

PRO V&V



Test Plan

**Dominion Voting Systems
Democracy Suite (D-Suite) System
Version 4.19
State of Colorado
Certification Testing**

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1 Introduction

The purpose of this Test Plan is to document the procedures that Pro V&V, Inc. will follow to perform certification testing of the Dominion Voting Systems Democracy Suite 4.19 System to the requirements set forth for voting systems by the State of Colorado.

1.1 References

The documents listed below were utilized in the development of this Test Plan:

- Colorado Secretary of State Election Rules [8 CCR 1505-1] Rule 21
- Colorado Requirements Gap Analysis Matrix
- Dominion Voting D-Suite 4.19 Testing Project Scope
- Dominion Voting Document 2.02 – Democracy Suite System Overview, Version 4.19::323 dated April 6, 2015
- Dominion Voting Document 2.03 – Democracy Suite ImageCast X Functionality Description, Version 4.19::4, dated April 6, 2015
- Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG)
- Federal Election Commission (FEC) 2002 Voting Systems Standards (VSS)
- Help America Vote Act (HAVA) of 2002, Public Law 107-252, 42 U.S.C. § 15301 *et seq.*

1.2 Terms and Abbreviations

The terms and abbreviations applicable to the development of this Test Plan are listed below:

“BMD” – Ballot Marking Device

“COTS” – Commercial Off-The-Shelf

“Dominion” – Dominion Voting Systems

“D-Suite” – Democracy Suite

“EAC” – Election Assistance Commission

“EMS” – Election Management System

“FCA” – Functional Configuration Audit

“ICC” – ImageCast Central

“ICX” – ImageCast X

“PCA” – Physical Configuration Audit

“TDP” – Technical Data Package

“UI” – User Interface

“2002 VSS” – 2002 Voting System Standards

“2005 VVSG” – 2005 Voluntary Voting System Guidelines

1.3 Background

On November 25, 2014, the Election Assistance Commission (“EAC”) granted certification of the D-Suite 4.14-D System (the predecessor of the D-Suite 4.19 System) to the 2005 Voluntary Voting System Guidelines (“2005 VVSG”). The D-Suite 4.19 System includes Democracy Suite Election Management System (“EMS”) System and the ImageCast Central (“ICC”) System that were tested as part of the previous test effort, as well as the ImageCast X (“ICX”) System that has been added as part of the current test campaign in order to satisfy the State of Colorado requirements.

Per Dominion, the complete list of modifications that were made to the D-Suite 4.14-D System that resulted in the D-Suite 4.19 System are summarized below:

- Added ICX component
- For Adjudication, added the ability to adjudicate ICX ballots including the ability to resolve write-ins and report appropriately
- Made the following changes to the ICC:
 - Modified to be compatible with Windows 8.1 operating system
 - Added ability to process vote information printed in QR barcode
 - Added capability for user to open a problem ballots when scanning is paused
 - Modified UI buttons to scale based on Window size
 - Added a progress bar during report generation
 - Added capability to allow TIF images to be used for scan from file tests

- Added primary and secondary path sets to log header
- Made the following modification to the EMS:
 - Modified to be compatible with Windows Server 2012, Windows 8.1, and SQL Server 2012
 - Added support for programming new ICX components

1.4 Scope

The scope of this testing event will incorporate a sufficient spectrum of physical and functional tests to verify that the D-Suite 4.19 System with ICX conforms to the State of Colorado Requirements. Specifically, the testing event has the following goals:

- Generate Trusted Builds of the new ICX application software components, ICC tabulator application software, and Adjudication application software, as well as a new Trusted Build of the D-Suite EMS application
- Verify that the D-Suite 4.19 System with ICX meets the requirements of the modified 2002 VSS with the additional Colorado-specific requirements
- Ensure the D-Suite 4.19 System with ICX provides support for all Colorado election management requirements (i.e. ballot design, results reporting, recounts, etc.).
- Simulate pre-election, Election Day, absentee, recounts, and post-election activities on the D-Suite 4.19 System with ICX and corresponding components of the EMS.

2 Test Candidate

Table 2-1: Vendor Name and Product Name and Model Number

Vendor/Manufacturer Information:	
Name:	Dominion Voting Systems
Address:	1201 18 th Street, Suite 210
	Denver, CO 80202
Primary Point of Contact:	Ian Piper
Product Name and Model Number:	Democracy Suite 4.19 System
Date of Submission:	April 16, 2015

The Democracy Suite 4.19 with ImageCast X System consists of a central count solution along with accessible ballot marking devices utilizing COTS tablets which produce voter-verifiable ballots that can be read by central count scanners.

The D-Suite 4.19 System consists of the major components listed below:

Democracy Suite EMS System

The Democracy Suite EMS is a set of applications that are responsible for all pre-voting and post-voting groups of activities in the process of defining and managing elections.

ImageCast Central (ICC) System

The ICC System consists of a central, high-speed, optical scan ballot tabulator coupled with ballot processing applications.

