation of Source Code

The source code was reviewed for compliance per the guidelines defined in EAC VVSG 1.0 *Volume 2, Section 5.4*. The source code was written adequately in terms of the EAC VVSG 1.0. The code is modular and contains sufficient error handling. Readability is sufficient and supports maintainability.

The assessment is based on the following observations:

- Software Integrity
 - There were no unbounded arrays. This follows the EAC VVSG 1.0 requirements for software integrity.
 - No instances of self-modifying or dynamically loaded code were observed.
- Modularity
 - The code is modular and self-contained.
 - Modules perform only the specified functionality.
 - The requirement of single entry and exit points are complied with.
 - Modules are small enough to facilitate ease of reading and understanding.
- Control Constructs
 - Control Constructs used are in accordance with those allowed by the EAC VVSG 1.0.
 - Loop control constructs have been appropriately chosen for the logical tasks to be accomplished.
 - Modules have fewer than 6 levels of indented scope.
 - Array boundaries are checked.
- Naming Conventions

- Function and variable names are in accordance with the requirements of the EAC VVSG 1.0.
 - Names differ by more than a single character and have been chosen as to enhance the readability of the code.
 - There are no instances of language keywords being used as a name for procedures or variables.
- Coding Conventions
 - Coding conventions employed are in compliance with the requirements of the EAC VVSG 1.0.
 - Code is well structured and was written appropriately to the standards.
- Comments
 - Module headers are in compliance with the requirements of the EAC VVSG 1.0.
 - In-line comments are sufficient in number and placement to facilitate a reasonable understanding of the code.
 - Variables have appropriate comments at the point of declaration.
- On the Application level, no more than 50% of the modules can exceed 60 lines, no more than 5% can exceed 120 lines, and none can exceed 240 lines without justification.
 - Functions/modules were within the EAC VVSG 1.0 tolerances.

3.2 Technical Data Package Review Summary

SLI reviewed the **ES&S EVS 6.0.0.0** TDP for compliance with the EAC VVSG 1.0 according to *Volume 2 Section 2*.

The review was conducted for the required content and format of:

- **System Overview:** System description and performance are adequately described.
- **System Functionality Description:** System functional processing capabilities, encompassing capabilities required by the Standards and any additional capabilities provided by the system, including a simple description of each capability.
- **System Hardware Specification:** System hardware characteristics, design and construction.
- **Software Design and Specification:** Purpose and scope, applicable documents, software overview, software standards and conventions, software operating environment, software functional specification, programming specifications, system database, interfaces and appendices.

- **System Security Specification:** Access control policy and measures, equipment and data security, software installation, telecommunications and data transmission security, elements of an effective security program.
- **System Test and Verification Specifications:** Development and certification test specifications that **ES&S** applied to their testing efforts.
- **System Operations Procedures:** Operation environment, system installation and test specifications, operational features, operating procedures, operations support.
- **System Maintenance Procedures:** Preventative and corrective maintenance procedures, maintenance equipment, facilities and support.
- **Personnel Deployment and Training Requirements:** Personnel resources and training required to operate and maintain the system.
- **Configuration Management:** Configuration management policy, configuration identification, procedures for baseline, promotion, demotion and configuration control, release process, configuration audits and management resources.
- **Quality Assurance Program:** Quality assurance policy, parts and materials special testing and examination, quality conformance inspections.
- **System Change Notes:** Changes to a previously certified system (N/A).

Evaluation of TDP

Once initially identified discrepancies were resolved, the Technical Data Package for the **ES&S EVS 6.0.0.0** voting system was found to sufficiently comply with the standards such that a jurisdiction would be able appropriately deploy **ES&S EVS 6.0.0.0** voting system.

3.3 Hardware Testing

SLI and their third-party certified hardware test laboratory, National Technical Systems (NTS), performed an analysis and review of the **ES&S EVS 6.0.0.0** voting system hardware components. During execution of testing performed at NTS, an SLI representative was present to oversee the testing.

The test methodologies for all tests are identified in the hardware test plans and hardware test reports, as listed in section 1.1 “Certification Test Report Attachments”.

SLI also conducted a review on the **ES&S EVS 6.0.0.0** Safety Report, no issues were found, all components were found to be compliant.

