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Test Plan for EAC VVSG 1.0 Certification Testing Election Systems & Software (ES&S) Voting System (EVS) 5.4.1.0

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1.0 INTRODUCTION

The purpose of this Test Plan is to document the procedures that Pro V&V, Inc. will follow to perform certification testing during a system modification campaign for the Election Systems and Software (ES&S) Voting System (EVS) 5.4.1.0 to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Prior to submitting the voting system for testing, ES&S submitted an application package to the EAC for certification of the EVS 5.4.1.0. The application was accepted by the EAC and the project was assigned the unique Project Number of EVS5410.

At test conclusion, the results of all testing performed as part of this test campaign will be submitted to the EAC in the form of a national certification test report.

1.1 Description and Overview of EAC Certified System Being Modified

The EAC Certified System that is the baseline for the submitted modification is described in the following subsections. All information presented was derived from the previous Certification Test Report, the EAC Certificate of Conformance and/or the System Overview.

EVS 5.4.1.0 includes the following hardware: ExpressVote Universal Voting System (ExpressVote) hardware 2.1, AutoMARK Voter Assist Terminal (AutoMARK), DS200 precinct-based scanner and tabulator (DS200), and DS850 high-speed central scanner and tabulator (DS850).

The following subsections describe the baselined EVS 5.4.0.0.

ES&S EVS 5.4.0.0 is comprised of the ExpressVote, AutoMARK, DS200, DS850, Electionware Election Management System (Electionware), Election Reporting Manager (ERM), ES&S Event Log Service (ELS), Removable Media Service (RMS), ExpressVote Previewer and VAT Previewer.

- The ExpressVote is a universal vote capture device designed for all voters, with independent voter-verifiable paper record that is digitally scanned for tabulation. This system combines paper-based voting with touch screen technology. The ExpressVote includes a mandatory vote summary screen that requires voters to confirm or revise selections prior to printing the summary of ballot selections using the internal thermal printer. Once printed, ES&S tabulators process the vote summary card. The ExpressVote can serve all voters, including those with special needs, allowing voters to cast ballots autonomously. ES&S has fully integrated the ExpressVote with the existing suite of ES&S voting system products.
- AutoMARK Voter Assist Terminal enables voters who are visually or physically impaired and voters more comfortable reading or hearing instructions and choices in an alternative language to privately mark optical scan ballots. The AutoMARK supports navigation through touchscreen, physical keypad or ADA support peripheral such as a sip and puff device or two position switch.

- DS200 digital scanner and tabulator is a paper ballot tabulator designed for use as a polling place scanner. After the voter makes their selections on their paper ballot, their ballot and/or vote summary card is inserted into the unit for immediate tabulation. Both sides of the ballot are scanned at the same time using a high-resolution image-scanning device that produces ballot images.
- The DS850 is a high-speed, digital scan central ballot tabulator that uses cameras and imaging algorithms to capture voter selections on the front and back of a ballot, evaluate results and then sort ballots into discrete bins without interrupting scanning. A dedicated audit printer generates a continuous event log. Machine level reports are produced from a second, laser printer. The scanner saves voter selections and ballot images to an internal hard disk and exports results to a USB memory stick for processing with ERM.
- Electionware integrates the election administration functionality into a unified application. Its intended use is to define an election and create the resultant media files used by the ExpressVote, DS200, AutoMARK, DS850, and ERM. An integrated ballot viewer allows election officials to view the scanned ballot and captured ballot data side-by-side and produce ballot reports.
- ES&S Event Log Service (ELS) is a Windows Service that runs in the background of any active ES&S Election Management software application to monitor the proper functioning of the Windows Event Viewer. The ELS closes any active ES&S software application if the system detects the improper deactivation of the Windows Event Viewer.
- The ExpressVote Previewer is an application within the EMS program that allows the user to preview audio text and screen layout prior to burning Election Day media for the ExpressVote.
- The VAT Previewer is an application within the EMS program that allows the user to preview audio text and screen layout prior to burning Election Day media for the AutoMARK.
- Removable Media Service (RMS) is an application that runs in the background of the EMS client workstation and supports the installation and removal of election and results media.
- Election Reporting Manager (ERM) generates paper and electronic reports for election workers, candidates, and the media. Jurisdictions can use a separate ERM installation to display updated election totals on a monitor as ballot data is tabulated, and send the results' reports directly to the media outlets. ERM supports accumulation and combination of ballot results data from all ES&S tabulators. Precinct and accumulated total reports provide a means to accommodate candidate and media requests for totals and are available upon demand. High-speed printers are configured as part of the system accumulation/reporting stations PC and related software.

1.8.7 **Baseline Certified System**

The baseline system for this modification is the EVS 5.4.0.0. The tables below describe the certified equipment and firmware versions.

Detailed descriptions of the EVS 5.4.0.0 test campaign are contained in NTS Report No. PR032474-TR-02, Rev. A, which is available for viewing on the EAC’s website at www.eac.gov.

This subsection lists the proprietary and COTS software to be provided by the manufacturer as part of the test campaign.

Table 1-1. EVS 5.4.0.0 EAC Certified System Components

System Component	Software or Firmware Version	Hardware Version	Description
ExpressVote (Marker)	2.1.0.0	2.1	Universal Voting System that combines paper-based voting with touch screen technology. Includes a mandatory vote summary screen that requires voters to confirm or revise selections prior to printing the summary of ballot selections.
ExpressVote (Tabulator)	2.1.0.0	2.1	Universal Voting System that combines paper-based voting with touch screen technology. Includes all functions of the ExpressVote Marker and also provides the optional capability of tabulating printed vote summary cards.
DS200	2.14.0.0	1.2.1, 1.2.3, 1.3	Precinct Digital Scanner that scans voter selections from both sides of the ballot simultaneously
Auto MARK A100	1.8.7.0	1.0	ADA Ballot Marking Device
AutoMARK A200 (SBC 2.0 & 2.5)	1.8.7.0	1.1	ADA Ballot Marking Device
AutoMARK A200	1.8.7.0	1.3	ADA Ballot Marking Device
AutoMARK A300 (SBC 2.0 & 2.5)	1.8.7.0	1.3	ADA Ballot Marking Device
DS850	2.11.0.0	1.0	Central Count Scanner, high-speed
Ballot Box Hardware	---	1.2, 1.3	Plastic ballot box
Ballot Box Hardware	---	1.0, 1.1, 1.2	Metal ballot box with/without diverter
EMS Reporting Workstation	---	Dell OptiPlex 980	Workstation for EMS Reporting
EMS Server	---	Dell PowerEdge T710	Server for EMS
EMS Reporting Laptop	---	Dell Latitude E6410	Laptop for EMS Reporting
DS850 Report Printer	---	Oki B430dn & Oki B431dn	Laser report printer
DS850 Audit Printer	---	Oki Microline 420	Dot Matrix Printer

Table 1-1. EVS 5.4.0.0 System Components (continued)

System Component	Software or Firmware Version	Hardware Version	Description
USB Flash Drive	---	Delkin 512MB	Storage for election and ballot definition
USB Flash Drive	---	Delkin 4GB	Storage for election and ballot definition
USB Flash Drive	---	Delkin 8 GB	Storage for election and ballot definition
USB Flash Drive	---	Delkin 1 GB	Storage for election and ballot definition
USB Flash Drive	---	Delkin 2 GB	Storage for election and ballot definition
USB Flash Drive	---	Delkin 16 GB	Storage for election and ballot definition
Compact Flash	---	Delkin Devices 1.0 GB capacity	Storage for election and ballot definition
Barcode Scanner	---	DS457-SR20009	Barcode scanner manufactured by Zebra
Electionware	4.8.0.0	---	Election management software that provides end-to-end election management activities
Election Reporting Manager (ERM)	8.13.0.0	---	Election results reporting program
Event Log Service (ELS)	1.5.6.0	---	Logs users' interactions with EMS.
Removable Media Service (RMS)	1.4.6.0	---	Utility that runs in the background of the Windows operating system
ExpressVote Previewer	2.1.0.0	---	Application within the EMS program that allows the user to preview audio text and screen layout prior to burning Election Day media for the ExpressVote
VAT Preview	1.8.7.0	---	Application within the EMS program
Adobe Acrobat Standard	11	---	---
Cerberus FTP	8.0.6 (x64)	---	---
Microsoft Server 2008	R2 w/SP1	---	---
Microsoft Windows 7	64-bit/SP1	---	---
WSUS Microsoft Windows Offline Update Utility	10.7.4	---	---
Micro Focus RM/COBOL Runtime	12.06	---	---
Symantec Endpoint Protection	12.1.6	---	---
Symantec Endpoint Protection Intelligent Updater	20160829-002-v5i64	---	---