ImageCast X (ICX) System

The ICX is a ballot marking device (BMD) used for the creation of paper ballots that can be scanned and tabulated by the ICC.

The follow table provides the software and hardware components of the D-Suite 4.19 System to be tested, identified with version numbers.

Table 2-2: Firmware/Software Versions

<p style="text-align: center;">State of Colorado Certification of D-Suite 4.19 System</p>	<p style="text-align: center;">Firmware/Software Version</p>
<p style="text-align: center;">D-Suite 4.19 EMS Software Platform Components</p>	
<p style="text-align: center;">Election Event Designer (EED)</p>	<p style="text-align: center;">4.19</p>
<p style="text-align: center;">Application Server (APPS)</p>	<p style="text-align: center;">4.19</p>
<p style="text-align: center;">Audio Studio (AS)</p>	<p style="text-align: center;">4.19</p>

Data Center Manager (DCM)	4.19
Election Data Translator (EDT)	4.19
File System Service (FSS)	4.19
Results Tally and Reporting (RTR)	4.19
EMS Adjudication Components:	2.5
- EMS Adjudication Service (runs on EMS Server)	2.5
- DVS Adjudication Service (runs on EMS Server)	2.5
- DVS Adjudication Client (runs on Windows 8.1)	2.5
Database Server	Microsoft SQL Server 2012, Microsoft SQL Server 2012 Express
NAS Server	Windows Server 2012
EMS Client Application Software Components	Microsoft Windows 8.1
D-Suite 4.19 ICC Software Components	
ImageCast Central (ICC) Application	4.19
Image-Analysis DLL	4.19
Microsoft Windows	8.1

D-Suite 4.19 ICX Platform Components	
ImageCast X (ICX) Client Application	4.19
RV Admin	4.19
RV App Services	4.19
D-Suite 4.19 ICX Software Components	
Microsoft Windows	8.1
Microsoft SQL Server	2012 Express with advance services
Android KitKat	4.4.2

Table 2-3: Hardware Versions

State of Colorado Certification of D-Suite 4.19 System	Hardware Version
D-Suite 4.19 ICC	
ImageCast Central (ICC) Scanner	Canon G1130
ImageCast Central (ICC) Workstation Computer	Dell 9020 AIO or DELL 9030 AIO

D-Suite 4.19 ICX	
Tablet, with 4.4 Kitkat, 32GB 12.2in. Display, Black	Samsung Galaxy Tab Pro 12.2, 32GB, Black
Printer, Ballots	DELL B2360dn
Printer, Ballots	Canon B6230dw
Tablet Enclosure, Black	Armodilo SPHERE-B-FPC-L-01-B
Card Reader, Mag Stripe, Black, HiCo	MagTek Dynamag USB
Hub, Multi-port networking	Lavalink STS-2UE+
Hub, Accessible Devices	Tecla Shield DOS
Joystick, 4-way Switch	Tecla
D-Suite 4.19 ICX RVS	
Remote Voting Server Computer	DELL Latitude e7440 Laptop, 8GB RAM, 500GB HDD, MS Windows 8.1 Professional, SQL Server 2012 Express with advanced services
Card Reader, Mag Stripe, Black, HiCo	MSR606

Ethernet Switch, 16 ports	DELL PowerConnect 2816
EMS Servers and Workstations	
EMS Standard Server	DELL PowerEdge R630 Server, Rack Mount, 32GB RAM, 6x 1TB HDD, HW RAID Controller (H710), 2x1GB NIC, eSATA, MS Windows Server 2012
EMS Client Workstation	DELL Precision T1700 Workstations, 8GB RAM, 500GB HDD, MS Windows 8.1 Professional
Computer Accessories	
UPS, Smart-UPS, 1000VA	APC SMC1000
UPS, Smart-UPS, 1500VA	APC SMC1500
Ethernet Switch, 8 ports	DELL PowerConnect 2808
Supplies and Accessories	

CF Card Reader/Writer	GGI Gear
iButton Programmer with Adapter	Maxim DS9490R#
iButton Security Key with Key Ring Mount, Black	Maxim DS1963S
Compact Flash Memory Card, 4G	SanDisk cards (SDCFAA-004G)
Cable, Ethernet Cat5e	Various
Paddle Switches	Enabling Devices 971
Sip and Puff Device	Enabling Devices 972
Straws/Filters, Sip and Puff, 10/pkg	Enabling Devices 970K
Headphones	Cyber-Acoustics ACM- 70

2.1 Test Candidate System Overview

The D-Suite with ICX System utilizes the following workflow to manage an election, as taken from the Dominion-provided technical documentation:

1. Election is defined in EED.
2. EED is used to create configuration files for ICC scanners and ICX systems.
3. Absentee/Mail-In ballots are printed.
4. ICX system is deployed with configuration from EED.