Hardware testing conducted specifically for this test campaign involved the **ExpressVote HW1.0, ExpressVote HW2.1, ExpressVote HW2.1.2, ExpressVote XL, ExpressTouch, DS200, DS450, and DS850**. The testing involved verification of the following requirements:

- VVSG 1.0 Vol. 1, Section 4 Hardware Requirements
- VVSG 1.0 Vol. 2, Section 4 Hardware Testing
- VVSG 1.0 Vol. 2, 4.6 Non-operating Environmental Tests

- VVSG 1.0 Vol. 2, 4.7.1 Temperature and Power Variation
- VVSG 1.0 Vol. 2, 4.7.3 Reliability

All critical components comply with IEC 61000-4, FCC Part 15 Class B, ANSI C63.4, EAC VVSG 1.0, or relevant component standards.

Operating Mode

Prior to and during testing, proper operation of the Unit Under Test (UUT) was confirmed using ES&S software. An operational status check was performed prior to and after each test to fully exercise the UUT and ensure that no damage occurred because of the test. To fully exercise all the features of each ES&S model, test software was run during electrical tests to exercise the model's hardware features.

During testing, the hardware was exercised via test software as follows:

- **DS200 HW1.2** on steel ballot box - tested all DS200 operations - Tabulation, Reporting
- **DS200 HW1.3** on plastic ballot box - tested all DS200 operations - Tabulation, Reporting
- **DS450 HW1.0** - Tested all functionality of DS450 - Tabulation, Reporting, Audit Log Report
- **DS850 HW1.0** - Tested all functionality of DS850 - Tabulation, Reporting, Audit Log Report
- **ExpressVote HW1.0** - Tested all functionality of ExpressVote - Key pad, Audio, Thermal Printer
- **ExpressVote HW2.1** - Tested all functionality of ExpressVote - Key Pad, Audio, QR barcode scanner, and Thermal Printer.
- **ExpressVote HW2.1** w/external QR barcode scanner - Tested all functionality of ExpressVote - Key Pad, Audio, external QR barcode scanner, and Thermal Printer.
- **ExpressVote XL HW1.0** - Tested all functionality of the ExpressVote XL - Report printer and Universal Voting Console
- **ExpressTouch HW1.0** - Tested all functionality of the ExpressTouch - Report printer and Universal Voting Console

Hardware Test Summary

Based upon an examination of the equipment listed in "Table 7 – COTS Equipment", SLI concluded that the hardware listed is COTS (Commercial off the Shelf). As such, it is not subject to Hardware Testing.

SLI and their third-party certified hardware test laboratory, National Technical Systems (NTS) tested on the non-COTS hardware listed in "Table 6 – ES&S EVS 6.0.0.0 Equipment" and "Table 4 – ES&S EVS 6.0.0.0 Software/Firmware".

The testing consisted of:

- Electromagnetic Emissions / Immunity Tests:
 - Radiated Emissions – FCC, Part 15 Class B ANSI C63.4.
 - Conducted Emissions – FCC, Part 15 Class B ANSI C63.4.
 - ESD – IEC 61000-4-2 (2008) Ed. 2.0.
 - Electromagnetic Susceptibility – IEC 61000-4-3 (1996).
 - Electrical Fast Transient – IEC 61000-4-4 (2004-07) Ed. 2.0.
 - Lightning Surge – IEC 61000-4-5 (1995-02).

- Conducted RF Immunity – IEC 61000-4-6 (1996-04).
- Magnetic Fields Immunity – IEC 61000-4-8 (1993-06).
- Electrical Power Disturbance – IEC 61000-4-11 (1996-06).
- Non-Operating Environmental Tests:
 - Bench Handling - MIL-STD-810D, Method 516.3, Procedure VI
 - Vibration - MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier.
 - Low Temperature - MIL-STD-810D, Methods 502.2, Procedure I-Storage.
 - High Temperature - MIL-STD-810D, Methods 501.2, Procedure I-Storage.
 - Humidity (85%) Soak - MIL-STD-810D, Method 507.2, Procedure I- Natural Hot-Humid.
- Operating Environmental Tests:
 - Temperature/Power Variation - similar to the low temperature and high temperature tests of MIL-STD-810-D, Method 502.2 and Method 501.2.
 - Reliability – Vol. 1, Section 4 for the acceptable Mean Time Between Failure (MTBF).

Evaluation of Hardware Testing

Any critical issues found were reported, resolved and re-tested. Attachments J1-J3 contain the hardware reports from SLI's EAC approved Hardware Test Subcontractor, NTS. These reports detail specific information on the hardware testing. All devices subjected to hardware testing, as listed above, have successfully passed all tests.

