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Job No. T57381.01
Certification Test Plan No. T57381.01-01, Rev. C
November 30, 2011

CERTIFICATION TEST PLAN

Prepared for:

Manufacturer Name	Dominion Voting Systems
Manufacturer System	Democracy Suite Version 4.0
EAC Application No.	**DVS1001**
Manufacturer Address	215 Spadina Avenue, Suite 200 Toronto, Ontario, Canada

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NVLAP LAB CODE 200771-0

U.S. Election Assistance Commission VSTL
EAC Lab Code 0704

WYLE LABORATORIES, INC.
Huntsville Facilities

wyle laboratories			**REPORT NO.** Test Plan T57381.01-01, Rev. C **DATE** November 30, 2011
REV	DATE	PAGE OR PARAGRAPH AFFECTED	DESCRIPTION OF CHANGES
---	4-19-11	Entire Document	Original Release
A	9-19-11	Entire Document	Complete Document Edit Based on EAC Comments
A	9-26-11	Section 1.0	Deleted second sentence due to redundancy.
A	9-26-11	Section 1.3.1.1	Corrected typo (changed "in" to "is").
A	9-26-11	Section 1.4.1	Removed "secure" from the second sentence of the second paragraph of the ICE description.
A	9-26-11	Section 1.4.1	Removed "safely" from the second sentence of the first paragraph of the ICP description.
A	9-26-11	Section 1.4.1	Added the following sentence to the second paragraph of the ICP description: There is no paper ballot or record produced when the ATI is utilized for voting.
A	9-26-11	Section 1.4.3	Provided definition for UPS and LAN and expanded description for EMS Express hardware configuration.
A	9-26-11	Section 1.4.7	Changed last sentence to read as follows: This testing is out of scope for this test campaign.
A	9-26-11	Section 2.0	Added Democracy Suite version 4.0 voting system to TDP description.
A	9-26-11	Section 2.2 and 2.2.1	Added reference to EAC RFI for summative usability reporting and corrected tense.
A	9-26-11	Section 3.2	Added "COTS equipment" to clarify manufacturer.
A	9-26-11	Section 4.1.2	Added "DRE" to second sentence of first paragraph.
A	9-26-11	Section 4.4.3	Second paragraph, second sentence, deleted "including entries for invalid data".

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REV	DATE	PAGE OR PARAGRAPH AFFECTED	DESCRIPTION OF CHANGES
A	9-26-11	Section 4.4.5	Deleted second sentence of second paragraph.
A	9-26-11	Section 4.5	Deleted first sentence in first paragraph and moved to previous section.
A	9-26-11	Section 4.5	Change "…they deem as valid" to "…that violate the standard" in the third sentence of the last paragraph.
A	9-26-11	Section 4.6	Restructured first sentence of first paragraph.
B	10-25-11	Section 1.4.5	Removed Open primary and ranked Choice Voting from supported functionality.
B	10-25-11	Section 6.2	Removed description for PRIM-02.
B	10-25-11	Section 1.3.1.4	Reworded section to provide additional information.
B	10-25-11	Section 1.4.3	Removed "(New York State)" from Table 1-2 and 1-3 titles and corrected title for Table 1-5.
B	10-25-11	Section 1.4.3, Tables 1-3 and 1-5	Changed column titles.
B	10-25-11	Section 1.4.4	Added Note: All stated languages will be verified to be supported; however, only English and Spanish ballots will be cast during functional testing.
B	10-25-11	Section 2.1	Added the following to the first sentence: "…as a complete system…" and additional wording to clarify testing.
B	10-25-11	Section 2.2	Added additional information on reuse of previous testing.
B	10-25-11	Section 2.3 and 2.3.1	Combined section and deleted Section 2.3.1.

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REV	DATE	PAGE OR PARAGRAPH AFFECTED	DESCRIPTION OF CHANGES
B	10-25-11	Section 4.1	Added "and/or evaluated" in Section 4 description.
B	10-25-11	Section 4.1.2	Reworded entire section to provide clarification on testing.
B	10-25-11	Section 4.2	Reworded entire section to provide clarification on testing.
B	10-25-11	Section 4.4.2	Deleted section and incorporated information into previous section.
B	10-25-11	Section 4.4.4	Reworded first paragraph.
B	10-25-11	Section 4.5	Deleted last sentence of first paragraph.
B	10-25-11	Section 4.8	Combined last two sentences and deleted reference to Appendix F.
B	10-25-11	Section 6.3.3	Provided additional information on Logic and Accuracy Test.
C	11-30-11	Section 2.1	Added additional information for re-use of prior VSTL testing.
C	11-30-11	Section 2.2	Added additional information for re-use of prior non-VSTL testing and usability testing.
C	11-30-11	Section 2.2.1	Deleted section and incorporated information into previous sections.
C	11-30-11	Section 4.1.2	Reworded section for clarification of not applicable requirements.
C	11-30-11	Section 4.2 and 4.4.1	Reworded paragraphs to provide clarification on components tested, previous state test effort, and third-party testing, and included Temperature Power test.
C	11-30-11	Section 6.2	Updated election descriptions.

wyle laboratories			**REPORT NO.** Test Plan T57381.01-01, Rev. C **DATE** November 30, 2011
REV	DATE	PAGE OR PARAGRAPH AFFECTED	DESCRIPTION OF CHANGES
C	11-30-11	Section 6.3.3	Reworded Volume/Stress/Reliability and Logic and Accuracy test descriptions.
C	11-30-11	Appendix A	Added Dominion Voting Systems Implementation Statement.
C	11-30-11	Appendix B	Added project schedule.
C	11-30-11	Appendix C	Added Usability reports.

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APPENDICES

1.0 INTRODUCTION

The purpose of this National Certification Test Plan (Test Plan) is to document the procedures that Wyle Laboratories, Inc., will follow to perform certification testing of the Dominion Voting Systems, Democracy Suite 4.0 System, to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (EAC 2005 VVSG). Prior to submitting the System for certification testing, Dominion Voting Systems submitted an application to the EAC for certification of the Democracy Suite 4.0 System to the requirements of the EAC 2005 VVSG.

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

1.1 References

The documents listed below were used in the development of the Test Plan and are utilized to perform certification testing.

- Election Assistance Commission 2005 Voluntary Voting System Guidelines, Volume I, Version 1.0, "Voting System Performance Guidelines", and Volume II, Version 1.0, "National Certification Testing Guidelines", dated December 2005
- Election Assistance Commission Testing and Certification Program Manual, Version 1.0, effective date January 1, 2007
- Election Assistance Commission Voting System Test laboratory Program Manual, Version 1.0, effective date July 2008
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2006 Edition, "NVLAP Procedures and General Requirements (NIST Handbook 150)", dated February 2006
- 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
- Wyle Laboratories' Test Guidelines Documents: EMI-001A, "Wyle Laboratories' Test Guidelines for Performing Electromagnetic Interference (EMI) Testing", and EMI-002A, "Test Procedure for Testing and Documentation of Radiated and Conducted Emissions Performed on Commercial Products"
- Wyle Laboratories' Quality Assurance Program Manual, Revision 4
- ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements"
- ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment"
- EAC Requests for Interpretation (listed on www.eac.gov)
- EAC Notices of Clarification (listed on www.eac.gov)
- EAC Quality Monitoring Program residing on:

  http://www.eac.gov/testing_and_certification/quality_monitoring_program.aspx

A listing of the Democracy Suite 4.0 System Technical Data Package (TDP) Documents submitted for this certification test effort is listed in Section 3.4: Deliverable Materials.

1.0 INTRODUCTION (CONTINUED)

1.2 Terms and Abbreviations

This subsection defines all terms and abbreviations applicable to the development of this Test Plan.

Table 1-1 Terms and Abbreviations

Term	Abbreviation	Definition
Americans with Disabilities Act of 1990 (Amended 2008)	ADA	ADA is a wide-ranging civil rights law that prohibits, under certain circumstances, discrimination based on disability.
EMS Audio Studio	AS	EMS application used to record audio files.
Audio Tactile Interface	ATI	Voter interface designed to not require visual reading of a ballot.
Conformité Européenne (European Conformity)	CE	---
Configuration Management	CM	---
Commercial Off the Shelf	COTS	Commercial, readily available hardware or software
Direct Record Electronic	DRE	---
United States Election Assistance Commission	EAC	Commission created per the Help America Vote Act of 2002, assigned the responsibility for setting voting system standards and providing for the voluntary testing and certification of voting systems.
EMS Election Event Designer	EED	EMS application used for election definition functionality.
Election Management System	EMS	The Election Management System equivalent for the Democracy Suite System.
Equipment Under Test	EUT	---
Functional Configuration Audit	FCA	Exhaustive verification of every system function and combination of functions cited in the manufacturer's documentation.
Federal Communications Commission	FCC	---
Help America Vote Act	HAVA	Act created by United States Congress in 2002.
National Institute of Standards and Technology	NIST	Government organization created to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhances economic security and improves our quality of life.
ImageCast Central	ICC	High-speed central ballot scan tabulator.
ImageCast Evolution	ICE	Precinct-level optical scanner, ballot marker, and tabulator with audio voting.
ImageCast Precinct	ICP	Precinct-level optical scanner and tabulator with audio voting capabilities.

1.0 INTRODUCTION (CONTINUED)

1.2 Terms and Abbreviations (continued)

Table 1-1 Terms and Abbreviations (continued)

Term	Abbreviation	Definition
Physical Configuration Audit	PCA	Review by accredited test laboratory to compare voting system components submitted for certification testing to the manufacturer's technical documentation, and confirmation the documentation meets national certification requirements. A trusted build of the executable system is performed to ensure the certified release is built from tested components.
Quality Assurance	QA	---
EMS Results, Tally and Reporting	RTR	EMS application used to integrate election results and reporting.
System Under Test	SUT	---
Test Case Procedure Specifications	TCPS	Wyle-developed document that specifies test items, input specifications, output specifications, environmental needs, special procedural requirements, inter-case dependencies, and all validated test cases that will be executed during the area under test.
Technical Data Package	TDP	Manufacturer documentation related to the voting system required to be submitted as a precondition of certification testing.
Underwriters Laboratories Inc.	UL	---
Uninterruptible Power Supply	UPS	---
Voluntary Voting System Guidelines	EAC 2005 VVSG	Published by the EAC, the third iteration of national level voting system standards.
Wyle Operating Procedure	WoP	Wyle Test Method or Test Procedure.

1.3 Testing Responsibilities

All core and non-core software and hardware certification testing will be conducted under the guidance of Wyle Laboratories, Inc., by personnel verified by Wyle to be qualified to perform the testing.

1.3.1 Project Schedule

This information is contained in a Wyle-generated Microsoft Project schedule. This schedule is presented in Appendix C "Dominion Voting Systems Project Schedule". The dates on the schedule are not firm dates but planned estimates presented for informational purposes.

1.3.1.1 Owner Assignments

This information is contained in a Wyle generated Microsoft Project schedule. This schedule is presented in Appendix C "Dominion Voting Systems Project Schedule".

1.0 INTRODUCTION (CONTINUED)

1.3 Testing Responsibilities (continued)

1.3.1 Project Schedule (continued)

1.3.1.2 Test Case Development

Wyle will utilize the "Wyle Baseline Test Cases" for the Functional Configuration Audit (FCA), Usability and System Integration Tests. These will be augmented with specially designed test cases tailored to the Dominion Voting Systems Democracy Suite 4.0. Wyle has designed specific election definitions for the Operational Status Check and the Logic & Accuracy Tests. The "Baseline" functional test cases, "Baseline" usability test cases, and the election definitions are being submitted as part of this test plan package.

Throughout the test campaign, Wyle will develop and submit to the EAC Test Case Procedure Specifications (TCPS) for major areas of testing. The TCPS documents, the test items, input specifications, output specifications, environmental needs, special procedural requirements, inter-case dependencies, and all validated test cases that will be executed for a given test.

1.3.1.3 Test Procedure Development and Validation

Wyle will utilize the Wyle Operating Procedures (WoPs) during the duration of this test program. These procedures are validated and are being submitted as part of the test plan package.

1.3.1.4 Third-Party Testing

Dominion Voting Systems also submitted five hardware test reports for the ICP unit. Wyle reviewed the reports and performed a comparison between the ICP version tested in the provided reports and the ICP version currently submitted for testing and concluded that a portion of the hardware testing for the ICP will be recommended for reuse to satisfy requirements for this testing campaign. Wyle determined that the ICP shall be subjected to the following hardware tests per the EAC 2005 VVSG: Electromagnetic Radiation, Electromagnetic Susceptibility, and all non-operational environmental testing. A listing of reports reviewed, and Wyle's evaluation of these reports is contained in Section 4.4.1 of this document.

Additionally, Wyle will be utilizing 3rd party testing to perform the product safety portion of the test campaign. Third party testing will be witnessed by Wyle personnel at MET Labs.

1.3.1.5 EAC and Manufacturer Dependencies

This information is contained in a Wyle generated Microsoft Project schedule. This schedule is presented in Appendix C "Dominion Voting Systems Project Schedule".

1.4 Target of Evaluation Description

The following sections address the design methodology and product description of the Democracy Suite 4.0 System, as taken from the Dominion Voting Systems technical documentation.

1.0 INTRODUCTION (CONTINUED)

1.4.1 Target of Evaluation Description (continued)

1.4.1 System Overview

The Dominion Voting Systems Democracy Suite 4.0 System is a paper-based optical scan voting system. The Democracy Suite 4.0 System consists of four major components: the Election Management System (EMS), ImageCast Evolution (ICE) precinct scanner and ballot marking device, ICP precinct scanner with audio ballot, and ImageCast Central (ICC) central count scanner.

Election Management System

The Dominion Voting Systems Democracy Suite 4.0 EMS consists of seven components running as either a front-end/client application or as a back-end/server application. Below is a list and brief description of each.

- Democracy Suite 4.0 EMS Election Event Designer client application - integrates election definition functionality and represents a main pre-voting phase end-user application.
- Democracy Suite 4.0 EMS Results Tally and Reporting client application - integrates election results acquisition, validation, tabulation, reporting and publishing capabilities and represents a main post-voting phase end-user application.
- Democracy Suite 4.0 EMS Audio Studio client application - represents an end-user helper application used to record audio files for a given election project. As such, it is utilized during the pre-voting phase of the election cycle.
- Democracy Suite 4.0 EMS Data Center Manager client application - represents a system level configuration application used in EMS back-end data center configuration.
- Democracy Suite 4.0 EMS Application Server server application - represents a server side application responsible for executing long running processes, such as rendering ballots, generating audio files and election files, etc.
- Democracy Suite 4.0 EMS Network Attached Storage (NAS) Server server application - represents a server side file repository for election project file based artifacts, such as ballots, audio files, reports, log files, election files, etc.
- Democracy Suite 4.0 EMS Database Server server application - represents a server side RDBMS repository of the election project database which holds all the election project data, including pre-voting and post-voting data.

Precinct Ballot Tabulator: ImageCast Evolution (ICE)

The ICE Ballot Counter device is a precinct-level, optical scan, ballot counter (tabulator) designed to perform six major functions**:**

- Ballot scanning
- Tabulation
- Ballot review
- Second chance voting
- Accessible voting
- Ballot marking

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.1 System Overview (continued)

The Dominion Democracy Suite ImageCast Evolution system employs a precinct-level optical scan ballot counter (tabulator) in conjunction with an external ballot box. This tabulator is designed to mark and/or scan paper ballots, interpret voting marks, communicate these interpretations back to the voter (either visually through the integrated LCD display or audibly via integrated headphones), and upon the voter's acceptance, deposit the ballots into the ballot box. The unit also features an Audio Tactile Interface (ATI) which permits voters who cannot negotiate a paper ballot to generate a synchronously human and machine-readable ballot from elector-input vote selections. In this sense, the ImageCast Evolution acts as a ballot marking device.

Photograph 1: ImageCast Evolution (ICE)

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.1 System Overview (continued)

Precinct Ballot Tabulator: ImageCast Precinct (ICP)

The ImageCast Precinct (ICP) Ballot Counter is a precinct-based optical scan ballot tabulator that is used in conjunction with ImageCast compatible ballot storage boxes. The system is designed to scan marked paper ballots, interpret voter marks on the paper ballot and store and tabulate each vote from each paper ballot. The ICP contains a small touch-screen LCD to allow the poll worker to access diagnostic and configuration settings.

In addition, enhanced accessibility voting may be accomplished via optional accessories connected to the ImageCast unit. The ICP utilizes an ATI device to allow voters with disabilities to navigate and submit a voted ballot. This is accomplished by presenting the ballot to the voter in an audio format. The ATI is connected to the tabulator, and allows the voter to listen to an audio voting session consisting of contest and candidate names. The ATI also allows a voter to adjust the volume and speed of audio playback. The cast vote record is recorded electronically when the ATI is used to cast a ballot. There is no paper ballot or paper record produced when the ATI is utilized for voting.

Photograph 2: ImageCast Precinct (ICP)

1.0 INTRODUCTION (CONTINUED)

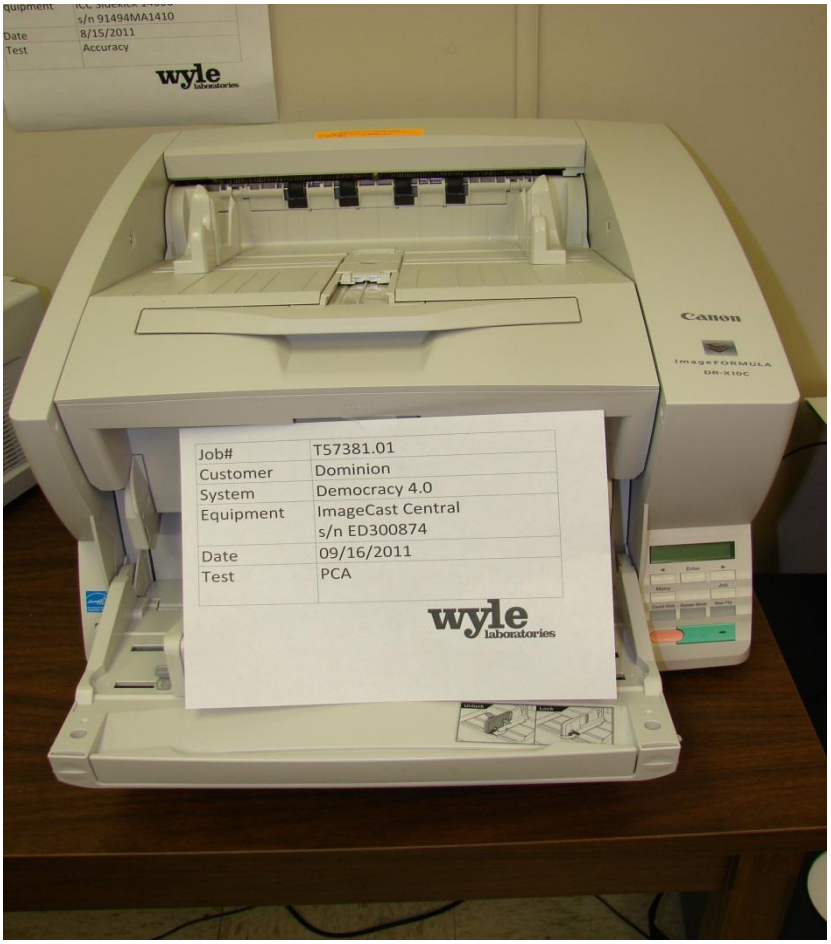
1.4 Target of Evaluation Description (continued)

1.4.1 System Overview (continued)

Central Tabulator: ImageCast Central Count (ICC)

The Dominion Democracy Suite ICC Ballot Counter system is a high-speed, central ballot scan tabulator based on Commercial off the Shelf (COTS) hardware, coupled with the custom-made ballot processing application software. It is used for high speed scanning and counting of paper ballots. Central scanning system hardware consists of a combination of two COTS devices used together to provide the required ballot scanning processing functionality:

- Canon DR-X10C Scanner: used to provide ballot scanning and image transfers to the local ImageCast Central Workstation.
- ImageCast Central Workstation: a COTS computer used for ballot image and election rules processing and results transfer to the EMS Datacenter. The ImageCast Central Workstation is a logical name for the Dominion pre-approved PC workstation hardware which executes the image processing and election rules software application.



Photograph 3: ImageCast Central Count (ICC)

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.2 Block Diagram

The entire system diagram is presented in Figure 1-1.

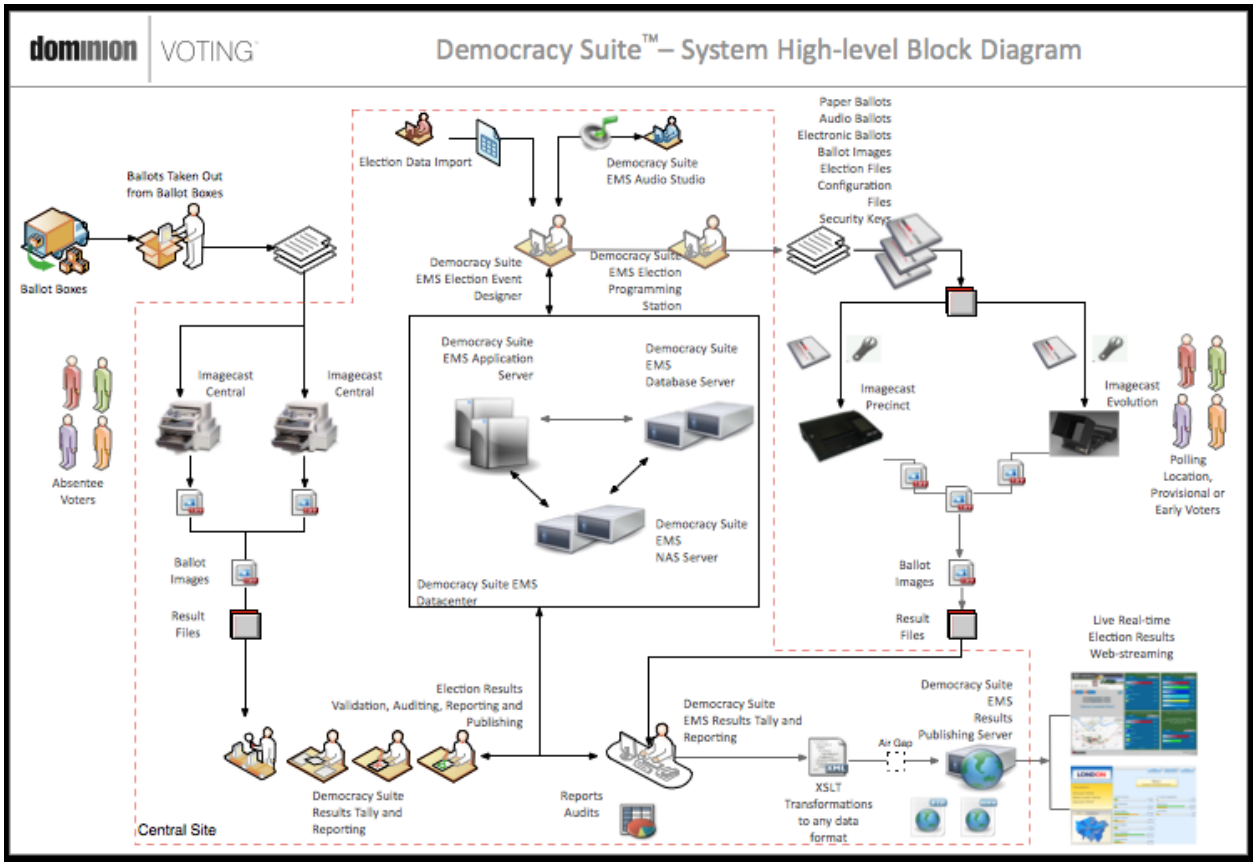


Figure 1-1 System Overview Diagram

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.3 System Limits

The EMS platform will be tested in all three deployable physical hardware configurations:

- EMS Express hardware configuration - all EMS software components are installed on a single physical PC or laptop. This is a standalone configuration.
- EMS Standard hardware configuration - the EMS server components are installed on a single physical server, in addition to the Universal Power Supply (UPS) and Local Area Network (LAN) switch devices, while the EMS client components are installed on one or more physical PCs or laptops. All system components are interconnected in a client-server local LAN environment.
- EMS Enterprise hardware configuration - represents a two-server configuration. In addition to the UPS and LAN network switch device, the EMS client components are installed on one or more physical PCs or laptops. All system components are interconnected in a client-server local LAN environment.

The system limits that Dominion Voting Systems has stated to be supported by the Democracy Suite 4.0 are compiled in the table below.

Table 1-2 Democracy Suite 4.0 System Limits for Landscape Ballot Style

Limit (Maximum Number of)	Value (by configuration)			Limiting Component
	Express	Standard	Enterprise	
Ballot Positions	292	292	292	22 Inch Landscape Ballot (240 candidates + 24 write-ins + 28 Yes/No choices)
Precincts in Election	250	1000	10000	Memory
Contests in Election	250	1000	4000	Memory
Candidates/Counters in Election	2500	10000	40000	Memory
Candidates/Counters in Precinct	240	240	240	22 Inch Landscape Ballot
Candidates/Counters in Tabulator	2500	10000	10000	Memory
Ballot Styles in Election	750	3000	30000	Memory
Contests in a Ballot Style	38	38	38	22 Inch Landscape Ballot (24 candidacy contests + 14 propositions)
Candidates in a Contest	240	240	240	22 Inch Landscape Ballot
Ballot Styles in a Precinct	5	5	5	Memory
Number of Parties	30	30	30	Memory
Vote For in Contest	24	24	24	22 Inch Landscape Ballot
Supported Languages per Election	5	5	5	Memory
Number of Write-ins	24	24	24	22 Inch Landscape Ballot

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.3 System Limits (continued)

Table 1-3 Democracy Suite EMS 4.0/ImageCast Ballot Target Limits for Landscape Ballot Style

Ballot Length	Maximum Positions (Row x Column)
11 Inch	11 x 9
14 inch	11 x 13
17 Inch	11 x 17
20 Inch	11 x 21
22 Inch	11 x 24

Table 1-4 Democracy Suite 4.0 System Limits for Portrait Ballot Style

Limit (Maximum Number of)	Value (by configuration)			Limiting Component
	Express	Standard	Enterprise	
Ballot Positions	462	462	462	22 Inch Portrait Ballot
Precincts in Election	250	1000	10000	Memory
Contests in Election	250	1000	4000	Memory
Candidates/Counters in Election	2500	10000	40000	Memory
Candidates/Counters in Precinct	462	462	462	22 Inch Portrait Ballot
Candidates/Counters in Tabulator	2500	10000	10000	Memory
Ballot Styles in Election	750	3000	30000	Memory
Contests in a Ballot Style	156	156	156	22 Inch Portrait Ballot
Candidates in a Contests	231	231	231	22 Inch Portrait Ballot (Column Span 3)
Ballot Styles in a Precinct	5	5	5	Memory
Number of Parties	30	30	30	No Limitation
Vote For in Contest	30	30	30	No Limitation
Supported Languages per Election	5	5	5	Memory
Number of Write-ins	462	462	462	22 Inch Portrait Ballot

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.3 System Limits (continued)

Table 1-5 Democracy Suite EMS 4.0/ImageCast Ballot Target Limits for Portrait Ballot Style

Ballot Length	Maximum Positions (Row x Column)
11 Inch	33 x 2
14 inch	45 x 3
17 Inch	57 x 3
20 Inch	69 x 3
22 Inch	77 x 3

1.4.4 Supported Languages

The following languages have been stated by Dominion Voting Systems to be supported by the Democracy Suite 4.0:

- Alaska Native
- Aleut
- Athabascan
- Eskimo
- Chinese
- Filipino
- French
- English
- Japanese
- Korean
- Vietnamese
- Spanish
- Native (other group specified)
    - Apache, Jicarilla, Keres, Navajo, Seminole, Towa, Ute, Yuman

Dominion Voting Systems also states that any language that has an ISO definition file can be supported by the Democracy Suite voting System.

Note: All stated languages will be verified to be supported; however, only English and Spanish ballots will be cast during functional testing. However Wyle will test 1 character based language (Chinese) during System Integration Testing.

1.0 INTRODUCTION (CONTINUED)

1.4 Target of Evaluation Description (continued)

1.4.5 Supported Functionality

The Democracy Suite 4.0 is designed to support the following voting variations:

- General Election
- Closed Primary
- Early Voting
- Partisan offices
- Non-Partisan offices
- Write-in voting
- Primary presidential delegation nominations
- Straight Ticket voting
- Split Precincts
- Ballot Rotation
- Vote for N of M
- Audio Ballot

As stated in the Supported Functionality Description, the Democracy Suite 4.0 System does not include functions for Cumulative Voting, Ranked Choice Voting (RCV), Open Primary, or Recall Issues; therefore, testing will not be conducted on these functions.

1.4.6 VVSG

The Democracy Suite 4.0 will be tested to all applicable EAC 2005 VVSG requirements. Please refer to the "2005 EAC Program Requirements Matrix" available online for further reference.

1.4.7 Beyond VVSG

Dominion Voting Systems submitted hardware test reports for Dust and Rain Tests on the ICP unit. This testing was performed during State-level certification effort. This testing is out of scope for this test campaign.

2.0 PRE-CERTIFICATION TESTING AND ISSUES

Currently, no pre-certification testing has been completed. Per EAC Notice of Clarification (NOC) 09-001, Wyle views the Certification Test Plan as a living document. It will be updated with "As Run" testing and resubmitted to the EAC as major areas of testing have been completed.