5. All counting systems undergo pre-logic and accuracy testing (Pre-LAT).
6. ImageCast Adjudication is configured for the election, including entry of qualified write-in names.
7. Voters at VSPCs complete the following process:
 - a. Voter is checked in and a magnetic voting card is created containing their authorized ballot style ID.
 - b. Voter swipes the voting card at the ICX tablet station to initiate vote session.
 - c. Voter makes selections and reviews choices.
 - d. Voter prints ballot at ICX tablet station.
 - e. Voter may review ballot for accuracy and either place the ballot in a ballot box or request spoilage of the ballot and restart of the voting session.
8. Absentee/Mail-In and ICX ballots are scanned at the central count location. ICX ballots require scanning into separate batches.
9. Ballots are adjudicated in the ImageCast Adjudication system.
10. Results reports are processed in the RTR system.

2.2 Testing Configuration

The testing event will utilize one setup of the D-Suite 4.19 System and its components. The following is a breakdown of the D-Suite 4.19 System components and configurations for the test setup:

Standard Testing Platform:

Individual ICX systems will be set up at various Voting Service Polling Centers (VSPCs) for both early and Election Day voting. Each VSPC will be supplied with a laptop computer containing the ICX RV Admin web application and RV App Services component, multiple COTS tablet devices loaded with the ICX client application, printers connected to the RV App Services laptop but physically located next to each tablet, accessibility devices (using a universal hub device), and Ethernet network connection hardware.

The central count location will utilize multiple Canon G1130 scanners connected to ICC workstations and ImageCast Adjudication clients. Additionally, the central count location will

house an EMS server containing all of the D-Suite Server components listed above. ImageCast Adjudication, Election Event Designer (EED), and Results Tally and Reporting (RTR) clients will require Ethernet connectivity with the EMS server.

Dominion is expected to provide software and equipment along with the supporting materials listed in section 2.3.

2.3 Test Support Equipment/Materials

The following materials are expected to be supplied by Dominion to facilitate testing:

- USB Flash Drives, PC Cards, Compact Flash, and Zip disks
- Test Decks
- Power Cords
- Ballot Paper
- Marking Devices
- Labels
- Other materials and equipment as required

2.4 Technical Data Package

This subsection lists all manufacturer provided documentation that is relevant to the system being tested.

Table 2.4-1: Technical Data Package

Document Name	Document Number
Democracy Suite System Overview	2.02
System Security Specification	2.06
System Test and Verification	2.07

System Test and Verification Test Suites	2.07
Personnel Training and Deployment Requirements	2.10
Configuration Management Process	2.11
Quality Assurance Program	2.12
System Change Notes	2.13
ImageCast Central	
Democracy Suite ImageCast X Functionality Description	2.03
ImageCast Central Software Design And Specification	2.08
ImageCast Central System Operation Procedures	2.09
Adjudication	
Adjudication Software Design and Specification	2.05
Adjudication Installation and Configuration Procedures	2.08
Adjudication System Maintenance Manual	2.09
ImageCast X	
ImageCast X Functionality Description	2.03

ImageCast X Software Design And Specification	2.05
ImageCast X System Operation Procedures	2.08
ImageCast X System Maintenance Manual	2.09
Election Management System	
EMS Functionality Description	2.03
EMS Software Design And Specification	2.05
EMS System Operation Procedures	2.08
EMS System Maintenance Manual	2.09
User Guides	
M.55-AdjudicationUsersGuideDenver	---
Election Event Designer User's Guide	---
Results Tally and Reporting User's Guide	---
Mobile Ballot Production User's Guide	---
ImageCast X Users Guide	---
RV Admin Users Guide	---

Supplementary Documents	
ImageCast Central Application Installation	---
ImageCast Central Build Environment Setup	---
ImageCast Central DR-G1130 Scanner Driver Installation	---
ImageCast Central Software Build Procedure	---
Canon DR-G1130 User Manual	---
Election Management System Build and Install	---
Adjudication Application Build Procedure	---
ICX Build Procedure	---
RV Build Procedure	---
ICX Installation and Configuration	---
RV Installation and Configuration	---
TreeViewEx Build	---
Adjudication Installation and Configuration Procedures	---

Addendum to EMS Build Document	---
Dominion Voting C/C++ Coding Standard	---
Dominion Voting C# Automated Code Review Guidelines and Config	---
Dominion Voting Java Coding Standard	---
ImageCast Election Definition Files	---
ImageCast Printing Specification	---
ImageCast Total Results File	---
C#-Automated-Review-Process	---
System ID Guide 4.19	---

2.5 Third Party Test Reports

This subsection lists the reports by third party entities that are relevant to the system being evaluated and the test engagement.

Table 2.5-1: Third Party Test Reports

Report Title	Revision	Issue Date
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3 Test Process

The following procedure outlines the steps that the test team will execute to evaluate the D-Suite 4.19 System under the scope defined in Section 1.4.

3.1 General Information

All testing will be conducted under the guidance of Pro V&V by personnel verified by Pro V&V to be qualified to perform the testing. The examination shall be performed at the Pro V&V, Inc. test facility located in Huntsville, AL.