The hardware testing conducted specifically for this test campaign involved verification of the following requirements:

- EAC VVSG 1.0 Vol. 1, Section 4 Hardware Requirements
- EAC VVSG 1.0 Vol. 2, Section 4 Hardware Testing

3.4 Functional Testing Summary

SLI performed tests on each of the system configurations identified above. The testing incorporated end-to-end election scenarios testing the functionality supported by **ES&S**.

3.4.1 How each ES&S EVS 6.0.0.0 Component was Tested

Functionality was tested as identified below. The following functional areas exist for the **ES&S EVS 6.0.0.0** voting system.

3.4.1.1 ExpressVote HW1.0

ExpressVote HW1.0 is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast

vote record, to be scanned for tabulation in any one of the ES&S precinct or central tabulators.

ExpressVote HW1.0 was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

ExpressVote HW1.0 was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration B, in several different test suites, where it accepted user input instructions, prior to producing marked vote summary cards that mirror user intent, utilizing all HAVA related options.

ExpressVote HW1.0 was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.2 ExpressVote HW2.1

ExpressVote HW2.1 is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit.

ExpressVote HW2.1 was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

ExpressVote HW2.1 was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration B, in several different test suites, where it accepted user input instructions, prior to producing marked vote summary cards that mirror user intent, utilizing all HAVA related options.

ExpressVote HW2.1 was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.3 DS200

DS200 is a polling place paper-based voting system, specifically a digital scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card for conversion of voter selection marks to electronic Cast Vote Records (CVR).

DS200 was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

DS200 was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration B, in several different test suites, where it accepted user input instructions, utilizing all HAVA related options.

DS200 was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.4 ExpressTouch

ExpressTouch is a DRE voting system which supports electronic vote capture for all individuals at the polling place.

ExpressTouch was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

ExpressTouch was then tested as an integrated piece of the voting system, as applicable to Configuration A, in several different test suites, where it accepted user input instructions, utilizing all HAVA related options.

ExpressTouch was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.5 ExpressVote XL

ExpressVote XL is a hybrid paper-based polling place voting device that provides touch screen vote capture that incorporates the printing of the voter's selections as a cast vote record, and tabulation scanning into a single unit.

ExpressVote XL was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

ExpressVote XL was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration C, in several different test suites, where it accepted user input instructions, prior to producing marked vote summary cards that mirror user intent, utilizing all HAVA related options.

ExpressVote XL was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.6 DS450

DS450 is a central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR).

DS450 was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

DS450 was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration B, in several different test suites, where it accepted user input instructions and processed ballots as expected.

DS450 was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.7 DS850

DS850 is a central scanner and tabulator that simultaneously scans the front and back of a paper ballot and/or vote summary card in any of four orientations for conversion of voter selection marks to electronic Cast Vote Records (CVR).

DS850 was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Electionware** produced media and data. All documented features were tested, and all functional features were verified to be documented.

DS850 was then tested as an integrated piece of the voting system, as applicable to Configuration A and Configuration B, in several different test suites, where it accepted user input instructions and processed ballots as expected.

DS850 was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.1.8 Electionware

Electionware software is an end-to-end election management software application that provides election definition creation, ballot formation, equipment configuration, result consolidation, adjudication and report creation.

Electionware was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All documented features were tested, and all functional features were verified to be documented.

Electionware was then tested as an integrated piece of the voting system, as applicable to Configuration A, Configuration B and Configuration C, in several different test suites, where it output **Electionware** produced media and data, which feed into **ExpressVote HW1.0**, **ExpressVote HW2.1**, **DS200**, **ExpressTouch**, **ExpressVote XL**, **DS450**, **DS850** and **Electionware Reporting**.

Electionware was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

3.4.2 Test Suites Utilized

The following test suites were executed:

3.4.2.1 Electionware – Standalone workstation

All functionality present in **Electionware** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.2 Electionware – Client/Server configuration

Testing of the client/server configuration, for **Electionware**, was the focus of this testing, such that reliability of data consistency was verified in a networked setting.

3.4.2.3 DS450– Standalone workstation

All functionality present in **DS450** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.4 DS450– Client/Server configuration

Testing of the client/server configuration, for **DS450** was the focus of this testing, such that reliability of data consistency was verified.