Wyle has performed the first pass review for all source code submitted by Dominion for the Democracy Suite version 4.0 voting system. The issues with compliance to the EAC 2005 VVSG were reported back to the manufacturer for resolution. Subsequent submissions will be reviewed by comparing the new submission against the last submission to ensure all documented issues are resolved before the source code review is completed.

2.0 PRE-CERTIFICATION TESTING AND ISSUES (CONTINUED)

An initial Technical Data Package (TDP) review was performed on the Dominion Democracy Suite version 4.0 voting system documents submitted as their TDP to determine compliance with the EAC 2005 VVSG and EAC requirements. Wyle found some documents were missing or included partial information, and the existing documentation contained information which was not consistent throughout the Dominion TDP. The results were reported to Dominion for resolution. Dominion has subsequently revised and resubmitted the TDP. Wyle is performing a review of these documents and will submit the results to Dominion as documented in Section 4.6 TDP Evaluation. Any incidences of non-certification issues (editing issues such as spelling or formatting) will be noted to Dominion as informational comments for them to decide whether to address them.

2.1 Evaluation of Prior VSTL Testing

The Dominion Voting Systems Democracy Suite 4.0 is a new voting system that has not been previously tested as a complete system to applicable federal standards in the EAC Program. It will be fully tested and the results will be submitted to the EAC in accordance with the requirements of the EAC Voting System Testing and Certification Manual, Section 4 Certification Testing and Technical Review. Wyle Laboratories performed testing to the EAC 2005 VVSG on the ICP-A configuration that consisted of an ICP unit, with firmware version 4.5.4, and a standalone EMS configuration, version 4.5 RC9, as part of a state test effort. Wyle will be utilizing the data obtained during that test effort to satisfy requirements for this test campaign for the following tests: Electrical, Environmental, Usability, Security, Maintainability, Availability, Safety, and Accuracy (performed via paper-based voting and audio voting sessions). More details of this evaluation are provided in Section 4.4.1 of this document.

2.2 Evaluation of Prior Non-VSTL Testing

Dominion Voting Systems has submitted an ICP and ICE summative usability report per EAC Request for Interpretation (RFI) 2007-03 "EAC Decision on Summative Usability Testing" for the Democracy Suite Version 4.0. Summative usability testing and submission to the VSTL is required by the manufacturer as part of the TDP. The testing focuses on the two components of the Democracy Suite that voters would use to cast and/or print and cast ballots – the ICE and the ICP. Participants in the test assumed the role of voters who cast ballots in person at a polling location as well as the tasks of testing the system used by the special needs voters who required auditory, visual or physical assistance to cast their vote.

2.3 Known Field Issues

This system has never been fielded in the configuration submitted for EAC 2005 VVSG certification testing. The ImageCast Precinct has been utilized in a small number of elections in New York State. There were no systemic or significant issues traceable to voting system performance.

3.0 MATERIALS REQUIRED FOR TESTING

The materials required for certification testing of the Democracy Suite 4.0 voting system include software, hardware, test materials, and deliverable materials to enable the test campaign to occur will be delivered by Dominion Voting Systems to Wyle.

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software

The tables below list the software the manufacturer must submit for testing. This section lists all software required for operation and testing of the voting system being certified. This includes software used for testing telecommunications, security and system integration; as well as supporting software required for the test environment including compilers, assemblers, and database managers, etc. Both COTS and non-COTS software components are listed in this section.

Table 3-1 Democracy Suite 4.0 EMS Software Platform Component Descriptions

Software Required For Testing	Software Version	Filename
Democracy Suite EMS EED Client Application	4.6	setup.exe: EED_FED_CERT.Setup.msi EED_FED_CERT.Setup_64b.msi
Democracy Suite EMS RTR Client Application	4.6	setup.exe: RTR_FED_CERT.Setup.msi RTR_FED_CERT.Setup_x64.Setup.msi
Democracy Suite EMS Application Server	4.6	setup.exe: EMSApplicationServer_FED_CERT.Setup.msi EMSApplicationServer_FED_CERT.Setup_x64.Setup.msi
Democracy Suite EMS File System Service	4.6	Setup.exe: DVS.Utilities.FileSystemServiceSetup.msi
Democracy Suite EMS Audio Studio Client Application	4.6	setup.exe: EMSAS2010_Setup.msi
Democracy Suite EMS Data Center Manager	4.6	DemocracySuiteEMS_DCM.exe
.NET Framework 3.5 Library	4.0	dotNetFx40_Full_x86_x64.exe
NetAdvantage for .NET 2008 Vol. 1 CLR 2.0	2008 Vol.1 CLR 2.0	NetAdvantage_WinForms_20081_CLR20_Product.exe (for details see document Components_3rdParty_1.0.xlsx)

Table 3-2 Democracy Suite 4.0 ImageCast Precinct Software Component Descriptions

Software Required For Testing	Software Version	Filename
Election Firmware	4.6.1-US	cf2xx.sig
Firmware Updater	4.6.1-US	firmUp.enc
Firmware Extractor	4.6.1-US	FirmwareExtract.enc
Kernel (uClinux)	4.6.1-US	Image.bin.gz
Boot Loader (COLILO)	20040221	colilo.bin

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-3 Democracy Suite 4.0 ImageCast Evolution Software Component Descriptions

Software Required For Testing	Software Version	Filename
VotingMachine	4.6.2	GApplication-4.6.2.vhd.7z
libAudio	0.3.7	libAudio-0.3.7.tar.bz2
MCFPGA	1.0.11	ice2_mc_p1.bit
SCFPGA	1.0.7	ice2_scb_p1.bit
Logo Platform	3.0.0	logo_platform.bmp
Logo OS	3.0.0	logo_os.bmp
Atmega Intrusion	1.0.9	logger.bin
Atmega Power	1.0.10	power.bin
Blob	1.2	mpc8347dvs.dtb
Integrated Printer	4.1.6	integratedPrinter.hex, printerFont.hex

Table 3-4 Democracy Suite 4.0 ImageCast Central Software Component Descriptions

Software Required For Testing	Software Version	Filename
ImageCast Central Application	4.0.tbd	ImageCast Central.exe
Image-Analysis DLL	4.0.tbd	ImgProc.dll

Table 3-5 Democracy Suite 4.0 EMS Software Platform Third Party Software Component Descriptions

Software Required For Testing	Software Version	Filename
NetAdvantage for .NET Windows Forms 2008 Subscription	2008 Vol.1 CLR 2.0	NetAdvantage_WinForms_20081_CLR20_Product.exe
TxText Control .NET Version 14	16.0	tx_1600_dotnetserver_sp1.zip
Cepstral Text-to-Speech Desktop Voices	5.1.0	Cepstral_Allison_windows_5.1.0.msi + 3 more voices

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-6 Democracy Suite 4.0 EMS Client Application Software Component Descriptions

Software Required For Testing	Software Version	Filename
Microsoft Windows 7 x64	6.1	Microsoft DVD provided
Windows Server 2008 R2 x64	6.1	Microsoft DVD provided
Microsoft SQL Server 2008 R2 x64 or Microsoft SQL Server 2008 Express R2 x64	10.0	Microsoft DVD provided
Microsoft .NET Framework 4.0	4.0	dotNetFx40_Full_x86_x64.exe
Microsoft Visual J# Redistributable 2.0 x64	2.0 x64	vjredist64.exe
Adobe Acrobat Reader 9.3 or higher	9.0	AdbeRdr930_en_US.exe
Dallas 1-Wire Device Driver version 4.0.3b x64	4.0	install_1_wire_drivers_x64_v403beta.msi
Cepstral Text-to-Speech Desktop Voices	5.1.0	Cepstral_Allison_windows_5.1.0.msi + 3 more voices
Java Runtime Environment 6.0	6.0	jre-6u18-windows-x64.exe
Microsoft IIS 7.5	7.5	Microsoft DVD provided

Table 3-7 Democracy Suite 4.0 EMS Software Platform Unmodified COTS Components Descriptions

Software Required For Testing	Software Version	Filename
TX Text Control Library for .NET	16.0	tx_1600_dotnetserver_sp1.zip (for details see document Components_3rdParty_1.0.xlsx)
OneWire API for .NET	4.0.2.0	OneWireAPI.NET.dll (for details see document Components_3rdParty_1.0.xlsx)
SOX – audio converter application	14.3.1	sox.exe (for details see document Components_3rdParty_1.0.xlsx)
Log4net	1.2.10	log4net.dll, log4net.xml (for details see document Components_3rdParty_1.0.xlsx)
NLog – log library	1.0.0.505	NLog.dll (for details see document Components_3rdParty_1.0.xlsx)

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-7 Democracy Suite 4.0 EMS Software Platform Unmodified COTS Components Descriptions (continued)

Software Required For Testing	Software Version	Filename
Cepstral Text-to-Speech	5.1.0	Cepstral_Allison_windows_5.1.0.msi + 3 more voices (for details see document Components_3rdParty_1.0.xlsx)
iTextSharp – pdf generation library	4.0.3	itextsharp.dll (for details see document Components_3rdParty_1.0.xlsx)
openssl.exe, libeay32.dll, ssleay32.dll	1.2	openssl.exe, lebeay32.dll, ssleay32.dll (for details see document Components_3rdParty_1.0.xlsx)
SQLite	1.0.65.0	System.Data.SQLite.DLL 32-bit and 64-bit (for details see document Components_3rdParty_1.0.xlsx)
Lame	3.98	System.Data.SQLite.DLL 32-bit and 64-bit (for details see document Components_3rdParty_1.0.xlsx)
Speex	1.0.4	speexdec.exe and speexenc.exe (for details see document Components_3rdParty_1.0.xlsx)
Ghostscript	8.71	gsdll32.dll – both 32-bit and 64-bit (for details see document Components_3rdParty_1.0.xlsx)
PdfToImage.dll	1.2	PdfToImage.dll (for details see document Components_3rdParty_1.0.xlsx)
Tamir.SharpSSH.dll, DiffieHellman.dll, Org.Mentalis.Security.dll – Cryptography	SharpSSh package 1.1.1.13	Tamir.SharpSSH.sll, Diffie.Hellman.dll, Org.Mentalis.Security.dll (for details see document Components_3rdParty_1.0.xlsx)

Table 3-8 Democracy Suite 4.0 ImageCast Precinct Unmodified COTS Software Component Descriptions

Software Required For Testing	Software Version	Filename
PNG Reference Library	1.2.24	libpng-1.2.24.tar.gz
OpenSSL	1.1.2	Openssl-fips-1.1.2.tar.gz
Zlib	1.2.3	Zlib-1.2.3.tar.gz

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-9 Democracy Suite 4.0 ImageCast Evolution Unmodified COTS Software Component Descriptions

Software Required For Testing	Software Version	Filename
apache-log4cxx	0.10.0	apache-log4cxx-0.10.0.tar.gz
apr	1.4.4	apr-1.4.4.tar.bz2
apr-util	1.3.11	apr-util-1.3.11.tar.bz2
autoconf	2.57	autoconf-2.57.tar.bz2
bison	2.3	bison-2.3.tar.bz2
busybox	1.18.5	busybox-1.18.5.tar.bz2
ccache	2.4	ccache-2.4.tar.gz
cksum	19990607	cksum-19990607.tar.gz
cramfs	20081121	cramfs-20081121.tar.gz
distcc	2.18.3	distcc-2.18.3.tar.bz2
dtc	1.2.0	dtc-1.2.0.tar.gz
e2fsprogs	1.41.14	e2fsprogs-1.41.14.tar.gz
expat	2.0.1	expat-2.0.1.tar.gz
flex	2.5.33	flex-2.5.33.tar.gz
fontconfig	2.8.0	fontconfig-2.8.0.tar.gz
freetype	2.4.4	freetype-2.4.4.tar.bz2
genext2fs	1.4.1	genext2fs-1.4.1.tar.gz
gen_init_cpio	2.6.25-rc7	gen_init_cpio-2.6.25-rc7.tar.gz
genromfs	0.5.1	genromfs-0.5.1.tar.gz
git	1.5.6.5	git-1.5.6.5.tar.gz
glibc	2.13	glibc-2.13.tar.bz2
glibc-ports	2.13	glibc-ports-2.13.tar.bz2
i2c-tools	3.0.3	i2c-tools-3.0.3.tar.bz2
jpegsrc	v8c	jpegsrc.v8c.tar.gz
libogg	1.2.2	libogg-1.2.2.tar.gz
libpng	1.5.4	libpng-1.5.4.tar.gz
libtool	1.5	libtool-1.5.tar.gz
libusb	1.0.8	libusb-1.0.8.tar.bz2

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-9 Democracy Suite 4.0 ImageCast Evolution Unmodified COTS Software Component Descriptions (continued)

libusb-compat	0.1.3	libusb-compat-0.1.3.tar.bz2
linux	2.6.30.9	linux-2.6.30.9.tar.bz2
lkc	1.4	lkc-1.4.tar.gz
mkspooflinks	3.4	mkspooflinks-3.4.tar.gz
mtd-utils	20060302	mtd-utils-20060302.tar.bz2
mux_server		mux_server.c
openssl-fips	1.2.3	openssl-fips-1.2.3.tar.gz
pkg-config	0.21	pkg-config-0.21.tar.gz
ppp	2.4.5	ppp-2.4.5.tar.gz
qt-everywhere	4.7.3	qt-everywhere-opensource-src-4.7.3.tar.gz
skell	1.19	skell-1.19.tar.gz
soundtouch	1.5.0	soundtouch-1.5.0.tar.gz
sparse	0.4	sparse-0.4.tar.gz
speex	1.2rc1	speex-1.2rc1.tar.gz
sqlite	3.7.7.1	sqlite-autoconf-3070701.tar.gz
sysfsutils	2.1.0	sysfsutils-2.1.0.tar.gz
texinfo	4.8	texinfo-4.8.tar.bz2
tiff	3.9.5	tiff-3.9.5.tar.gz
tunctl	1.5	tunctl-1.5.tar.gz
tzcode	2011g	tzcode2011g.tar.gz
tzdata	2011h	tzdata2011h.tar.gz
u-boot-tools	1.1.6	u-boot-tools-1.1.6.tar.bz2
unifdef	1.0	unifdef-1.0.tar.gz
usb-modeswitch	1.1.7	usb-modeswitch-1.1.7.tar.bz2
usb-modeswitch-data	20110227	usb-modeswitch-data-20110227.tar.bz2
wget	1.9.1	wget-1.9.1.tar.gz
yaffs_utils	20060418	yaffs_utils-20060418.tar.gz
zlib	1.2.5	zlib-1.2.5.tar.bz2
rpm	4.0.4	rpm-4.0.4.tar.gz

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-10 Democracy Suite 4.0 - ImageCast Central Build Environment Software Build Components (Unmodified COTS)

Software Required For Build	Software Version	Filename
Windows 7	Home Premium	OEM installed, or full CD from Microsoft
Visual Studio	2005	Full CD from Microsoft

Table 3-11 Democracy Suite 4.0 - ImageCast Central Build Environment Setup Software Utilities (Unmodified COTS)

Software Required For Build	Software Version	Filename
7-Zip	9.20	7z920.exe
Active Perl 64-bit	5.12.4.1205	ActivePerl-5.12.4.1205-MSWin32-x64-294981.msi
Active Perl 32-bit	5.12.4.1205	ActivePerl-5.12.4.1205-MSWin32-x86-294981.msi
Nasm	2.09.07	nasm-2.09.07-win32.zip

Table 3-12 Democracy Suite 4.0 - ImageCast Central Software Build Library Source Code (Unmodified COTS)

Software Required For Build	Software Version	Filename
OpenSSL	Fips 1.2.3	openssl-fips-1.2.3.tar.gz

Table 3-13 Democracy Suite 4.0 - ImageCast Central Runtime Software Components (Unmodified COTS)

Software Required For Testing ICC application	Software Version	Filename
Imgcomp.dll	2.11	apiman.zip
1 Wire driver 64-bit	4.03	install_1_wire_drivers_x64_v403.msi
1 Wire driver 32-bit	4.03	install_1_wire_drivers_x86_v403.msi
Kofax VRS	4.50	Full CD from Kofax
Canon Scanner driver	1.8	X10DRIT_V18.exe
VCredist	4/10/2006	vcredist_x86.exe

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-14 Democracy Suite 4.0 ImageCast Precinct Modified COTS Software Component Descriptions

Software Required For Testing	Software Version	Filename
uClinux	20070130	uClinux-dist-20070130.tar.gz
COLILO Boot Loader	20040221	Colilo20040221.tar.gz

Table 3-15 Democracy Suite 4.0 ImageCast Evolution Modified COTS Software Component Descriptions

Software Required For Testing	Software Version	Filename
Kernel	2.6.30.9-dvs-8	uImage
U-BOOT	1.3.4.19	u-boot.bin

Table 3-16 Democracy Suite 4.0 EMS Software Build Environment Component Descriptions

Software Required For Testing	Software Version	Filename
Microsoft Windows Server 2008 R2 x64	6.1	Microsoft DVD provided
.NET Framework	4.0	dotNetFx40_Full_x86_x64.exe
Microsoft Visual J# 2.0 Redistributable	2.0 x64	vjredist64.exe
Microsoft Visual Studio 2010	10.0	Microsoft DVD provided (Microsoft patch KB2286556 VS10-KB2286556-x86.exe has to be installed)
Microsoft Visual Studio 2010 Service Pack 1	10.0.30319 SP1	VS2010SP1dvd1.iso
Cruise Control	1.5	CruiseControl.NET-1.5.7256.1-Setup
Nant	0.90	nant-0.90-bin.zip
Csunit	2.1.1	csUnit.2.1.1.BETA.setup
7-Zip	9.20 x64	7z920-x64.msi
NetAdvantage Infragistics	2008 Vol.1 CLR 2.0	NetAdvantage_WinForms_20081_CLR20_Product.exe
Tx Text Control 16.0.NET	16.0	tx_1600_dotnetserver_sp1.zip
Adobe Acrobat Reader 9.3 or higher	9.3	AdbeRdr930_en_US.exe
ImgBurn 2.5 or higher	2.5.1.0	SetupImgBurn_2.5.0.0.exe

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.1 Software (continued)

Table 3-17 Democracy Suite 4.0 ImageCast Precinct Election Firmware Compiler Descriptions

Software Required For Testing	Software Version	Filename
g++ (GNU C++ compiler)	gcc3.4.0-20040603	m68k-uclinux-tools-c++-gcc3.4.0-20040603.sh

Table 3-18 Democracy Suite 4.0 ImageCast Evolution Election Firmware Compiler Descriptions

Software Required For Testing	Software Version	Filename
g++ (GNU C++ compiler)	gcc-4.5.55-eglibc-2.11.55	freescale-powerpc-linux-gnu-2010.09-55.i686.rpm

Table 3-19 Democracy Suite 4.0 ImageCast Precinct Firmware Build Environment Component Descriptions

Software Required For Testing	Software Version	Filename
Ubuntu 10.04 LTS – Long-term support	10.04	ubuntu-10.04.2-desktop-amd64.iso
Toolchain Installation Script	N/A	Toolchain.sh
m68k uClinux tools base gcc	3.4.0-20040603	m68k-uclinux-tools-base-gcc3.4.0-20040603.sh
m68k uClinux tools c++ gcc	3.4.0-20040603	m68k-uclinux-tools-c++-gcc3.4.0-20040603.sh
m68k uClinux tools gdb	20040603	m68k-uclinux-tools-gdb-20040603.sh
OpenSSL	1.1.2	Openssl-fips-1.1.2.tar.gz

Table 3-20 Democracy Suite 4.0 ImageCast Evolution Firmware Build Environment Component Descriptions

Software Required For Testing	Software Version	Filename
Ubuntu	10.04 LTS	ubuntu-10.04.2-desktop-i386.iso
LTIB	10.1.1a	ltib-10-1-1a-sv.tar.gz
g++ (GNU C++ compiler)	gcc-4.5.55-eglibc-2.11.55	freescale-powerpc-linux-gnu-2010.09-55.i686.rpm

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.2 Equipment

This subsection categorizes the equipment the manufacturer has submitted for testing. Each test element is included in the list of the equipment required for testing of that element, including system hardware, general purpose data processing and communications equipment, and any required test instrumentation.

Every effort is made to verify that the COTS equipment has not been modified for use. Wyle will perform research using the COTS equipment manufacturers' websites based on the serial and service tag numbers for each piece of equipment and will evaluate COTS hardware, system software and communications components for proven performance in commercial applications other than elections. For PCs, laptops, and servers, the service tag information is compared to the system information found on each machine. Physical external and internal examination is also performed to the best of Wyle's abilities when the equipment is easily accessible without the possibility of damage. Hard drives, RAM memory, and other components are examined to verify that the components match the information found on the COTS equipment manufacturers' websites.

The manufacturer provided the hardware listed in Table 3-21 for the purpose of testing three documented system configurations: Enterprise, Standard, and Express. This hardware consists of PCs, Application/Database Servers, encrypted Network Attached Storage (NAS) servers, and ruggedized encrypted portable hard drives.

The system configurations consist of:

- **Enterprise:** (2) PCs, (1) Application Servers, (1) Database Servers, (1) encrypted NAS for Application Server, (1) encrypted NAS for Database Server
- **Standard:** (1) PC, (1) Application Server/ Database Server, (1) encrypted NAS for Application/Database Server
- **Express:** (1) PC and (1) Portable Hard Drive

Table 3-21 Democracy 4.0 Voting System Equipment Description

Equipment	Manufacturer	Version/Model	Specifications	Serial Number
PC1	Dell	Precision T1500	Processor: Intel Core i7-860 2.8 GHz, Memory: 4x 1GB 1333MHz DDR3, Hard Drive Capacity: 500 GB	61VNNM1
PC2	Dell	Precision T1500	Processor: Intel Core i7-860 2.8 GHz, Memory: 4x 1GB 1333MHz DDR3, Hard Drive Capacity: 500 GB	61TPNM1
PC3	Dell	Precision T1500	Processor: Intel Core i7-860 2.8 GHz, Memory: 4x 1GB 1333MHz DDR3, Hard Drive Capacity: 500 GB	61YMNM1
PC4	Dell	Precision T1500	Processor: Intel Core i7-860 2.8 GHz, Memory: 4x 1GB 1333MHz DDR3, Hard Drive Capacity: 500 GB	61TNNM1

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.2 Equipment (continued)

Table 3-21 Democracy 4.0 Voting System Equipment Description (continued)

Equipment	Manufacturer	Version/Model	Specifications	Serial Number
PC5	Dell	Inspiron One 2305	Processor: AMD Athlon II X2 240e 2.8 GHz, Memory: 8GB Dual Channel 1333MHz DDR3, Hard Drive Capacity: 1 TB	564C3P1
SERVER1	Dell	PowerEdge R610	Processor: Intel Xeon E5620 2.4 GHz, Memory: 8x 2GB 1333MHz DDR3, Hard Drive Capacity: 2x 500 GB	5M9NNM1
SERVER2	Dell	PowerEdge R610	Processor: Intel Xeon E5620 2.4 GHz, Memory: 8x 2GB 1333MHz DDR3, Hard Drive Capacity: 2x 500 GB	5M8PNM1
SERVER3	Dell	PowerEdge R610	Processor: Intel Xeon E5620 2.4 GHz, Memory: 8x 2GB 1333MHz DDR3, Hard Drive Capacity: 2x 500 GB	5M8QNM1
STORAGE1	Rocstor	Guardian 4RM Raid System	Disk space: 2 TB (Striped + Mirrored), Processor: 400 MHz storage I/O, Hot bus interface: eSATA, Drive bus interface: SATA II	ROC7326210 47/SB090101 54
STORAGE2	Rocstor	Guardian 4RM Raid System	Disk space: 2 TB, Processor: 400 MHz storage I/O, Hot bus interface: eSATA, Drive bus interface: SATA II	ROC7326210 45/SB090101 57
STORAGE3	Rocstor	Guardian 4RM Raid System	Disk space: 2 TB, Processor: 400 MHz storage I/O, Hot bus interface: eSATA, Drive bus interface: SATA II	ROC7326210 46/SB090101 61
STORAGE4	Rocstor	Commander 2UE Portable Hard Drive	Hard Drive Capacity: 500 GB	5VJ4DRJP
STORAGE5	Rocstor	Commander 2UE Portable Hard Drive	Hard Drive Capacity: 500 GB	5VJ48VFJ

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.2 Equipment (continued)

In order to perform the software Witness and Trusted Builds, one Personal Computer has been provided as a build machine. The build machine is described in the table below:

Table 3-22 Build Machine Description

Equipment	Manufacturer	Version/Model	Serial Number	COTS/ Non-COTS
Build 1	Super Micro PC w/4 Hard Drives	PC w/4 Hard Drives	BM-57381-001	COTS

To support the test program, Dominion has provided additional supporting hardware for the provided Personal Computers. A list of these items is provided in Table 3-23.

Table 3-23 Dominion 4.0 COTS Voting System Support Equipment Description

Test Material	Make	Model	Quantity	Serial Number
COTS Central High Speed Scanner	Canon	DR-X10C	2	ED300874, ED300880
iButton (SHA-1) with USB Reader/Writer	Maxim	USB R/W: DS9490R iButton: DS1963S	3	4D027C, 4C9CF5, 514DFD
iButton (SHA-1)	Maxim	DS1963S	2	4CE4C9, 4D064A
LCD Monitor	Soyo	18.5” wide LCD	1	DYLM19R6-KLE-10202
LCD Monitor	Samsung	23” wide LCD	1	MY23HVMS701197B
LCD Monitor	Dell	1909W	4	07E-4EUS, 07F-071S, 07F-06US, 07F-074S
LCD Monitor	Dell	N445N	3	2TWC, 2UOC, 2U6C
Audio Adapter	Soundwave	USB Soundwave 7.1 Audio Adapter	2	SW-57381-001, SW-57381-002
PCI Software	Soundwave	Soundwave 7.1 PCI Software	2	n/a
USB Software	Soundwave	USB Soundwave 7.1 Software	1	n/a
Networking Switch	D-Link	D-Link DES-1105 5-Port Switch	1	DRL728A001397
Mouse	Dell	USB w/rollerball	4	G1A00M0M, 10203JTI, LZA30491960, 438027372
Mouse	Microsoft	USB w/rollerball	1	X800898
Keyboard	Kensington	USB	1	D0713000487
Keyboard	Microsoft	USB	1	6968200717217

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.2 Equipment (continued)

Table 3-23 Dominion 4.0 COTS Voting System Support Equipment Description

Test Material	Make	Model	Quantity	Serial Number
Keyboard	IBM	USB	1	2162079
Compact Flash Reader	SanDisk	USB	3	0171618, 0201833, 0171631
Networking Switch	D-Link	DGS-2208 8-Port Switch	2	F36J69C004821, F36J69C004824
Headphones	Radio Shack	33-276-01	1	Headphones
eSATA PCI Card (Installed into Servers and PCs)	SIIG, Inc.	eSATA II PCIe Pro Card	7	n/a
Card Reader	GGI Gear	Compact Flash Card Reader	4	CFRW-57381-001 thru 004
Sony	Headphone	MDR-G45LP-01	1	Sony
Cyber Acoustics Headphone	Cyber Acoustics	ACM-70	2	DVS23000048

Table 3-23 Dominion 4.0 COTS Voting System Support Equipment Description

Test Material	Make	Model	Quantity	Serial Number
Sip & Puff	Origin Instruments	Air Voter	7	AV-57381-001 thru 003, 002251, 002268, 002267
Footswitch Pair	4	Kinesis	4	FS-57381-001 thru 004
Buddy Button 5700 Series Pair	1	Tash	1	BB-57381-001
#970 Armrest Sip & Puff Attachment	6	Enabling Devices	6	AR-57381-001 thru 006
Compact Flash	RiData	CFC-14A	50	Wyle-assigned numbers: CF-XXX

The table below provides the serial numbers of the equipment submitted for testing:

Table 3-24 Democracy 4.0 Voting System Equipment

Equipment	Description	Serial Numbers
ICP	Precinct Count Optical Scanner PCOS 320A	WLDAFBH0001, WLDAFBH0002, WLDAFBH0004, WLDAFBH0005, WLDAFBH0018, WLDAFBH0019, WLDAFBH0023
ICE	Precinct Count Optical Scanner PCOS 400A	ICE2P1005, ICE2P1006, ICE2P1007, ICE2P1008
ICP Ballot Box	Externally secure ballot box	BOX-57381-011, BOX-57381-012, BOX-57381-013, BOX-57381-014,
ICE Ballot Box	Externally secure ballot box	BOX-57381-01, BOX-57381-02, BOX-57381-03, BOX-57381-04,

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.3 Test Support Materials

This subsection enumerates any and all test materials needed to perform voter system testing. The scope of testing determines the quantity of a specific material required.