3.2 Test Cases/Procedures

Pro V&V has will develop test procedures designed to evaluate the system being tested against the stated requirements. The test procedures can be executed independently.

Prior to execution of the required test procedures, the system under test will undergo testing initialization. The testing initialization will seek to establish the baseline for testing and ensure that the testing candidate matches the expecting testing candidate and that all equipment and supplies are present.

The following will be completed during the testing initialization:

- Ensure proper system of equipment. Check network connections, power cords, keys, etc.
- Check version numbers of (system) software and firmware on all components.
- Verify the presence of only the documented COTS.
- Ensure removable media is clean
- Ensure batteries are fully charged.
- Inspect supplies and test decks.
- Record protective counter on all tabulators.
- Review physical security measures of all equipment.
- Record basic observations of the testing setup and review.
- Record serial numbers of equipment.
- Retain proof of version numbers.

The procedures that will be utilized for this test engagement are summarized below (*Reference Attachment A*):

- TDP Review - This review is conducted only for stated functionality review and verification. This review does not address consistency or completeness of documents. Results of the review of each document are entered on the TDP Review Checklist and are reported to the customer for disposition of any discrepancies. This process is ongoing until all discrepancies are resolved. Any revised documents during the TDP review process are compared with the previous document revision to determine changes made, and the document is re-reviewed to determine whether the discrepancies have been resolved.
- Trusted Build – The trusted build is a specific type of source code inspection. It consists of inspecting customer submitted source code, COTS, and Third Party software products and combining them to create the executable code. This inspection follows the documented process from the “United States Election Assistance Commission Voting System Test Laboratory Program Manual” Section 5.5 – 5.7. *Performance of the trusted build includes the build documentation review.*
- Functional Configuration Audit (FCA) – This area of testing 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.
- Accuracy – The accuracy test ensures that the voting system components can process ballot positions within the allowable target error rate. This test is designed to test the ability of the system to “capture, record, store, consolidate, and report” specific voter selections and absences of a selection.
- System Integration – The system level certification tests address 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.
- Regression Testing – Regression testing will be performed on all system components to verify that all functional and/or firmware modifications made during the test campaign did not adversely affect the system and its operation.
- Physical Configuration Audit (PCA) – The PCA compares the voting system components submitted for testing to the manufacturer’s technical documentation.
- Security – During the execution of this test case, the system shall be inspected for various controls and measure that are in place to meet the objectives of the security standards which include: protection of the critical elements of the voting system; establishing and maintaining controls to minimize errors; protection from intentional manipulation, fraud

and malicious mischief; identifying fraudulent or erroneous changes to the voting system; and protecting the secrecy in the voting process

- Usability – This area of 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. Lack of independence or privacy may adversely affect effectiveness (e.g., by possibly inhibiting the voter's free choice) and efficiency (e.g., by slowing down the process).
- Accessibility – This area of testing evaluates the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B). Ideally, every voter would be able to vote independently and privately. As a practical matter, there may be some number of voters whose disabilities are so severe that they will need personal assistance. Nonetheless, these requirements are meant to make the voting system independently accessible to as many voters as possible.
- Electrical Supply – This requirement addresses the battery power source for providing electrical supply during a power failure.
- Reliability – The reliability of the system being evaluated will be measured during the performance of the system level tests.
- Maintainability – The maintainability of the system represents the ease with which preventive and corrective maintenance actions can be performed based on the design characteristics of the system being evaluated and the process the manufacturer has in place for prevention and reacting to failures.

4 Conditions of Satisfaction

The voting system will be evaluated against the Colorado Requirements Gap Analysis Matrix, which incorporates the 2002 VSS requirements and the Colorado-specific requirements in the Colorado Secretary of State Election Rules [8 CCR 1505-1] Rule 21. Throughout this test campaign, Pro V&V will execute tests, inspect resultant data and perform technical documentation reviews to ensure that each applicable requirement is met. The Gap Analysis Matrix and the Conditions of Satisfaction for meeting each requirement will be included in the Final Test Report for this test campaign.

5 Test Data

The output test data will be collected and stored in an appropriate manner as to allow for data analysis. Actual results from executed tests will be recorded in real-time in Test Execution Logs.

6 Test Report

At test conclusion, a Test Report will be generated documenting all findings. Pro V&V will follow standard requirements for the format of the Test Report. The Recommendation section of the Test Report will follow the requirements of the NIST 150 Handbook for opinions and interpretations.

7 Agreement

Dominion agrees to have the D-Suite 4.19 System evaluated using this Test Plan as presented with the understanding that the Test Plan is a dynamic document that may be modified as necessary in order to fulfill the requirements set forth by the State of Colorado for voting systems.