1.1.2 Description of Modification

The EVS 5.4.1.0 is a modified voting system configuration that includes upgrades to the components of the EVS 5.4.0.0 and introduces a new hardware version for the ExpressVote. EVS 5.4.1.0 adds four new ExpressVote configuration options: Quad Express Cart, MXB ExpressVote Voting Booth, ExpressVote Single Table and ExpressVote Double Table. EVS 5.4.1.0 also: adds a new ADA table configuration for the AutoMARK; provides security upgrades to third-party EMS COTS products; and contains minor enhancements to Electionware and ExpressVote.

The list below includes specific changes between this system and the baseline of the EVS 5.4.0.0:

General

- Security upgrades to third-party EMS COTS products

ExpressVote Universal Voting System

- Introduced new hardware version of the ExpressVote (Hardware 2.1)
 - The new hardware version for the ExpressVote addresses end-of-life components as well as improved manufacturability (ES&S ECO 975)
- Introduced new configuration options for the ExpressVote
 - ExpressVote Single Table: Holds one ExpressVote in place while providing privacy for the voter. The table features a hole for cord management and a privacy screen. With side approach, this table accommodates voters in wheelchairs as well as standing voters
 - ExpressVote Double Table: Holds two ExpressVote units in place while providing privacy for each voter. The table features a hole for cord management and a double privacy screen.
 - MXB ExpressVote Voting Booth: A configurable voting booth solution that accommodates seated voters on one side and standing voters on the other. Each side of this voting booth includes privacy screens
 - Quad Express Cart: A rolling cart with four locking caster wheels. It is capable of holding up to four ExpressVote units in place. Three of the units are positioned for standing voters while the fourth accommodates a seated voter. Each of the four stations on this cart include deployable privacy screens
- Resolved an issue with write-in entries using a two-position switch in multi-language elections
- Resolved an issue where very long candidate text can truncate instead of displaying the entire text string.

AutoMARK

- Introduced new configuration option

- AutoMARK Table: Holds one AutoMARK in place while providing privacy for the voter. The table features a hole for cord management. With side approach, this table accommodates voters in wheelchairs as well as standing voters

Electionware

- Updated audio prompts for enhanced support of ADA voting with a two-position switch
- Updated Users xml export filename
- Updated User Guide

1.1.3 Initial Assessment

An initial assessment on the submitted modifications was performed to determine the scope of testing. Testing from the previous test campaign was used to establish the baseline. Based on the assessment, it was determined the following tasks would be required to verify compliance of the modifications:

- Source Code Review, Compliance Build, Trusted Build, and Build Document Review
- System Level Testing
 - System Integration
 - Accuracy
- Technical Documentation Package (TDP) Review
- Functional Configuration Audit (FCA)
- System Loads & Hardening
- Physical Configuration Audit (PCA)
- Hardware Testing
 - Operating Environmental Testing
 - Non-Operating Environmental Testing
 - Electrical Testing
- Usability & Accessibility Testing

1.1.4 Regression Test

Regression testing for this test campaign will consist of the execution of the System Integration and Accuracy Tests.

1.2 References

- ES&S Engineering Change Order (ECO) No. 975, Rev. D, dated 2/6/2018
- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, “Voting System Performance Guidelines”, and Volume II, “National Certification Testing Guidelines”
- Election Assistance Commission Testing and Certification Program Manual, Version 2.0
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 2.0
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2016 Edition, “NVLAP Procedures and General Requirements (NIST HB 150-2016)”, dated July 2016
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2008 Edition, “Voting System Testing (NIST Handbook 150-22)”, dated May 2008
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Pro V&V, Inc. Quality Assurance Manual, Revision 1.0
- Election Assistance Commission “Approval of Voting System Testing Application Package” letter dated May 6, 2016
- EAC Requests for Interpretation (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)
- NTS Report No. PR032474-TR-02, Rev. A, “Test Report of EAC VVSG 1.0 Certification Testing Performed on Election Systems & Software EVS 5.4.0.0”
- EAC Certificate of Conformance ES&S EVS 5.4.0.0, dated February 24, 2017
- ES&S Technical Data Package (*A listing of the EVS 5.4.1.0 documents submitted for this test campaign is listed in Section 4.6 of this Test Plan*)

1.3 Terms and Abbreviations

This subsection lists terms and abbreviations relevant to the hardware, the software, or this Test Plan.

“ADA” – Americans with Disabilities Act 1990

“BMD” – Ballot Marking Device

“BOD” – Ballot On Demand

“CM” – Configuration Management

“COTS” – Commercial Off-The-Shelf

“EAC” – United States Election Assistance Commission

“ELS” – Election Log Service

“EMS” – Election Management System

“ERM” – Election Reporting Manager

“ES&S” – Election Systems and Software

“FCA” – Functional Configuration Audit

“HAVA” – Help America Vote Act

“ISO” – International Organization for Standardization

“NOC” – Notice of Clarification

“PCA” – Physical Configuration Audit

“QA” – Quality Assurance

“RMS” – Removable Media Service

“RFI” – Request for Interpretation

“TDP” – Technical Data Package

“UPS” – Uninterruptible Power Supply

“UVS” – Universal Voting System

“VAT” – Voting Assist Terminal

“VSTL” – Voting System Test Laboratory

“VVSG” – Voluntary Voting System Guidelines

1.4 Project Schedule

The Project Schedule for the test campaign is located in Appendix A. The dates on the schedule are not firm dates but planned estimates based on the anticipated project work flow.

1.5 Scope of Testing

The scope of testing focused on evaluating the modifications detailed in Section 1.1.2 of this Test Plan. Primarily, these modifications focused on upgrades to the components of the EVS 5.4.0.0 and the introduction of a new hardware version for the ExpressVote.

ES&S submitted an Engineering Change Order (ECO 975) for consideration as part of this test campaign. This ECO addressed end-of-life components for the ExpressVote as well as improved manufacturability.

To evaluate the EVS 5.4.1.0 test requirements, the submitted modifications were evaluated against each section of the EAC VVSG 1.0 to determine the applicable tests to be performed. Based on this assessment, it was determined that multiple areas within the EAC VVSG 1.0 would be evaluated to encompass the required tests.