The following test materials are required to support the Democracy Suite 4.0 certification testing:

Table 3-25 Democracy Suite 4.0 Test Support Materials

Test Material	Quantity	Make	Model
Hasp Locks (red)	50	N/A	N/A
Tamper Evident Seals	50	N/A	SE-37
Disposable Gloves	3	N/A	N/A
Gloves and Mouthpiece Kit	17	N/A	N/A
Green and White Mouthpiece Kit	5	N/A	N/A
Black and Clear Mouthpiece	1	N/A	N/A
ATI Handsets	12	Dominion	ATI-57381-001 thru 012
Black Ballot Privacy Sleeves	4	Dominion	N/A
White Ballot Privacy Sleeves	4	Dominion	N/A
Black Privacy Panels (set of 2 pieces)	4	Dominion	N/A
White Privacy Panels	4	Dominion	N/A
Thermal Printer Rolls	100	N/A	N/A
Combination Lock	2	MASTER Lock	646T
Keyed Lock	4	MASTER Lock	121Q
Security Keys	50	Maxim	N/A
Ballots	2000	Dominion	N/A
Dominion Cleaning Kit	1	Dominion	N/A
Permanent Markers	20	p/n SHARPIE1 BK	N/A

3.4 Deliverable Materials

The materials listed below are to be delivered as part of the Democracy 4.0 System to the users:

Table 3-26 Deliverable Materials

Deliverable Material	Version	Description
Election Event Designer	4.6	EMS client application
Results Tally and Reporting	4.6	EMS client application
Audio Studio	4.6	EMS client application
Application Server	4.6	EMS server application
Datacenter Manager	4.6	EMS server application
ImageCast Evolution	400A w/Firmware version 4.1.3.2 loaded	Precinct ballot scanner and ADA accessible voting device
ImageCast Precinct	320A w/Firmware version 4.5.4 loaded	Precinct ballot scanner and ADA accessible voting device

3.0 MATERIALS REQUIRED FOR TESTING (CONTINUED)

3.4 Deliverable Materials (continued)

Table 3-26 Deliverable Materials (continued)

Deliverable Material	Version	Description
ImageCast Central Count	Canon DR-X10C w/Firmware version 4.0.26 loaded	Central ballot scanner
ImageCast Evolution Metal Ballot Box	BOX-400A	ICE Metal Ballot box
ImageCast Evolution Plastic Ballot Box	BOX-410A	ICE Plastic Ballot box
ImageCast Precinct Metal Ballot Box	BOX-310A	ICP Metal Ballot box
ImageCast Precinct Plastic Ballot Box	BOX-330A	ICP Plastic Ballot box
Rocstor Encrypted NAS	Dell PowerEdge R610	Encrypted Network Attached Storage module for server and data backup
Rocstor Portable Hard Drive	Rocstor Commander 2UE Portable Hard Drive	Encrypted and ruggedized external hard drive
iButton with Reader/Writer	Maxim USB R/W: DS9490R iButton: DS1963S	Security authentication token with programmer
Gigabit Network Switch	D-Link DGS-2208 8-Port Switch	Network switch for enterprise configuration
ICE/ICP Headphones	Cyber Acoustics	Headphones used for audio voting
Sip/Puff Device	Origin Instruments Air Voter	Binary input device for disabled voters
ICP System Operation Procedures	1.1.0::120	TDP Document
EMS System Operation Procedures	1.2.0::282	TDP Document
ICE System Operation Procedures	1.0.0::45	TDP Document
ICC System Operation Procedures	1.1.0::49	TDP Document
ICP System Maintenance Manual	1.1.0::30	TDP Document
ICE System Maintenance Manual	1.1.0::56	TDP Document
Election Event Designer User's Guide	1.2.7	TDP Document
Results Tally and Reporting User's Guide	1.2.4	TDP Document
Audio Studio User's Guide	1.2.1	TDP Document

4.0 TEST SPECIFICATIONS

Certification testing of the Democracy Suite 4.0 is the configuration submitted in the EAC application DVS-1001. Wyle qualified personnel will ensure that all certification testing performed on the manufacturer's voting system follows Wyle's procedures for testing and the specific test cases to ensure the requirements of the EAC 2005 VVSG and EAC Testing and Certification Program Manual are met.

Below is a list of EAC Request for Interpretations (RFI) and Notice of Clarifications (NOC) that will be incorporated in the test campaign:

Interpretations

2010-08 EAC Decision on Calling Sequence

2010-07 EAC Decision on Module Length

2010-06 EAC Decision on DRE Accessibility Requirements and Other Accessible Voting stations

2010-05 EAC Decision on Testing of Modifications to a Certified System

2010-04 EAC Decision on Functional Requirements with Respect to Security

2010-03 EAC Decision on Database Coding Conventions

2010-01 EAC Decision on Voltage Levels and ESD Test

2009-06 EAC Decision on Temperature and Power Variation

2009-05 EAC Decision on T-Coil Requirements

2009-04 EAC Decision on Audit Log Events

2009-03 EAC Decision on Battery Backup for Central Count Systems

2009-02 EAC Decision on Alternate Languages

2009-01 EAC Decision on VVPAT Accessibility New

2008-12 EAC Decision on Ballot Marking Device/Scope of Testing

2008-10 EAC Decision on Electrical Fast Transient

2008-09 EAC Decision on Safety Testing

2008-08 EAC Decision on Automatic Bar Code Readers

2008-07 EAC Decision on Zero Count to Start Election

2008-06 EAC Decision on Battery Backup for Central Count

2008-05 EAC Decision on Durability

2008-04 EAC Decision on Supported Languages

2008-03 EAC Decision on OS Configuration

2008-02 EAC Decision on Battery Backup for Optical Scan Voting Machines

2008-01 EAC Decision on Temperature and Power Variation

2007-06 EAC Decision on Recording and Reporting Undervotes

2007-05 EAC Decision on Testing Focus and Applicability

2007-04 EAC Decision on Presentation of Alternative Language

4.0 TEST SPECIFICATIONS (CONTINUED)

2007-03 EAC Decision on Summative Usability Testing

2007-02 EAC Decision on Variable Names

2007-01 EAC Decision on Accessible Design

Notice of Clarifications

NOC 09-005 – Development and Submission of Test Plans for Modifications to EAC Certified Systems

NOC 09-004 – Development and Submission of Test Reports

NOC 09-003 – De Minimis Change Determination Requirement

NOC 09-002 -- Laboratory Independence Requirement

NOC 09-001 -- Requirements for Test Lab Development and Submission of Test Plans

NOC 08-003 -- EAC Conformance Testing Requirements

NOC 08-002 -- EAC Mark of Certification

NOC 08-001 -- Validity of Prior Non-core Hardware Environmental and EMC Testing

NOC 07-005 -- Voting System Test Laboratory Responsibilities in the Management and Oversight of Third Party Testing

NOC 07-004 -- Voting System Manufacturing Facilities

NOC 07-003 -- State Testing Done in Conjunction with Federal Testing within the EAC Program

NOC 07-002 -- VSTL Work with Manufacturers Outside of Voting System Certification Engagements

NOC 07-001 -- Timely Submission of Certification Application

4.1 Requirements (Strategy of Evaluation)

To evaluate the system test requirements, each section of the EAC 2005 VVSG will be analyzed to determine the applicable tests. The EAC 2005 VVSG Volume I Sections, along with the strategy for evaluation, are described below:

- **Section 2: Functional Requirements** – The requirements in this section will be tested during the FCA and System Integration test utilizing the "Wyle Baseline Test Cases" along with test cases specially designed for the Dominion Democracy Suite 4.0 per sections 4.4.3 and 4.4.5. The data input during these tests will be the predefined election definitions submitted as part of the Test Plan Package.
- **Section 3: Usability and Accessibility** – The requirements in this section will be tested during the Usability Test utilizing a combination of the "Wyle Baseline Test Cases" and the "Wyle Baseline Usability Test Cases". The data input during this test will be the predefined election definitions submitted as part of the Test Plan Package.
- **Section 4: Hardware Requirements** – The requirements in this section will be tested and/or evaluated by trained Wyle personnel per sections 4.4.2 and the table in section 6.
- **Section 5: Software Requirements** – The requirements in this section will be tested during source code review, TDP review, and FCA. A combination of review and functional testing will be performed to ensure these requirements are met.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.1 Requirements (Strategy of Evaluation) (continued)

- **Section 6: Telecommunication** – A test of the telecommunication technologies utilized by the Dominion Democracy Suite 4.0 will be tested for data accuracy and correctness by analyzing the packet level information being transmitted. Section 6.2.6 will be excluded since the Democracy Suite 4.0 does not support the use of public networks.
- **Section 7: Security Requirements** – The requirements in this section will be tested during source code review, FCA, System Integration, and Security Tests. In addition to functional testing, the source code for the Dominion Democracy Suite 4.0 will be analyzed utilizing Fortify ™ Source Code Analysis (SCA) for security vulnerabilities in addition to the manual line by line review.
- **Section 8: Quality Assurance (QA) Requirements** – The requirements in this section will be tested throughout the test campaign via various methods. TDP review will be performed on the Dominion QA documentation to determine compliance to EAC 2005 VVSG requirements and the requirements stated in the Dominion Voting Systems QA Program document. All source code will be checked to ensure that proper QA documentation has been completed. All equipment received for initial testing and follow up testing will be checked against Dominion documentation to ensure their QA process is being followed. Wyle personnel will complete the requirements of EAC 2005 VVSG Vol. 2 Section 7, Quality Assurance Testing and Section 1.3.1.5, Focus of Vendor Documentation that requires Wyle personnel to physically examine documents at Dominion's location or conduct an external evaluation utilizing equipment, documents and support information provided by Dominion during the test campaign.
- **Section 9: Configuration Management (CM) Requirements** – The requirements in this section will be tested throughout the test campaign. TDP review will be performed on the Dominion configuration management documentation to determine EAC 2005 VVSG compliance and to further determine whether Dominion is following its documented CM requirements within the TDP. During source code review, Wyle qualified personnel will verify that Dominion Voting Systems is following EAC 2005 VVSG CM requirements as well as Dominion CM requirements. Any anomalies will be formally reported to Dominion and the EAC. All equipment received for testing will be checked against Dominion documentation to ensure their CM process is being followed.

4.1.1 Mapping of Requirements to Equipment Type and Features

Refer to the "2005 EAC Program Requirements Matrix" available online.

4.1.2 Rationale for 'Not Applicable' Requirements

The Dominion Voting Systems Democracy Suite 4.0 is a paper-based precinct counting system that supports a closed network (does not support transmission over public networks). Therefore, all EAC 2005 VVSG requirements, with the exceptions listed below, will be evaluated as part of this test campaign.

- Volume I Section 6.2.6 (Telecommunication Requirements)
- Volume I Section 7.5.2 – 7.5.4 (Telecommunications and Data Transmission)
- Volume I Section 7.6 (Use of Public Communication Networks)
- Volume I Section 7.7 (Wireless Communications)
- Volume I Section 7.9 (Voter Verifiable Paper Audit Trail Requirements)

4.0 TEST SPECIFICATIONS (CONTINUED)

4.1 Requirements (Strategy of Evaluation) (continued)

4.1.2 Rationale for 'Not Applicable' Requirements (continued)

The rationale for not evaluating the Democracy Suite 4.0 to the requirements contained in the indicated sections of the EAC 2005 VVSG is described below. Refer to the EAC online matrix tool for specific requirements that are excluded during this test campaign.

Table 4-1 Not Applicable Requirements

EAC 2005 VVSG Volume I Section	Rationale for 'Not Applicable'
6.2.6, 7.5.2, and 7.5.3	These requirements are written for use of public networks. The Dominion Democracy Suite 4.0 does not use public networks.
7.5.4	This section was intended for a shared operating environment on ballot recording and vote counting equipment. The ICE and ICP use dedicated operating environments and will be excluded from this requirement. The EMS and ICC components do use a shared operating environment and will be tested to this VVSG clause.
7.6	This section pertains to "Voting systems that transmit data over public telecommunications…" The Dominion Democracy Suite 4.0 does not support transmission over public networks.
7.7	No wireless technology is present in the Dominion Democracy Suite 4.0.
7.9	The Dominion Democracy Suite 4.0 is a paper based system.

4.2 Hardware Configuration and Design

The Dominion Voting Systems Democracy Suite is a paper-based optical scan voting system. The Democracy Suite system consists of four major components: the EMS, ICE precinct scanner and ballot marking device, ICP precinct scanner, and ICC central count scanner. The Democracy Suite is comprised of two proprietary pieces of hardware (ICE and ICP) and one piece of COTS hardware (ICC). All EMS functions are handled by proprietary software running on COTS PC/laptops/severs. Wyle has determined that these COTS PC/laptops/severs are not subject to hardware testing per the EAC 2005 VVSG. The provided PC/laptops/severs documented in Section 3 Materials Required For Testing all contained CE, UL, and FCC labeling.

ICP – Wyle Laboratories previously performed testing to the EAC 2005 VVSG on the ICP-A configuration that consisted of an ICP unit, with firmware version 4.5.4, and a standalone EMS configuration, version 4.5 RC9, as part of a state test effort. Wyle will be utilizing the data obtained during that test effort to satisfy requirements for this test campaign for the following tests: Electrical, Environmental, Usability, Security, Maintainability, Availability, Safety, and Accuracy (performed via paper-based voting and audio voting sessions).

ICE - ICE will be set on the ballot box to simulate the actual election configuration. During operational tests the unit will be in auto feed mode ("Shoe-Shine") and scan test ballots for the duration of the operational test. Each unit will be loaded with the Operational Status Check Hardware election definition configured for early voting. This will allow all the data generated for the Pre-operational, Operational, and Post-operational test to be further analyzed, compiled and included in the Reliability and Availability Test results.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.2 Hardware Configuration and Design (continued)

ICC - ICC consists of COTS scanner and COTS Workstation PC. The Canon DR-X10C (S/N ED300874) scanner and the Dell Inspiron One 2305 (S/N 564C3P1) Workstation PC contain CE, UL, and FCC labeling. Due to the fact that these components are unmodified COTS equipment, as well as central count equipment, they will be exempt from non-operational hardware testing; however the ICC will undergo Temperature Power testing in conjunction with the ICE. Beyond the Temperature Power test, the ICC will only be utilized in functional and system testing for this campaign.

4.3 Software System Functions

The Dominion Democracy Suite 4.0 System software is written in the C, C++, C# (C Sharp) programming languages. The system software is broken into three areas: EMS, Precinct tabulator software acting as firmware, and central count application running on a COTS workstation.

The Democracy Suite EMS software consists of seven applications listed below:

- Election Event Designer
- Results Tally and Reporting
- Audio Studio
- Datacenter Manager
- Application Server
- Network Attached Storage Server
- Database Server

The Democracy Suite 4.0 contains two precinct tabulators. Both tabulators run software that is treated as firmware. The software applications are ICP and ICE. The Democracy Suite 4.0 has an independent workstation running proprietary software. The ICC application provides the central tabulation function for the system.

4.4 Test Case Design

Wyle uses the V-Model Life Cycle as defined by the Institute of Electrical and Electronics Engineers (IEEE). The IEEE definition of the V-Model Life Cycle uses two concepts “Verification” and “Validation”. Wyle’s test approach is to use both “Verification” and “Validation” to some degree. There are four basic levels of testing in the V-Model Life Cycle: Component, Integration, System, and Acceptance. Wyle will be evaluating the Dominion Democracy Suite 4.0 to all four levels.

4.4.1 Hardware Qualitative Examination Design

<u>ICP Testing</u>

As stated previously, Wyle Laboratories performed testing to the EAC 2005 VVSG on the ICP-A configuration that consisted of an ICP unit, with firmware version 4.5.4, and a standalone EMS configuration, version 4.5 RC9, as part of a state test effort. Wyle will be utilizing the data obtained during that test effort to satisfy requirements for this test campaign for the following tests: Electrical, Environmental, Usability, Security, Maintainability, Availability, Safety (this testing was witnessed by Wyle personnel at a third party laboratory), and Accuracy (performed via paper-based voting and audio voting

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4.1 Hardware Qualitative Examination Design (continued)

sessions). Prior to initiation of that test effort, Wyle reviewed the results of testing performed on a previous version of the Democracy Suite tested by the New York State Board of Elections.

The version submitted to NYSBOE consisted of an earlier version of the EMS and the ICP. Wyle researched this test campaign and performed a comparison between the ICP version tested in the provided reports and the ICP version submitted as part of the ICP-A test campaign and concluded that some hardware tests could be accepted and any test not accepted would be tested as part of the ICP-A test campaign.

Additionally, Wyle reviewed the results of previous testing in the form of the following test reports submitted by Dominion:

- Sun Microsystems, Advanced Product Testing Lab Test Report Number 08-00735, "Testing Services Report, ImageCast Precinct Ballot Counter & Ballot Marker," dated July 16, 2008
- Criterion Technology Test Report Number 090826-1455R, "EMC Qualification Test Report, Dominion, ImageCast Precinct Ballot Counter With Ballot Box, ICP 300B", dated October 5, 2009
- EMC Integrity Incorporated Test Report Number ETRA80606, Rev. A, "Radiated and Conducted Emissions, ImageCast Precinct Ballot Counter and Ballot Marker," dated July 22, 2008
- EMC Integrity Incorporated Test Report Number TRA80606, Rev. A, "Full Compliance Immunity, ImageCast Precinct Ballot Counter and Ballot Marker," dated July 22, 2008
- Compliance Integrity Services Test Report Number DVS-0807-R02, "Electrical Safety Testing To UL 60950-1: 2007, ImageCast Precinct Counter and Marker," dated August 11, 2008

Wyle performed a hardware qualitative examination to assess if the testing documented in the Dominion-supplied reports was performed under the guidelines of the EAC program, if the tests were performed per the EAC 2005 VVSG, and the scope of the engineering changes implemented since test performance. The results from this examination deemed that the majority of the previous test results required further analysis before they can be accepted for the current test campaign based on the following:

- Previous testing was performed on the ICP with a Ballot Marking Device Attached.
- After initial testing was completed there were multiple ECO's applied to the ICP system. Based on the changes Wyle performed Electrostatic Disruption and Electromagnetic Radiation testing to verify the system operated within acceptable limits and no further electrical testing would be required.

It was noted that initial testing was performed on the ICP with an attached ballot marking device. The ICP equipment configuration submitted to Wyle for the ICP-A test campaign did not include the ballot marking device. To verify that the Ballot Marking device did not significantly alter the unit's electronic signature, analysis was performed using an Electromagnetic Radiation quick scan and an Electromagnetic Susceptibility Test. The resulting electronic signature generated during the quick scan was within acceptable limits; therefore, prior EMI testing was accepted for the ICP-A test campaign.

The Logic and Accuracy test performed on the ICP during the ICP-A test campaign is also being utilized to satisfy the requirements for this test effort. Since Wyle considers the ICP as a paper based scanner and a DRE, the Accuracy test for the ICP was performed by using both paper-based and audio ballots. The majority of the vote processing was utilizing the paper-based functionality, while audio votes were being cast at defined intervals between ballot scans.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4.1 Hardware Qualitative Examination Design (continued)

After analyzing the processes and researching past testing, Wyle believes that the architecture and integration of the recording process of an audio ballot and the scanning of a paper ballot are similar and use many of the same software modules. Based on this, Wyle concluded that the audio feature should not be subjected to the full requirement of Volume II, Section 4.7.1.1; therefore during test performance, 5000 audio ballot positions were cast to satisfy the execution of the feature. The remaining ballot positions were captured with paper-based voting. All results were validated and verified against the election definition voting matrix for expected results.

Based on the results of the examination, the summary of acceptable testing is provided in the table below. The details of those tests are presented in Section 6.0.

Table 4-2 ICP Hardware Test Examination Results

Test/EAC 2005 VVSG Section	Procedure/Description	Configuration Tested	Status
Logic and Accuracy/4.1.1	Ensure the unit can process 1,549,703 consecutive ballot positions correctly within the allowable target error rate.	ICP	Accept
Usability/3.1	Measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users	ICP	Accept
Accessibility/3.2	Tests the voting system to ensure accessibility for individuals with disabilities to include, but not limited to visually impaired voters by providing the same access and participation opportunity.	ICP	Accept
Security/7	Tests the ability of the system to detect, prevent, log, and recover from a broad range of security risks identified.	ICP	Accept
Maintainability/4.3.4	Tests the ease in which preventative and corrective maintenance actions can be performed based on design, software, and documentation.	ICP	Accept
Availability/4.3.5	Tests the voting system to help ensure the probability that the equipment will be operational and accomplish set functions. This shall be calculated using the following formula at a 99% availability rate: Ai=(MTBF)/(MTBF+MTTR)	ICP	Accept
Safety/4.3.8	UL 60950-1 product safety review	ICP	Accept*
Electrical Supply/4.1.2.4	Meets voltage and power requirements of EAC 2005 VVSG Vol. 1 Section 4.1.2.4	ICP	Accept
Electromagnetic Radiation/4.1.2.9	FCC Part 15 Class B for both radiated and conducted emissions	ICP	Accept
Electromagnetic Susceptibility/4.1.2.10	IEC 61000-4-3 electromagnetic field of 10V/m modulated by a 1kHZ, 80% AM modulation at 80MHz to 1000MHz frequency	ICP	Accept

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4.1 Hardware Qualitative Examination Design (continued)

Table 4-2 Hardware Test Examination Results (continued)

Test/EAC 2005 VVSG Section	Procedure/Description	Configuration Tested	Status
Temperature/Power Variation/4.1.2.13	MIL-STD-810D, Method 502.2 and Method 501.2 163 hours at 50 degrees to 95 degrees	ICP	Accept
High Temperature/4.1.2.14	MIL-STD-810D, Method 501.2 maximum temperature shall be 140 degrees F	ICP	Accept
Low Temperature/4.1.2.14	MIL-STD-810D minimum temperature shall be -4 degrees F	ICP	Accept
Bench Handling	MIL-STD-810D, Method 516.3 Procedure VI six 4" drops on each edge totaling 24 drops	ICP	Accept
Vibration/4.1.2.14	MIL-STD-810D, Method 514.3 physical shock and vibration during handling and transport	ICP	Accept
Humidity Test/4.1.2.14	MIL-STD-810D, Method 501.2 ten 24 hour humidity cycles	ICP	Accept
Electrical Power Disturbance/4.1.2.5	IEC 61000-4-11 (1994-06) power surges and dips	ICP	Accept
Electrical Fast Transient/4.1.2.6	IEC 61000-4-4 (1995-01)	ICP	Accept
Lightning Surge/4.1.2.7	IEC 61000-4-5 (1995-02)	ICP	Accept
Electrostatic Disruption/4.1.2.8	IEC 61000-4-2 (1995-01) 15kV air discharge and 8kV contact discharge	ICP	Accept
Conducted RF Immunity/4.1.2.11	IEC 61000-4-6 (1996-04) conducted radio frequency energy	ICP	Accept
Magnetic Fields Immunity/4.1.2.12	IEC 61000-4-8 (1993-06) AC magnetic fields of 30 A/m at 60Hz	ICP	Accept

*Safety testing was witnessed by Wyle at a third party laboratory

ICE Testing

The Dominion Democracy Suite 4.0 ICE hardware will be tested by the Wyle Laboratories' EMI, Dynamics, and Environmental test facilities for testing to the hardware requirements in accordance with Wyle Laboratories A2LA certifications 845.01-.03. All EMI testing will be performed per the following Wyle Laboratories' Test Guidelines Documents: EMI-001A, "Wyle Laboratories' Test Guidelines for Performing Electromagnetic Interference (EMI) Testing", and EMI-002A, "Test Procedure for Testing and Documentation of Radiated and Conducted Emissions Performed on Commercial Products". These proprietary documents shall be submitted under separate cover for reference. All hardware testing will be performed per the guidelines of ANSI/NCSL Z540-1, "Calibration Laboratories and Measuring and Test Equipment, General Requirements", and ISO 10012-1, "Quality Assurance Requirements for Measuring Equipment" and the governing MIL-STD to which the test is required. All pre-voting and post-voting tests will be conducted by Wyle qualified personnel at the Wyle Huntsville, AL facility.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4 Test Case Design (continued)

4.4.1 Hardware Qualitative Examination Design (continued)

The following hardware tests shall be performed on the ICE per Volume I of the EAC 2005 VVSG:

- Electrical Supply (Section 4.1.2.4)
- Electrical Power Disturbance (Section 4.1.2.5)
- Electrical Fast Transient (Section 4.1.2.6)
- Lightning Surge (Section 4.1.2.7)
- Electrostatic Disruption (Section 4.1.2.8)
- Electromagnetic Emissions (Section 4.1.2.9)
- Electromagnetic Susceptibility (Section 4.1.2.10)
- Conducted RF Immunity (Section 4.1.2.11)
- Magnetic Fields Immunity (Section 4.1.2.12)
- Environmental Control – Operating Environment (Section 4.1.2.13)
- Environmental Control – Transit and Storage (Section 4.1.2.14)
- Safety (Section 4.3.8) *This testing will be performed at MET Labs and witnessed by Wyle personnel*

ICC Testing

ICC consists of COTS scanner and COTS Workstation PC. The Canon DR-X10C (S/N ED300874) scanner and the Dell Inspiron One 2305 (S/N 564C3P1) Workstation PC contain CE, UL, and FCC labeling. Due to the fact that these components are unmodified COTS equipment, as well as central count equipment, they will be exempt from non-operational hardware testing; however the ICC will undergo Temperature Power testing in conjunction with the ICE. Beyond the Temperature Power test, the ICC will only be utilized in functional and system testing for this campaign.

Support Equipment

Dominion submitted COTS PCs and Laptops to be used during the test campaign that were labeled CE, UL, and FCC compliant. The supporting documentation for this testing has not been submitted to Wyle at this time. During this test campaign Wyle will review this documentation to ensure that it meets the requirements of the EAC 2005 VVSG.

4.4.1.1 Mapping of Requirements to Specific Interfaces

Please refer to the EAC online matrix tool for further reference on requirements mapping.

4.4.2 Software Module Test Case Design and Data

Wyle implements Component Level Testing during the FCA for each component and subcomponent, exercising the functionality of each component and subcomponent as designed and documented. Wyle will utilize limited structural-based techniques (white-box testing) mainly in the area of Source Code Review,

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4 Test Case Design (continued)

4.4.2 Software Module Test Case Design and Data (continued)

Compliance Builds and Security Testing and Review. Wyle will depend heavily on specification-based techniques (black-box testing) for the individual software components.

The most common specification-based techniques applied to the Dominion Voting Systems Democracy Suite 4.0 during the software testing portion of testing will be "equivalence partitioning" and "boundary value testing":

- "Equivalence partitioning" will be used to evaluate specific software functions and data entry points of the Democracy Suite for valid and invalid data during the FCA. For software functions and data entry points, an entry will be made for a valid data requirement and at least one invalid data requirement to test for normal and abnormal conditions.

- "Boundary Value Testing" will be used to evaluate specific software functions and data entry points for minimums and maximums during the FCA. 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 technique will be used for numeric ranges as well as non-numeric ranges.

Wyle will document an expected result for each test. The ACCEPT/REJECT criteria at the Component Level will be based on the expected result. If the System Under Test (SUT) performs as expected the results will be accepted. If the SUT does not perform as expected the test will be evaluated for tester error. If it is determined there was no tester error, the test will be repeated in an attempt to reproduce the results. If the results can be reproduced and the expected results are not met the SUT will have failed the test. If the results cannot be reproduced the results would be determined to not be repeatable and the test would continue. Wyle will document the error and track the error through resolution. Wyle will not move to the next level of testing until all documented errors are resolved to try and minimize errors that might occur farther along in the test campaign. Engineering analysis will be performed to determine what effect the resolution has on the component. A determination will be made whether Regression Testing will be sufficient or a complete re-test is necessary.

4.4.3 Software Functional Test Case Design and Data

Wyle implements Integration Level Testing primarily focusing on the interface between components and applications. The test approach to be used for the Dominion Democracy Suite 4.0 will be a bottom-up approach where the lower-level components will be tested first and then used to facilitate the testing of higher-level components. The specification-based technique used by Wyle at the Integration Level is "Use Case". The actors that have been identified to use the Dominion Democracy Suite 4.0 are the following:

- Election Administrator – the actor with responsibility of entering the election definition with translation and audio. This actor is also responsible for maintaining EMS users and the election database.
- Warehouse Technician – the actor responsible for loading the election definition onto the ICE and ICP units. This actor also runs diagnostic tests and maintains the units.
- Poll Worker- the actor at the precinct location to set up and close down the ICE and ICP on Election Day.
- Voter – the actor who physically casts the ballot on Election Day.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.4 Test Case Design (continued)

4.4.3 Software Functional Test Case Design and Data (continued)

- ADA Voter – the actor with special needs who has to vote unassisted on Election Day.
- Election Official – the actor who reports and audits the election results post-Election Day.

"Use Case" will be used during the FCA with a single pass through each component using only valid data. This pass will be considered the "Master Copy" of data to be passed between interfacing points of applications during Integration level testing. If a component downstream in the test process needs data from previous processes, the "Master Copy" of data can be used or altered to accelerate the test process. Known tests that will utilize the "Master Copy" of data at the Integration Level are Security, Telecommunication, and Usability. During test performance, if an error occurs between data interfaces or in the process flow, an engineering analysis will be performed to determine if the error is data, process, or tester error. The ACCEPT/REJECT criteria for Integration Level testing is whether the components and applications interface using the documented process for each actor. If there is an error interfacing between components, the error will be documented and tracked through resolution. Engineering analysis will be performed to determine what effect the resolution has on the component. A determination will be made whether Regression Testing will be sufficient or a complete re-test is necessary.

4.4.4 System-Level Test Case Design

Wyle implements System Level testing focusing on a complete system including all proprietary software, proprietary hardware, proprietary peripherals, COTS software, COTS hardware, and COTS peripherals in a configuration of the system's intended use. The Dominion Democracy Suite 4.0 is intended to support both large and small jurisdictions. Wyle's approach for Dominion Democracy Suite 4.0 will be to execute System Level Testing with a variety of elections that include various combinations of jurisdictions, parties, and ballot styles. Wyle will have three different test setup configurations for the EMS components as referenced in section 1.4.1 of this document.