Dominion Voting Systems Representative

Date



May 12, 2015

Attachment A

FUNCTIONAL CONFIGURATION AUDIT (FCA)	
Test Objective: To determine if the voting system functions in accordance with all representations including attached peripherals.	Test Configuration: Normal operational configuration
Equipment:	All system documentation submitted as part of the application.
Special Procedural Requirements:	The voting system will be configured per the system documentation submitted by the voting system manufacturer. The voting system firmware will be loaded by the examiner from a trusted source.
Assumptions:	This test is a system level test that requires all equipment and software that is being considered for certification.
Test Approach:	<p>During the performance of the functional configuration audit (FCA) each component and subcomponent of the voting system will be functionally evaluated as designed and documented. The FCA will depend heavily on black box testing techniques for the individual software components. The examiner will use “equivalence partitioning” and “boundary value testing” to evaluate the robustness and stability of the software submitted for evaluation.</p> <p>“Equivalence partitioning” will be used to evaluate specific software functions and data entry points. For software functions and data entry points, an entry will be made for valid data requirement and at least one invalid data requirement to test for normal and abnormal conditions. This can include the input of numeric values and special characters for alphabetic and text fields and may also include alphabetic and special characters for numeric fields.</p> <p>“Boundary value testing” will be used to evaluate specific software functions and data entry points for minimums and maximums. For software functions and data entry points an entry will be made for all minimum and all maximum documented requirements to test for normal and abnormal conditions. This can include numeric ranges as well as non-numeric ranges.</p>
<p>Test Method: The method for testing these requirements is execution. The Functional Configuration Audit (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:</p> <p><u>Overall System Capabilities:</u> 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.</p> <p><u>Pre-voting Capabilities:</u> These functional capabilities are used to prepare the voting system for voting.</p>	

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.

During performance of the FCA, the examiner will input both positive and negative test data to trigger normal and abnormal conditions. If negative test data is allowed to be input, the examiner will continue the process of the data flow as document in the “mapping of the data life cycle” to ensure the negative testing data does not have an effect on downstream processes.

Criteria for Evaluation of the Test Results: At the conclusion of the FCA, the examiner will analyze all deficiencies and make a determination on the voting system’s ability to perform in accordance with all representations concerning functionality, usability, security, accessibility, and sustainability.

TECHNICAL DATA PACKAGE (TDP) REVIEW	
Test Objective: To review and verify stated functionality in the TDP.	Test Configuration: None
Equipment:	All system documentation submitted as part of the application.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Review.
<p>Test Method: The method for testing these requirements is review. This review is conducted only for stated functionality review and verification. This review does not address consistency or completeness of documents. Results of the reviewed documents are entered on the TDP Review Checklist and are reported to the customer for disposition of any discrepancies. This process is ongoing until all discrepancies are resolved. Any revised documents during the TDP review process are compared with the previous document revision to determine changes made, and the document is re-reviewed to determine whether the discrepancies have been resolved.</p>	
<p>Criteria for Evaluation of the Test Results: At the conclusion of the TDP Review, the examiner will verify that all deficiencies have been met.</p>	

TRUSTED BUILD	
Test Objective: To executable code of the system under test.	Test Configuration: None
Equipment:	Build machine.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution.
<p>Test Method: A Build Inspection will be performed in order to provide a chain of custody from the source to the machine to a readable application. It consists of combining inspected customer submitted source code, COTS, and Third Party software products in order to create the executable code (Software Under Test – SUT) with adequate security measures that provide confidence that the executable code is verifiable and a faithful representation of the source.</p>	
<p>Criteria for Evaluation of the Test Results: At the conclusion of the Trusted Build, executable code will be generated.</p>	

RELIABILITY	
Test Objective: The reliability of the system being evaluated will be measured during the performance of the system level tests.	Test Configuration: As for normal operation.
Equipment:	Voting system configured for normal use.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution.
<p>Test Method: The system reliability will be evaluated throughout the test campaign. The data from each system level test will be combined to determine the acceptable MTBF of the system.</p> <p>A specific test for reliability will be conducted by utilizing a modified functional reliability test that is typically performed during the Temperature and Power Variation Test. This test will be conducted at standard ambient conditions. Ballots will be cast continually until test conclusion.</p>	
<p>Criteria for Evaluation of the Test Results: The voting system successfully completes the test with all actual results matching the expected results.</p>	

PHYSICAL CONFIGURATION AUDIT (PCA)

Test Objective: The Physical Configuration Audit (PCA) compares the voting system components submitted for qualification to the manufacturer’s technical documentation. The PCA includes the following activities:

- Establish a configuration baseline of software and hardware to be tested; confirm whether the 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.
- Review drawings, specifications, technical data, and test data associated with system hardware (if non-COTS) to establish system hardware baseline associated with software baseline.
- Review manufacturer 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

Equipment:	For the PCA, the manufacturer shall provide a list of all documentation and data to be audited, cross-referenced to the contents of the TDP, along with the following: <ul style="list-style-type: none"> a. Identification of all items that are to be part of the software release b. Specification of compiler (or choice of compilers) to be used to generate executable programs c. Identification of all hardware that interfaces with the software d. Configuration baseline data for all hardware that is unique to the system e. Copies of all software documentation intended for distribution to users, including program listings, specifications, operations manual, voter manual, and maintenance manual f. User acceptance test procedures and acceptance criteria
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution.
Test Method: The PCA will be conducted in two phases: Initial – Baseline the system prior to test commencement Final – Verify final software and hardware configurations	