A breakdown of the areas and associated tests is listed below:

- EAC VVSG 1.0 Volume 1, Section 2: Functional Requirements
 - System Integration Testing
 - Functional Configuration Audit (FCA)
 - Physical Configuration Audit (PCA), including System Loads & Hardening
 - Technical Documentation Package (TDP) Review
 - Accuracy Testing
- EAC VVSG 1.0 Volume 1, Section 3: Usability & Accessibility
 - Usability & Accessibility Testing
 - Technical Documentation Package (TDP) Review
- EAC VVSG 1.0 Volume 1, Section 4: Hardware Requirements
 - Hardware Testing (Non-Operating Environmental Testing, Operating Environmental Testing, and Electrical Hardware Testing)
 - Technical Documentation Package (TDP) Review
- EAC VVSG 1.0 Volume 1, Section 5: Software Requirements
 - Source Code Review, Compliance Build, Trusted Build, and Build Document Review
 - Technical Documentation Package (TDP) Review
 - Functional Configuration Audit (FCA)

1.5.1 Block Diagram

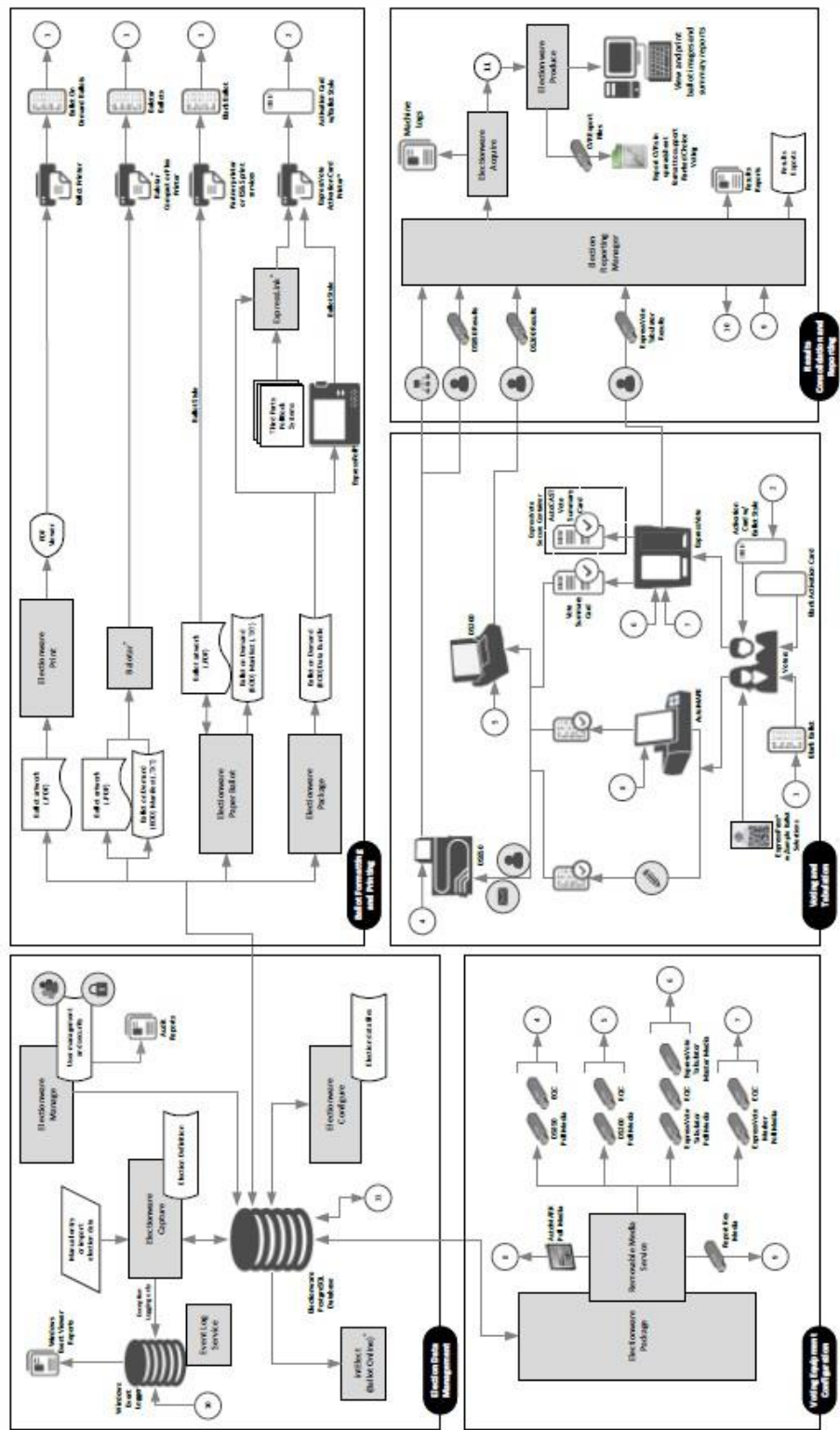


Figure 1-1. EVS 5.4.1.0 System Overview

1.5.2 System Limits

The system limits that ES&S has stated to be supported by the EVS 5.4.1.0 are provided in the table below.

Table 1-2. EVS 5.4.1.0 System Limits

System Characteristic	Boundary or Limitation	Limiting System Component
Max. precincts allowed in an election	At least 9,900	ERM
Max. count for any precinct element	500,000 (99,990 from any tabulator media)	ERM report (ERM results import)
Max. candidates allowed per election	Depends on election content (limited by 21,000 maximum counters)	ERM
Max. contests allowed in an election	Depends on election content (limited by 21,000 maximum counters)	ERM
Max. counters allowed per precinct	Limits candidates and contests assigned to a precinct to 1,000	ERM
Max. contests allowed per ballot style	200 or # of positions on ballot	N/A
Max. candidates (ballot choices) allowed per contest	175	ERM (database create)
Max. number of parties allowed	General election: 75 Primary election: 20 (including nonpartisan party)	ERM (database create)
Max. 'vote for' per contest	98	ERM (database create)
Ballot formats	All paper ballots used in an election must be the same size. Votable paper ballots must contain the same number of rows	Ballot scanning equipment
Max. Ballot Styles	9,900	ERM
Max. District Types/Groups	20	ERM
Max. districts of a given type	40	---

Additionally, the following EVS 5.4.1.0 component limitations have been identified:

Paper Ballot Limitations

1. The paper ballot code channel, which is the series of black boxes that appear between the timing track and ballot contents, limits the number of available ballot variations depending on how a jurisdiction uses this code to differentiate ballots. The code can be used to differentiate ballots using three different fields defined as: Sequence (available codes 1- 16,300), Type (available codes 1-30) or Split (available codes 1-18).

2. For paper ballots, if Sequence is used as a ballot style ID, it must be unique election-wide and the Split code will always be 1. In this case the practical style limit would be 16,300.
3. The ExpressVote activation card has a ballot ID consisting of three different fields defined as: Sequence (available codes 1-16,300), Type (available codes 1-30) or Split (available codes 1-18).

DS200

1. The ES&S DS200 configured for an early vote station does not support precinct level results reporting. An election summary report of tabulated vote totals is supported.
2. The DS200 storage limitation for write-in ballot images is 3,600 images. Each ballot image includes a single ballot face, or one side of one page.
3. Write-in image review requires a minimum 1GB of onboard RAM.
4. To successfully use the write-in report, ballots must span at least three vertical columns. Using two columns or fewer results in the write-in area being too large to print on the report tape.

AutoMARK Voter Assist Terminal

1. ES&S AutoMARK capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting system. For this reason, Election Management System and ballot tabulator limitations define the boundaries and capabilities of the AutoMARK system as the maximum capacities of the ES&S AutoMARK are never approached during testing.

Electionware

1. Electionware capacities exceed the boundaries and limitations documented for ES&S voting equipment and election reporting software. For this reason, ERM and ballot tabulator limitations define the boundaries and capabilities of the Electionware system.
2. Limits were calculated using default text sizes for ballot and report elements. Some uses and conditions, such as magnified ballot views or combining elements on printed media or ballot displays, may result in limits lower than those listed. Check printed media and displays before finalizing the election.
3. The Electionware Export Ballot Images function is limited to 250 districts per export.
4. Electionware supports the language special characters listed in the System Overview. Language special characters other than those on this list may not appear properly when viewed on equipment displays or reports.
5. The Straight Party feature must not be used in conjunction with the single or Multiple Target Cross Endorsement features.

ExpressVote

1. ExpressVote capacities exceed all documented limitations for the ES&S election management, vote tabulation and reporting system.

For this reason, Election Management System and ballot tabulator limitations define the boundaries and capabilities of the ExpressVote system as the maximum capacities of the ES&S ExpressVote are never approached during testing.