Wyle will test the function of all hardware, software, and peripherals of the complete system during System Level Testing. The ACCEPT/REJECT criteria for System Level testing is whether the system can continue in testing. The two scenarios are: Accept or Reject. Accept is either 1) if no errors are found, or 2) if an error is encountered but the system continues to operate and engineering analysis determines that the root cause does not affect testing. Reject if the system is too unstable to continue or engineering analysis determines the root cause could affect further testing.

Wyle implements Acceptance Level testing focusing on all the data collected during the entire test campaign along with performing the "Trusted Build" for the system. All data from pre-testing, hardware testing, software testing, functional testing, security testing, volume testing, stress testing, telecommunication testing, usability testing, accessibility testing, and reliability testing activities will be combined to ensure all requirements that are supported by the Dominion Democracy Suite 4.0 in the EAC 2005 VVSG have been tested. All requirements will be checked against the test data to ensure the EAC 2005 VVSG requirements are met. Items not supported by Dominion Democracy Suite 4.0 will be documented. Any issues documented during testing will be resolved or annotated in the test report.

Wyle will report all issues discovered during this test campaign to the EAC. The EAC has the final determination on whether the system meets all the requirements for an EAC certified system. The ACCEPT/REJECT criteria for Acceptance Level testing is whether or not the data for the test campaign

4.0 TEST SPECIFICATIONS (CONTINUED)

supports a recommendation for certification by the EAC. If Wyle determines there is not enough data to ensure a requirement was met, the test plan will be altered and further testing will be done.

4.5 Security Functions

The purpose of the security testing will be to evaluate the effectiveness of the Democracy Suite in detecting, preventing, logging, and recovering from any security risks identified by simulating attacks on the system. To accomplish this, Wyle has developed internal operating procedures to evaluate the Dominion Democracy Suite 4.0 to the security requirements set forth in the EAC 2005 VVSG. These procedures have been specifically tailored to assess the Dominion Democracy Suite 4.0 to the applicable requirements. Wyle will attempt to defeat the access controls and physical security measures documented in the Dominion technical data package. A threat matrix will be created to determine the risks and vulnerabilities.

Wyle will utilize a combination of functional testing, source code review, and Fortify ™ SCA to evaluate the Democracy Suite. Wyle's strategy for evaluating the Democracy Suite will be to utilize the Express Hardware Configuration and the Enterprise Hardware Configuration. Wyle excluded the Standard Hardware Configuration because this configuration overlaps the other two.

The following areas are not applicable to the Democracy Suite 4.0 and are therefore not included in the scope of the security testing:

- Use of Public Networks
- Wireless Communication

Testing will be performed by a qualified security expert. All findings will be reported to Dominion for resolution. Dominion will review all findings and correct risks that violate the standard. All documented risks will be reported as an addendum to the final test report.

4.6 TDP Evaluation

Wyle qualified personnel will perform a comprehensive review of the Dominion TDP to determine compliance to the EAC 2005 VVSG requirements and Dominion-specific requirements. Wyle qualified personnel utilize a TDP Review Matrix which lists every EAC 2005 VVSG requirement pertaining to TDP review. Wyle qualified personnel will record the results of the review of each document to the applicable requirements listed in the TDP Review Matrix.

During the TDP review process, each document will be reviewed for completeness, clarity, and correctness, and continuity between the TDP documents. The review results will be formally reported to Dominion for resolution. If a revised document is received, it will be re-reviewed as discussed in this section. The TDP will be continued to be reviewed during the entire testing process as these documents will be utilized to set up the systems, verify correct operational results and numerous other tests. At the end of the TDP review process, an Anomaly Report will be issued listing the non-compliant items on a document-by-document basis, if applicable.

A listing of all documents contained in the Dominion Democracy Suite 4.0 System TDP is provided in Table 4-2.

4.0 TEST SPECIFICATIONS (CONTINUED)

4.6 TDP Evaluation (continued)

Table 4-2 Democracy Suite 4.0 TDP Documents

Democracy Suite 4.0 TDP Documents	System	Version	Date	Document Number
Documents describing overall system performance:				
System Configuration Overview	All	1.2.0::197	9/6/2011	2.02
System Security Specification	All	1.1.0::261	9/6/2011	2.06
Configuration Management Process	All	1.2.0::135	9/6/2011	2.11
Quality Assurance Program	All	1.2.0::68	9/6/2011	2.12
System Test and Verification	All	1.1.0::88	9/6/2011	2.07
System Test and Verification Suites	All	1.2.0::2	9/6/2011	2.07
Personnel Training and Deployment Requirements	All	1.1.0::33	9/6/2011	2.10
Documents describing functionality, hardware, software design, maintenance, and operation:				
EMS Functional Description	EMS	1.1.0::49	9/6/2011	2.03
ICE Functional Description	ICE	1.2.0::37	9/6/2011	2.03
ICP Functional Description	ICP	1.1.0::73	9/6/2011	2.03
ICC Functional Description	ICC	1.1.0::27	9/6/2011	2.03
ICE Tabulator System Hardware Specification	ICE	1.2.0::220	9/6/2011	2.04
ICP Tabulator System Hardware Specification	ICP	1.1.0::51	9/6/2011	2.04
ICE System Hardware Characteristics	ICE	1.2.0::46	9/6/2011	2.04
ICP System Hardware Characteristics	ICP	1.1.0::30	9/6/2011	2.04
EMS Software and Design Specification	EMS	1.0.0::163	9/6/2011	2.05
ICE Software and Design Specification	ICE	1.0.0::29	9/6/2011	2.05
ICP Software and Design Specification	ICP	1.1.0::77	9/6/2011	2.05
ICC Software and Design Specification	ICC	1.0.0::17	9/6/2011	2.05
ICP System Operation Procedures	ICP	1.1.0::120	9/6/2011	2.08
EMS System Operation Procedures	EMS	1.2.0::282	9/6/2011	2.08
ICE System Operation Procedures	ICE	1.0.0::45	9/6/2011	2.08
ICC System Operation Procedures	ICC	1.1.0::49	9/6/2011	2.08
ICP System Maintenance Manual	ICP	1.1.0::30	9/6/2011	2.09
ICE System Maintenance Manual	ICE	1.1.0::56	9/6/2011	2.09
EMS System Maintenance Manual	EMS	1.0.0::20	9/6/2011	2.09
Election Event Designer Users Guide	EMS	1.2.7	9/6/2011	N/A
Results Tally and Reporting Users Guide	EMS	1.2.4	9/6/2011	N/A
Audio Studio Users Guide	EMS	1.2.1	9/6/2011	N/A
Democracy Suite EMS Software Build Environment Install Document	EMS	1.3.1::1	9/6/2011	N/A
ImageCast Precinct Approved Parts List	ICP	V3	9/6/2011	N/A
ImageCast Precinct Configuration Files	ICP	1.0.0::18	9/6/2011	N/A
ImageCast Precinct Election Definition Files	ICP	2.5.1	9/6/2011	N/A
ImageCast Precinct Firmware Build and Install Document	ICP	1.0.0::15	9/6/2011	N/A
ImageCast Precinct Firmware Update	ICP	1.0.0::6	9/6/2011	N/A

4.0 TEST SPECIFICATIONS (CONTINUED)

4.6 TDP Evaluation (continued)

Table 4-2 Democracy Suite 4.0 TDP Documents (continued)

Democracy Suite 4.0 TDP Documents	System	Version	Date	Document Number
ImageCast Precinct Technical Guide	ICP	1.1.5	9/6/2011	N/A
ImageCast Million Ballot Scan Test	ICP	1.0.0::11	9/6/2011	N/A
Engineering Product Development Processes	ICP	P0.2	9/6/2011	N/A
Dominion Voting C C++ Coding Standard	All	1.0.0::7	9/6/2011	N/A
Dominion Voting Usability Study	ICP	1.0.0::20	9/6/2011	N/A
Dominion Voting Usability Study	ICE	1.0.0::35	11/29/2011	N/A

4.7 Source Code Review

As part of the pre-testing activities, the Dominion Democracy Suite 4.0 source code will be reviewed to the EAC 2005 VVSG coding standards and the manufacturer supplied coding standards. The review will be conducted per the guidelines described in the following paragraphs.

As the source code is received, an SHA1 hash value will be created for each source code file. The source code team will then conducted a visual scan of every line of source code for an initial review and every line of modified source code for a re-review. This is done to identify any violation of EAC 2005 VVSG coding standards or manufacturer supplied coding standards. Each identified violation will be recorded by making notes of the standards violation along with directory name, file name, and line number.

If the review was the initial review, the source code team performed a peer-review on a percentage of the code. This was done to evaluate the correctness of the review and look for standards violations that may have been missed or violations that were noted in error. Any standards violations that the team concluded were recorded in error or missed were then corrected in the code review notes.

A technical summary report of all identified standards violations will be sent to Dominion for resolution. Dominion will then correct all standards violations and re-submit the source code for re-review. This process will be repeated as many times as necessary, until all identified standards violations are corrected. All reports will be included in an anomaly report for source code and submitted to the EAC and included in the final test report.

Dominion Voting Systems uses an auto-feed option designed in the system to repetitively feed ballots in and out of the scanner. This feature is documented as “Auto-Feed” mode or “Shoe Shine” mode. As part of the source code review this function will be inspected in detail to meet the requirements of EAC 2005 VVSG Volume 1 Section 2.2.4 g and h. The final step will be to create a “Trusted Build” from the reviewed source code. The “Trusted Build” will be performed by completed the following tasks in the order listed:

- Clean the build machine
- Retrieve the compliant source code
- Retrieve the installation media for OS, compilers, and build software
- Construct the build environment
- Create digital signatures of the build environment

4.0 TEST SPECIFICATIONS (CONTINUED)

4.7 Source Code Review (continued)

- Load the compliant source code into the build environment
- Create a digital signature of the pre build environment
- Create a disk image of the pre-build environment
- Build executable code
- Create a digital signature of executable code
- Create a disk image of the post-build environment
- Build installation media
- Create a digital signature of the installation media
- Install executable code onto the system a validate the software/firmware
- Deliver source code with digital signature, disk image of pre-build environment with digital signatures, disk image of post-build environment with digital signatures, executable code with digital signatures, and installation media with signatures to EAC Approved Repository.

The "Trusted Build" for the Dominion Democracy Suite 4.0 includes source code, data, and script files, in clear text form. The build also includes COTS software on commercially available media, COTS software downloaded by the VSTL, COTS software verified by SHA1 from the software supplier, and picture and sound files in binary format provided by Dominion Voting Systems. The first step of the process is to clean the hard drives by writing data to every spot on the hard drive, so the drive is cleared of existing data. The Microsoft Windows XP Professional operating system will then be loaded and the applications from the VSTL reviewed source along with the VSTL verified COTS software will be built. The final step is installing the applications on the hardware.

4.8 QA and CM System Review

The Dominion QA Plan and CM Plan state that they comply with ISO 9001 and cite internal Dominion ISO 9001 documentation for details. Both the Dominion QA Plan and CM Plan will be reviewed to determine compliance with EAC 2005 VVSG Volume II Section 2, and Volume I Sections 8 and 9, EAC stated requirements, and with the requirements of the internal Dominion ISO documentation. Also, the Dominion TDP documentation package will be reviewed to determine if the Dominion QA Plan and the CM Plan are being followed. The results of the TDP review will be entered on a spreadsheet as previously described in Section 4.6 TDP Evaluation of this test plan. The results of the TDP review, including the QA and CM compliance results, will also be included in the final Test Report.

5.0 TEST DATA

5.1 Test Data Recording

All equipment utilized for test data recording shall be identified in the test data package. For hardware environmental and operational testing, the equipment will be listed on the Instrumentation Equipment Sheet for each test. The output test data will be recorded in an appropriate manner as to allow for data analysis. For source code and TDP reviews, results will be compiled in output reports and submitted to Dominion Voting Systems for resolution. Additionally, all test results, including functional test data, will be recorded on the relevant Wyle Laboratories' Operating Procedure and Test Cases. Results will also be recorded real-time in engineering log books.

5.0 TEST DATA (CONTINUED)

5.2 Test Data Criteria

Wyle Laboratories, Inc. will evaluate all test results against the Dominion Voting Systems provided technical documentation for the Democracy Suite 4.0 and the requirements set forth in the EAC 2005 VVSG. The Democracy Suite 4.0 shall be evaluated for its performance against the EAC 2005 VVSG. The acceptable range for system performance and the expected results for each test case shall be derived from the Democracy Suite 4.0 documentation. Per the EAC 2005 VVSG, these parameters shall encompass the test tolerances, the minimum number of combinations or alternatives of input and output conditions that can be exercised to constitute an acceptable test of the parameters involved, and the maximum number of interrupts, halts or other system breaks that may occur due to non-test conditions (excluding events from which recovery occurs automatically or where a relevant status message is displayed).

5.3 Test Data Reduction

Test data shall be manually processed and recorded in the relevant Wyle Laboratories' Operating Procedures and Test Cases. Results will also be recorded real-time in engineering log books.

6.0 TEST PROCEDURES AND CONDITIONS

The following subsections describe test procedures and a statement of the criteria by which readiness and successful completion shall be indicated and measured.

6.1 Facility Requirements

All testing will be conducted at the Wyle Huntsville, AL facility unless otherwise annotated. Hardware environmental non-operating (storage) and operating testing will be conducted utilizing an adequately sized environmental test chamber or dynamic shaker system equipped with the required data gathering support equipment. All remaining operating hardware tests will be conducted at the appropriate test site with the required support equipment. All instrumentation, measuring, and test equipment used in the performance of this test program will be listed on the Instrumentation Equipment Sheet for each test and shall be calibrated in accordance with Wyle Laboratories' Quality Assurance Program, which complies with the requirements of ANSI/NCSL Z540-1 and ISO 10012-1. Standards used in performing all calibrations are traceable to the National Institute of Standards and Technology (NIST) by report number and date. When no national standards exist, the standards are traceable to international standards or the basis for calibration is otherwise documented.

Unless otherwise specified herein, all remaining tests, including system level functional testing, shall be performed at standard ambient conditions:

- Temperature: 25°C ± 10°C (77°F ± 18°F)
- Relative Humidity: 20 to 90%
- Atmospheric Pressure: Local Site Pressure

Unless otherwise specified herein, the following tolerances shall be used:

- Time ± 5%
- Temperature ± 3.6°F (2°C)
- Vibration Amplitude ± 10%

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.1 Facility Requirements (continued)

- Vibration Frequency ± 2%
- Random Vibration Acceleration
  - 20 to 500 Hertz ± 1.5 dB
  - 500 to 2000 Hertz ± 3.0 dB
- Random Overall grms ± 1.5 dB
- Acoustic Overall Sound Pressure Level +4/-2 dB

Deviations to the above tolerances may be submitted by the test responsible agency with sufficient engineering information to substantiate the deviation request, but only when best effort technique and system limitations indicate the need for a deviation.

6.2 Test Set-Up

All voting machine equipment (hardware and software), shall be received and documented utilizing Wyle Receiving Ticket (WL-218, Nov'85) and proper QA procedures. When voting system hardware is received, Wyle Shipping and Receiving personnel will notify Wyle QA personnel. With Wyle QA personnel present, each test article will be unpacked and inspected for obvious signs of degradation and/or damage that may have occurred during transit. Noticeable degradation and/or damage, if present, shall be recorded, photographs shall be taken, and the Dominion Voting Systems, Inc., representative shall be notified.

Wyle QA personnel shall record the serial numbers and part numbers. Comparison shall be made between those numbers recorded and those listed on the shipper's manifest. Any discrepancies noted shall be brought to the attention of the Dominion Voting Systems, Inc., representative for resolution. TDP items, including all manuals, and all source code modules received will be inventoried and maintained by the Wyle Project Engineer assigned to testing.

For hardware test setup, the system will be configured as would for normal field use. This includes connecting all supporting equipment and peripherals. Wyle personnel will properly configure and initialize the system, and verify that it is ready to be tested, by following the procedures detailed in the Democracy Suite 4.0 technical documentation. Wyle will develop an operational status test to be performed prior to and immediately following each hardware test. Wyle will develop the system performance levels to be measured during operational tests.

Wyle has developed eight election definitions to be used during this test campaign.

Operational Status Check

This election definition will exercise the operational status of the Democracy Suite 4.0 System, during the operational hardware tests, and prior to and immediately following the non-operational hardware tests.

Logic and Accuracy

This test must exercise all possible voting positions for the ballot.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.2 Test Set-Up (continued)

General Election: GEN-01

A basic election held in four precincts, one of which is a split precinct, containing nineteen contests compiled into four ballot styles. Five of the contests are in all four ballot styles. The other fifteen contests are split between at least two of the precincts with a maximum of four different contests spread across the four precincts. This election was designed to functionally test the handling of multiple ballot styles, support for at least two languages, support for common voting variations, and audio support for at least two languages.

The parameters of this election are listed below:

- Closed Primary: No
- Open Primary: No
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: No
- Straight Party voting: Yes
- Cross-party endorsement: No
- Split Precincts: Yes
- Vote for N of M: Yes
- Recall issues, with options: No
- Cumulative voting: No
- Ranked order voting: No
- Provisional or challenged ballots: Yes
- Early Voting: No

This election was designed to functionally test the handling of multiple ballot styles, support for at least two languages, support for common voting variations, and audio support for at least two languages. Test Pattern 8 was chosen for audio input in an alternative language because it is a basic voting pattern using an ADA device. Test pattern 9 was chosen for audio input to demonstrate support for write-in voting using an ADA device. Test Pattern 3 was chosen for Spanish language input because it is a basic vote pattern using Spanish. Test Pattern 10 was chosen for Spanish language input because it exercises write-in using Spanish.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.2 Test Set-Up (continued)

General Election: GEN-02

A basic election held in three precincts. This election contains fifteen contests compiled into three ballot styles. Ten of the contests are in all three ballot styles with the other five split across the three precincts. This election was designed to functionally test the handling of multiple ballot styles, support for ballot rotation, support for two languages, support for complex voting variations, and audio support for multiple languages.

The parameters of this election are listed below:

- Closed Primary: No
- Open Primary: No
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: Yes
- Straight Party voting: No
- Cross-party endorsement: No
- Split Precincts: No
- Vote for N of M: Yes
- Recall issues, with options: Yes
- Cumulative voting: No
- Ranked order voting: Yes
- Provisional or challenged ballots: No
- Early Voting: Yes

This election was designed to functionally test the handling of multiple ballot styles, support for ballot rotation, support for two languages, support for complex voting variations, and audio support for multiple languages. The election will be an early voting election with at least one machine running all precincts. Voting options for overvoting and undervoting will be exercised. Ballots 7 and 16 were selected for Spanish based language input. Ballots 13 and 17 were selected for casting of ballot using the ADA Audio capability.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.2 Test Set-Up (continued)

General Election: GEN-03

A basic election held in two precincts. This election contains eight contests compiled into two ballot styles. Four of the contests are in both ballot styles. The other four contests are split between the two precincts. This election was designed to functionally test the handling of multiple ballot styles, support for at least three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

The parameters of this election are listed below:

- Closed Primary: No
- Open Primary: No
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: No
- Straight Party voting: No
- Cross-party endorsement: No
- Split Precincts: No
- Vote for N of M: Yes
- Recall issues, with options: No
- Cumulative voting: No
- Ranked order voting: No
- Provisional or challenged ballots: Yes
- Early Voting: No

This election was designed to functionally test the handling of multiple ballot styles, support for at least three languages including a character-based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device. Test patterns 3 and 4 were chosen for input in the Spanish language because they are a basic voting pattern with a write-in. Test patterns 5 and 6 were chosen for audio input using the Spanish language to demonstrate support for write-in voting using an ADA device with and alternative language. Test pattern 7 was chosen for character-based language input because it is a basic vote pattern using Chinese. Test pattern 8 was chosen for character-based language using an ADA device to demonstrate support for character-based ADA device support. Test pattern 9 was chosen for binary input to show support for ADA binary input device. Test pattern 10 was chosen for binary input using ADA audio deceive to show support for binary input and ADA support.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.2 Test Set-Up (continued)

Primary Election: PRIM-01

An open primary election in two precincts, containing thirty contests compiled into five ballot styles. Each ballot style contains six contests. This election was designed to functionally test an open primary with multiple ballot styles, support for two languages, and support for common voting variations.

The parameters of this election are listed below:

- Closed Primary: No
- Open Primary: Yes
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: No
- Straight Party voting: No
- Cross-party endorsement: No
- Split Precincts: Yes
- Vote for N of M: Yes
- Recall issues, with options: No
- Cumulative voting: No
- Ranked order voting: No
- Provisional or challenged ballots: Yes
- Early Voting: No

This election designed to functionally test an open primary with multiple ballot styles, support for two languages, and support for common voting variations. Test patterns 5 and 18 are input in an alternative language. Test patterns 8 and 18 are input using an ADA audio device. These patterns were select to exercise the write-in functionality in a primary election.

Primary Election: PRIM-03

A basic election held in two precincts. This election contains ten contests and is compiled into two ballot styles. Two of the contests are in both ballot styles. The other eight contests are split between the two parties‟ ballots. This election was designed to functionally test the handling of multiple ballot styles, support for at least three languages including an Ideographic based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.2 Test Set-Up (continued)

The parameters of this election are listed below:

- Closed Primary: Yes
- Open Primary: No
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: No
- Straight Party voting: No
- Cross-party endorsement: No
- Split Precincts: No
- Vote for N of M: Yes
- Recall issues, with options: No
- Cumulative voting: No
- Ranked order voting: No
- Provisional or challenged ballots: Yes
- Early Voting: No

This election was designed to functionally test the handling of multiple ballot styles, support for at least three languages including an Ideographic based language, support for common voting variations, and audio support for at least three languages and an ADA binary input device. Test patterns 3 and 4 were chosen for input in the Spanish language because it is a basic voting pattern with a write-in. Test patterns 5 and 6 were chosen for audio input using the Spanish language to demonstrate support for write-in voting using an ADA device with and alternative language. Test pattern 7 was chosen for Ideographic based language input because it is a basic vote pattern using Chinese. Test pattern 8 was chosen for character based language using an ADA device to demonstrate support for Ideographic based ADA device support. Test pattern 9 was chosen for binary input to show support for ADA binary input device. Test pattern 10 was chosen for binary input using ADA audio deceive to show support for binary input and ADA support.

6.3 Test Sequence

The components of the Democracy Suite 4.0 will undergo all applicable hardware software tests as described in the EAC 2005 VVSG. There is not a required sequence for the tests to be performed. The following sections provide a brief description of the each test:

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.1 Hardware Test Description

Hardware tests are divided into two categories: Non-Operating and Operating. The Non-Operating tests are intended to simulate the storage and transport of equipment between the storage facility and the polling location. The Operating tests are intended to simulate conditions that the EUT may encounter during operation. Prior to and immediately following Non-Operating and Operating test, the EUT will be subjected to an operational status check.

The Non-Operating tests include the following:

Low Temperature – This requirement addresses a range of tests for voting machines and precinct counters, as such devices are stored between elections and are transported between the storage facility and polling place, to meet specific minimum performance standards for low temperatures.

Vibration – This requirement addresses a range of tests for voting machines and precinct counters, as such devices are stored between elections and are transported between the storage facility and polling place, to meet specific minimum performance standards for vibration.

High Temperature – This test addresses a range of tests for voting machines and precinct counters, as such devices are stored between elections and are transported between the storage facility and polling place, to meet specific minimum performance standards for high temperature.

Bench Handling – The bench handling test simulates stresses faced during maintenance and repair of voting machines and ballot counters.

Humidity Test – This requirement addresses a range of tests for voting machines and precinct counters, as such devices are stored between elections and are transported between the storage facility and polling place, to meet specific minimum performance standards.

The Operating tests include the following:

Electromagnetic Radiation – This test verifies that radiated and conducted emissions from the voting system hardware do not exceed the allowable limits of Title 47CFR, Part 15, Class B. The test for electromagnetic radiation shall be conducted in compliance with the FCC Part 15 Class B requirements by testing per ANSI C63.4 (Volume II, Section 4.8.b).

Lightning Surge – This test demonstrates the voting system's hardware to withstand power line lightning surges during normal operation. This test is equivalent to the procedure of IEC 61000-4-5. The test for lightning surge protection shall be conducted in compliance with the test specified in IEC 61000-4-5 (Volume II, Section 4.8.f).

Electrical Fast Transient – This test demonstrates the voting system's hardware to withstand electrical fast transients during normal operation. This test is equivalent to the procedure of IEC 61000-4-4. The test for electrical fast transient protection shall be conducted in compliance with the test specified in IEC 61000-4-4 (Volume II, Section 4.8.e).

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.1 Hardware Test Descriptions (continued)

Electrostatic Disruption – This test demonstrates the voting system's hardware to withstand electrostatic discharges during normal operation. This test is equivalent to the procedure of IEC 61000-4-2. The test for electrostatic disruption shall be conducted in compliance with the test specified in IEC 61000-4-2 (Volume II, Section 4.8.c).

Electromagnetic Susceptibility – This test demonstrates the voting system's hardware to withstand radiated electromagnetic fields during normal operation. This test is equivalent to the procedure of IEC 61000-4-3. The test for electromagnetic susceptibility shall be conducted in compliance with the test specified in IEC 61000-4-3 (Volume II, Section 4.8.d.).

Conducted RF Immunity – This test demonstrates the voting system's hardware ability to withstand conducted RF energy on power and I/O lines during normal operation. This test is equivalent to the procedure of IEC 61000-4-6. The test for conducted RF immunity shall be conducted in compliance with the test specified in IEC 61000-4-6 (Volume II, Section 4.8.g).

Magnetic Fields Immunity – This test demonstrates the voting system's hardware ability to withstand Magnetic Fields during normal operation. This test is equivalent to the procedure of IEC 61000-4-8. The test for AC magnetic fields RF immunity shall be conducted in compliance with the test specified in IEC 61000-4-8 (Volume II, Section 4.8.h).

Electrical Power Disturbance – This test demonstrates the voting system's hardware to withstand power disturbances during normal operation. This test is equivalent to the procedure of IEC 61000-4-11 (Volume I, Section 4.1.2.5). The test for power disturbance disruption shall be conducted in compliance with the test specified in IEC61000-4-11 (Volume II, Section 4.8.a).

Temperature Power Variation – The Environmental Test, Operating, subjects the system hardware to varying temperatures and voltages, demonstrating hardware/data recording accuracy reliability Mean-Time-Between-Failure (MTBF) of 163 hours.

Maintainability – Maintainability represents the ease with which preventive and corrective maintenance actions can be performed based on the design characteristics of equipment and software and the processes the manufacturer and election officials have in place for preventing failures and for reacting to failures.

Electrical Supply – This requirement addresses the battery power source for providing electrical supply during a power failure.

Safety – a safety inspection will be performed to verify that the EUT meets the following requirements for safety:

a. All voting systems and their components shall be designed to eliminate hazards to personnel or to the equipment itself.

b. Defects in design and construction that can result in personal injury or equipment damage must be detected and corrected before voting systems and components are placed into service.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.1 Hardware Test Descriptions (continued)

c. Equipment design for personnel safety shall be equal to or better than the appropriate requirements of the Occupational Safety and Health Act, Code of Federal Regulations, Title 29, Part 1910.

Safety testing will be performed off-site at a third party laboratory with Wyle personnel witnessing.

6.3.2 Software Test Description

The software tests include the following:

Source Code Compliance Review – Wyle Laboratories personnel will compare the source code to the manufacturer's software design documentation to ascertain how completely the software conforms to the manufacturer's specifications. Source code inspection shall also assess the extent to which the code adheres to the requirements in Section 5 of Volumes I and II.

Compliance Build of the Democracy 4.0 System Software, Firmware, and Utilities– Before testing can begin a compliance build of all the applications will be constructed by Wyle personnel using the build environment, build documentation and reviewed source code. This is to insure the software being tested is constructed from the same source code that was reviewed.

COTS Source Code Review – Unmodified, general purpose COTS non-voting software (e.g., operating systems, programming language compilers, data base management systems, and Web browsers) is not subject to the detailed examinations specified in this section. However, Wyle Laboratories personnel will examine such software to confirm the specific version of software being used against the design specification to confirm that the software has not been modified. Wyle will verify by downloading the software directly from the manufacturer site, verifying against NRSL, or by being provided original OEM discs.

Portions of COTS software that have been modified by the manufacturer in any manner are subject to review. Unmodified COTS software is not subject to code examination. However, source code generated by a COTS package and embedded in software modules for compilation or interpretation will be provided in human readable form to Wyle Laboratories. Wyle Laboratories personnel may inspect COTS source code units to determine testing requirements or to verify the code is unmodified.

Wyle Laboratories may inspect the COTS generated software source code in preparation of test plans and to provide some minimal scanning or sampling to check for embedded code or unauthorized changes. Otherwise, the COTS source code is not subject to the full code review and testing. For purposes of code analysis, the COTS units shall be treated as unexpanded macros, as per Volume II, Section 5.2 of the EAC 2005 VVSG.

Baseline of EMS Operating and Build Machine OS – Wyle will review the submitted NIST SCAP FDCC checklist for the EMS Operating System and Build Machine OS Dominion. The review will be performed for completeness, clarity, and consistency.