Initial PCA

1. Assigned test personnel will document each hardware and software component of the voting system by component name, model, serial number, major component, and any other relevant information needed to identify the component. Information will be recorded in the Engineering Log Book. Photographs of each hardware component will also be taken. All photographs taken shall include the following information: Manufacturer name, Pro V&V assigned job number, date, system name, component name.
2. Assigned test personnel will document if the components are COTS, modified COTS, or manufacturer-developed.
3. For COTS equipment, every effort will be made to verify that the COTS equipment has not been modified for use.
4. Assigned test personnel will document each piece of documentation submitted in the manufacturer TDP and record the document name, description, document number, revision number, and date of release.
5. Assigned test personnel will compile all data.

Final PCA

1. Assigned test personnel will verify that any changes made to the software, hardware, or documentation during the test process are fully and properly documented in the Engineering Log Book.
2. For the system hardware, assigned test personnel will verify that any changes made are documented and that all ECOs are properly implemented, and take photographs of any modified components.
3. Assigned test personnel will create a list of filenames and directories for each software component along with the software description, version, coding language, and unique identifier (digital signature or hash value).
4. A final list of all system documentation will be compiled that will include the document name, description, number, revision, and date.

Criteria for Evaluation of the Test Results: Assigned test personnel will compile all data for inclusion into the final report.

SECURITY	
<p>Test Objective:</p> <p>The objectives of the security standards for voting systems are:</p> <ul style="list-style-type: none"> • To protect critical elements of the voting system • To establish and maintain controls to minimize errors • To protect the system from intentional manipulation, fraud and malicious mischief • To identify fraudulent or erroneous changes to the voting system • To protect secrecy in the voting process 	<p>Test Configuration: Normal field use.</p>
Equipment:	Manufacturer-submitted TDP.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution and review.
<p>Test Method:</p> <p>During the Security Tests, the voting system shall be tested for:</p> <p><u>Access Control</u> – procedures and system capabilities that limit or detect access to critical system components in order to guard against loss of system integrity, availability, confidentiality, and accountability</p> <p><u>Physical Security</u> – physical security measures and procedures that prevent disruption of the voting process at the polling place and corruption of data</p> <p><u>Software Security</u> – standards that address the installation of software, including firmware, in the voting system and the protection against malicious software.</p> <p><u>Telecommunications and Data Transmission</u> – standards that address security for the electronic transmission of data between system components or locations over private, public, and wireless networks</p> <p><u>Use of Public Communications Networks</u> – standards that address security for systems that communicate individual votes or vote totals over public communications networks</p> <p><u>Wireless Communications</u> – address the security of the voting system and voting data when wireless is used</p> <p><u>Independent Verification Systems</u> – the requirements for DREs with voter verifiable paper audit trails</p>	
<p>Criteria for Evaluation of the Test Results:</p> <ol style="list-style-type: none"> 1. Verify that the manufacturer’s TDP contains documented access and physical controls. 2. Following the manufacturer’s documented procedures, configure the voting system for use and functionally verify that the documented controls are in place and adequate and meet the stated requirements. 	

USABILITY	
<p>Test Objective: Voting systems shall be designed in such a way that they can be used by voters in a way that is comfortable, efficient, and that provides voters with confidence that they have cast their votes effectively. During the Usability test, the following principles shall be addressed:</p> <ol style="list-style-type: none"> 1. All eligible voters shall have access to the voting process without discrimination. 2. Each cast ballot shall accurately capture the selections made by the voter. 3. The voting process shall preserve the secrecy of the ballot. 	<p>Test Configuration: Normal field use.</p>
<p>Equipment:</p>	<p>Manufacturer-submitted TDP, voting system configured for use.</p>
<p>Special Procedural Requirements:</p>	<p>None.</p>
<p>Assumptions:</p>	<p>None.</p>
<p>Test Approach:</p>	<p>Execution and review.</p>
<p>Test Method:</p> <ol style="list-style-type: none"> 1. Following the manufacturer’s documented instructions, assigned test personnel shall setup and configure the voting system as for normal operation at the polling place, with privacy screens and peripheral devices in place. 2. Perform the Operational Status Check that has been developed specifically for the system under test. 3. Verify that each function and capability operates as expected and documented. Specifically, verify that: <ol style="list-style-type: none"> a. Instructions on system operation are clear and concise b. The ballot is displayed on the system in a manner that is clear and usable c. The voting process is clear d. There is a way to verify and accept or modify ballot selections prior to the casting of a ballot e. The voting system notifies the voter upon successful casting of the ballot f. The voting system shall provide feedback to the voter that identifies specific contests or ballot issues for which he or she has made no selection or fewer than the allowable number of selections (e.g., undervotes) g. The voting system shall notify the voter if he or she has made more than the allowable number of selections for any contest (e.g., overvotes) h. The voting system shall notify the voter before the ballot is cast and counted of the 	