Election Reporting Manager (ERM)

1. ERM requires a minimum monitor screen resolution of 800x600.
2. ERM Database Create allows 1600 Precincts per Ballot Style.
3. There is a limit of 3510 precincts in the precincts counted/not counted display.
4. There is a limit of 3000 precincts in the precincts counted/not counted scrolling display.
5. Contest/Precinct selection pop up display limited to 3000 contests/precincts.
6. Non-English characters are not supported in ERM. This has to do with the creation of the XML results file out of ERM.
7. ERM's maximum page size for reports is 5,000 pages.

1.5.3 Supported Languages

The following languages are supported by the EVS 5.4.1.0:

- English
- Spanish
- Chinese
- Korean
- Japanese
- Hindi

Support for all stated languages will be verified; however, only English and Spanish language ballots will be cast during the performance of functional testing. Additionally, one character based language (Chinese) will be tested during System Integration Testing.

1.5.4 Supported Functionality

The EVS 5.4.1.0 is designed to support the following voting variations:

- General Election
- Closed Primary
- Open Primary
- Early Voting
- Partisan/Non-Partisan Offices
- Write-In Voting

- Split Precincts
- Vote for N of M
- Ballot Rotation
- Provisional or Challenged Ballots
- Ranked Order Voting

1.5.5 VVSG

The EVS 5.4.1.0 shall be evaluated against the relevant requirements contained in the EAC VVSG 1.0.

1.5.6 RFIs

There are no RFIs released by the EAC as of the date of this Test Plan that pertain to this test campaign that were not in effect at the time of the baseline system certification.

1.5.7 NOCs

There are no NOCs released by the EAC as of the date of this Test Plan that pertain to this test campaign that were not in effect at the time of the baseline system certification.

2.0 PRE-CERTIFICATION TESTING AND ISSUES

This section describes previous testing performed prior to submitting the voting system to the EAC.

2.1 Evaluation of Prior VSTL Testing

Pro V&V evaluated to the published Final Test Report for the EVS 5.4.0.0 in order to baseline the current system under test.

2.2 Evaluation of Prior Non-VSTL Testing

No prior non-VSTL testing of the EVS 5.4.1.0 modifications were considered for this test campaign.

2.3 Known Field Issues

EVS 5.4.1.0 is a modification to a previously certified system and has not been fielded.

3.0 MATERIALS REQUIRED FOR TESTING

The following sections list all materials needed to enable the test engagement to occur.

The materials required for testing of the EVS 5.4.1.0 include all materials to enable the test campaign to occur. This includes the applicable hardware and software as well as the TDP, test support materials, and deliverable materials, as described in the following subsections.

3.1 Software

This subsection lists the proprietary and COTS software to be provided by the manufacturer as part of the test campaign.

All software required for testing is identified in Section 1.1 of this test plan. Pro V&V will perform a comparison on the submitted source code against the previously certified versions. Pro V&V will review the submitted modified source code to the EAC VVSG 1.0 and the manufacturer-submitted coding standards.

3.2 Equipment

This subsection lists the proprietary and COTS equipment to be provided by the manufacturer as part of the test campaign.

For COTS equipment, every effort will be made to verify that the COTS equipment has not been modified for use. This will be accomplished by performing research using the COTS equipment manufacturer's websites based on the serial numbers and service tag numbers for each piece of equipment. Assigned test personnel will evaluate COTS hardware, system software and communications components for proven performance in commercial applications other than voting. For PCs, laptops, and servers, the service tag information will be compared to the system information found on each machine. Physical external and internal examination will also be performed when the equipment is easily accessible without the possibility of damage. Hard drives, RAM memory, and other components will be examined to verify that the components match the information found on the COTS equipment manufacturer's websites.

All hardware required for testing is identified in Section 1.1 of this test plan.

3.3 Test Materials

This subsection lists the test materials required to execute the required tests throughout the test campaign.

- Ballot on Demand Printer (OKI Data C9650)
- ExpressVote Activation Card Printer (Microcom 4200)
- QR Code Scanner (Zebra DS9208), (DS457-SR20009)
- Security Seals/Locks/Sleeves

- CF Card Reader/Writer
- Headphone Covers
- Ethernet Switch
- Printer Paper
- Ballots and blank ballot grade paper
- Activation cards
- Ballot pens
- CF memory cards
- USB flash drives

3.4 Proprietary Data

All data and documentation considered by the manufacturer to be proprietary will be identified and documented in an independent submission along with a Notice of Protected Information.

4.0 TEST SPECIFICATIONS

Certification testing of EVS 5.4.1.0 submitted for evaluation will be performed to ensure the applicable requirements of the EAC VVSG 1.0 and the EAC Testing and Certification Program Manual, Version 2.0 are met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test will be incorporated in the test campaign. A complete listing of the EAC RFIs and NOCs is available on the EAC website.

4.1 Requirements (Strategy of Evaluation)

To evaluate the EVS 5.4.1.0 test requirements, the submitted modifications were evaluated against each section of the EAC VVSG 1.0 to determine the applicable tests to be performed. Based on this assessment, it was determined the following evaluations would be required to verify compliance of the modifications:

Section 1: Technical Documentation Package (TDP) Review

A TDP Review will be performed to ensure that all submitted modifications are accurately documented and that the documents meet the requirements of the EAC VVSG 1.0. The preliminary TDP is performed to gather information concerning the system under test and its capabilities or design intentions. Additionally, a TDP review will be performed throughout the test campaign. The TDP Review includes the Initial Review, the Regulatory/Compliance Review, and the Final Review. This review is conducted to determine if the submitted technical documentation meets the regulatory, customer-stated, or end-user requirements and includes reviewing the documents for stated functionality and verification.

Section 2: Functional Requirements

The requirements in this section shall be tested during the FCA, Accuracy Test, and System Integration Test. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data.

The FCA targets the specific functionality claimed by the manufacturer to ensure the product functions as documented. This testing uses both positive and negative test data to test the robustness of the system. The FCA encompasses an examination of manufacturer tests, and the conduct of additional tests, to verify that the system hardware and software perform all the functions described in the manufacturer's documentation submitted in the TDP (such as system operations, voter manual, maintenance, and diagnostic testing manuals). It includes a test of system operations in the sequence in which they would normally be performed. These system operations and functional capabilities are categorized as follows by the phase of election activity in which they are required:

- Overall System Capabilities: These functional capabilities apply throughout the election process. They include security, accuracy, integrity, system audit ability, election management system, vote tabulation, ballot counters, telecommunications, and data retention.
- Pre-voting Capabilities: These functional capabilities are used to prepare the voting system for voting. They include ballot preparation, the preparation of election-specific software (including firmware), the production of ballots, the installation of ballots and ballot counting software (including firmware), and system and equipment tests.
- Voting System Capabilities: These functional capabilities include all operations conducted at the polling place by voters and officials including the generation of status messages.
- Post-voting Capabilities: These functional capabilities apply after all votes have been cast. They include closing the polling place; obtaining reports by voting machine, polling place, and precinct; obtaining consolidated reports; and obtaining reports of audit trails.
- Maintenance, Transportation and Storage Capabilities: These capabilities are necessary to maintain, transport, and store voting system equipment.

The system integration testing addresses the integration of the hardware and software. This testing focuses on the compatibility of the voting system software components and subsystems with one another and with other components of the voting system. During test performance, the system is configured as would be for normal field use.

The accuracy test ensures that each component of the voting system can each process 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy test is designed to test the ability of the system to "capture, record, store, consolidate and report" specific selections and absences of a selection. The required accuracy is defined as an error rate. This rate is the maximum number of errors allowed while processing a specified volume of data.

Section 3: Usability and Accessibility Requirements

The requirements in this section shall be tested during the Usability and Accessibility Testing. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data.

The usability testing focuses on the usability of the system being tested. Usability is defined generally 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 voter ballot selections. Additional requirements for task performance are independence and privacy: the voter should normally be able to complete the voting task without assistance from others, and the voter selections should be private. Accessibility evaluates the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B).