Error Recovery Test – This will be tested to ensure that unit is capable of recovering from a non- catastrophic failure of a device, or from any error or malfunction that is within the operator’s ability to correct and restoration of the device gracefully from the failures. Testing will include powering units off while operating, disconnecting various cables and components to ensure operation once restored.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.2 Software Test Description (continued)

Security Source Code Review – The security source code review is a detailed review of the functionality of the source code that has been submitted. Both a manual line by line review and an automated analysis of the source code will be performed.

Trusted Build – The trusted build is a process of converting the reviewed source code into machine-readable binary instructions for a computer. This test will follow Section 5.6 of the EAC Testing and Certification Program manual.

Table 6-1 Democracy Suite 4.0 System Software Test Sequence

Test	Description	Procedure	Test Level	Specimen
Compliance Source Code Review (Pre-testing Activity)	Source code review for compliance	WHVS07.2 WOP 5a	Component	Democracy Suite 4.0 Source Code Package
Compliance Build	Using the build documents and source code to construct the EMS	WHVS07.3 WOP 7b	Component	Democracy Suite 4.0
Source Code COTS Review	Source code review to examine 3rd party products for modification and versions	WHVS07.2 WOP 5d	Component	Democracy Suite 4.0 Source Code Package
Baseline OS	RFI 2008-03 OS Configuration	WHVS07.3 WOP 25	Component	Democracy Suite 4.0
Source Code Functional Review	Source code review for functionality and high level software design	WHVS07.2 WOP5b	Component & Integration	Democracy Suite 4.0 Source Code Package
Source Code Security Review (manual – automated)	Source code review for specific security concerns and an automated review using Fortify	WHVS07.2 WOP5c WOP 6a	Component & Integration	Democracy Suite 4.0 Source Code Package

6.3.3 System Testing

Physical Configuration Audit – The Physical Configuration Audit 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
- Review drawings, specifications, technical data, and test data associated with system hardware, if non-COTS, to establish system hardware baseline associated with software baseline

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.3 System Testing (continued)

- 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

Functional Configuration Audit – The functional configuration audit 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 for the TDP. In addition to functioning according to the manufacturer's documentation tests will be conducted to insure all applicable EAC 2005 VVSG requirements are met.

TDP Review – The technical data package must be submitted as a precondition of national certification testing. These items are necessary to define the product and its method of operation; to provide technical and test data supporting the manufacturer's claims of the system's functional capabilities and performance levels; and to document instructions and procedures governing system operation and field maintenance. Any information relevant to the system evaluation shall be submitted to include source code, object code, and sample output report formats.

Security Test – The security test is designed and performed to test the capabilities of the voting system against the requirements defined in Volume I Section 7. These procedures shall focus on the ability of the system to detect, prevent, log, and recover from a broad range of security risks identified. This test will also examine system capabilities and safeguards claimed by Dominion in the TDP to go beyond these risks. The range of risks tested is determined by the design of the system and potential exposure to risk.

Telecommunication Test – The telecommunication test focuses on system hardware and software function and performance for the transmission of data that is used to operate the system and report election results. This test applies to the requirements for Volume I, Section 6 of the EAC 2005 VVSG.

Usability – The usability test is 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. This test applies to the requirements for Volume I, Section 3 of the EAC 2005 VVSG.

Volume/Stress/Reliability – Tests to investigate the system's response to conditions that tend to overload the system's capacity to process, store, and report data. The test parameters will focus on the system's stated limits and the ballot logic for areas such as the maximum number of active voting positions, maximum number of ballot styles, maximum candidates, maximum contests, and stated limits within the EMS. This test will be utilized to ensure the system can achieve the manufacturer's TDP claims of what the system can support. Testing will be performed by exercising an election definition and test cases developed specifically to test for volume and stress conditions of the system being tested.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.3 System Testing (continued)

Each sub-component will be subjected to the test as outlined in the EAC 2005 VVSG as follows:

- The EMS shall be subjected to overload conditions such as processing more than the expected number of ballots/voters per precinct and processing more than expected number of precincts.
- The ICE and ICP shall be subjected to ballot processing at the high volume rates at which the equipment can be operated to evaluate software response to hardware-generated interrupts and wait states.
- The ICC shall be subjected to overload conditions.

Throughout the duration of the test, any errors that occur will be noted. The error handling abilities of each component will be evaluated (through available error messages, audit log inspection, and any other available means) and documented. To ensure the system's ability to gracefully shutdown and recover from error conditions, negative test cases will be performed to introduce such error conditions. The error conditions introduced will be based on the system limits specified within the vendors TDP documentation

Logic and Accuracy – The logic and accuracy test insures that each component of the voting system (ICC, ICE and ICP) 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 each component of the voting system:

The Accuracy test requirements for the ICE will be met by the execution of two accuracy tests. Since Wyle considers the ICE as a paper based scanner and a ballot marker, the first accuracy test for the ICE will be performed by using both paper-based and audio ballots. The majority of the vote processing will be utilizing the paper-based functionality, while audio votes are being cast at defined intervals between ballot scans. After analyzing the processes and researching past testing, Wyle believes the architecture, data flow, and integration of the recording process of an audio ballot and the scanning of a paper ballot in an ICE unit are similar and use many of the same software modules. Based on this, Wyle has concluded that the audio feature should not be subjected to the full requirement of Volume II, Section 4.7.1.1; therefore during test performance, 5000 audio ballot positions will be cast to satisfy the execution of the feature. The remaining ballot positions will be captured with paper-based voting. All results will be validated and verified against the election definition voting matrix for expected results. If the ICE processes the minimum number of ballot positions without error the test shall be accepted. If the ICE should not process the minimum requirement an evaluation will be performed to determine the root cause and the test will not be accepted.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.3 System Testing (continued)

The second accuracy test will consist of the ICE Ballot Marking Device (BMD). Wyle will utilize a maximum position ballot with the ICE, which will be manually voted in order to verify the components correctly tabulate 1,549,703 ballot positions within the allowable target error rate. All results will be validated and verified against the election definition voting matrix for expected results. If the ICE processes the minimum number of ballot positions, during both tests, without error the test shall be accepted. If the ICE should not process the minimum requirement an evaluation will be performed to determine the root cause and the test will not be accepted.
ICC accuracy will be exercised by using only paper-based ballots. All results will be validated and verified against the election definition voting matrix for expected results. If the ICC processes the minimum number

of ballot positions without error the test shall be accepted. If the ICC should not process the minimum requirement an evaluation will be performed to determine the root cause and the test will not be accepted.

The results of previous testing on the ICP will be utilized to satisfy the accuracy test requirements for this test campaign.

System Integration – System Level certification test address the integrated operation of both hardware and software, along with any telecommunication capabilities. 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.

Regression Testing

Regression Testing will be performed on all system components to verify all firmware modifications.

Table 6-2 Democracy 4.0 System Testing Sequence

Test	Description	Procedure	Test Level	Specimen	Election Data
Technical Data Package (TDP) Review	Documentation review for compliance, correctness, and completeness	WHVS07.1 WOP 3	Document	TDP package	---
Physical Configuration Audit	Audit hardware and software models and versions	WHVS07.3 WOP 25	Component & System	System hardware and software	---
Functional Configuration Audit	Functional testing to the system documentation and EAC 2005 VVSG requirements	WHVS07.4 WOP 26 WOP30a	Component & Integration	System	Gen-01 Prim-01

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (continued)

6.3.3 System Testing (continued)

Table 6-2 Democracy 4.0 System Testing Sequence (continued)

Test	Description	Procedure	Test Level	Specimen	Election Data
Telecommunication	Test of telecommunication technology of the system for accuracy and correctness	WHVS07.6 WOP 31	Integration & System	System	Gen-01 Volume & Stress
Usability/ Accessibility	Testing to the system documentation and EAC 2005 VVSG requirements	WOP 22 WOP 24-1a-g WOP 24-2 a-f	Integration	System	Gen-01 Prim-01
Volume, Stress, & Reliability Test	Test to investigate the system's response to larger amounts of data than it is expecting.	WOP 21 WOP 30	System	System	Volume and Stress Election
Security	Assess the system to the 2005 VVSG requirements and execute basic system security tests.	WHVS07.7 WOP 6 WOP 6a WOP 6b WOP 6c WOP 6d	Integration & System	System	Gen-01 Prim -01
Logic and Accuracy	Test of accuracy to ~1.6 million ballot positions per system component (ICC, ICE, and ICP)	WHVS07.9 WOP 30 WOP 21	System	System	L&A Election
System Integration Test	Test of all system hardware, software and peripherals.	WOP 30	System	System	Gen-01-03 Prim-01&03
Trusted Build	Creation and installation of the final system software	WHVS07.6 WOP 7 WOP 7a	Component	System software	Democracy Suite 4.0 Source Code Package

7.0 TEST OPERATIONS PROCEDURES

7.1 Proprietary Data

All proprietary data that is marked will be distributed only to those persons that the manufacturer or EAC identifies as needing the information to conduct qualification testing. The manufacturer is required to mark all proprietary documents as such. All organizations and individuals receiving proprietary documents will ensure those documents are not available to non-authorized persons.

APPENDIX A

DOMINION VOTING SYSTEMS DEMOCRACY SUITE 4.0 IMPLEMENTATION STATEMENT

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Dominion Voting Systems - Democracy Suite 4.0 Voting System consisting of:

1. **Election Management System EMS**
2. **ImageCast Evolution- Precinct Count Optical Scanner (PCOS)**
3. **ImageCast Evolution- Precinct Count Optical Scanner (PCOS) with Electronic Ballot Printer (EBP)**
4. **ImageCast Central Central- Count Optical Scanner (CCOS)**

Vendor Name: Dominion Voting **Preparer: Ed Smith**
Date Prepared: August 22, 2011

This section addresses functionality that is covered by the Voluntary Voting System Guidelines (2005).
Identify the functionality supported by marking with a ☑.
Insert Required descriptions where needed (Rotation, VVPAT, Open Primary, Closed Primary, etc).
(P & M= Paper and Marksense ballots)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
Voter Verified Paper Audit Trails			
VVPAT			
Accessibility (vol. 1. sect. 3.2)			
Forward Approach	☑		
Parallel (Side) Approach	☑		
Closed Primary (vol. 1. sect. 2.1.7.2)			
Primary: Closed	☑	A registered voter may vote in any *party primary* regardless of his own party affiliation	Separate ballots will be produced per Party. Non-partisan races can be placed either on a separate ballot or on each Partisan ballot. **Supported.**
Open Primary (vol. 1. sect. 2.1.7.2)			
Primary: Open Standard (provide definition of how supported)		Voter choice of party with	

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Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
		exclusive rules	
Primary: Open Blanket (provide definition of how supported)	☑		
Partisan & Non-Partisan: (vol. 1, sect. 2.1.7.2)			
Partisan & Non-Partisan: Vote for 1 of N race	☑		**Supported.**
Partisan & Non-Partisan: Multi-member ("vote for N of M") board races	☑		**Supported.**
Partisan & Non-Partisan: "vote for 1" race with a single candidate and write-in voting	☑		**Supported.**
Partisan & Non-Partisan "vote for 1" race with no declared candidates and write-in voting	☑		**Supported.**
Write-In Voting: (vol. 1, sect. 2.1.7.2)			
Write-in Voting: System default is a voting position identified for write-ins.	☑		Image-cast ballots will have separate voting boxes next to Write-in fields. **Supported.**
Write-in Voting: Without selecting a write in position *	☑		.
Write-in: With No Declared Candidates	☑	A race may consist of only Write-in fields.	**Supported.**
Write-in: Identification of write-ins for resolution at central count *	☑	Diversion functionality provided on precinct units	
Primary Presidential Delegation Nominations & Slates: (vol. 1, sect. 2.1.7.2)			
Primary Presidential Delegation Nominations: Displayed delegate slates for each presidential party*	☑		
Slate & Group Voting: one selection votes the slate*	☑		
Ballot Rotation: (vol. 1, sect. 2.1.7.2)			

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2. 2.2.1.3.a. 2.3.3.3. 4.1.5.1.b. 4.1.5.1.d. 5.4.4	Supported	Required description(s)	EMS Comments
Rotation of Names within an Office; define all supported rotation methods for location on the ballot and vote tabulation/reporting	☑	Top down by precinct, others (bottom up)?	
Straight Party Voting: (vol. 1. sect. 2.1.7.2*)*			
Straight Party: A single selection for partisan races in a general election	☑		**Supported.**
Straight Party: Vote for each candidate individually	☑		**Supported.**
Straight Party: Modify straight party selections with crossover votes	☑		**Supported.**
Straight Party: A race without a candidate for one party	☑		**Supported.**
Straight Party: "N of M race (where "N">1)	☑		**Supported.**
Straight Party: Excludes a partisan contest from the straight party selection.	☑		**Supported.**
Cross-Party Endorsement: (vol. 1. sect. 2.1.7.2*)*			
Cross party endorsements, multiple parties endorse one candidate*	☑		**QA to verify.**
Split Precincts: (vol. 1. sect. 2.1.7.2*)*			
Split Precincts: Multiple ballot styles	☑		**Supported.**
Split Precincts: P & M system support splits with correct contests and ballot identification of each split	☑		**Supported.**
Split Precincts: DRE matches voter to all applicable races.	NA	Not a DRE system	
Split Precincts: Reporting of voter counts (# of voters) to the precinct split level; Reporting of vote totals is to the precinct level			? Number of electors and number of voters (ballots cast) is stored on split level. Reporting is done on split level as well.
Vote N of M: (vol. 1. sect. 2.1.7.2*)*			

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Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
Vote for N of M: Counts each selected candidate, if the maximum is not exceeded.	☑		**Supported.**
Vote for N of M: Invalidates all candidates in an overvote (paper)	☑		**Supported.**
Recall Issues, with options: (vol. 1. sect. 2.1.7.2)			
Recall Issues with Options: Simple Yes/No with separate race/election. (Vote Yes or No Question)	☑		We do not have correlation between these two contests.
Recall Issues with Options: Retain is the first option, Replacement candidate for the second or more options (Vote 1 of M)	☑		If it is "vote for 1", than it is regular contest: supported.
Recall Issues with Options: Two contests with access to a second contest conditional upon a specific vote in contest one. (Must vote Yes to vote in 2nd contest.)			
Recall Issues with Options: Two contests with access to a second contest conditional upon any vote in contest one. (Must vote Yes or No to vote in 2nd contest)		Overturned - US District Court 7/29/03: CA Election Code sect. 11383	
Cumulative Voting (vol. 1. sect. 2.1.7.2)			
Cumulative Voting: Voters are permitted to cast, as many votes as there are seats to be filled for one or more candidates. Voters are not limited to giving only one vote to a candidate. Instead, they can put multiple votes on one or more candidate.			
Ranked Order Voting (vol. 1. sect. 2.1.7.2)			

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
Ranked Order Voting: Voters rank candidates in a contest in order of choice. A candidate receiving a majority of the first choice votes wins. If no candidate receives a majority of first choice votes, the last place candidate is deleted, each ballot cast for the deleted candidate counts for the second choice candidate listed on the ballot. The process of eliminating the last place candidate and recounting the ballots continues until one candidate receives a majority of the vote.			
Ranked Order Voting: Voters can write in a ranked vote.			
Ranked Order Voting: A ballot stops being counting when all ranked choices have been eliminated			
Ranked Order Voting: A ballot with two choices ranked the same, stops being counted at the point of two similarly ranked choices.			
Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank.			
Ranked Order Voting: The total number of votes for two or more candidates with the least votes is less than the votes of the candidate with the next highest number of votes, the candidates with the least votes are eliminated simultaneously and their votes transferred to the next-ranked continuing candidate.			
Provisional or Challenged Ballots (vol. 1. sect. 2.1.7.2*)*			
Provisional/Challenged Ballots: A voted provisional ballots is identified but not included in the tabulation, but can be added in the central count.	☑	Provisional ballots are not included in tabulation.	

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
Provisional/Challenged Ballots: A voted provisional ballots is included in the tabulation, but is identified and can be subtracted in the central count.			
Provisional/Challenged Ballots: Provisional ballots maintain the secrecy of the ballot.	☑	No connection is made between the voter and the cast ballot.	
Overvotes (vol. 1. sect. 5.4.4)	*Must support for specific type of voting system*		
Overvotes: P & M: Overvote invalidates the vote. Define how overvotes are counted.	☑	If a contest is overvoted the number of overvotes always equals the M number. Overvotes are stored per contest	**Supported.**
Overvotes: DRE: Prevented from or requires correction of overvoting.			
Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted.			
Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes.			
Undervotes (vol. 1. sect. 5.4.4)	*Must support*		
Undervotes: System counts undervotes cast for accounting purposes	☑	Undervotes are always counted.	**Supported.**
Blank Ballots (vol. 1. sect. 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, & 5.4.4)			
Totally Blank Ballots: Any blank ballot alert is tested.	☑		**Supported.**

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2. 2.2.1.3.a. 2.3.3.3. 4.1.5.1.b. 4.1.5.1.d. 5.4.4	Supported	Required description(s)	EMS Comments
Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them	☑		**Supported.**
Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution.	☑		
Display/Printing Multi-Lingual Ballots (vol. 1. sect. 2.2.1.3.a*)*	*Must support one* ☑		
Spanish	☑		
Alaska Native (Other Group specified)			
Aleut			
Athabascan			
Eskimo	AK		
Native (Other Group Specified)			
Chinese	☑		
Filipino*	CA		
Japanese*	CA		
Korean*	CA		
Vietnamese*	CA		
Apache	AZ		
Cent/So American			
Cheyenne			
Chickasaw			
Choctaw			
Navajo	AZ		

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

Voting Variations Functionality & Languages Vol. 1 Sect 2.1.7.2, 2.2.1.3.a, 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, 5.4.4	Supported	Required description(s)	EMS Comments
Other Tribe-Specified	LA, NM	French, Jicarilla, Keres, Navajo, Towa).	
Paiute			
Pueblo			
Seminole	FL		
Shoshone			
Sioux			
Tohono O'Odham			
Tribe not specified			
Ute	CO		
Yaqui			
Yuman	AZ		
Demonstrates the voting system capability to handle the designated language groups. (vol. 1 sect. 2.2.1.3.a)			
Default language (English),	☑		**Supported.**
Secondary language using a Western European font	☑		**Supported.**
Ideographic language (such as Chinese or Korean),	☑		Ballots can be created, but LCD monitor on ICP and ICE cannot show these characters, and can not print on the print tape.
Non-written languages requiring audio support	☑		**Supported.**

NOTE: System supports all ISO approved languages.

2005 VVSG Supported Functionality Declaration rec05-01 (Dominion Version 2.1 20110822)

This section covers any additional functionality provided by the submitted system that is not accounted for in the VVSG.

Additional Vendor Provided functionality	Description
<Please enter the high level component within which the functionality resides>	
<Please enter a listing of the additional functionality, within the high level component >	
<Please enter the high level component within which the functionality resides>	
<Please enter a listing of the additional functionality, within the high level component >	
<Please enter the high level component within which the functionality resides>	
<Please enter a listing of the additional functionality, within the high level component >	

End of Supported Functionality Declaration

APPENDIX B

DOMINION VOTING SYSTEMS PROJECT SCHEDULE

ID		Task Name	Duration	Start	Finish	Predecessors
1	✓	EAC Application	0 days	Fri 3/19/10	Fri 3/19/10	
2	✓	EAC Kickoff Meeting	3 days	Tue 5/18/10	Fri 5/21/10	
3		**Technical Data Package Review**	**436 days**	**Mon 3/15/10**	**Mon 11/21/11**	
4	✓	Partial Document Submission	1 day	Mon 3/15/10	Tue 3/16/10	
5		Document Review for VVSG Requirements	406 days	Mon 3/15/10	Mon 10/10/11	4
6		Document Discrepancy Report	5 days	Mon 10/10/11	Mon 10/17/11	5
7		Dominion Review of Report and Correct Documents	10 days	Mon 10/17/11	Mon 10/31/11	6
8		Document Re-Review	10 days	Mon 10/31/11	Mon 11/14/11	7
9		Final Report TDP Review	5 days	Mon 11/14/11	Mon 11/21/11	8
10		**Source Code Review**	**391 days**	**Mon 5/3/10**	**Mon 11/7/11**	
11		**Review EMS**	**360.06 days**	**Mon 5/17/10**	**Fri 10/7/11**	
12	✓	Initial Submission of EMS Coding Standards	1 day	Mon 5/17/10	Tue 5/18/10	
13	✓	Initial Review of EMS Coding Standards	2 days	Tue 5/18/10	Thu 5/20/10	12
14	✓	Submission of EMS Coding Standards	1 day	Tue 9/21/10	Wed 9/22/10	
15	✓	Review EMS Coding Standards	1 day	Wed 9/22/10	Thu 9/23/10	14
16	✓	EMS Source Code Submission	1 day	Mon 6/14/10	Tue 6/15/10	
17		**EMS Source Code Review**	**340.06 days**	**Mon 6/14/10**	**Fri 10/7/11**	
18	✓	Wyle Source Code Review	30 days	Mon 6/14/10	Mon 7/26/10	
19	✓	Wyle Report	2 days	Mon 7/26/10	Wed 7/28/10	18
20	✓	Manufacturer Review	97 days	Wed 7/28/10	Tue 12/14/10	19
21	✓	Wyle Receives Revised Code	1 day	Tue 12/14/10	Wed 12/15/10	20
22	✓	Wyle Source Code Review	12 days	Wed 12/15/10	Tue 1/4/11	21
23	✓	Wyle Report	1 day	Tue 1/4/11	Wed 1/5/11	22
24	✓	Manufacturer Review	24 days	Wed 1/5/11	Tue 2/8/11	23
25	✓	Wyle Receives Revised Code 4.0.8	1 day	Tue 2/8/11	Wed 2/9/11	24
26	✓	Wyle Source Code Review	29 days	Wed 2/9/11	Tue 3/22/11	25
27	✓	Wyle Report	1 day	Tue 3/22/11	Wed 3/23/11	26
28	✓	Manufacturer Review	8 days	Wed 3/23/11	Mon 4/4/11	27
29	✓	Wyle Receives Revised Code 4.0.10	1 day	Mon 4/4/11	Tue 4/5/11	28
30	✓	Wyle Source Code Review	20 days	Tue 4/5/11	Tue 5/3/11	29
31	✓	Wyle Report	1 day	Tue 5/3/11	Wed 5/4/11	30
32	✓	Manufacturer Review	66 days	Wed 5/4/11	Thu 8/4/11	31
33	✓	Wyle Receives Revised Code 4.6.00	1 day	Thu 8/4/11	Fri 8/5/11	32
34	✓	Wyle Source Code Review	5 days	Fri 8/5/11	Fri 8/12/11	33

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Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
External Tasks	Duration-only	Deadline

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ID	✓	Task Name	Duration	Start	Finish	Predecessors
35	✓	Wyle Report	1 day	Fri 8/12/11	Mon 8/15/11	34
36	✓	Manufacturer Review	9 days	Mon 8/15/11	Fri 8/26/11	35
37	✓	Wyle Receives Revised Code 4.6.02	1 day	Fri 8/26/11	Mon 8/29/11	36
38	✓	Wyle Source Code Review	6 days	Mon 8/29/11	Tue 9/6/11	37
39	✓	Wyle Report	1 day	Tue 9/6/11	Wed 9/7/11	38
40	✓	Manufacturer Review	5 days	Wed 9/7/11	Wed 9/14/11	39
41	✓	Wyle Receives Revised Code 4.6.03	1 day	Thu 9/15/11	Fri 9/16/11	40
42	✓	Wyle Source Code Review	1 day	Fri 9/16/11	Mon 9/19/11	41
43	✓	Wyle Report	1 day	Mon 9/19/11	Tue 9/20/11	42
44	✓	Manufacturer Review	5 days	Tue 9/20/11	Tue 9/27/11	43
45	✓	Wyle Receives Revised Code 4.6.04	1 day	Thu 9/22/11	Tue 9/27/11	44
46	✓	Wyle Source Code Review	1 day	Tue 9/27/11	Wed 9/28/11	45
47	✓	Wyle Report	0 days	Wed 9/28/11	Wed 9/28/11	46
48		Manufacturer Review	5 days	Wed 9/28/11	Wed 10/5/11	47
49		Final Review	2 days	Wed 10/5/11	Fri 10/7/11	48
50		**Review ICP FIRMWARE**	**381 days**	**Mon 5/17/10**	**Mon 11/7/11**	
51	✓	Submission of ICP Coding Standards	1 day	Mon 5/17/10	Tue 5/18/10	
52	✓	Review ICP Coding Standards	2 days	Wed 7/7/10	Fri 7/9/10	51
53	✓	ICP Code Submission	0 days	Fri 6/4/10	Fri 6/4/10	
54		**ICP Source Code Review**	**356 days**	**Mon 6/21/10**	**Mon 11/7/11**	**52,53**
55	✓	Wyle Source Code Review	19 days	Mon 6/21/10	Fri 7/16/10	
56	✓	Wyle Report	2 days	Fri 7/16/10	Tue 7/20/10	55
57	✓	Manufacturer Review	63 days	Wed 7/21/10	Mon 10/18/10	56
58	✓	Wyle Receives Revised Code	1 day	Mon 10/18/10	Tue 10/19/10	57
59	✓	Wyle Source Code Review	13 days	Tue 10/19/10	Fri 11/5/10	58
60	✓	Wyle Report	2 days	Fri 11/5/10	Tue 11/9/10	59
61	✓	Manufacturer Review	50 days	Tue 11/9/10	Mon 1/24/11	60
62	✓	Wyle Receives Revised Code 4.014	1 day	Mon 1/24/11	Tue 1/25/11	61
63	✓	Wyle Source Code Review	21 days	Tue 1/25/11	Wed 2/23/11	62
64	✓	Wyle Report	1 day	Wed 2/23/11	Thu 2/24/11	63
65	✓	Manufacturer Review	13 days	Thu 2/24/11	Tue 3/15/11	64
66	✓	Wyle Receives Revised Code 4.0.16	1 day	Tue 3/15/11	Wed 3/16/11	65
67	✓	Wyle Source Code Review	4 days	Wed 3/16/11	Tue 3/22/11	66
68	✓	Wyle Report	1 day	Tue 3/22/11	Wed 3/23/11	67

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Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
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ID	ℹ	Task Name	Duration	Start	Finish	Predecessors
69	✓	Manufacturer Review	14 days	Wed 3/23/11	Tue 4/12/11	68
70	✓	Wyle Receives Revised Code 4.0.19	1 day	Tue 4/12/11	Wed 4/13/11	69
71	✓	Wyle Source Code Review	2 days	Wed 4/13/11	Fri 4/15/11	70
72	✓	Wyle Report	1 day	Fri 4/15/11	Mon 4/18/11	71
73	✓	Manufacturer Review	2 days	Mon 4/18/11	Wed 4/20/11	72
74	✓	Wyle Receives Revised Code 4.0.20	1 day	Wed 4/20/11	Thu 4/21/11	73
75	✓	Wyle Source Code Review	2 days	Thu 4/21/11	Mon 4/25/11	74
76	✓	Wyle Report	0 days	Mon 4/25/11	Mon 4/25/11	75
77	✓	Manufacturer Review	9 days	Mon 4/25/11	Fri 5/6/11	76
78	✓	Wyle Receives Revised Code 4.0.21	1 day	Fri 5/6/11	Mon 5/9/11	77
79	✓	Wyle Source Code Review	3 days	Mon 5/9/11	Thu 5/12/11	78
80	✓	Wyle Report	1 day	Thu 5/12/11	Fri 5/13/11	79
81	✓	Manufacturer Review	6 days	Fri 5/13/11	Mon 5/23/11	80
82	✓	Wyle Receives Revised Code 4.0.24	0 days	Mon 5/23/11	Mon 5/23/11	81
83	✓	Wyle Source Code Review	1 day	Mon 5/23/11	Tue 5/24/11	82
84	✓	Wyle Report	0 days	Tue 5/24/11	Tue 5/24/11	83
85	✓	Manufacturer Review	65 days	Tue 5/24/11	Tue 8/23/11	84
86	✓	Wyle Receives Revised Code 4.0.28	1 day	Tue 8/23/11	Wed 8/24/11	85
87	✓	Wyle Source Code Review	2 days	Wed 8/24/11	Fri 8/26/11	86
88	✓	Wyle Report	2 days	Thu 8/25/11	Tue 8/30/11	87
89	✓	Manufacturer Review	7 days	Tue 8/30/11	Thu 9/8/11	88
90	✓	Wyle Receives Revised Code	1 day	Thu 9/8/11	Fri 9/9/11	89
91	✓	Wyle Receives Revised Code 4.0.29	1 day	Wed 9/7/11	Thu 9/8/11	90
92	✓	Wyle Source Code Review	7 days	Fri 9/9/11	Tue 9/20/11	91
93	✓	Wyle Report	1 day	Fri 8/19/11	Wed 9/21/11	92
94	✓	Manufacturer Review	7 days	Wed 9/21/11	Fri 9/30/11	93
95	✓	Wyle Receives Revised Code 4.0.30	1 day	Fri 9/30/11	Mon 10/3/11	94
96	✓	Wyle Source Code Review	1 day	Mon 10/3/11	Tue 10/4/11	95
97	✓	Wyle Report	7 days	Thu 9/22/11	Thu 10/13/11	96
98	✓	Manufacturer Review	7 days	Thu 10/13/11	Mon 10/24/11	97
99	✓	Wyle Receives Revised Code 4.6.2	1 day	Mon 10/24/11	Tue 10/25/11	98
100	✓	Wyle Source Code Review	1 day	Tue 10/25/11	Wed 10/26/11	99
101	✓	Wyle Report	1 day	Wed 10/26/11	Thu 10/27/11	100
102		Manufacturer Review	3 days	Thu 10/27/11	Tue 11/1/11	101