3.4.2.5 DS850 – Standalone workstation

All functionality present in **DS850** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.6 DS850 – Client/Server configuration

Testing of the client/server configuration, for **DS850** was the focus of this testing, such that reliability of data consistency was verified.

3.4.2.7 Electionware Reporting – Standalone workstation

All functionality present in **Electionware Reporting** was verified to work as documented, and that all functionality is appropriately documented.

3.4.2.8 Reporting – Client/Server configuration

Testing of the client/server configuration, for **Electionware Reporting**, was the focus of this testing, such that reliability of data consistency was verified.

3.4.2.9 DS200

All functionality, including administrative, maintenance as well as Election Day poll worker functionality, present in **DS200** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.10 ExpressTouch

All functionality, including administrative, maintenance as well as Election Day poll worker functionality, present in **ExpressTouch** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.11 ExpressVote HW1.0

All functionality, including administrative, maintenance as well as Election Day poll worker functionality, present in **ExpressVote HW1.0** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.12 ExpressVote HW2.1

All functionality, including administrative, maintenance as well as Election Day poll worker functionality, present in **ExpressVote HW2.1** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.13 ExpressVote XL

All functionality, including administrative, maintenance as well as Election Day poll worker functionality, present in **ExpressVote XL** was verified to work as documented, and all functionality is appropriately documented.

3.4.2.14 GenVariation1

The test focused on validating N of M voting, Partisan offices, Non-Partisan Offices, Straight Party Voting, Ballot Rotations, Ballot Formatting, precincts and districts, and Tally and Reporting functionality.

This test covered **Electionware, ExpressTouch, ExpressVote HW1.0, ExpressVote HW2.1, ExpressVote XL, DS200, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressTouch, ExpressVote XL, ExpressVote HW2.1 and DS200**.

3.4.2.15 GenVariation2

Additional definition is added, with a focus on validating Cross-Party Endorsement, Provisional Ballots, and Write-Ins.

This test covered **Electionware, ExpressTouch, ExpressVote HW1.0, ExpressVote HW2.1, ExpressVote XL, DS200, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressTouch, ExpressVote XL, ExpressVote HW2.1 and DS200**.

3.4.2.16 GenVariation3

Additional definition is added, with a focus on validating the accessibility features of the voting system (for example ATI usage, paddles, sip and puff, audio, visual adjustments), as well as items such as pre-vote capabilities.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressVote HW2.1, ExpressTouch, ExpressVote XL, and DS200**.

3.4.2.17 PriClosed

This suite implemented a Closed primary election definition utilizing four partisan parties.

This test covered **Electionware, ExpressTouch, ExpressVote HW1.0, ExpressVote HW2.1, ExpressVote XL, DS200, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressVote HW2.1, ExpressTouch, ExpressVote XL, and DS200**.

3.4.2.18 PriOpen

This suite implemented an Open Primary election definition utilizing four partisan parties.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressVote HW2.1, and DS200**.

3.4.2.19 Error Recovery

Testing of Error Messaging focused on the appropriate error messages being generated in response to a specific error and content of the message.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.20 Audit

This testing focused on validating the system's ability to provide audit capability throughout the entire voting system, including availability, generation, integrity, and accuracy of the system's audit capability to ensure it meets the necessary requirements.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.21 Access Control Security

Access control testing verified procedures and system capabilities that detect or limit access to system components in order to guard against loss of system integrity, availability, confidentiality, and accountability.

This testing verified that system resources such as data files, application programs and computer-related facilities and equipment are protected against unauthorized operation, modification, disclosure, loss or impairment. Unauthorized operations include modification of compiled or interpreted code, run-time alteration of flow control logic or of data, and abstraction of raw or processed voting data in any form other than a standard output report by an authorized operator.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.22 Software Security

Software security testing was conducted to verify the installation procedures and ongoing foreign software detection mitigation abilities of the voting system in order to protect against the modification of the software and/or the insertion of malicious software during the installation and during ongoing operations.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.23 Physical Security Measures.

Physical security testing verified monitoring and control of the environment of the work place and computing facilities. It also verified monitor and control access to and from such facilities. Separating the network and work place into functional areas also involves physical controls. Some portions of physical security are functional while other portions

are procedural. Functional portions were tested as appropriate while procedural portions were verified to be documented as called out by the EAC VVSG.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.24 Telecommunications and Data Transmission Security

Telecommunications and Data Transmission testing verified that voting systems which use electrical or optical transmission of data, ensure the receipt of valid vote records is verified at the receiving station, such that data integrity remains intact.