effect of making more than the allowable number of selections for a contest

- i. The voting system shall provide the voter the opportunity to correct the ballot for either an undervote or overvote before the ballot is cast and counted
- j. The voting system shall allow the voter, at his or her choice, to submit an undervoted ballot without correction
- k. DRE voting machines shall allow the voter to change a vote within a contest before advancing to the next contest
- l. DRE voting machines should provide navigation controls that allow the voter to advance to the next contest or go back to the previous contest before completing a vote on the contest currently being presented (whether visually or aurally)
- m. The system is capable of presenting the ballot, ballot selections, review screens and instructions in any language required by state or federal law or stated to be supported by the manufacturer
- n. The voting system supports a voting process that does not introduce any bias for or against any of the selections to be made by the voter and that contest choices are presented in an equivalent manner.
- o. The voting system provides clear instructions and assistance to allow voters to successfully execute and cast their ballots independently
- p. The voting system provides the capability to design a ballot for maximum clarity and comprehension.
- q. Warnings and alerts issued by the voting system should clearly state the nature of the problem and the set of responses available to the voter.
- r. The use of color by the voting system should agree with common conventions: (a) green, blue or white is used for general information or as a normal status indicator; (b) amber or yellow is used to indicate warnings or a marginal status; (c) red is used to indicate error conditions or a problem requiring immediate attention.
- s. The voting process is designed to minimize perceptual difficulties for the voter.
- t. The system is designed to minimize interaction difficulties for the voter.
- u. When deployed according to the manufacturer instructions, the voting system shall prevent others from observing the contents of a voter's ballot.

Criteria for Evaluation of the Test Results: The manufacturer's submitted TDP contains all required information and the system being evaluated meets the required standards for usability,

ACCESSIBILITY	
<p>Test Objective: Voting systems shall be designed in such a way that they can be used by voters in a way that is comfortable, efficient, and that provides voters with confidence that they have cast their votes effectively. During the Accessibility test, the following principles shall be addressed:</p> <ol style="list-style-type: none"> 1. All eligible voters shall have access to the voting process without discrimination. 2. Each cast ballot shall accurately capture the selections made by the voter. 3. The voting process shall preserve the secrecy of the ballot. 	<p>Test Configuration: Normal field use.</p>
<p>Equipment:</p>	<p>Manufacturer-submitted TDP, voting system configured for use.</p>
<p>Special Procedural Requirements:</p>	<p>None.</p>
<p>Assumptions:</p>	<p>None.</p>
<p>Test Approach:</p>	<p>Execution and review.</p>
<p>Test Method:</p> <ol style="list-style-type: none"> 1. Following the manufacturer’s documented instructions, assigned test personnel shall setup and configure the voting system as for normal operation at the polling place, with privacy screens and peripheral devices in place. 2. Perform the Operational Status Check that has been developed specifically for the system under test. 3. Verify that each function and capability operates as expected and documented. Specifically, verify that: <ul style="list-style-type: none"> – All messages posted on a voting machine are also posted in a format that can be utilized by the visually impaired – All messaged and instructions presented to a voter that is voting in any alternate method are the same instructions that are presented to a standard voter – Voting can be completed with items provided within the voting system or detailed in the TDP as supplied by the Polling Station. Disabled voters are not required to bring special devices with them in order to vote successfully – If the voting system utilizes biometric measures that requires a voter to possess particular biological characteristics, the voting process shall provide a secondary means that does not depend on those characteristics – The accessible voting system is accessible to voters with visual disabilities. 	

- The accessible voting system is accessible to voters who are blind.
- The voting process shall be accessible to voters who lack fine motor control or use of their hands.
- The voting process shall be accessible to voters who use mobility aids, including wheelchairs.
- The voting process shall be accessible to voters with hearing disabilities.
- The voting process does not require speech for its operation.
- For voters who lack proficiency in reading English, or whose primary language is unwritten, the voting equipment shall provide spoken instructions and ballots in the preferred language of the voter, consistent with state and federal law

Criteria for Evaluation of the Test Results: The manufacturer's submitted TDP contains all required information and the system being evaluated meets the required standards for accessibility.