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Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
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Project Summary	Manual Task	Progress
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ID	Indicators	Task Name	Duration	Start	Finish	Predecessors
103		Final Review	4 days	Tue 11/1/11	Mon 11/7/11	102
104		**Review ICC Firmware**	**340 days**	**Mon 5/3/10**	**Fri 8/26/11**	
105	✓	Submission of ICC Coding Standards	1 day	Mon 5/17/10	Tue 5/18/10	
106	✓	Review ICC Coding Standards	2 days	Tue 5/18/10	Thu 5/20/10	105
107	✓	Central Count Code Submission	0 days	Mon 5/3/10	Mon 5/3/10	
108		**ICC Source Code Review**	**288 days**	**Wed 7/14/10**	**Fri 8/26/11**	
109	✓	Wyle Source Code Review	14 days	Wed 7/14/10	Tue 8/3/10	
110	✓	Wyle Report	4 days	Tue 8/3/10	Mon 8/9/10	109
111	✓	Manufacturer Review	155 days	Mon 8/9/10	Fri 3/18/11	110
112	✓	Wyle Receives Revised Code 4.0.12	1 day	Fri 3/18/11	Mon 3/21/11	111
113	✓	Wyle Source Code Review	11 days	Mon 3/21/11	Tue 4/5/11	112
114	✓	Wyle Report	1 day	Tue 4/5/11	Wed 4/6/11	113
115	✓	Manufacturer Review	10 days	Wed 4/6/11	Wed 4/20/11	114
116	✓	Wyle Receives Revised Code 4.0.14	0 days	Wed 4/20/11	Wed 4/20/11	115
117	✓	Wyle Source Code Review	3 days	Wed 4/20/11	Mon 4/25/11	116
118	✓	Wyle Report	1 day	Mon 4/25/11	Tue 4/26/11	117
119	✓	Manufacturer Review	19 days	Tue 4/26/11	Mon 5/23/11	118
120	✓	Wyle Receives Revised Code 4.017	0 days	Mon 5/23/11	Mon 5/23/11	119
121	✓	Wyle Source Code Review	1 day	Mon 5/23/11	Tue 5/24/11	120
122	✓	Wyle Report	1 day	Tue 5/24/11	Wed 5/25/11	121
123	✓	Manufacturer Review	26 days	Wed 5/25/11	Thu 6/30/11	122
124	✓	Wyle Receives Revised Code 4.0.22	1 day	Thu 6/30/11	Fri 7/1/11	123
125	✓	Wyle Source Code Review	7 days	Fri 7/1/11	Tue 7/12/11	124
126	✓	Wyle Report	1 day	Tue 7/12/11	Wed 7/13/11	125
127	✓	Manufacturer Review	9 days	Wed 7/13/11	Tue 7/26/11	126
128	✓	Wyle Receives Revised Code 4.0.25	1 day	Tue 7/26/11	Wed 7/27/11	127
129	✓	Wyle Source Code Review	4 days	Wed 7/27/11	Tue 8/2/11	128
130	✓	Wyle Report	0 days	Tue 8/2/11	Tue 8/2/11	129
131	✓	Manufacturer Review	1 day	Tue 8/2/11	Wed 8/3/11	130
132	✓	Wyle Receives Revised Code 4.0.26	0 days	Wed 8/3/11	Wed 8/3/11	131
133	✓	Wyle Source Code Review	1 day	Wed 8/3/11	Thu 8/4/11	132
134	✓	Wyle Report	0 days	Thu 8/4/11	Thu 8/4/11	133
135	✓	Manufacturer Review	1 day	Thu 8/4/11	Fri 8/5/11	134
136	✓	Wyle Receives Revised Code 4.0.27	1 day	Fri 8/5/11	Mon 8/8/11	135

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Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
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ID	Indicators	Task Name	Duration	Start	Finish	Predecessors
137	✓	Wyle Source Code Review	1 day	Mon 8/8/11	Tue 8/9/11	136
138	✓	Wyle Report	0 days	Tue 8/9/11	Tue 8/9/11	137
139	✓	Manufacturer Review	1 day	Tue 8/9/11	Wed 8/10/11	138
140	✓	Wyle Receives Revised Code 4.6.2	1 day	Wed 8/10/11	Thu 8/11/11	139
141	✓	Wyle Source Code Review	1 day	Thu 8/11/11	Fri 8/12/11	140
142	✓	Wyle Report	0 days	Fri 8/12/11	Fri 8/12/11	141
143		Manufacturer Review	5 days	Fri 8/12/11	Fri 8/19/11	142
144		Final Review	5 days	Fri 8/19/11	Fri 8/26/11	143
145		**Review ICE Firmware**	**367 days**	**Mon 5/3/10**	**Tue 10/4/11**	
146	✓	Submission of ICE Coding Standards	1 day	Mon 5/24/10	Tue 5/25/10	
147	✓	Review ICE Coding Standards	2 days	Tue 5/25/10	Thu 5/27/10	146
148	✓	ICE Code Submission	0 days	Mon 5/3/10	Mon 5/3/10	
149		**ICE Source Code Review**	**322 days**	**Mon 7/5/10**	**Tue 10/4/11**	
150	✓	Wyle Source Code Review	20 days	Mon 7/5/10	Mon 8/2/10	
151	✓	Wyle Report	4 days	Tue 8/3/10	Mon 8/9/10	150
152	✓	Manufacturer Review	60 days	Mon 8/9/10	Mon 11/1/10	151
153	✓	Wyle Receives Revised Code 1.0.8	1 day	Mon 11/1/10	Tue 11/2/10	152
154	✓	Wyle Source Code Review	37 days	Tue 11/2/10	Wed 12/29/10	153
155	✓	Wyle Report	1 day	Wed 12/29/10	Thu 12/30/10	154
156	✓	Manufacturer Review	87 days	Thu 12/30/10	Mon 5/2/11	155
157	✓	Wyle receives Revised Code 1.0.16	1 day	Mon 5/2/11	Tue 5/3/11	156
158	✓	Wyle Source Code Review	15 days	Tue 5/3/11	Tue 5/24/11	157
159	✓	Wyle Report	1 day	Tue 5/24/11	Wed 5/25/11	158
160	✓	Manufacturer Review	47 days	Wed 5/25/11	Fri 7/29/11	159
161	✓	Wyle receives Revised Code 4.1.3.2	1 day	Fri 7/29/11	Mon 8/1/11	160
162	✓	Wyle Source Code Review	8 days	Mon 8/1/11	Thu 8/11/11	161
163	✓	Wyle Report	1 day	Thu 8/11/11	Fri 8/12/11	162
164	✓	Manufacturer Review	26 days	Fri 8/12/11	Mon 9/19/11	163
165	✓	Wyle receives Revised Code 4.6	1 day	Fri 9/16/11	Mon 9/19/11	164
166	✓	Wyle Source Code Review	2 days	Fri 9/16/11	Tue 9/20/11	165
167	✓	Wyle Report	2 days	Mon 9/19/11	Tue 9/20/11	166
168	✓	Manufacturer Review	5 days	Wed 9/21/11	Tue 9/27/11	167
169	✓	Wyle receives Revised Code 4.6.2.1	0 days	Wed 9/14/11	Wed 9/14/11	168
170	✓	Wyle Source Code Review	3 days	Thu 9/15/11	Mon 9/19/11	169

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Task	External Milestone	Manual Summary Rollup
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Milestone	Inactive Milestone	Start-only
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Project Summary	Manual Task	Progress
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ID	ℹ	Task Name	Duration	Start	Finish	Predecessors
171	✓	Wyle Report	2 days	Mon 9/19/11	Tue 9/20/11	170
172	✓	Manufacturer Review	5 days	Wed 9/21/11	Tue 9/27/11	171
173	✓	Wyle Receives Revised Code	1 day	Wed 9/28/11	Wed 9/28/11	172
174		Final Review	3 days	Thu 9/29/11	Mon 10/3/11	173
175		**Source Code Review Completion**	**0 days**	**Mon 11/7/11**	**Mon 11/7/11**	
176		Final Report Source Code Review Test	0 days	Mon 11/7/11	Mon 11/7/11	174,144,49,103
177	✓	**Creation of the Build Environment**	**79 days**	**Mon 1/10/11**	**Fri 4/29/11**	
178	✓	Receive Build Equipment	5 days	Mon 1/10/11	Mon 1/17/11	
179	✓	Receive Build Documentation	64 days	Mon 1/10/11	Fri 4/8/11	
180	✓	Scrub Build PC's	5 days	Fri 4/8/11	Fri 4/15/11	179
181	✓	Load OS and Compilers According to Build Instructions	5 days	Fri 4/15/11	Fri 4/22/11	180
182	✓	Initial Creation of Build Environment Complete	5 days	Fri 4/22/11	Fri 4/29/11	181
183		**Test Plan**	**377 days**	**Wed 5/5/10**	**Thu 10/20/11**	
184	✓	Receive Documentation	45 days	Mon 5/17/10	Mon 7/19/10	
185	✓	Receive Partial Shipment of Hardware Equipment	1 day	Wed 5/5/10	Thu 5/6/10	
186	✓	Draft Test Plan	20 days	Fri 10/22/10	Fri 11/19/10	
187	✓	Draft Test Plan Reviewed by Dominion	10 days	Fri 11/19/10	Tue 12/7/10	186
188	✓	Wyle/Dominion Review of Test Plan	56 days	Tue 12/7/10	Fri 2/25/11	187
189	✓	Draft Test Plan Update	1 day	Fri 2/25/11	Mon 2/28/11	188
190	✓	Draft Test Plan Reviewed by Dominion	21 days	Mon 2/28/11	Tue 3/29/11	189
191	✓	Revise Draft	5 days	Tue 3/29/11	Tue 4/5/11	190
192	✓	Test Plan to EAC	1 day	Thu 4/21/11	Fri 4/22/11	
193	✓	EAC Review	20 days	Fri 4/22/11	Fri 5/20/11	192
194	✓	Review TR's Comments	10 days	Fri 5/20/11	Fri 6/3/11	193
195	✓	Revise Draft	14 days	Fri 9/9/11	Thu 9/29/11	
196		Create Test Plan Package	5 days	Thu 9/29/11	Thu 10/6/11	195
197		Test Plan Approved by EAC	10 days	Thu 10/6/11	Thu 10/20/11	196
198		**Physical Configuration Audit**	**357 days**	**Wed 5/5/10**	**Thu 9/22/11**	
199		**PCA Hardware Configuration**	**350 days**	**Wed 5/5/10**	**Tue 9/13/11**	
200	✓	PCA Initial Hardware Submitted	1 day	Wed 5/5/10	Thu 5/6/10	
201	✓	PCA Initial Hardware Photographed	10 days	Thu 5/6/10	Thu 5/20/10	200
202	✓	PCA Proprietary Hardware Documentation Submitted	1 day	Thu 5/6/10	Fri 5/7/10	201
203	✓	PCA COTS Initial Hardware Documentation Submitted	1 day	Fri 5/7/10	Mon 5/10/10	202
204	✓	PCA Proprietary Initial Hardware Verification Against CM	12 days	Tue 11/23/10	Mon 12/13/10	203

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Task	External Milestone	Manual Summary Rollup
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Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
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ID		Task Name	Duration	Start	Finish	Predecessors
205	✓	PCA COTS Initial Hardware Verification Against CM	1 day	Wed 11/24/10	Mon 12/13/10	204
206	✓	PCA Hardware Discrepancy Resolution	10 days	Mon 12/13/10	Wed 12/29/10	205
207		PCA Final Hardware Photographed	2 days	Tue 9/6/11	Thu 9/8/11	200
208		PCA Final Verification with Hardware and CM Documentation	2 days	Thu 9/8/11	Mon 9/12/11	207
209		PCA Report Hardware	1 day	Mon 9/12/11	Tue 9/13/11	208
210		**PCA SCAP Checklist (Baseline of OS)**	**278 days**	**Tue 8/24/10**	**Thu 9/22/11**	
211	✓	Research FDCC for all OS and Server for System	10 days	Tue 8/24/10	Tue 9/7/10	
212	✓	Submit Benchmark Checklist to Manufacturer	53 days	Tue 9/7/10	Fri 11/19/10	211
213	✓	Manufacturer Review	83 days	Fri 11/19/10	Tue 3/22/11	212
214	✓	Analysis Manufacturers Response	3 days	Tue 3/22/11	Fri 3/25/11	213
215	✓	Report to Manufacturer Any Discrepancies	2 days	Fri 3/25/11	Tue 3/29/11	214
216		Re-Analysis Checklist	2 days	Mon 9/19/11	Wed 9/21/11	
217		Report to EAC VSTL Findings	1 day	Wed 9/21/11	Thu 9/22/11	216
218		**Functional Configuration Audit**	**376 days**	**Thu 7/1/10**	**Thu 12/15/11**	
219		**Pre FCA Setup**	**320 days**	**Thu 7/1/10**	**Wed 9/28/11**	
220	✓	EMS Version Installed	4 days	Thu 7/1/10	Wed 7/7/10	
221	✓	Pre-Voting Test Case Sequencing, Specific Test Case Design and Data Inputs	62 days	Wed 7/7/10	Fri 10/1/10	220
222	✓	EMS Version 4.0 Installed	2 days	Fri 10/1/10	Tue 10/5/10	221
223		Pre-Voting Test Case Sequencing, Specific Test Case Design and Data Inputs	237 days	Tue 10/5/10	Wed 9/7/11	222
224		Voting Test Case Sequencing, Specific Test Case Design, and Data Inputs	5 days	Wed 9/7/11	Wed 9/14/11	223
225		Post-Voting Test Case Sequencing, Specific Test Case Design, and Data Inputs	5 days	Wed 9/14/11	Wed 9/21/11	224
226		Usability Test Case Sequencing, Specific Test Case Design, and Data Inputs	5 days	Wed 9/21/11	Wed 9/28/11	225
227		**FCA Execution**	**28 days**	**Mon 11/7/11**	**Thu 12/15/11**	
228		Pre-Voting Execution	10 days	Mon 11/7/11	Mon 11/21/11	10,223
229		Voting Execution	5 days	Mon 11/21/11	Mon 11/28/11	228
230		Post Voting Execution	10 days	Mon 11/28/11	Mon 12/12/11	229
231		Complete FCA	0 days	Mon 12/12/11	Mon 12/12/11	230
232		**FCA Completion**	**3 days**	**Mon 12/12/11**	**Thu 12/15/11**	
233		Report FCA Test	3 days	Mon 12/12/11	Thu 12/15/11	231
234		**Usability Execution**	**10 days**	**Wed 9/28/11**	**Wed 10/12/11**	
235		Usability Start	0 days	Wed 9/28/11	Wed 9/28/11	226
236		Complete Usability	6 days	Wed 9/28/11	Thu 10/6/11	235
237		Complete Usability	1 day	Thu 10/6/11	Fri 10/7/11	236
238		**Usability Completion**	**3 days**	**Fri 10/7/11**	**Wed 10/12/11**	

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Task	External Milestone	Manual Summary Rollup
Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
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ID	Indicators	Task Name	Duration	Start	Finish	Predecessors
239		Report Usability	3 days	Fri 10/7/11	Wed 10/12/11	237
240		**Hardware Testing**	**148 days**	**Thu 5/26/11**	**Tue 12/20/11**	
241	✓	**Electrical Tests ICP**	**42 days**	**Thu 5/26/11**	**Mon 7/25/11**	
242	✓	Electromagnetic Radiation (FCC)	2 days	Thu 5/26/11	Mon 5/30/11	
243	✓	Electromagnetic Susceptibility	2 days	Tue 6/7/11	Thu 6/9/11	
244	✓	**Environmental Transportation Tests ICP**	**13 days**	**Wed 6/1/11**	**Mon 6/20/11**	
245	✓	Bench Handling	1 day	Fri 6/17/11	Mon 6/20/11	
246	✓	Vibration	1 day	Fri 6/17/11	Mon 6/20/11	
247	✓	Low Temperature	1 day	Mon 6/13/11	Tue 6/14/11	
248	✓	High Temperature	1 day	Tue 6/14/11	Wed 6/15/11	247
249	✓	Humidity	8 days	Wed 6/1/11	Mon 6/13/11	
250	✓	**Other Hardware Tests ICP**	**22 days**	**Thu 6/23/11**	**Mon 7/25/11**	
251	✓	Electrical Power Supply (2 hour Battery Backup)	1 day	Tue 7/12/11	Wed 7/13/11	
252	✓	Temperature Power/Reliability	5 days	Thu 6/23/11	Thu 6/30/11	
253	✓	Acoustic	3 days	Wed 7/20/11	Mon 7/25/11	
254	✓	Product Safety	3 days	Mon 7/11/11	Thu 7/14/11	
255	✓	Maintainability	5 days	Thu 7/14/11	Thu 7/21/11	254
256	✓	**Electrical Tests ICE**	**31 days**	**Fri 9/9/11**	**Mon 10/24/11**	
257	✓	Electromagnetic Radiation (FCC)	1 day	Fri 9/9/11	Mon 9/12/11	
258	✓	Electrical Power Disturbance	1 day	Tue 9/20/11	Wed 9/21/11	
259	✓	Electrostatic Disruption	2 days	Fri 10/14/11	Tue 10/18/11	260
260	✓	Electrostatic Susceptibility	2 days	Wed 10/12/11	Fri 10/14/11	263
261	✓	Electrical Fast Transient	1 day	Mon 9/19/11	Tue 9/20/11	
262	✓	Lightning Surge	1 day	Wed 9/21/11	Thu 9/22/11	
263	✓	Lightning Surge Retest	1 day	Tue 10/11/11	Wed 10/12/11	
264	✓	Conducted RF Immunity	2 days	Tue 10/18/11	Thu 10/20/11	259
265	✓	Magnetic Fields Immunity	2 days	Thu 10/20/11	Mon 10/24/11	264
266	✓	Electrical Tests Complete	1 day	Mon 10/24/11	Tue 10/25/11	265
267	✓	**Environmental Transportation Tests ICE**	**16 days**	**Fri 9/30/11**	**Mon 10/24/11**	
268	✓	Bench Handling	1 day	Fri 10/21/11	Mon 10/24/11	269
269	✓	Vibration	1 day	Thu 10/20/11	Fri 10/21/11	272
270	✓	Low Temperature	1 day	Fri 9/30/11	Mon 10/3/11	
271	✓	High Temperature	1 day	Mon 10/3/11	Tue 10/4/11	270
272	✓	Humidity	12 days	Tue 10/4/11	Thu 10/20/11	271

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Split	Inactive Task	Manual Summary
Milestone	Inactive Milestone	Start-only
Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
External Tasks	Duration-only	Deadline

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ID	ℹ	Task Name	Duration	Start	Finish	Predecessors
273		**Other Hardware Tests**	**28 days**	**Mon 10/10/11**	**Thu 11/17/11**	
274	✓	Electrical Power Supply (2 hour Battery Backup) ICE	1 day	Mon 10/24/11	Tue 10/25/11	268
275	▦	Electrical Power Supply (2 hour Battery Backup) ICC	1 day?	Mon 12/5/11	Tue 12/6/11	
276	▦	Temperature Power/Reliability - ICC/ICE	4 days	Tue 12/13/11	Mon 12/19/11	275
277	✓	Acoustic - ICE	3 days	Mon 10/24/11	Thu 10/27/11	268
278	✓	Product Safety - ICE	5 days	Mon 9/26/11	Mon 10/3/11	
279	▦	Maintainability - ICC-ICE	5 days	Mon 10/10/11	Mon 10/17/11	
280		**Completion of All Hardware Testing**	**5 days**	**Tue 12/13/11**	**Tue 12/20/11**	
281		Hardware Test Report	5 days	Tue 12/13/11	Tue 12/20/11	273,266,267
282		**System Level Performance Testing**	**57.5 days**	**Thu 10/27/11**	**Wed 1/18/12**	
283		**Accuracy Test**	**5 days**	**Mon 12/19/11**	**Tue 12/27/11**	
284		Execution of Accuracy Test	4 days	Mon 12/19/11	Fri 12/23/11	267,276
285		Completion of Accuracy Test	1 day	Fri 12/23/11	Tue 12/27/11	284
286		**Volume and Stress Test**	**6 days**	**Tue 12/27/11**	**Thu 1/5/12**	
287		Execution of Volume and Stress Test	5 days	Tue 12/27/11	Wed 1/4/12	285
288		Completion of Volume and Stress Test	1 day	Wed 1/4/12	Thu 1/5/12	287
289		**Security Test**	**44 days**	**Thu 10/27/11**	**Thu 12/29/11**	
290		**Access Controls Review (WoP 6)**	**5 days**	**Wed 11/30/11**	**Wed 12/7/11**	
291	▦	Completion of Access Control Review	5 days	Wed 11/30/11	Wed 12/7/11	226,10
292		**Source Code Automated Review (Fortify)**	**10 days**	**Thu 10/27/11**	**Thu 11/10/11**	
293	✓	Run Fortify on Software Supported	3 days	Thu 10/27/11	Tue 11/1/11	
294		Report to Manufacturer	2 days	Tue 11/1/11	Thu 11/3/11	293
295		Review Manufacturers Response	2 days	Thu 11/3/11	Mon 11/7/11	294
296		Regression Test	1 day	Mon 11/7/11	Tue 11/8/11	295
297		Report Source Code Automated Review	1 day	Tue 11/8/11	Wed 11/9/11	296
298		Submit Findings to EAC	1 day	Wed 11/9/11	Thu 11/10/11	297
299		**Penetration Test**	**7 days**	**Wed 12/7/11**	**Fri 12/16/11**	
300		Discovery Phase	3 days	Wed 12/7/11	Mon 12/12/11	291
301		Exploration Phase	2 days	Mon 12/12/11	Wed 12/14/11	300
302		Risk Assessment	2 days	Wed 12/14/11	Fri 12/16/11	301
303		**Security Assessment**	**5 days**	**Fri 12/16/11**	**Fri 12/23/11**	
304		Report Security Assessment	5 days	Fri 12/16/11	Fri 12/23/11	302
305		**Completion of Security Test**	**3 days**	**Fri 12/23/11**	**Thu 12/29/11**	
306		Final Report Security Assessment	3 days	Fri 12/23/11	Thu 12/29/11	304

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ID		Task Name	Duration	Start	Finish	Predecessors
307		**Telecommunication Testing**	**6 days**	**Mon 12/19/11**	**Wed 12/28/11**	
308		Setup Telecom Testing	1 day	Mon 12/19/11	Tue 12/20/11	267,276
309		Execute Telecom Testing	4 days	Tue 12/20/11	Tue 12/27/11	308
310		Report Telecom Testing	1 day	Tue 12/27/11	Wed 12/28/11	309
311		Completion of Telecom Test	0 days	Wed 12/28/11	Wed 12/28/11	310
312		**System Integration Testing**	**9.5 days**	**Thu 1/5/12**	**Wed 1/18/12**	
313		**GEN 01 - Contests, Candidates, Alt Language, Split Precinct, and Audio Ballot**	**3 days**	**Thu 1/5/12**	**Tue 1/10/12**	
314		GEN 01 Setup	1 day	Thu 1/5/12	Fri 1/6/12	288
315		GEN 01 Execution	1 day	Fri 1/6/12	Mon 1/9/12	314
316		GEN 01 Complete	1 day	Mon 1/9/12	Tue 1/10/12	315
317		**GEN 02 - N of M, Recall, Ranked Order, Early Voting, Alt Language and Audio Ballot**	**3 days**	**Tue 1/10/12**	**Fri 1/13/12**	
318		GEN 02 Setup	1 day	Tue 1/10/12	Wed 1/11/12	316
319		GEN 02 Execution	1 day	Wed 1/11/12	Thu 1/12/12	318
320		GEN 02 Complete	1 day	Thu 1/12/12	Fri 1/13/12	319
321		**GEN 03 - Ideographic Language, Audio Ballot, and ADA Devices**	**3 days**	**Fri 1/13/12**	**Wed 1/18/12**	
322		GEN 03 Setup	1 day	Fri 1/13/12	Mon 1/16/12	320
323		GEN 03 Execution	1 day	Mon 1/16/12	Tue 1/17/12	322
324		GEN 03 Complete	1 day	Tue 1/17/12	Wed 1/18/12	323
325		**PRIM 01 - Closed Primary, Split Precinct, Multiple Ballot Styles, and Audio Ballot**	**3 days**	**Thu 1/5/12**	**Tue 1/10/12**	
326		PRIM 01 Setup	1 day	Thu 1/5/12	Fri 1/6/12	288,302
327		PRIM 01 Execution	1 day	Fri 1/6/12	Mon 1/9/12	326
328		PRIM 01 Complete	1 day	Mon 1/9/12	Tue 1/10/12	327
329		**PRIM 03 - Closed Primary, Ideographic Language, and ADA devices**	**3 days**	**Wed 1/11/12**	**Mon 1/16/12**	
330		PRIM 03 Setup	1 day	Wed 1/11/12	Thu 1/12/12	
331		PRIM 03 Execution	1 day	Thu 1/12/12	Fri 1/13/12	330
332		PRIM 03 Complete	1 day	Fri 1/13/12	Mon 1/16/12	331
333		**Completion of System Integration Testing**	**0.5 days**	**Wed 1/18/12**	**Wed 1/18/12**	
334		Final Report System Integration Tests	0.5 days	Wed 1/18/12	Wed 1/18/12	324,332
335		**All Testing Activities Completed**	**0.5 days**	**Wed 1/18/12**	**Thu 1/19/12**	
336		Verification and compilation of all test data	0.5 days	Wed 1/18/12	Thu 1/19/12	3,10,177,183,198,218,240
337		**PCA Completion**	**3 days**	**Thu 1/26/12**	**Tue 1/31/12**	
338		Regression All Changes to PCA that Occurred during the Test Campaign	2 days	Thu 1/26/12	Mon 1/30/12	335

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Summary	Inactive Summary	Finish-only
Project Summary	Manual Task	Progress
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ID		Task Name	Duration	Start	Finish	Predecessors
339		Final Report PCA	1 day	Mon 1/30/12	Tue 1/31/12	338
340		**Final Trusted Build**	**7 days**	**Thu 1/19/12**	**Mon 1/30/12**	
341		Verify Build Environment	1 day	Thu 1/19/12	Fri 1/20/12	335
342		Trusted Build	3 days	Fri 1/20/12	Wed 1/25/12	341
343		Install and Verify System Build	1 day	Wed 1/25/12	Thu 1/26/12	342
344		Final Trusted Build Complete	1 day	Thu 1/26/12	Fri 1/27/12	343
345		Delivery of Images to EAC Repository	1 day	Fri 1/27/12	Mon 1/30/12	344
346		**Post Testing Activities**	**40 days**	**Thu 1/19/12**	**Thu 3/15/12**	
347		**Certification Report**	**40 days**	**Thu 1/19/12**	**Thu 3/15/12**	
348		Initial Draft Report 90%	5 days	Thu 1/19/12	Thu 1/26/12	335
349		Manufacturer Review	3 days	Thu 1/26/12	Tue 1/31/12	348,336
350		Final Test Report for Submission to EAC for Review	5 days	Tue 1/31/12	Tue 2/7/12	349
351		EAC Review	20 days	Tue 2/7/12	Tue 3/6/12	350
352		Address Comments From TR's	5 days	Tue 3/6/12	Tue 3/13/12	351
353		Submit Final Report	2 days	Tue 3/13/12	Thu 3/15/12	352

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Milestone	Inactive Milestone	Start-only
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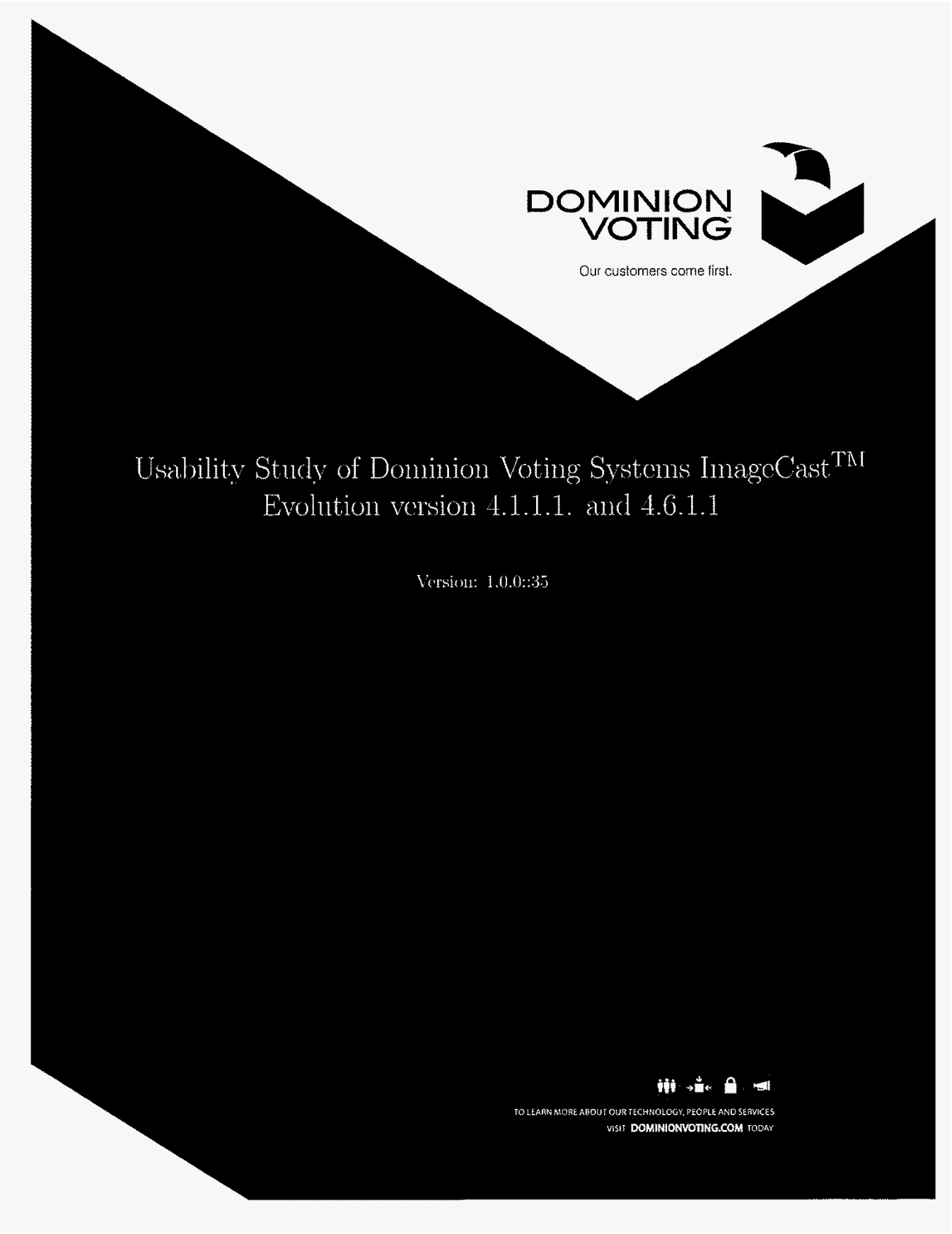
APPENDIX C
USABILITY REPORTS