This test covered **Electionware, DS450 and DS850** as well as **Electionware Reporting**.

3.4.2.25 Language

Testing was conducted to ensure the voting system is capable of presenting the ballot, ballot selections, review screens and instructions in the required languages. The system's ability to handle the prescribed foreign languages that have been declared to be supported – English, Spanish, Chinese, Korean, Japanese, Hindi, Bengali, Vietnamese, Tagalog, Creole, Russian, French, Punjabi and Gujarati – was validated.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressVote HW2.1, ExpressTouch, ExpressVote XL, and DS200**.

3.4.2.26 Data Retention/HW Integrity

Testing the integrity requirements ensures the physical stability and function of the vote recording and counting processes, such that the system is not prone to a single point of failure that would prevent voting at a polling place. Testing verified prevention of failure of data input or storage, in terms of data retention, as well as confirming that appropriate audit records are maintained without modification. **ES&S** has also provided an attestation that all data is able to be maintained for a minimum of 22 months.

This test covered **Electionware, ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450 and DS850, ExpressVote HW2.1, DS200, ExpressTouch, and ExpressVote XL**.

3.4.2.27 Accessibility

Accessibility requirements for a voting system generally include both objective and observable requirements. In combination, the two types of requirements verify that the voting system components are accessible to as many eligible voters as possible, including those that have a type of challenge that creates a need for assistance of some type. The voting systems should be self-contained such that the individual voter is able to cast their vote without assistance from another party. Accessibility calls for the voting system to take into account vision, varying degrees of vision, dexterity, mobility, aural issues, and speech and language proficiency.

This test covered **ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch and ExpressVote XL**.

3.4.2.28 Maintainability

Maintainability encompasses a range of maintenance actions that examine all scheduled and unscheduled events in place for preventing failures on all hardware devices. Testing verifies the ease with which maintenance actions can be performed based on the design characteristics of the equipment and software. Non-technical election workers are able to be made aware of the problem through the equipment and software's ability to correctly self-diagnose problems.

This test included review of **ES&S** documentation for maintenance actions as well as performance of those maintenance actions for ease of use and understandability.

This test covered **ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch, ExpressVote XL, DS450 and DS850**.

3.4.2.29 Usability

Usability is defined as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks. In the context of voting, the primary user is the voter, the product is the voting system, and the task is the correct recording of the voters' ballot selections. Testing is conducted to ensure voters are able to negotiate the process effectively, efficiently and comfortably according to the requirements dictated.

This test's focus was described above, as well as a review of the report of mandated usability study performed by **ES&S**, as per EAC VVSG 1.0 requirements.

This test covered **ExpressVote HW1.0, ExpressVote HW2.1, DS200, ExpressTouch and ExpressVote XL**.

3.4.2.30 Mark Sensitivity

The purpose of Ballot Mark Sensitivity testing was to determine that the system under test is able to accurately determine when a mark has been made within a ballot marking position. For this test, various marks were made within the ballot marking positions, using **ES&S EVS 6.0.0.0** supported colors of ink (black), as well as non-supported, in order to determine how the system handled unexpected colors.

Marks included fully filled boxes, left and right oriented slashes, "X" markings, check marks, horizontal single line marks, and circles of various sizes. Marks also included vertical lines within the marking position that fill approximately 10 percent of the designated space. Small dots down to approximately five percent of the ballot marking position were also included.

This test covered **DS200, DS450, DS850**, as well as the adjudication algorithm within the **Electionware Results** application. Vote counts were accumulated from **DS450** and **DS850**, and **DS200**.

3.4.2.31 Accuracy

This test focused on the ability of the system to capture, record, store, consolidate and report the specific selections and absence of selections made by the voter for each ballot position without error. Required accuracy is defined in terms of an error rate that for testing purposes represents the maximum number of errors allowed while processing a specified volume of data.

Accuracy testing is conducted at both the device level and the system level.

Each device was subjected to scrutiny to verify that the requirements for accuracy are met. Additionally, the system was reviewed and exercised to validate that the accumulation, tallying and reporting mechanisms at the system level are able to accurately perform their functions.

The **ExpressVote HW1.0** and **ExpressVote HW2.1** were both utilized to mark and print vote summary cards, which were then scanned into an **ExpressVote HW2.1** tabulator, as well as **DS200**, **ExpressVote XL**, **DS450** and **DS850** devices.