MAINTAINABILITY	
<p>Test Objective: Maintainability represents the ease with which maintenance actions can be performed based on the design characteristics of equipment and software and the processes the vendor and election officials have in place for preventing failures and for reacting to failures. Maintainability includes the ability of equipment and software to self-diagnose problems and make non-technical election workers aware of a problem. Maintainability addresses all scheduled and unscheduled events, which are performed to:</p> <ul style="list-style-type: none"> • Determine the operational status of the system or a component • Adjust, align, tune or service components • Repair or replace a component having a specified operating life or replacement interval • Repair or replace a component that exhibits an undesirable predetermined physical condition or performance degradation • Repair or replace a component that has failed • Verify the restoration of a component or the system to operational status 	<p>Test Configuration: Normal field use.</p>
Equipment:	Manufacturer-submitted TDP, voting system configured for use.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution and review.
<p>Test Method:</p> <ol style="list-style-type: none"> 1. Assigned test personnel shall evaluate the manufacturer technical documentation to verify that all maintenance activities are identified. 2. Assigned test personnel shall verify the following physical attributes of the voting system: <ol style="list-style-type: none"> a. Presence of labels and the identification of test points b. Provision of built-in test and diagnostic circuitry or physical indicators of condition c. Presence of labels and alarms related to failures d. Presence of features that allow non-technicians to perform routine maintenance tasks (such as update of the system database) 3. Assigned test personnel shall assess the following additional attributes: <ol style="list-style-type: none"> a. Ease of detecting that equipment has failed by a non-technician b. Ease of diagnosing problems by a trained technician 	

- c. Low false alarm rates (i.e., indications of problems that do not exist)
- d. Ease of access to components for replacement
- e. Ease with which adjustment and alignment can be performed
- f. Ease with which database updates can be performed by a non-technician
- g. Adjust, align, tune or service components

Criteria for Evaluation of the Test Results: The manufacturer's submitted TDP contains all required information and the system being evaluated meets the required standards for maintainability.

ACCURACY	
Test Objective: The Logic and Accuracy Test is designed to test the ability of the voting 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.	Test Configuration: Normal field use.
Equipment:	Voting system configured for use.
Special Procedural Requirements:	None.
Assumptions:	None.
Test Approach:	Execution.
Test Method:	
<ol style="list-style-type: none"> 1. Using the developed election definition, generate a test deck of paper ballots. 2. Following the manufacturer instructions, complete all steps necessary to open the polls and print the zero totals report. 3. Determine the number of times the test deck will be run to achieve the target of 1,549,703 ballot positions. 4. Review and sign the zero totals report. 5. Run the test deck the determined number of times. 6. Following the manufacturer’s instructions, complete all steps necessary to close the polls, perform precinct level tabulations, and export the ballot results. 7. Following the manufacturer’s instructions, complete all steps necessary steps to import all election results into the EMS/Central Tabulation. 8. Following the manufacturer’s instructions, complete all steps necessary steps to print, export, and review the audit log. 9. At Central Tabulation site, perform all steps necessary to import the totals (including absentee ballots), resolve irregular ballots (write-ins, etc.), consolidate votes from all precinct components, finalize results, print all results, and print the audit log 	
Criteria for Evaluation of the Test Results: The voting system successfully completes the test with all actual results matching the expected results.	

SYSTEM INTEGRATION	
<p>Test Objective: This test addresses the integrated operation of both hardware and software, along with any telecommunications capabilities. System integration includes the cumulative results of functional testing, Volume and Stress, Logic and Accuracy, Security and Usability, as well as the PCA and FCA. The primary objective of system integration testing is to validate that the voting system functions correctly.</p>	<p>Test Configuration: Normal field use.</p>
<p>Equipment:</p>	<p>Voting system configured for use, TDP</p>
<p>Special Procedural Requirements:</p>	<p>None.</p>
<p>Assumptions:</p>	<p>PCA has been completed.</p>
<p>Test Approach:</p>	<p>Execution and review</p>
<p>Test Method:</p> <ol style="list-style-type: none"> 1. The assigned test personnel will review the TDP to determine the declared capabilities of the system being tested. 2. The assigned test personnel will perform the PCA as required which includes documenting each system hardware and software component. 3. Election definitions will be created to cover all voting variations support by the system. This data will be input into test cases that will be utilized to baseline the system. 4. Following the manufacturer’s documented instruction, completes all steps necessary to perform the following steps: <ol style="list-style-type: none"> 1. Use EMS to input election definitions into the voting system 2. Print pre-election reports. 3. Load election media. 4. Load machines with election information. 5. Configure voting system for voting by opening polls and printing the zero report. 6. Input voting data as required by the test cases. 7. Perform actions required to close polls, perform precinct level tabulations, print totals report, and export the results. 8. Perform actions required to import all election results into the EMS/Central Tabulation. 9. Perform all steps necessary to import the totals, consolidate votes from all precinct components, finalize results, print all results, and print the audit log. 	
<p>Criteria for Evaluation of the Test Results: The voting system successfully completes the test with all actual results matching the expected results.</p>	

ELECTRICAL SUPPLY	
Test Objective: This test determines if the system under test meets the requirements for electrical supply.	Test Configuration: Normal field use.
Equipment:	Voting system configured for use.
Special Procedural Requirements:	None.
Assumptions:	None
Test Approach:	Execution.
<p>Test Method: Test Summary:</p> <p>This test demonstrates the ability of the system to meet the following standards:</p> <ol style="list-style-type: none"> 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. 	
<p>Criteria for Evaluation of the Test Results: The voting system successfully completes the test with all actual results matching the expected results.</p>	