DOMINION VOTING
Our customers come first.
Usability Study of Dominion Voting Systems ImageCast™ Evolution version 4.1.1.1. and 4.6.1.1
Version: 1.0.0::35
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Denver, Colorado, 80202

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Facsimile: 1-416-762-8663

Revision History

Revision	Date	Author	Summary
35	2011-11-29	yvonne.cai	added reference to floor plan
34	2011-11-29	yvonne.cai	repositioned questionnaire
33	2011-11-29	yvonne.cai	updated floor plan
32	2011-11-29	yvonne.cai	usability floor plan
31	2011-11-29	yvonne.cai	fixed cases
30	2011-11-29	yvonne.cai	fixed case
29	2011-11-28	yvonne.cai	grammar and style edits
28	2011-11-28	yvonne.cai	fixed appendix section
27	2011-11-28	yvonne.cai	added appendix for demographic questionnaire
26	2011-11-28	yvonne.cai	added appendix for voting location
25	2011-11-28	yvonne.cai	votinglocation framework
24	2011-11-28	yvonne.cai	edited grammar
23	2011-11-28	yvonne.cai	edited for style
22	2011-11-28	yvonne.cai	edited for style
21	2011-11-28	yvonne.cai	added satisfaction calculations
20	2011-11-28	yvonne.cai	added results details
19	2011-11-28	yvonne.cai	edited page size
18	2011-11-28	yvonne.cai	demo ballot images
17	2011-11-28	yvonne.cai	dDVS demographic questionnaire p1
16	2011-11-28	yvonne.cai	DVS demographic questionnaire p2
15	2011-11-28	yvonne.cai	Image of voter instruction hand out
14	2011-11-28	yvonne.cai	added image of instructions hand out
13	2011-11-28	yvonne.cai	Added image of post test survey
12	2011-11-28	yvonne.cai	Fixed the caption of results table
11	2011-11-24	devan.vandenboomen	Adding Test Ballot Specification Appendix.
10	2011-11-24	yvonne.cai	removed error appendix file.
9	2011-11-24	yvonne.cai	edited appendix name
8	2011-11-24	yvonne.cai	added informed consent agreement
7	2011-11-24	yvonne.cai	Updated the ICE usability test framework
6	2011-11-24	yvonne.cai	First Draft of ICE Usability Test
5	2011-11-16	peter	Extended length and width of revisionhistory.tex
4	2011-11-01	devan.vandenboomen	Updated full product description for ICE2.
3	2011-11-01	devan.vandenboomen	Draft Framework Entry.
2	2011-10-31	devan.vandenboomen	Added files and set keywords.
1	2011-10-31	root	Initial Import

Allowed Authors

subversionID	Firstname Lastname	TitlePosition
devan.vandenboomen	Devan Vanden Boomen	Documentation Manager
peter	Peter Androutsos	Director, PLM
root	root	system
yvonne.cai	Yvonne Cai	Product Manager

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Chapter 1

Executive Summary

The ImageCast™ Evolution is a PCOS with an integrated touch screen interface and an internal ballot marker for fully accessible voting.

Dominion Voting Systems (or DVS) conducts ongoing usability tests of the ImageCast™ Evolution (or ICE). This usability testing program is aimed at improving the usability of the ICE throughout the design and development process.

This purpose of this usability test report is to fulfill the requirements of the Voluntary Voting System Guidelines 2005 (VVSG). It will be offered to regulatory agencies such as the National Institute of Standards and Technology (NIST) and the Election Assistance Commission (EAC).

Usability tests have been conducted on ICE firmware versions 4.1.1.1 and 4.6.1.1 Testing took place in a simulated polling place with a registration desk, voting booths, and a free-standing voter-fed tabulator (the ICE). This configuration was set up at the DVS office in San Leandro, CA, and at the Center for Independent Living (CIL) in Berkeley, CA.

Date	Location	ICE Firmware Version
August 16, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
August 17, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
August 30, 2011	DVS, San Leandro, CA	ICE 4.1.1.1
September 8, 2011	CIL, Berkeley, CA	ICE 4.1.1.1
November 4, 2011	CIL, Berkely, CA	ICE 4.6.1.1

Table 1.1: Usability testing dates, locations, and ICE firmware version tested.

During the usability tests, 14 participants (mainly older voters and voters with physical limitations) used the ICE to vote in a simulated election. The election consisted of one test ballot (created by DVS) with 5 contests, including:

- Federal and state contests
- Partisan and nonpartisan contests
- Single member contests
- Propositions

Voters were asked to mark the ballot in a prescribed pattern that models typical ballots from around the country.

Participants were given 2 voting scenarios that were designed to test the various features and user interfaces of the ICE. Participants were to vote in at least 1 of the given scenarios.

The first scenario will be referred to as manual voting (or MV) and requires that the participant be able to make their selections on a paper ballot using a marking pen. The marked ballot is inserted into the ICE for participants to review their ballot selections and cast their ballot using the ICE touch screen interface. This scenario is designed to evaluate the usability of the ICE touch screen interface and ballot review features. This scenario includes 13 tasks that simulate typical voting procedures using the ICE.

The second scenario will be referred to as accessible voting (or AV) and is designed to evaluate the usability of the ICE accessible voting interfaces, specifically the ballot marking feature. Voters use an electronic input device to navigate, mark, and cast their ballot. Though 3 different accessible input interfaces are offered, all participants chose to use the Audio Tactile Interface (or ATI).

This scenario includes 8 to 10 tasks depending on their preferred interface (audio only, visual only, or audio and visual).

During the usability testing, participants worked alone and were not provided assistance or help by the test administrators, unless requested. While participants voted, test administrators noted accessible interface(s) used, assists requested, verbal comments, and anything that may affect the data being collected.

The usability test administrators collected and analyzed the following types of data to determine participant effectiveness, efficiency, and satisfaction using the ICE:

- Number of ballots successfully cast.
- Number of contests voted as per instructions.
- Count of assists provided.
- Time to complete the voting session.
- Voters' confidence that they had used the system correctly.
- Voter satisfaction with the system.

Below is a high-level summary of the results:

Measure	Description	Usability Test Results
Successful Completion	*The average number of voters who were able to successfully complete their voting session.*	**100%**
Number of ballots cast without any errors	*Count of the number of voters who were able to submit their ballot(s) without any errors.*	**12 of 14 voters**
Count of assists provided	*The total number of assists provided to voters during the usability tests.*	**3**
Average Session Time for Manual Voting (MV)	*Mean time taken per test participant to complete the process of hand marking, reviewing, and casting the ballot.*	**2 minutes and 50 seconds**
Average Session Time for Accessible Voting (AV)	*Mean time taken per test participant to customize the ICE accessible voting interface and use it to mark and cast their ballot.*	**8 minutes and 11 seconds**
Average Voter Confidence	*Mean confidence level expressed by voters that they believed they voted correctly and the system successfully recorded their votes.*	**MV: 4.77/5 AV: 4.36/5**
Voter Satisfaction Score	*Mean satisfaction level expressed by voters in response to a 5-question post test satisfaction questionnaire.*	**MV: 91.9/100 AV: 73/100**

Chapter 2

Introduction

2.1 Full Product Description

The ImageCast™ Evolution (or ICE) is a precinct-level voting system that uses scan technology to validate and tabulate marked paper ballots. The ICE unit features an 18.5" touch screen display that allows voters to review and cast their marked paper ballot through a customizable visual interface. In addition, the ICE features several accessible voting interfaces that allow voters with various disabilities to effectively mark, review and cast a paper ballot in a private and independent manner. When a voter casts their ballot, the ICE stores a complete image of the ballot and selections, and the paper ballot is securely deposited into a sealed ballot box located under the unit. When polls close, the ICE produces a results report with cumulative totals of all votes cast. The ICE is evaluated as part of Dominion's ongoing usability testing program. So far, ICE firmware versions 4.1.1.1 and 4.6.1.1 have been evaluated. ICE hardware remains unchanged.

ICE firmware 4.1.1.1 was the first version evaluated during usability testing. Based on voter feedback, the following modifications were made to the ICE accessible voting interfaces for firmware version 4.6.1.1.

- Static screens displayed during the accessible voting instructions were modified to create a more uniform and consistent appearance.
- Static audio instructions were added to notify accessible voters that their ballot was being printed.

ICE firmware version 4.6.2 is being provided to the Voting System Test Laboratory (VSTL). This is an upgrade from version 4.6.1.1. Features added include:

- An audio interface for accessible ballot review. Previously, voters only had the option to review their ballot through the ICE visual interface.
- A detailed and informative message displayed when the ICE detects an issue with a scanned ballot. Previous versions gave a standard "Ballot Rejected" message without describing the issue.

The ICE is is typically used in federal, state and local elections and is set up in designated voting locations. The usability testing attempts to simulate these environmental conditions and users' real-world context of use.

Dominion's ongoing usability testing program evaluates the ICE user interfaces. This includes:

- The ICE touch screen interface for visual ballot review and ballot casting.

- ICE-accessible ballot marking interfaces (both audio and visual).
- Assistive input devices for accessible ballot navigation and voting.

Accessible voting interfaces are the primary focus of ICE usability testing. This is an area that is susceptible to usability issues. Dominion Voting strives to enhance the accessibility and usability of its ICE system for voters who face barriers to equal participation.

Standard scanning and ballot review features were included in the evaluation because they are most frequently used.

2.2 Test Objectives

The usability test objectives are:

- To assess the effectiveness of the ICE by measuring the abilities of various user groups to successfully complete and cast a ballot.
- To assess the efficiency of the ICE by measuring the average time to complete a voting session.
- To assess the user satisfaction of the ICE system by measuring average voter confidence and ease of use.
- To assess the usability of the ICE accessible voting interfaces for different disability groups.
- To elicit user feedback on how the accessible voting interfaces can be further developed and/or improved.

Chapter 3

Method

3.1 Participants

A total of 14 voters have participated in the ICE usability testing program so far. Each round of usability testing targets a specific type of user group.

The first round of usability testing focused on users who were over 60 years old and had at least 10 years of voting experience. These users were recruited through asking friends and family if they knew someone over 60 years old in the San Leandro area who would be available to participate.

The second round of usability testing focused on people with physical limitations. Dominion Voting teamed up with the Center for Independent Living (CIL) in Berkeley, California to recruit participants with mobility impairments, visual impairments, and hearing impairments.

All participants received a $10 gift card (for Starbucks™ or Peet's™) as compensation for their time.

Participants were not Dominion Voting employees or family members of employees. All participants were over the age of 18, eligible to vote in the U.S., and fluent in English.

Note: In the State of California, there are restrictions to the collection of data related to race or ethnicity and disability. There appeared to be a range of ethnically diverse people in the participant sample, representative of the larger population. Many participants volunteered information about limitations they have that may restrict their access to voting privately and independently.

The following tables show the additional participant demographics.

Targeted User Group	
Over 60 years old	6
Mobility Limitation	5
Low Vision (Legally Blind)	3
Completely Blind	1
Auditory Disability	1
Dexterity Disability	1
General Population (under 60)	1

Table 3.1: Participants For Each Targeted User Group. Note that user group characteristics intersect.

Gender	
Men	7
Women	7
TOTAL (participants)	14

Table 3.2: Participant Gender

Age	
18-24	0
25-34	2
35-44	2
45-54	2
55-64	4
64+	3
Unknown	1
TOTAL (participants)	14

Table 3.3: Participant Age Group

Years of Voting Experience	
None	1
Less than 2 Years	1
2-5 Years	0
5-10 Years	2
10-20 Years	3
More than 20 years	7
TOTAL (participants)	14

Table 3.4: Participant Voting Experience

Please see Apendix A for a full spreadsheet of participant demographics.

3.2 Context of Use in the Test

3.2.1 Tasks

During the usability test, participants were instructed to vote in a simulated election consisting of one test ballot with 5 contests, including:

- Federal and State Offices
- Partisan and Nonpartisan Contests
- Propositions

The participants simulated typical voting scenarios for marking this ballot by hand, then used the ICE to thoroughly test the ICE touch screen interface for ballot review and ballot casting. Participants also tested the ICE accessible ballot marking feature using the accessible interfaces that best suited their needs. These tasks were designed to evaluate the defined objectives of this usability test.

Participants who could hand mark a ballot were asked to perform 13 tasks:

- Take their blank ballot to a voting booth.
- Follow the voter instructions printed on the ballot.
- Vote the ballot contests in the pattern prescribed on the instructions.
- Undervote the ballot.
- Take their ballot to the ICE.
- Follow on-screen prompts and instructions.
- Review their contest selections on the ICE display screen.
- Move through the ballot review using the ICE touch screen interface.
- Use the touch screen interface to return their ballot without casting.
- Return to the voting booth.
- Vote the remaining office on the ballot.

- Bring their ballot to the ICE again to review their modified ballot on the ICE display screen.
- Cast their ballot using the ICE touch screen interface.

Participants who tested the ICE accessible ballot marking feature were first given audio instructions that described how to use the equipment.

For the purpose of this usability testing session, the test administrator acted as a poll worker and handed an ATI, with connected headphones, to the voter. Once the voter was comfortably seated in front of the ICE and had the headphones on, the test administrator activated an accessible voting session using the ICE touch screen interface, as a poll worker would normally do.

Voters are instructed to increase the volume immediately by using the volume control button on the ATI. Note: this is necessary because the ICE is set to the VVSG initial volume requirement of 40 - 50 dB SPL. This volume tends to be too low for many people.

Accessible voters were asked to perform the following tasks during their accessible voting session:

- Select the input interface they are using for navigation, as instructed on the ICE display screen. Note: All voters chose to use the ATI for their voting session. The ICE audio and visual interfaces provide prompts to voters informing them of which buttons to press throughout the instructions and ballot marking session.
- Customize the AV session by turning the display screen off or leaving it on according to their needs.
- If voters leave the display screen on, they are given the option to turn the audio track off or leave it on.
- Press the down arrow on the ATI to continue through the instructions.
- Voters who left the display screen on were also given the option to customize their visual interface by setting the zoom and/or contrast.
- Press the down arrow on the ATI to begin the voting session.
- Continue using the ATI to navigate through contests and names within a contest.
- Use the ATI to mark their selections in the pattern prescribed on the instructions.
- Press the X shaped select button on the ATI to cast the ballot.

In both scenarios, participants were instructed to perform these tasks without assistance. The voting session was considered successful if the participant was able to independently cast their ballot using the an ICE interface.

Data was collected for these tasks, including successful completions, time to complete voting, number of errors, and number and type of assists provided.

3.2.2 Test Location

The ICE is intended to be used at precinct level polling locations across the U.S., including schools, libraries, churches and other public facilities large enough to house multiple voting stations. ICE usability testing has taken place at the DVS office in San Leandro, California and also in an office at the Center for Independent Living in Berkeley, California. Usability tests are always held in wheelchair accessible locations.

In order to simulate the polling place environment, testing locations are set up with a registration desk, two voting booths, and one ICE unit that sits above a free standing ballot box. The simulated polling place is arranged in a way that maximizes privacy and accessibility.

Please see Appendix H for a diagram of the room layout.

Standard usability testing procedures for obtaining consent forms and informing participants that their actions will be recorded is an imperative part of the test plan. These activities took place at the registration desk. Voters who could not complete surveys on their own received help from their personal assistants or from the testing administrators.

3.2.3 Voting Environment

During an actual election, voters are expected to use the voting system provided at the polling location. Voters may have experience with a wide-range of systems or may only have experience with one type of system. During the usability test, all participants were instructed to use the ICE just as if this system was implemented at their local polling location.

3.2.3.1 Display Devices

The ICE has an integrated 18.5 inch full color touch screen display. The touch screen interface is used for poll worker menu navigation and voter ballot review. During an accessible voting session, the display screen acts as a visual interface that displays instructions and a digital image of the ballot. Voters can customize the zoom and contrast of their ballot display, or simply turn it off using an accessible input device (such as the ATI).

All text is displayed in sans serif font at a default size of 3.00mm or higher.

8.5" x 14" paper ballots were provided for hand marking. DVS provided optional Fresnel sheet magnifiers to assist those with perceptual disabilities. A copy of this ballot is included in Appendix D.

3.2.3.2 Audio Devices

The ATI provides its audio signal through an industry standard connector for private listening using a 3.5mm stereo headphone jack to allow voters to use their own audio assistive devices. Voters are given headphones with new sanitary coverings that are disposed of after each use.

The initial (default) volume for each voter is set between 40 - 50 dB SPL for each device as per VVSG requirements. This volume level was typically inaudible for most voters and needed to be increased.

Voters can hear all the voting instructions, navigational prompts, and all ballot content through audio headphones.

Voters use an input device, such as the ATI, to control the audio. Voters can adjust the volume and speed of the synthesized audio track. Voters can also pause or replay instructions.

3.2.3.3 Input Devices

During an accessible voting session, voters do not use the ICE touch screen interface. Though the ballot and accessible voting instructions can be shown on the ICE display screen, voters use one of three accessible input devices to navigate their ballot and make their selections:

- The Audio Tactile Interface (ATI)
- Paddle button Interface

- Gooseneck Sip and Puff device

The audio and visual instructions reflect the device selected.

All the participants who tested the ballot marking interface chose to use the ATI.

3.2.4 Test Administrator Tools

During the usability test, various tools were used to facilitate the test sessions, including:

- Pen and paper
- Stopwatch
- Demographic Questionnaire (See Appendix F)
- Informed Consent Form (See Appendix B)
- Instructions for Participants (See Appendix C)
- Post-test Questionnaire (See Appendix G)

Participants' votes were recorded by the ICE system, as it would be in a real election. Test facilitators used a stopwatch to time voter sessions. Pen and paper was also used to record assists and verbal comments, as well as other relevant data during the voting sessions.

3.3 Experimental Design

During the usability test, participants interacted with only one voting system, the ICE. Each participant voted the same demonstration ballot in at least one testing scenario.

The ICE was evaluated for effectiveness, efficiency and satisfaction. To evaluate these factors, the usability team collected data on:

- Number of ballots successfully cast/completed
- Percent of tasks completed without any errors
- Count of assists provided
- Time to complete the voting session
- Voters' confidence that they had used the system correctly
- Voters' satisfaction with the system

Additional information about the various measures and associated metrics can be found in Section 3.4 Usability Metrics.

3.3.1 Procedure

The usability test administrators introduced themselves to participants upon arrival. Participants were informed that the usability of the ICE voting system was being tested. The goal was to make private and independent voting accessible to everyone, including voters such as themselves, and that usability feedback was much appreciated. Participants were reminded that this was a test of their abilities and that their identities would remain confidential.

Participants were then asked to complete a demographic questionnaire (Appendix F). The ICE usability testing program targets specific voter groups for each testing session. However, no eligible participant is turned away.

Following the questionnaire, participants were asked to review and sign the Informed Consent Agreement (Appendix B), which described their rights during the study. Participants were then given the following instructions:

> We can only work with one person at a time. Today's demo is in English only. Please follow all ballot instructions and attempt to vote unassisted. It is important to completely fill in the oval when marking your paper ballot. This is a test of the tabulator and not of you or your ability to follow instructions. You will be observed and timed. If necessary, you may request help at any time by raising your hand or by asking for assistance.

During the usability test, test administrators observed users' interactions with the ICE interfaces and timed each test session with a stop watch. Once the user finished the test, he/she was asked to complete a Post-Test Satisfaction Questionnaire (Appendix G). At the conclusion of the test, participants were thanked for their time and given a $10 gift card for Starbucks^{TM} or Peets^{TM}. Participants were welcome to stay and try out other features of the ICE when all the testing was complete.

Three DVS staff members shared the responsibilities for administering the usability test, collecting the demographic survey, and logging the data. One administrator was responsible for interviewing each participant after they completed their voting session. Every individual was thanked for their participation and feedback.

3.3.2 Participant General Instructions

During the usability sessions, the participants were instructed that they should try to complete the tasks without assistance. However, they could still ask for assistance if they felt it was necessary.

3.3.3 Participant Task Instructions

Participants were also provided with verbal and written instructions on how to vote in the mock election. These voter instructions were provided to users on a piece of paper (Appendix C). Participants testing out the accessible voting interface were also given a quick audio guide for how the ICE ballot marking feature works.

3.4 Usability Metrics

The usability test collected various metrics for effectiveness, efficiency and satisfaction.

3.4.1 Effectiveness

To measure the effectiveness of the ICE, the testing team measured voters' completion rate, errors encountered and assists provided.

3.4.1.1 Completion Rate

Measure: Ballots successfully completed and cast.

Description: *Percentage of test participants who were able to complete the process of voting and cast their ballots so that their ballot choices were recorded by the system. Failure to cast a ballot might involve problems such as a voter simply "giving up" during the voting session because of an inability to operate the system, or a mistaken belief that the casting has been successful.*

3.4.1.2 Errors

To measure voters' error rate, the testing team calculated the percentage of voters who were able to accurately mark and cast their ballot as per instructions.

Measure: Ballots completed and cast without any errors.

Description: *Percentage of ballots that were completed without any errors. An error might involve a voter selecting a different candidate than instructed.*

3.4.1.3 Assists

To measure voters' abilities to successfully use the ICE without assistance, the testing team recorded the count and type of assistance provided.

Measure: Count of assists provided.

Description: *Count of the number of times assistance was given to participants. Each assist was also categorized into one of three categories:*

- Technical assistance to help voters recover from a system error or bug.
- Instructional assistance to provide clarification on the test or task instructions.
- Task assistance to help voters a complete a task. Tasks that were completed with the assistance of the test facilitator were recorded as a failure.

3.4.2 Efficiency

To measure the efficiency of the ICE, the testing team measured voters' average time to complete the voting session in each testing scenario.

3.4.2.1 Time on Task

To measure voters' efficiency with the ICE, the testing team analyzed the time it took participants to complete their testing session.

Measure: Average voting session time.

Description: *Mean time taken per test participant to complete the process of activating, filing out and casting the ballot, or for ICE accessible ballot marking, the mean time taken per test participant to go through the accessible voting instructions, start their voting session, mark their ballot, and cast their ballot.*

3.4.3 Satisfaction

To measure voters' satisfaction with the ICE™, the testing team measured voters' confidence levels and usability perceptions through a post test satisfaction questionnaire.

3.4.3.1 Confidence Rating

Measure: Average voter confidence level.

Description: *mean confidence level expressed by voters when asked if they felt confident using the voting machine. Rating is calculated using numbers assigned on the Likert Scale.*

3.4.3.2 Satisfaction Rating

Measure: Average voter satisfaction.

Description: *Mean satisfaction level expressed by voters in response to a 5 voter satisfaction ratings in the post-test satisfaction questionnaire.*

The satisfaction score was calculated based on the System Usability Scale (SUS). Voters expressed their reactions to questions about their ICE voting experience on a Likert Scale.

The scale positions are as follows:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Responses to the following statements were included in the satisfaction rating.

3B (Negative): I think that I would need support to be able to use this voting machine.

3C (Positive): I think that most people would be able to use this voting machine without problems.

3D (Negative): I found that voting on this machine was unnecessarily difficult.

3E (Positive): I thought this voting machine was easy to use.

3F (Negative): I felt voting on this machine was very awkward.

Each item was given a score contribution that ranged from 0-4. For 'positive' questions, the score contribution is the scale position minus 1. For 'negative' questions, the score contribution is 5 minus the scale position.

Satisfaction ratings were calculated for each scenario.

The mean score contribution for each item was calculated and the sum of the score contributions was multiplied by 5 to obtain the overall satisfaction score (a range from 0 to 100).

Chapter 4

Results

4.1 Data Analysis

Demographic and satisfaction data was captured by paper and pencil. Voters who could not independently complete the paper questionnaires received help from their personal assistant or from a test administrator. Votes were automatically recorded by the voting system and the paper ballot was kept as a reference for data loggers. Time data was captured with a stopwatch and then entered into a spreadsheet. Open-ended comments were noted by hand by the test facilitators during and after the voting session. If assists were provided to voters by test administrators, the type of assist and details were recoded by the test administrator. To analyze the data, each voting session was scored for completion, ballot marking accuracy, number and type of assists required during the voting session, and time to complete all the tasks. Each contest that was not voted as instructed was counted as an error (this can include voting for a different candidate, skipping the contest, or over voting the contest).

In addition, the test administrators analyzed voter's satisfaction and confidence using the post-test satisfaction questionnaire.

All data was scored manually by all the test administrators.

4.2 Presentation of Results

This section details the performance results for effectiveness (completion rate, errors, assists), efficiency (time to vote) and satisfaction (satisfaction and confidence rating). Specifically, this section includes:

- Number of ballots successfully submitted/completed
- Number of ballots completed without any errors
- Count of assists provided
- Time to complete the voting session for each scenario
- Voters' confidence that they had used the system correctly
- Voters' satisfaction with the system

4.2.1 Performance Results

100% of the ballots were cast successfully. Of the 14 participants, 12 were able to accurately select all the candidates as instructed. No participant made more than 2 (out of a possible 5) ballot marking errors on a given ballot. A total of 3 assists were provided during the usability testing. All of the assists were instructional.

The average manual voting session time was 170 seconds (or 2 minutes and 50 seconds) The average accessible voting session time was 491 seconds (or 8 minutes and 11 seconds)

More detailed results can be found in Appendix E.

4.2.2 Satisfaction Results

Following the completion of the usability tasks, participants completed a Post Test Satisfaction questionnaire. 5 questions in this questionnaire were related to ease of use of the ICE. Based on voters' responses to these questions, a satisfaction rating, ranging from 0-100, was calculated. The average satisfaction rating for manual voting was 92 and the average satisfaction rating for the accessible voting interface was 73.

In addition, voters gave the system an overall confidence rating of 4.56 out of 5.

More detailed results can be found in Appendix E.

Chapter 5

Conclusion

Dominion strives to continuously enhance the usability and accessibility of the ImageCast™ Evolution . All the usability testing conducted so far has been fundamental in making modifications that have improved the user interfaces. The changes between versions, as outlined in the introduction of this usability report are examples of improvements that have been incorporated in the ICE firmware version being submitted to the VSTL.

5.1 Ongoing Usability Testing

As part of the ongoing ICE usability testing program, Dominion Voting Systems plans to conduct more usability studies on its continuously improving ICE firmware. Future usability tests will continue to evaluate the usability of the ICE accessible voting interfaces for:

- Voters with mobility limitations
- Voters with partial vision
- Voters who are completely blind
- Voters with cognitive impairments
- Voters with dexterity disabilities
- Voters who need alternative languages

In addition, usability tests will continue to evaluate the efficiency of standard ballot review and ballot casting using the ICE touch screen interface. User groups from various age groups and from the general population will be recruited.

Lastly, Dominion Voting Systems will be working with poll workers to evaluate the usability of the ICE administrator interfaces.

Appendices

Appendix A

Participant Demographics

Voter	Sex	Age	Years of Voting Experience	Types of Voting Machines Used Before	Physical Limitations (if any)
1	F	77	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Mobility
2	M	78	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Low Vision
3	M	67	Over 20	Mechanical lever, Punch Card, Touch Screen DRE, Optical Scan	
4	F	43	10 - 20	Touch Screen DRE, Optical Scan	Mobility
5	M	60	Over 20	Punch Card, Optical Scan	
6	F	61	Over 20	Punch Card	
7	M	48	10 - 20	Touch Screen DRE, Optical Scan	
8	F	32	5 - 10	Optical Scan	Auditory, Mobility
9	M	N/A	Over 20	Punch Card, Touch Screen DRE, Optical Scan	Mobility
10	M	48	10 - 20	Punch Card, Optical Scan	Low Vision
11	M	60	Over 20	Mechanical lever, Punch Card, Optical Scan	Low Vision
12	F	34	None	None	Completely Blind
13	F	56	Under 2	None	Mobility
14	F	41	5 - 10	Optical Scan	Auditory

Table A.1: Summary of All Participant Demographics

Appendix B

Informed Consent Agreement

Dominion Voting Systems regularly conducts community outreach demonstrations to determine how easy it is for voters to use its voting systems. By testing with a broad spectrum of voters, overall system usability can be measured and voter satisfaction gauged. Your participation in this testing is appreciated!