Section 4: Hardware Requirements

The hardware tests specified in the VVSG are divided into two categories: non-operating and operating. The non-operating tests apply to the elements of the system that are intended for use at poll site locations and are intended to simulate the storage and transport of equipment between the storage facility and the polling location. The operating tests apply to the entire system, including hardware components that are used as part of the voting system telecommunications capability, and are intended to simulate conditions that the voting system may encounter during operation. Prior to and immediately following each required non-operating and operating test, the system shall be subjected to an operational status check.

The requirements in this section shall be tested and/or evaluated by personnel verified by Pro V&V to be qualified to perform the testing.

Section 5: Software Requirements

The requirements in this section shall be tested utilizing a combination of review and functional testing during the source code review, TDP review, and FCA.

To perform the source code review, Pro V&V will review the submitted source code to the EAC VVSG 1.0 and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V shall verify that the submitted documentation is sufficient to enable: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met. The source code review includes a compliance build and a trusted build of the submitted source code.

4.1.1 Rationale for ‘Not Applicable’ Requirements

All requirements that were excluded from the previous test campaign (EVS 5.4.0.0) were also deemed not applicable to this test campaign due to the submitted modifications not impacting the specific requirements.

4.2 Hardware Configuration and Design

The EVS 5.4.1.0 is an electronic voting system consisting of the following hardware: ExpressVote hardware 2.1, AutoMARK, DS200, and DS850.

4.3 Software System Functions

The EVS 5.4.1.0 EMS is an application suite consisting of Electionware, ERM, RMS, ELS, ExpressVote Previewer, and VAT Previewer.

4.4 Test Case Design

Test cases are designed based on the manufacturer's design specifications and the relevant technical requirements set forth by the VVSG. Test cases shall be based on the following aspects of the voting system:

- Hardware qualitative examination design
- Hardware environmental test case design
- Software module test case design and data
- Software functional test case design
- System level test case design

Test cases shall provide information regarding the sequence of actions to be performed for the execution of a test, the requirements being met, the test objective, test configuration, equipment needed, special requirements, assumptions, and pass/fail criteria. Once the test cases are finalized, they will be validated and published for use in the test campaign. The validation of the test case will be accomplished by technical review and approval. This validation will include the following: confirmation of adequate test coverage of all requirements; confirmation that test case results are not ambiguous and gave objective pass/fail criteria; and confirmation that any automated test suites will produce valid results.

4.4.1 Hardware Qualitative Design

The updates to the modified system will require the full suite of hardware testing to include both environmental and electrical testing as detailed in the EAC VVSG 1.0. This determination was based on the following changes to the ExpressVote:

- Motherboard update - The Eurotech TC RL will replace the RG model.
- Display update - implement AUO displays
- IOB and PMB respin - replace "cuts & jumpers" introduced to address ESD susceptibility with identical permanent changes to boards

Based on the modifications to the ExpressVote the following hardware tests shall be performed:

Electrical Tests:

- Electrical Power Disturbance
- Electromagnetic Radiation
- Electrostatic Disruption
- Electromagnetic Susceptibility
- Electrical Fast Transient
- Lightning Surge
- Conducted RF Immunity
- Magnetic Fields Immunity
- Electrical Supply

Environmental Tests:

- Bench Handling
- Vibration
- Low Temperature
- High Temperature
- Humidity
- Temperature Power Variation
- Acoustic

4.4.2 Hardware Environmental Test Case Design

The voting system hardware shall be subjected to the tests specified in Section 4.4.1. Testing will be performed by personnel verified by Pro V&V to be qualified to perform the test. Pro V&V will utilize third-party test facilities (NTS Longmont facility located in Longmont, Colorado) for performance of the electrical and environmental tests. All pre and post operational status checks shall be conducted by Pro V&V personnel.

4.4.3 Software Module Test Case Design and Data

Pro V&V shall review the manufacturer's program analysis, documentation, and module test case design and shall evaluate the test cases for each module with respect to flow control parameters and entry/exit data. As needed, Pro V&V shall design additional test cases to satisfy the coverage criteria specified in Volume II, Section 7.2.1.

Component Level Testing will be implemented during the FCA for each component and subcomponent.

During the Source Code Review, Compliance Builds, and Security Testing, Pro V&V will utilize limited structural-based techniques (white-box testing). Additionally, specification-based techniques (black-box testing) will be utilized for the individual software components.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted. If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.4 Software Functional Test Case Design and Data

Pro V&V shall review the manufacturer-submitted test plans and data to verify that the individual performance requirements specified in the EAC VVSG 1.0 and the TDP are reflected in the software. As part of this process, Pro V&V shall review the manufacturer's test case design and prepare a detailed matrix of system functions and the test cases that exercise them. Pro V&V shall also prepare a test procedure describing all test ballots, operator procedures, and the data content of output reports. Pro V&V shall define abnormal input data and operator actions and then design test cases to verify that the system is able to handle and recover from these abnormal conditions. During this review, emphasis shall be placed on those functions where the manufacturer data on module development, such as the system release notes and comments within the source code, reflects significant debugging problems, and on functional tests that resulted in high error rates.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted.

If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.5 System-Level Test Case Design

System Level testing will be implemented to evaluate the complete system. This testing will include all proprietary components and COTS components (software, hardware, and peripherals) in a configuration of the system's intended use.

For software system tests, the tests shall be designed according to the stated design objective without consideration of its functional specification. The system level hardware and software test cases shall be prepared independently to assess the response of the hardware and software to a range of conditions.

4.5 Test Specifications

Descriptions of the tests required to evaluate the EVS 5.4.1.0 to the scope defined in Section 1.5 are provided in the subsections below.

4.5.1 TDP Evaluation

In order to determine compliance of the modified TDP documents with the EAC VVSG 1.0, a limited TDP review shall be conducted. This review will focus on TDP documents that have been modified since the certification of the baseline system. The review will consist of a compliance review to determine if each regulatory, state, or manufacturer-stated requirement has been met based on the context of each requirement. Results of the review of each document will be entered on the TDP Review Checklist and reported to the manufacturer for disposition of any anomalies. This process will be ongoing until all anomalies are resolved.

Any revised documents during the TDP review process will be compared with the previous document revision to determine changes made, and the document will be re-reviewed to determine whether subject requirements have been met.

A listing of all documents contained in the EVS 5.4.1.0 TDP is provided in Table 4-1.

Table 4-1. TDP Documents

Document ID	Description	Document Revision
<i>Preface</i>		
ESSSYS_5'4'1'0_L_RequirementsMatrix_QA	Requirements of the EAC VVSG 1.0 Trace to Vendor Testing	1.0
ESSSYS_5'4'1'0_L_RequirementsMatrix_TDP	Requirements of the EAC VVSG 1.0 Trace to Technical Data Package	1.0
<i>System Overview</i>		
ESSSYS_5'4'1'0_D_SYSOVER	ES&S Voting System 5.4.1.0 System Overview	1.0
<i>System Functionality Description</i>		
ESSSYS_5'4'1'0_D_SFD	ES&S Voting System 5.4.1.0 System Functionality Description	1.0
AQS-17-5001-001-R	AutoMARK(i) System Functionality	2
<i>System Hardware Specification</i>		
AQS-18-5000-001-F	AutoMARK System Hardware Specification	6
AQS-18-5002-000-S	AutoMARK System Hardware Overview	8
DS200_1'2_SPC_HWSPEC	DS200 Hardware Specification, Hardware Revision 1.2	3.5
DS200_1'3_SPC_HWSPEC	DS200 Hardware Specification, Hardware Revision 1.3	4.6

Table 4-1. TDP Documents (continued)