This test covered **ExpressVote HW1.0**, **ExpressVote HW2.1**, **DS200**, **ExpressTouch**, **ExpressVote XL**, **DS450** and **DS850** as well as **Electionware Reporting**. Vote counts were accumulated from **DS450** and **DS850**, **ExpressVote HW2.1**, **ExpressTouch**, **ExpressVote XL**, and **DS200**.

The **ExpressVote HW1.0** and **ExpressVote HW2.1** support four activation card sizes:

- 4.5" x 11"
- 4.5" x 14"
- 4.5" x 17"
- 4.5" x 19"

Each card size was exercised in two **ExpressVote HW1.0** and two **ExpressVote HW2.1** devices. Each size contained 250 cards and 2,000 total voting positions per card size. This totaled 2,000 cards with 16,000 voting positions read by **ExpressVote HW1.0** and 2,000 cards with 16,000 voting positions read by **ExpressVote HW2.1**.

The **ExpressVote XL** supports four activation card sizes:

- 4.5" x 11"
- 4.5" x 14"
- 4.5" x 17"
- 4.5" x 19"

Each card size was exercised in two **ExpressVote XL** devices. Each size contained 80 cards with 16 voting positions or 1,280 voting positions per card size. The Logic and Accuracy (L&A) function on each machine was also used to execute a vote one-to-max test pattern for 496 cards or 7,936 voting positions per card size. This totaled 576 cards and 9,216 voting positions per card size or 4,608 cards and 73,728 voting positions read by the **ExpressVote XL**.

Three **ExpressTouch** devices were used for accuracy testing. Each device was exercised with 100 voting sessions and 16 marking positions per voting session or 1,600 marking positions per device. The Logic and Accuracy (L&A) function on each machine was also

used to execute a vote one-to-max test pattern totaling 992 voting sessions and 15,872 marking positions per device. This totaled 1,092 voting sessions and 17,472 marking positions per device or 3,276 voting sessions and 52,416 marking positions read by the **ExpressTouch**.

The **DS200**, **DS450**, and **DS850** support four ballot sizes. Each ballot size was exercised in four **DS200**, two **DS450**, and two **DS850** devices. Each size contained a variable number of markings to achieve a desired striping pattern, according to the table below:

Ballot Size	Ballots	Marking Positions
8.5" x 11"	1,360	432,000
8.5" x 14"	1,054	435,240
8.5" x 17"	850	437,400
8.5" x 19"	782	452,088

This totaled 4,046 ballots and 1,756,728 ballot marking positions read by each the **DS200**, **DS450**, and **DS850**.

3.4.2.32 Volume and Stress Test Suite

Volume and Stress testing consists of testing a system's response when subjected to large quantities of data and transient overload conditions. Experience has shown that large amounts of data can slow a system, or even cause failures and loss of data due to architectural limitations. The testing focused on achieving system limitations stated in documentation, tallying large amounts of data, and verifying how the system operates and handles the data in key areas of functionality within the voting system.

The Volume test covered the **DS200**, **DS450**, and **DS850**.

The **DS200** precinct tabulator expected usage in an election environment is 2,300 ballots per device over the course of a 15-hour continuous period. The test was conducted across two 8-hour days and processed 4,032 ballots per device.

The **DS450** high-throughput central count tabulator expected usage in an election environment is approximately 3,974 11-inch ballots or 2,237 19-inch ballots per hour or approximately 31,792 11-inch ballots or 17,896 19-inch ballots per 8-hour continuous period. The test was conducted across four 8-hour days and processed 100,224 14-inch ballots.

The **DS850** high-speed central count tabulator expected usage in an election environment is approximately 8,640 11-inch ballots or 7,200 19-inch ballots per hour or approximately 69,120 11-inch ballots or 57,600 19-inch ballots per 8-hour continuous period. The test was conducted across four 8-hour days and processed 225,216 14-inch ballots. Results from the **DS850** were networked to the election management system for proper reconciliation.

Stress testing consisted of running various elections on each device that were specifically designed to test stated architectural limitations. Results from each election were processed in the election management system to ensure proper data handling and reconciliation.