DS850_1'0_SPC_HWSPEC	DS850 Hardware Specification, Hardware Revision 1.0	1.7
EVOTE_2'1_SPC_HWSPEC	ExpressVote Hardware Specification, Hardware Revision 2.1	1.3
EVOTE_2'1_L_APL	Approved Parts List: ExpressVote HW 2.1	2.3
<i>Software Design and Specification</i>		
DS200_2'14'0'0_SDS	DS200 - Software Design Specification	1.3
DS850_2'11'0'0_SDS	DS850 – Software Design Specification	1.1
ELS_1'5'6'0_SDS	ES&S Software Design Specifications Event Log Service ES&S Voting System	1.2
ERM_8'13'0'0_SDS	ES&S Software Design Specifications Election Reporting Manager (ERM) ES&S Voting System	1.1
ERM_8'13'0'0_SDS_APPEN DICES	ES&S Software Design Specifications ERM Appendices ES&S Voting System	1.0
ESSSYS_1'0_P_CODINGST ANDARDS	Coding Standards	1.1
ESSSYS_1'0_P_SYSDEVPR OGRAM	System Development Program	1.3
EVOTE_2'1'1'0_SDS	ExpressVote - Software Design Specification	1.0
EWARE_4'8'1'0_SDS	Electionware – Software Design Specification	1.0
AQS-18-5002-003-S	AutoMARK Ballot Image Processing Specifications	6
AQS-18-5002-007-S	AutoMARK Ballot Scanning and Printing Specification	5
AQS-18-5000-002-F	AutoMARK Driver API Specification	5
AQS-18-5002-005-S	AutoMARK ESS Embedded Database Interface Specifications	5
AQS-18-5001-005-R	AutoMARK Graphical User Interface Design Specifications	6
AQS-18-5001-002-R	AutoMARK Operating Software (AMOS) Design Specifications	5
AQS-18-5002-004-S	AutoMARK Operations and Diagnostic Log Specifications	6
AQS-18-5001-011-R	AutoMARK Programming Specifications Details	5
AQS-18-5001-004-S	AutoMARK Software Design Specifications	6
---	Software Design and Specifications Overview AutoMARK Voter Assist Terminal (VAT)	1.8
AQS-18-5001-006-R	AutoMARK Software Development Environment Specifications	5
AQS-18-5000-004-F	AutoMARK Software Diagnostics Specification	5
AQS-18-4000-000-S	AutoMARK ESS Software Standards Specification	5

Table 4-1. TDP Documents (continued)

<i>System Test and Verification</i>		
ESSSYS_5'4'1'0_D_TESTPLAN	ES&S Voting System 5.4.1.0 System Test Plan	1.0
AMVAT_1'X_D_CIFRpt	Usability Test Report ES&S AutoMARK Voter Assist Terminal (VAT) Version 1.X	---
DS200_1'2'1_D_CIFRpt	Usability Test Report DS200 Precinct Ballot Scanner Version 1.2.1	---
EVOTE_1'0_D_CIFRpt	ExpressVote Usability Report ES&S Voting System 5.2.0.0	---
<i>System Security Specification</i>		
AQS-18-5002-001-S	AutoMARK System Security Specifications	7
ESSSYS_1'0_SPC_SYSTEM SECURITY_LOCAL	ES&S Voting System Security Specification	1.5
ESSSYS_5'4'1'0_SPC_CLIENTWORKSTATIONSETUP CONFIGGUIDE	ES&S Voting System 5.4.1.0 EMS Client Workstation Secure Setup & Configuration Guide	1.1
ESSSYS_5'4'1'0_SPC_EMSSERVERSETUPCONFIGGUIDE	ES&S Voting System 5.4.1.0 EMS Server Secure Setup & Configuration Guide	1.1
ESSSYS_5'4'1'0_SPC_SECURITY_SCRIPTDESCRIPTION	ES&S Voting System 5.4.1.0 Security Script Description	1.1
ESSSYS_5'4'1'0_SPC_STANDALONEWORKSTATIONSETUPCONFIGGUIDE	ES&S Voting System 5.4.1.0 Standalone EMS Workstation Secure Setup & Configuration Guide	1.1
AMVAT_1'8_L_ValFileList	Validation File List: AutoMARK	1.2
AMVATP_1'8_L_ValFileList	Validation File List: AutoMARK Previewer	1.2
DS200_2'14_L_ValFileList	Validation File List: DS200	1.1
DS850_2'11_L_ValFileList	Validation File List: DS850	1.1
ELS_1'5_L_ValFileList	Validation File List: Event Log Service	1.1
ERM_8'13_L_ValFileList	Validation File List: Election Reporting Manager	1.2
RMS_1'4_L_ValFileList	Validation File List: RMS	1.1
<i>System Operations Procedures</i>		
AMVAT_1'8'7'0_SOP	AutoMARK Operator's Guide, Firmware Version 1.8	1.3
DS200_2'14'0'0_SOP	DS200 Operator's Guide, Firmware Version 2.14	1.7
DS200_2'14'0'0_SOP_Appendices	DS200 Operator's Guide Appendices, Firmware Version 2.14	1.0
DS850_2'11'0'0_SOP	DS850 Operator's Guide, Firmware Version 2.11	1.7
DS850_2'11'0'0_SOP_Appendices	DS850 Operator's Guide Appendices, Firmware Version 2.11	1.0

Table 4-1. TDP Documents (continued)

ELS_1'5'6'0_SOP	EVS Event Logging Service User's Guide, Software Version 1.5	1.2
ERM_8'13'0'0_SOP	Election Reporting Manager User's Guide, Software Version 8.13	1.6
ERM_8'13'0'0_SOP_APPX	Election Reporting Manager User's Guide Appendices, Software Version	1.2
EVOTE_2'1'1'0_SOP	ExpressVote Operator's Guide, Firmware Version 2.1	1.0
EVOTE_2'1'1'0_SOP_Appendices	ExpressVote Operator's Guide Appendices, Firmware Version 2.1	1.0
EWARE_4'8'1'0_SOP_01Admin	Electionware Vol. I: Administrator Guide, Software Version 4.8	1.0
EWARE_4'8'1'0_SOP_02Define	Electionware Vol. II: Define User Guide, Software Version 4.8	1.0
EWARE_4'8'1'0_SOP_03Design	Electionware Vol. III: Design User Guide, Software Version 4.8	1.0
EWARE_4'8'1'0_SOP_04Deliver	Electionware Vol. IV: Deliver User Guide, Software Version 4.8	1.0
EWARE_4'8'1'0_SOP_05Results	Electionware Vol. V: Results User Guide, Firmware Version 4.8	1.0
EWARE_4'8'1'0_SOP_Appendices	Electionware Vol. VI: Appendices, Firmware Version 4.8	1.0
<i>System Maintenance Manuals</i>		
AMVAT_1'8'7'0_SMM	AutoMARK Maintenance Manual, Firmware Version 1.8	1.3
DS200_2'14'0'0_SMM	DS200 Maintenance Manual, Firmware Version 2.14	1.3
DS850_2'11'0'0_SMM	DS850 Maintenance Manual, Firmware Version 2.11	1.3
EVOTE_2'1'1'0_SMM	ExpressVote Maintenance Manual, Firmware Version 2.1	1.0
<i>Personnel Deployment and Training</i>		
ESSSYS_1'0_P_TRAININGPROGRAM	Personnel Deployment and Training Program	1.0
<i>Configuration Management Plan</i>		
ESSSYS_1'0_P_CMPROGRAM	Configuration Management Program	1.1
ESSSYS_1'0_P_TDPROGRAM	Technical Documentation Program	1.1
<i>QA Program</i>		
ESSSYS_5'4'1'0_P_MNFQA PROGRAM	Manufacturing Quality Assurance Program	1.0
ESSSYS_5'4'1'0_P_SWQAP PROGRAM	Software Quality Assurance Program	1.0

Table 4-1. TDP Documents (continued)

<i>System Change Notes</i>		
ESSSYS_5'4'1'0_D_CHANG ENOTES	ES&S Voting System 5.4.1.0 System Change Notes	1.0
<i>Attachments</i>		
BPG_1'0_SOP	Ballot Production Guide for EVS	3.0

4.5.2 Source Code Review

Pro V&V will review the submitted source code to the EAC VVSG 1.0 and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V shall verify that the submitted documentation is sufficient to enable: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met.

A combination of Automated Source Code Review and Manual Source Code Review methods will be used to review the changes in the source code from the previously certified EVS 5.4.0.0 voting system. In addition, 10% of the source code comments will be manually reviewed.