Stated architectural limitations that were tested as part of the **Volume and Stress Test Suite** are:

- Maximum precincts in an election (9900)
- Maximum ballot styles in an election (15000)
- Maximum Candidates allowed per election (10000)
- Maximum Contests allowed in an election (10000)
- Maximum number of parties allowed in a General Election (75)
- Maximum number of parties allowed in a Primary Election (30)
- Maximum District Types/Groups in an election (25 arbitrary)
- Maximum Districts of a given type in an election (250 arbitrary)
- Maximum contests allowed per ballot style (500)
- Maximum Reporting Groups in an election (14)
- Maximum candidates allowed per contest (230)
- Maximum "Vote For" per contest (230)
- Maximum ballots per batch (1500)

4 Evaluation of Testing

The above tests were successfully conducted.

Issues were found during functional testing as described in section “4.1 – Discrepancies Found During Testing”. This resulted in a total of seven Compliance Builds and one Trusted Build.

4.1 Discrepancies Found During Testing

Discrepancies found fall into four major categories: Hardware, Documentation, Source Code, and Functional. Hardware discrepancies are issues that occur specifically in the hardware arena, and are usually found during the hardware testing phase. Documentation discrepancies are identified during the PCA documentation review phase and are resolved by updates to the documentation. Source Code discrepancies are identified during source code review and must be fixed in the source code prior to the Trusted Build. Functional discrepancies are issues that occur during functional testing and can be related to any software or firmware within the system. Functional discrepancies often lead to source code modifications, additional source code review and an additional Trusted Build.

All discrepancies identified in source code, documentation, hardware and functionality were corrected prior to the conclusion of the project.

4.1.1 Source Code Discrepancies

Source code review generated 2,210 discrepancies during the review process. Basic formatting and naming convention issues accounted for 1,853 of the issues. Basic construct issues were addressed in 347 of the discrepancies. Issues of a logic nature accounted for 10 of the discrepancies.

All issues were addressed by the Trusted Build

4.1.2 Documentation Discrepancies

124 documentation issues were written during the PCA documentation review phase. The issues centered around two main issues, incorrect information or missing information. In all instances the issues were addressed and resolved prior to the writing of this report.

4.1.3 Functional Discrepancies

Functional testing generated 51 discrepancies.

User interface issues accounted for 26 discrepancies.

System functionality issues accounted for 21 discrepancies.

Physical Security accounted for four discrepancies.

All issues were resolved prior to the final Trusted Build.

4.1.4 Hardware Discrepancies

Three hardware discrepancies were written during this test campaign for issues encountered during hardware testing. **ES&S** appropriately resolved each issue and subsequently passed all hardware tests.

- The first issue was related to a unit that was failing electrostatic discharge due to being subject to a lot of destructive testing. This was remedied by testing a backup unit.
- The second issue was determined to be caused by excessive condensation in a unit during low temperature testing, which passed upon retesting after allowing the unit to dry out appropriately.
- The third issue was related to multi-feed errors during temperature and power variance testing. The issue was fixed by appropriately calibrating sensors in the unit.

4.2 Remaining Discrepancies

There are no remaining unresolved discrepancies against the EAC VVSG requirements.

4.3 Evaluation of Hardware Testing

As this test project was an initial certification campaign, all pertinent hardware components of the **ES&S EVS 6.0.0.0** voting system were evaluated against applicable hardware requirements. Issues found were reported, resolved and re-tested. All devices subjected to hardware testing have successfully passed all tests.

4.4 Evaluation of Source Code Review

In this initial certification test campaign, all non-COTS software was subjected to review. COTS products were validated to be unmodified. Issues found during source code review were reported, resolved and re-reviewed prior to the Trusted Build. All code has successfully passed all reviews.

4.5 Evaluation of Functional Testing

In this initial certification campaign, **ES&S EVS 6.0.0.0** was subjected to all examination for all requirements within EAC VVSG 1.0, minus requirements deemed to be excluded for technologies or functionality not included within the voting system. Issues found were reported, resolved and re-tested. All components of the **ES&S EVS 6.0.0.0** voting system have successfully passed all tests.

5 Recommendations

SLI has successfully completed the testing of the **ES&S EVS 6.0.0.0** voting system. It has been determined that the **ES&S EVS 6.0.0.0** voting system meets the required acceptance criteria of the Election Assistance Commission Voluntary Voting System Guidelines, version 1.0.

This recommendation reflects the opinion of SLI Compliance based on testing scope and results. It is SLI's recommendation based on this testing effort that the EAC grant certification of the **ES&S EVS 6.0.0.0** voting system.

6 APPROVAL SIGNATURES

SLI:



Traci Mapps
VSTL Director
April 12th, 2018

End of Certification Test Report