4.5.3 Physical Configuration Audit (PCA)

The Physical Configuration Audit (PCA) compares the voting system components submitted for qualification to the manufacturer's technical documentation, and shall include the following activities:

- Establish a configuration baseline of software and hardware to be tested; confirm whether manufacturer's documentation is sufficient for the user to install, validate, operate, and maintain the voting system
- Verify software conforms to the manufacturer's specifications; inspect all records of manufacturer's release control system; if changes have been made to the baseline version, verify manufacturer's engineering and test data are for the software version submitted for certification
- If the hardware is non-COTS, Pro V&V shall review drawings, specifications, technical data, and test data associated with system hardware to establish system hardware baseline associated with software baseline
- Review manufacturer's documents of user acceptance test procedures and data against system's functional specifications; resolve any discrepancy or inadequacy in manufacturer's plan or data prior to beginning system integration functional and performance tests
- Subsequent changes to baseline software configuration made during testing, as well as system hardware changes that may produce a change in software operation are subject to re-examination

4.5.4 Functional Configuration Audit (FCA)

The Functional Configuration Audit (FCA) encompasses an examination of manufacturer's tests, and the conduct of additional tests, to verify that the system hardware and software perform all the functions described in the manufacturer's documentation submitted in the TDP.

In addition to functioning according to the manufacturer's documentation, tests will be conducted to ensure all applicable EAC VVSG 1.0 requirements are met.

4.5.5 Accuracy

The Accuracy test ensures that each component of the voting system can each process 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy test is designed to test the ability of the system to "capture, record, store, consolidate and report" specific selections and absences of a selection. The required accuracy is defined as an error rate. This rate is the maximum number of errors allowed while processing a specified volume of data. For paper-based voting systems, the ballot positions on a paper ballot must be scanned to detect selections for individual candidates and contests and the conversion of those selections detected on the paper ballot converted into digital data.

In an effort to achieve this and to verify the proper functionality of the units under test, the following methods will be used to test components of the voting system:

The accuracy requirements for the DS200, DS850, and the ExpressVote will be met by the execution of the standard accuracy test utilizing pre-marked ballots of each ballot length supported, along with a portion of ballots produced from the AutoMARK to be scanned in the DS200 and DS850.

The DS200 and DS850 will be tested by utilizing a combination of hand marked (70%) and pre-marked (30%) ballots to achieve accuracy rate greater than 1,549,703 correct ballot positions.

4.5.6 System Integration

System Level test for the integrated operation of both hardware and software.

Compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment, shall be determined through functional tests integrating the voting system software with the remainder of the system.

Additionally, the system shall be configured exactly as it would for normal field use. This includes connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties.

Pro V&V personnel shall properly configure and test the system by following the procedures detailed in the EVS 5.4.1.0 technical documentation.

4.5.7 Hardware Testing

The EVS 5.4.1.0 will be subjected to the hardware tests listed below:

Electrical Tests:

- Electrical Power Disturbance

This test demonstrates the ability of the system to be able to withstand the following conditions without disruption of normal operation or loss of data:

- a. Surges of 30% dip @ 10 ms;
- b. Surges of 60% dip @ 100 ms & 1 sec;
- c. Surges of >95% interrupt @ 5 sec;
- d. Surges of $\pm 15\%$ line variations of nominal line voltage
- e. Electric power increases of 7.5% and reductions of 12.5% of nominal specified power supply for a period of up to four hours at each power level.

- Electromagnetic Radiation

This test demonstrates the ability of the system to comply with the Rules and Regulations of the Federal Communications Commission, Part 15, Class B requirements for both radiated and conducted emissions.

- Electrostatic Disruption

This test demonstrates the ability of the system to be able to withstand, without damage or loss of data, ± 15 kV air discharge and ± 8 kV contact discharge. The equipment may reset or have momentary interruption so long as normal operation is resumed with human intervention or loss of data (votes that have been completed and confirmed to the voter).

- Electromagnetic Susceptibility

This test demonstrates the ability of the system to be able to withstand, without disruption of normal operation or loss of data, an electromagnetic field of 10 V/m modulated by a 1 kHz 80% AM modulation over the frequency range of 80 MHz to 1000 MHz.

- Electrical Fast Transient

This test demonstrates the ability of the system to be able to withstand, without disruption of normal operation or loss of data, electrical fast transients of:

- a. +2 kV and -2kV on External Power lines (both AC and DC)
- b. +1 kV and -1 kV on Input/Output lines (signal, data, and control lines) longer than 3 meters
- c. Repetition Rate for all transient pulses will be 100 kHz

- Lightning Surge

This test demonstrates the ability of the system to be able to withstand, without damage or loss of data, surges of:

- a. ± 2 kV AC line to line
- b. ± 2 kV AC line to earth
- c. ± 5 kV DC line to line >10m
- d. ± 5 kV DC line to earth >10m
- e. ± 1 kV I/O signal/control >30m

- Conducted RF Immunity

This test demonstrates the ability of the system to be able to withstand, without disruption of normal operation or loss of data, conducted RF Immunity of:

- a. 10V rms over the frequency range 150 KHz to 80 MHz with an 80% amplitude modulation with a 1 KHz sine wave AC & DC power
- b. 10V sig/control >3 m over the frequency range 150 KHz to 80 MHz with an 80% amplitude modulation with a 1 KHz sine wave

- Magnetic Fields Immunity

This test demonstrates the ability of the system to be able to withstand, without disruption of normal operation or loss of data, AC magnetic fields of 30 A/m at 60 Hz.

- Electrical Supply

This test demonstrates the ability of the system to meet the following standards:

- a. Precinct count voting systems shall operate with the electrical supply ordinarily found in polling places (nominal 120 Vac/60Hz/1 phase)
- b. Central count voting systems shall operate with the electrical supply ordinarily found in central tabulation facilities or computer room facilities (nominal 120 Vac/60Hz/1 phase, nominal 208 Vac/60 Hz/3 phase or nominal 240 Vac/60Hz/2 phase)
- c. All voting machines shall also be capable of operating for a period of at least 2 hours on backup power, such that no voting data is lost or corrupted nor normal operations interrupted. When backup power is exhausted, the voting machine shall retain the contents of all memories intact.

Note: Per the EAC Decision on Request for Interpretation 2008-06 (which amends RFI 2008-02), Central Count systems are not required to have a 2-hour battery backup. A

central count system shall provide for a graceful shutdown to allow switching to an alternate power source. The graceful shutdown shall meet the following requirements:

- 1. All ballots shall reside in either the input or output hopper with no ballots in process at the end of the shutdown process.*
- 2. All ballots in the output hopper shall be fully read and saved.*
- 3. A report, including the final state of all ballots, timestamps and of the final state of the unit, shall be printed or saved in a file. The report shall be part of the permanent election record and shall be available when power is restored to the system.*
- 4. The system shall be capable of resuming operation from the point it stopped once power is restored.*

Testing for the graceful shutdown shall maintain ballots in the input hopper through the shutdown process. The purpose of this requirement is to confirm that the system will stop processing further ballots, complete ballots in process and save a report that accurately identifies the final state of the ballots and the system. The second part of the test shall restore power to the system and confirm that the system restarts properly and that the status report reflects accurately the state of the ballots and the system.

Environmental Tests:

- **Bench Handling**

This test simulates stresses faced during maintenance and repair of voting machines and ballot counters. This test is equivalent to the procedure of MIL-STD-810D, Method 516.3, Procedure VI (six 4" drops on each edge for a total of 24 drops).

- **Vibration**

This test simulates stresses faced during transport of voting machines and ballot counters between storage facilities and polling places. This test is equivalent to the procedure of MIL-STD-810D, Method 514.3, Category 1 – Basic Transportation, Common Carrier (30 minutes of vibration in each axis for a total of 90 minutes).

- **Low Temperature**

This test simulates stresses faced during storage of voting machines and ballot counters. This test is equivalent to the procedure of MIL-STD-810D, Method 502.2, Procedure I - Storage (minimum temperature of -4 degrees F maintained for four hours).

- **High Temperature**

This test simulates stresses faced during storage of voting machines and ballot counters. This test is equivalent to the procedure of MIL-STD-810D, Method 501.2, Procedure I - Storage (maximum temperature of 140 degrees F maintained for four hours).

- Humidity

This test simulates stresses faced during storage of voting machines and ballot counters. This test is similar to the procedure of MIL-STD-810D, Method 507.2, Procedure I – Natural Hot-Humid. The intention of this test is to evaluate the ability of the equipment to survive exposure to an uncontrolled temperature and humidity environment during storage (ten 24-hour humidity cycles).

- Temperature Power Variation

This test simulates stresses faced during maintenance and repair of voting machines and ballot counters. This test is similar to the low and high temperature tests of MIL-STD-810D, Methods 502.2 and 501.2, with test conditions that correspond to the requirements of the performance standards. This procedure tests system operation under various environmental conditions for at least 163 hours. During 48 hours of the operating time, the equipment shall be in a test chamber under imposed test conditions. For the remaining hours, the equipment shall be operated at room temperature. The system shall be powered for the entire period of this test; the power may be disconnected if necessary for removal of the system from the test chamber. Operation shall consist of ballot-counting cycles, which vary by system type, as outlined below:

Precinct count systems: 100 ballots/hour

Central count systems: 300 ballots/hour

5.0 TEST DATA

The following subsections provide information concerning test data recording, criteria, and reduction.

5.1 Test Data Recording

All equipment utilized for test data recording shall be identified in the test data package. The output test data shall be recorded in an appropriate manner as to allow for data analysis. For source code and TDP reviews, results shall be compiled in reports and submitted to ES&S for resolution.

5.2 Test Data Criteria

The EVS 5.4.1.0 shall be evaluated against all applicable requirements contained in the EAC VVSG 1.0. The acceptable range for system performance and the expected results for each test case shall be derived from the manufacturer-submitted technical documentation and the EAC VVSG 1.0.

6.0 TEST PROCEDURE AND CONDITIONS

The following subsections detail the facility requirements, test setup conditions, and sequence of testing.

6.1 Facility Requirements

Unless otherwise annotated, all testing shall be conducted at the Pro V&V test facility located in Huntsville, AL, by personnel verified by Pro V&V to be qualified to perform the test.

Unless otherwise specified herein, testing shall be performed at the following standard ambient conditions and tolerances:

- Temperature: 68-75° F ($\pm 3.6^\circ\text{F}$)
- Relative Humidity: Local Site Humidity
- Atmospheric Pressure: Local Site Pressure
- Time Allowable Tolerance: $\pm 5\%$

Testing performed at third-party laboratories will be subjected to the test parameters and tolerances defined by the test facility and will be reported in the final Test Report.

6.2 Test Set-up

All voting system equipment shall be received and documented using Pro V&V proper QA procedures. Upon receipt of all hardware, an inspection will be performed to verify that the equipment received is free from obvious signs of damage and/or degradation that may have occurred during transit. If present, this damage shall be recorded, photographed, and reported to the ES&S Representative. Additionally, a comparison shall be made between the recorded serial numbers/part numbers and those listed on shipper's manifest and any discrepancies shall be reported to the ES&S Representative. TDP items and all source code received shall be inventoried and maintained by Pro V&V during the test campaign.

During test performance, the system shall be configured as it would be for normal field use. This includes connecting all supporting equipment and peripherals.

6.3 Test Sequence

The EVS 5.4.1.0 will be evaluated against all applicable requirements in the EAC VVSG 1.0. There is no required sequence for test performance.

6.4 Test Operations Procedure

Pro V&V will identify PASS/FAIL criteria for each executed test case. The PASS/FAIL criteria will be based on the specific expected results of the system. In the case of an unexpected result that deviates from what is considered standard, normal, or expected, a root cause analysis will be performed.

Pro V&V will evaluate every EAC VVSG 1.0 requirement applicable to the EVS 5.4.1.0. Any deficiencies noted will be reported to the EAC and the manufacturer. If it is determined that there is insufficient data to determine compliance, this Test Plan will be altered and additional testing will be performed.

APPENDIX A
PROJECT SCHEDULE

Task Name	Start Date	End Date	Assigned To	Duration	Predecessors	Status
TDP	03/08/18	04/26/18		33d		In Progress
Initial Review	03/08/18	03/12/18	Alan Simmons	3d		In Progress
Compliance Review	03/13/18	04/20/18	Alan Simmons	26d	3	In Progress
Final review	04/23/18	04/26/18	Alan Simmons	4d	4	Not Started
Test Plan	03/15/18	05/22/18		46d		In Progress
Test Plan Creation	03/15/18	04/02/18	Wendy Owens	10d		Complete
Vendor Review & Comments	04/03/18	04/05/18	Wendy Owens	3d	7	Complete
EAC Submission and Review	04/06/18	05/03/18	Wendy Owens	20d	8	Not Started
EAC Comment Review & Update	05/04/18	05/07/18	Wendy Owens	2d	9	Not Started
EAC Submission & Review of Revision	05/08/18	05/21/18	Wendy Owens	10d	10	Not Started
EAC Approved Test Plan	05/22/18	05/22/18	Wendy Owens	1d	11	Not Started
Source Code	03/19/18	03/26/18		3d		Not Started
Automated Review	03/19/18	03/19/18	Jack Cobb	1d		Complete
Source Code Review	03/19/18	03/19/18	Jack Cobb	1d		Complete
Source Code Re-Review	03/20/18	03/20/18	Jack Cobb	1d	15	Complete
Document Review	03/19/18	03/19/18	Jack Cobb	1d		Complete
Compliance Build	03/20/18	03/26/18	Jack Cobb	2d	17	Complete
System Delivery & Setup	03/05/18	04/06/18		22d		Not Started
PCA	04/02/18	04/02/18	Stephen Han	1d		Complete
System Setup	04/03/18	04/03/18	Stephen Han	1d	20	Complete
System Loads & Hardening	04/04/18	04/05/18	Stephen Han	2d	21	In Progress
Hardware Testing	03/29/18	03/29/18		1d		In Progress
Electrical Testing	03/05/18	03/26/18	Michael Walker	13d		Complete
Environmental Testing	03/05/18	03/26/18	Michael Walker	13d		Complete
Temp Power (85 hours)	03/26/18	03/30/18	Michael Walker	5d		Complete
Electrical Supply	04/06/18	04/06/18	Michael Walker	1d	22	Not Started
System Level Testing	04/09/18	04/27/18		15d		Not Started
FCA	04/09/18	04/10/18	Stephen Han	2d	27	Not Started
Usability	04/11/18	04/11/18	Stephen Han	1d	29	Not Started
Accessibility	04/12/18	04/13/18	Stephen Han	2d	30	Not Started
Accuracy	04/16/18	04/17/18	Stephen Han	2d	31	Not Started
Trusted Build	04/18/18	04/19/18	Jack Cobb	2d	32	Not Started
System Loads & Hardening	04/20/18	04/23/18	Stephen Han	2d	33	Not Started
Regression Testing	04/24/18	04/24/18	Stephen Han	1d	34	Not Started
System Integration	04/25/18	04/27/18	Stephen Han	3d	35	Not Started
Test Report	04/30/18	07/04/18		48d		Not Started
Test Report Creation	04/30/18	05/17/18	Wendy Owens	14d	36	Not Started
Vendor Review & Comments	05/18/18	05/18/18	Wendy Owens	1d	38	Not Started
EAC Submission & Review	05/21/18	06/15/18	Wendy Owens	20d	39	Not Started
EAC Comment Review & Update	06/18/18	06/19/18	Wendy Owens	2d	40	Not Started
EAC Submission & Review of Revision	06/20/18	07/03/18	Wendy Owens	10d	41	Not Started
EAC Approved Test Report	07/04/18	07/04/18	Wendy Owens	1d	42	Not Started