You will receive written instructions on how you, as a voter will "want to vote". In addition to collecting your votes, there may be a camera focused on the system and your hands, but your face will not be photographed. After you cast your ballot, you will be asked for your opinion about the voting system and your voting experience. You will also be asked for demographic data to include age, gender, education level, and other experiences related to voting. This process should take you no more than 30 minutes.

CONFIDENTIALITY: All the data collected will be anonymous. The data will be used by Dominion Voting Systems to evaluate the usability of the ImageCast tabulators. The data will not be associated with any particular individual. All of the time and error data, demographic data, and voter experience and satisfaction data will be anonymous. All of the data will only be identified and linked together by a number, and will not be linked back to an individual in any way.

You are free to withdraw from the study at any time during the experiment. In total, we expect to have approximately 20 subjects complete this demonstration.

There are no risks involved in participating in this study, nor are there any immediate benefits. The long term benefits of this study should be improved voting systems.

CONTACT INFORMATION: For questions regarding this study, please contact:

`Larry Korb  (510) 373-0818  x9405  mailto:larry.korb@dominionvoting.com`

"I have read the above description of this demonstration. I have also spoken to the test facilitator who answered any questions I had about this project. I acknowledge that I have received a personal copy of this form. I agree to participate in this demonstration and I understand that I may withdraw at any time."

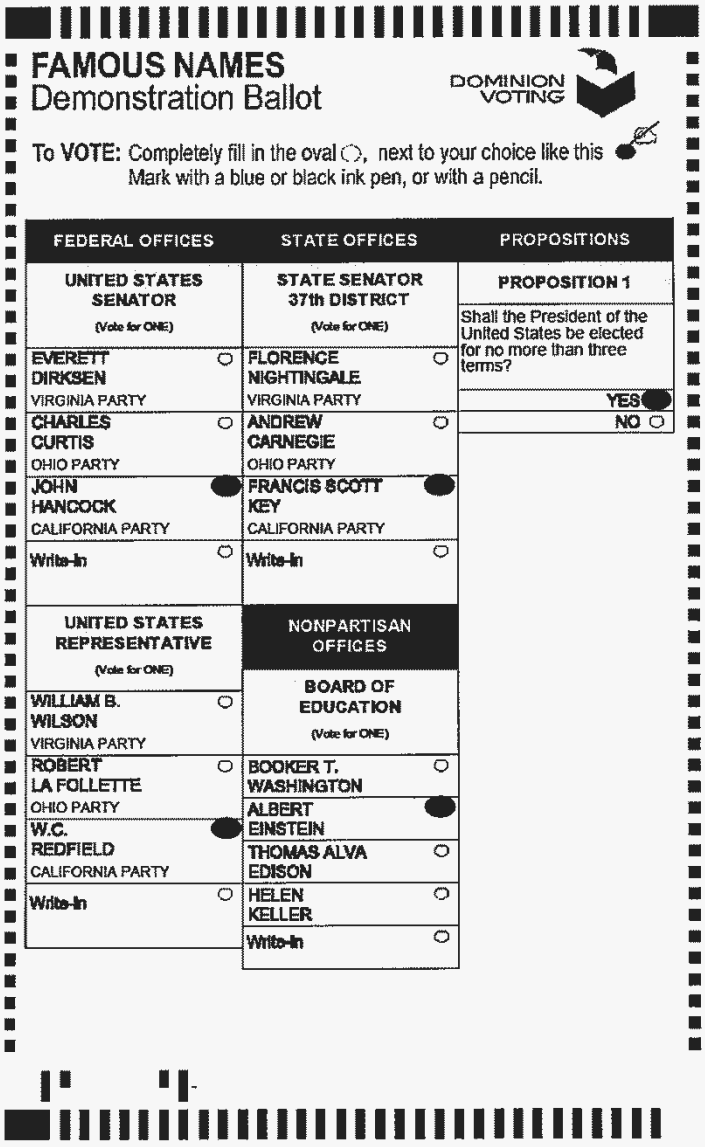
Signature: _____. Date: _____.

Appendix C

Instructions for Participants

VOTER INSTRUCTIONS

Please vote the ballot as shown:



FAMOUS NAMES
Demonstration Ballot

DOMINION VOTING

To VOTE: Completely fill in the oval ○, next to your choice like this ● Mark with a blue or black ink pen, or with a pencil.

FEDERAL OFFICES	STATE OFFICES	PROPOSITIONS
UNITED STATES SENATOR (Vote for ONE)	**STATE SENATOR 37th DISTRICT** (Vote for ONE)	**PROPOSITION 1**
EVERETT DIRKSEN ○ VIRGINIA PARTY	FLORENCE NIGHTINGALE ○ VIRGINIA PARTY	Shall the President of the United States be elected for no more than three terms?
CHARLES CURTIS ○ OHIO PARTY	ANDREW CARNEGIE ○ OHIO PARTY	YES ●
JOHN HANCOCK ● CALIFORNIA PARTY	FRANCIS SCOTT KEY ● CALIFORNIA PARTY	NO ○
Write-In ○	Write-In ○	
UNITED STATES REPRESENTATIVE (Vote for ONE)	**NONPARTISAN OFFICES**	
WILLIAM B. WILSON ○ VIRGINIA PARTY	**BOARD OF EDUCATION** (Vote for ONE)	
ROBERT LA FOLLETTE ○ OHIO PARTY	BOOKER T. WASHINGTON ○	
W.C. REDFIELD ● CALIFORNIA PARTY	ALBERT EINSTEIN ●	
Write-In ○	THOMAS ALVA EDISON ○	
	HELEN KELLER ○	
	Write-In ○	

- Follow the voter instructions printed on the ballot or displayed on the voting machine.
- Please try to vote the exact pattern shown in red on the ballot to the left:

  John Hancock
  W.C Redfield
  Francis Scott Key
  Albert Einstein
  "Yes" on Prop. 1

- Try to vote un-assisted if you can, and cast the ballot as shown.
- If you are lost or stuck, you can ask for assistance.
- Remember that this is a test of the voting system, NOT of you the voter.

THANKS!

Date: 2011-11-29 21:27:55Z
Rev: 1.0.0::35

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Appendix D

Demonstration Ballot for Voters

The following ballot was created by Dominion Voting Systems, using Democracy Suite. To include a replica of the ballot, factoring in the size (8.5" x 14"), an image of the ballot has been split into two on the following two pages.

FAMOUS NAMES
Demonstration Ballot

DOMINION VOTING

To VOTE: Completely fill in the oval ◯, next to your choice like this ●
Mark with a blue or black ink pen, or with a pencil.

FEDERAL OFFICES	STATE OFFICES	PROPOSITIONS
UNITED STATES SENATOR (Vote for ONE)	**STATE SENATOR 37th DISTRICT** (Vote for ONE)	**PROPOSITION 1** Shall the President of the United States be elected for no more than three terms?
◯ **EVERETT DIRKSEN** VIRGINIA PARTY	◯ **FLORENCE NIGHTINGALE** VIRGINIA PARTY	◯ **YES**
◯ **CHARLES CURTIS** OHIO PARTY	◯ **ANDREW CARNEGIE** OHIO PARTY	◯ **NO**
◯ **JOHN HANCOCK** CALIFORNIA PARTY	◯ **FRANCIS SCOTT KEY** CALIFORNIA PARTY	
◯ **Write-in**	◯ **Write-in**	

Date: 2011-11-29 21:27:55Z
Rev: 1.0.0::35

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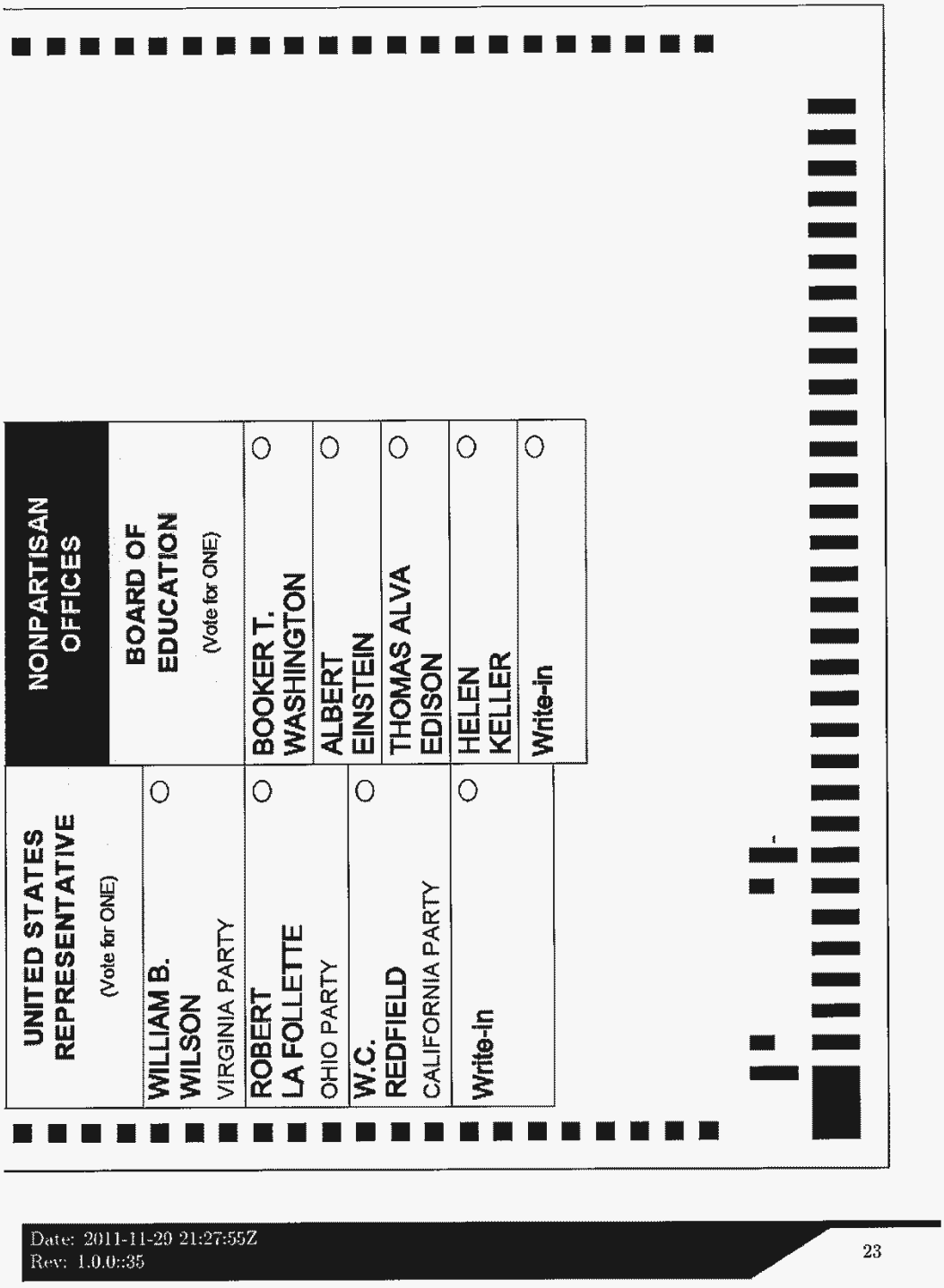
UNITED STATES REPRESENTATIVE
(Vote for ONE)
WILLIAM B. WILSON
VIRGINIA PARTY
ROBERT LA FOLLETTE
OHIO PARTY
W.C. REDFIELD
CALIFORNIA PARTY
Write-In
NONPARTISAN OFFICES
BOARD OF EDUCATION
(Vote for ONE)
BOOKER T. WASHINGTON
ALBERT EINSTEIN
THOMAS ALVA EDISON
HELEN KELLER
Write-in
Date: 2011-11-20 21:27:55Z
Rev: 1.0.0::35
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Appendix E

Results

The following two pages shows the results from testing in tabular format. Some results headings have been shortened. The responses 3A, 3B, 3C, 3D, 3E, and 3F refer to question 3 on the Post Test Questionnaire.

The actual questions are as follows: 3A: I felt confident using this voting machine.

3B: I think that I would need support to be able to use this voting machine.

3C: I think that most people would be able to use this voting machine without problems.

3D: I found that voting on this machine was unnecessarily difficult.

3E: I thought this voting machine was easy to use.

3F: I felt voting on this machine was very awkward.

A rating of 1 to 5 was given as it corresponds to the Likert Scale.

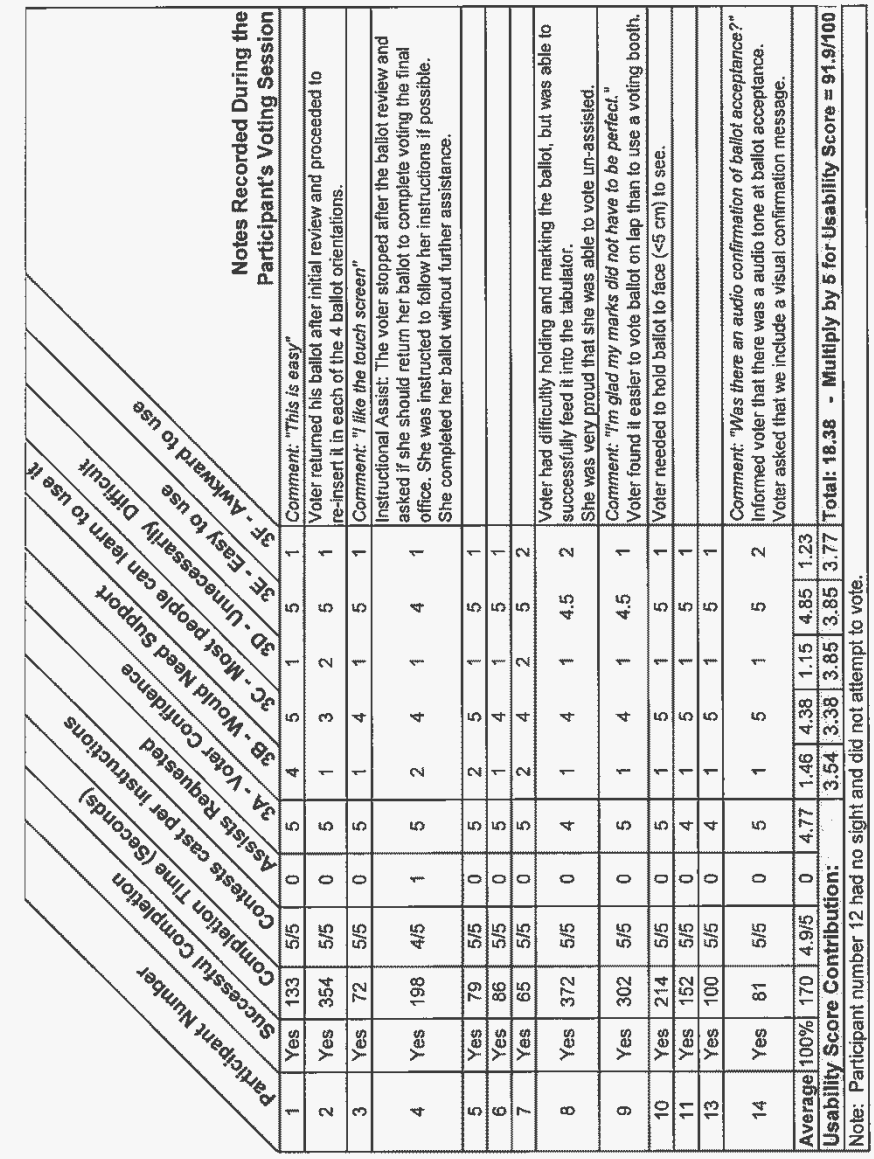
1 = Strongly Disagree

2 = Disagree

3 = Neutral

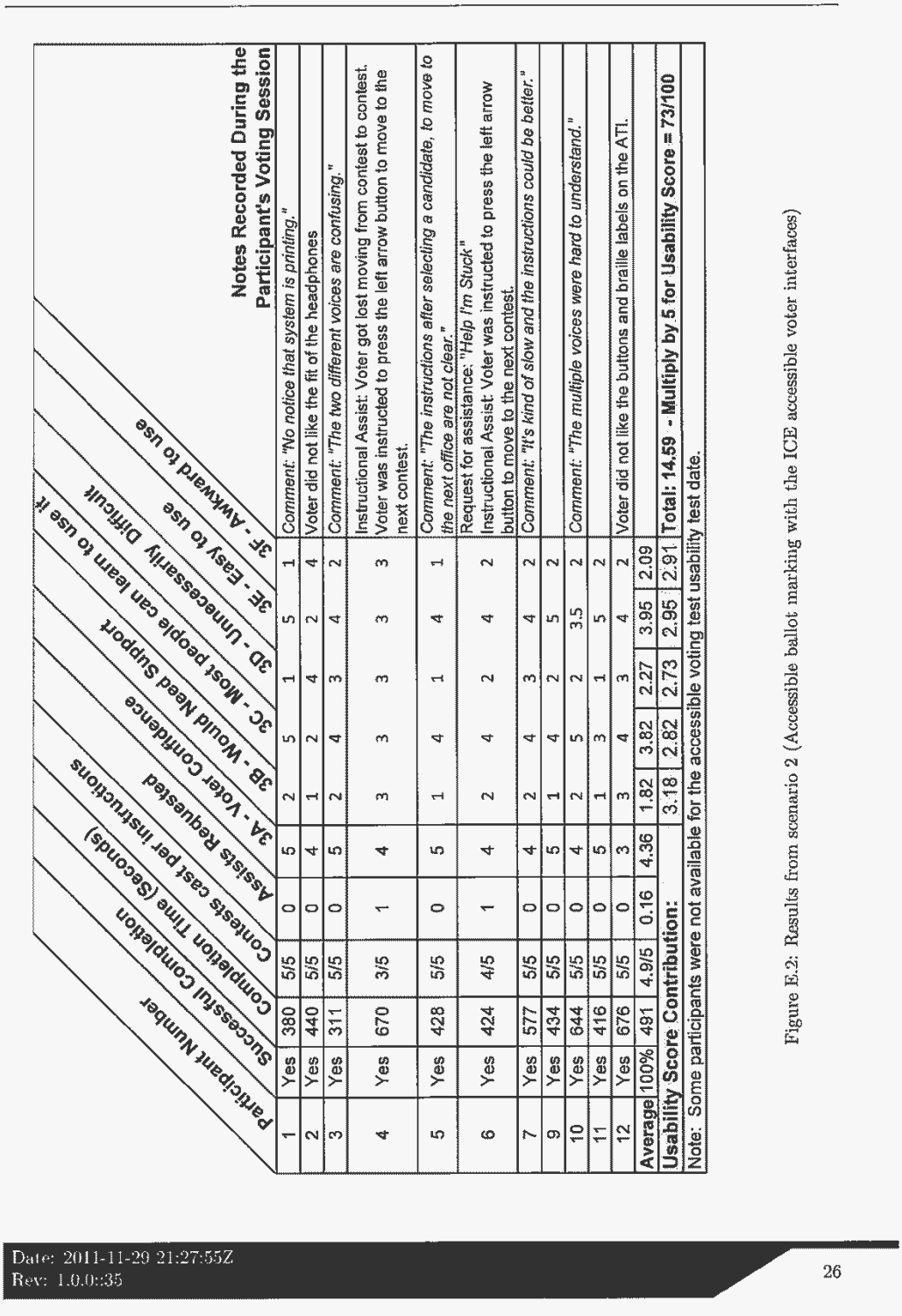
4 = Agree

5 = Strongly Agree



Participant Number	Successful Completion	Completion Time (Seconds)	Contests cast per instructions	Assists Requested	3A - Voter Confidence	3B - Would Need Support	3C - Most people can learn to use it	3D - Unnecessarily Difficult	3E - Easy to use	3F - Awkward to use	Notes Recorded During the Participant's Voting Session
1	Yes	133	5/5	0	5	4	5	1	5	1	*Comment: "This is easy"*
2	Yes	354	5/5	0	5	1	3	2	5	1	Voter returned his ballot after initial review and proceeded to re-insert it in each of the 4 ballot orientations.
3	Yes	72	5/5	0	5	1	4	1	5	1	*Comment: "I like the touch screen"*
4	Yes	198	4/5	1	5	2	4	1	4	1	Instructional Assist: The voter stopped after the ballot review and asked if she should return her ballot to complete voting the final office. She was instructed to follow her instructions if possible. She completed her ballot without further assistance.
5	Yes	79	5/5	0	5	2	5	1	5	1	
6	Yes	86	5/5	0	5	1	4	1	5	1	
7	Yes	65	5/5	0	5	2	4	2	5	2	
8	Yes	372	5/5	0	4	1	4	1	4.5	2	Voter had difficultly holding and marking the ballot, but was able to successfully feed it into the tabulator. She was very proud that she was able to vote un-assisted.
9	Yes	302	5/5	0	5	1	4	1	4.5	1	*Comment: "I'm glad my marks did not have to be perfect."* Voter found it easier to vote ballot on lap than to use a voting booth.
10	Yes	214	5/5	0	5	1	5	1	5	1	Voter needed to hold ballot to face (<5 cm) to see.
11	Yes	152	5/5	0	4	1	5	1	5	1	
13	Yes	100	5/5	0	4	1	5	1	5	1	
14	Yes	81	5/5	0	5	1	5	1	5	2	*Comment: "Was there an audio confirmation of ballot acceptance?"* Informed voter that there was a audio tone at ballot acceptance. Voter asked that we include a visual confirmation message.
Average	100%	170	4.9/5	0	4.77	1.46	4.38	1.15	4.85	1.23	
Usability Score Contribution:						3.54	3.38	3.85	3.85	3.77	**Total: 18.38 - Multiply by 5 for Usability Score = 91.9/100**
Note: Participant number 12 had no sight and did not attempt to vote.											

Figure E.1: Results from scenario 1 (Using the ICE to review and cast a manually marked ballot)



Participant Number	Successful Completion	Completion Time (Seconds)	Contests cast per instructions	Assists Requested	3A - Voter Confidence	3B - Would Need Support	3C - Most people can learn to use it	3D - Unnecessarily Difficult	3E - Easy to use	3F - Awkward to use	Notes Recorded During the Participant's Voting Session
1	Yes	380	5/5	0	5	2	5	1	5	1	*Comment: "No notice that system is printing."*
2	Yes	440	5/5	0	4	1	2	4	2	4	Voter did not like the fit of the headphones
3	Yes	311	5/5	0	5	2	4	3	4	2	*Comment: "The two different voices are confusing."*
4	Yes	670	3/5	1	4	3	3	3	3	3	Instructional Assist: Voter got lost moving from contest to contest. Voter was instructed to press the left arrow button to move to the next contest.
5	Yes	428	5/5	0	5	1	4	1	4	1	*Comment: "The instructions after selecting a candidate, to move to the next office are not clear."*
6	Yes	424	4/5	1	4	2	4	2	4	2	Request for assistance: "*Help I'm Stuck*" Instructional Assist: Voter was instructed to press the left arrow button to move to the next contest.
7	Yes	577	5/5	0	4	2	4	3	4	2	*Comment: "It's kind of slow and the instructions could be better."*
9	Yes	434	5/5	0	5	1	4	2	5	2	
10	Yes	644	5/5	0	4	2	5	2	3.5	2	*Comment: "The multiple voices were hard to understand."*
11	Yes	416	5/5	0	5	1	3	1	5	2	
12	Yes	676	5/5	0	3	3	4	3	4	2	Voter did not like the buttons and braille labels on the ATI.
Average	100%	491	4.9/5	0.16	4.36	1.82	3.82	2.27	3.95	2.09	
Usability Score Contribution:						3.18	2.82	2.73	2.95	2.91	**Total: 14.59 - Multiply by 5 for Usability Score = 73/100**
Note: Some participants were not available for the accessible voting test usability test date.											

Figure E.2: Results from scenario 2 (Accessible ballot marking with the ICE accessible voter interfaces)

Appendix F

Demographic Questionnaire

DOMINION VOTING

DEMOGRAPHIC QUESTIONNAIRE

Any information you share will be kept strictly confidential and your name will not be associated with the data we collect. **Your privacy will be protected.**

Please tell us a little about yourself:

First name (only) _____

Are you:

- ☐ Male
- ☐ Female
- ☐ Decline to state

What is your age? _____

Are you eligible to vote in the USA?

- ☐ Yes
- ☐ No
- ☐ Don't Know

How many years of voting experience do you have?

- ☐ None
- ☐ Less than 2 years
- ☐ 2-5 years
- ☐ 5-10 years
- ☐ 10-20 years
- ☐ More than 20 years

Different areas in the US have used various types of voting systems over the years. Which, if any, of the following types of machines have you used?

- ☐ I have never used any voting system.
- ☐ Mechanical lever machine – where the voter sets switches and pulls a big lever on a mechanical voting machine.
- ☐ Punch card – where the voter uses a device that punches holes in a ballot card.
- ☐ Touch screen / DRE – an electronic voting system where the voter touches a screen to record their vote.
- ☐ Optical scan – a paper ballot system where the voter fills in a circle or oval to indicate a vote and which is counted by a machine.
- ☐ Other, please describe _____

Have you ever worked as a poll worker?

- ☐ Yes
- ☐ No

Do you have any physical limitations?

- ☐ Visual impairment – low vision, partial or complete blindness, other visual impairment?
- ☐ Auditory impairment – hearing loss, deafness or other hearing impairment?
- ☐ Mobility impairment – any condition that limits your physical activities?
- ☐ Speech impairment – difficulty speaking or communicating?
- ☐ Cognitive impairment – problems with learning, remembering, comprehending or other impairment?
- ☐ Decline to state

Thank You!

Appendix G

Post-Test Satisfaction Questionnaire

Upon completing their voting session, each participant was asked to fill out a Post-Test Satisfaction Questionnaire. Participants who could not complete the questionnaire independently received assistance filling it out from their personal assistant or from the usability administrator.

QUESTIONNAIRE

DOMINION VOTING

Please complete the following questionnaire

1. To the best of my ability, I followed the instructions telling me how to vote.

- ☐ Yes
- ☐ No

2. I am confident I was able to vote this ballot exactly as instructed.

- ☐ Agree
- ☐ Disagree
- ☐ Don't Know

3. Place an "X" in the choice that describes your reaction to each statement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	1	2	3	4	5
I felt confident using this voting machine.					
I think that I would need support to be able to use this voting machine.					
I think that most people would be able to use this voting machine without problems.					
I found that voting on this machine was unnecessarily difficult.					
I thought this voting machine was easy to use.					
I felt voting on this machine was very awkward.					

Thank You!

Figure G.1: Post Test Satisfaction Questionnaire

Appendix H

Voting Location

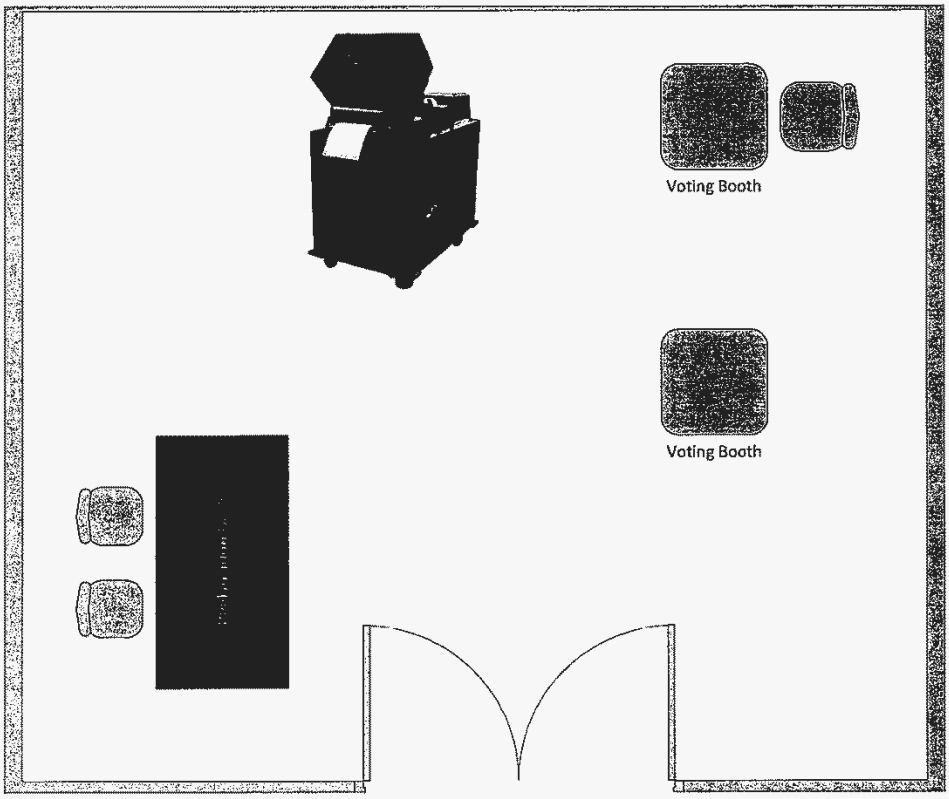
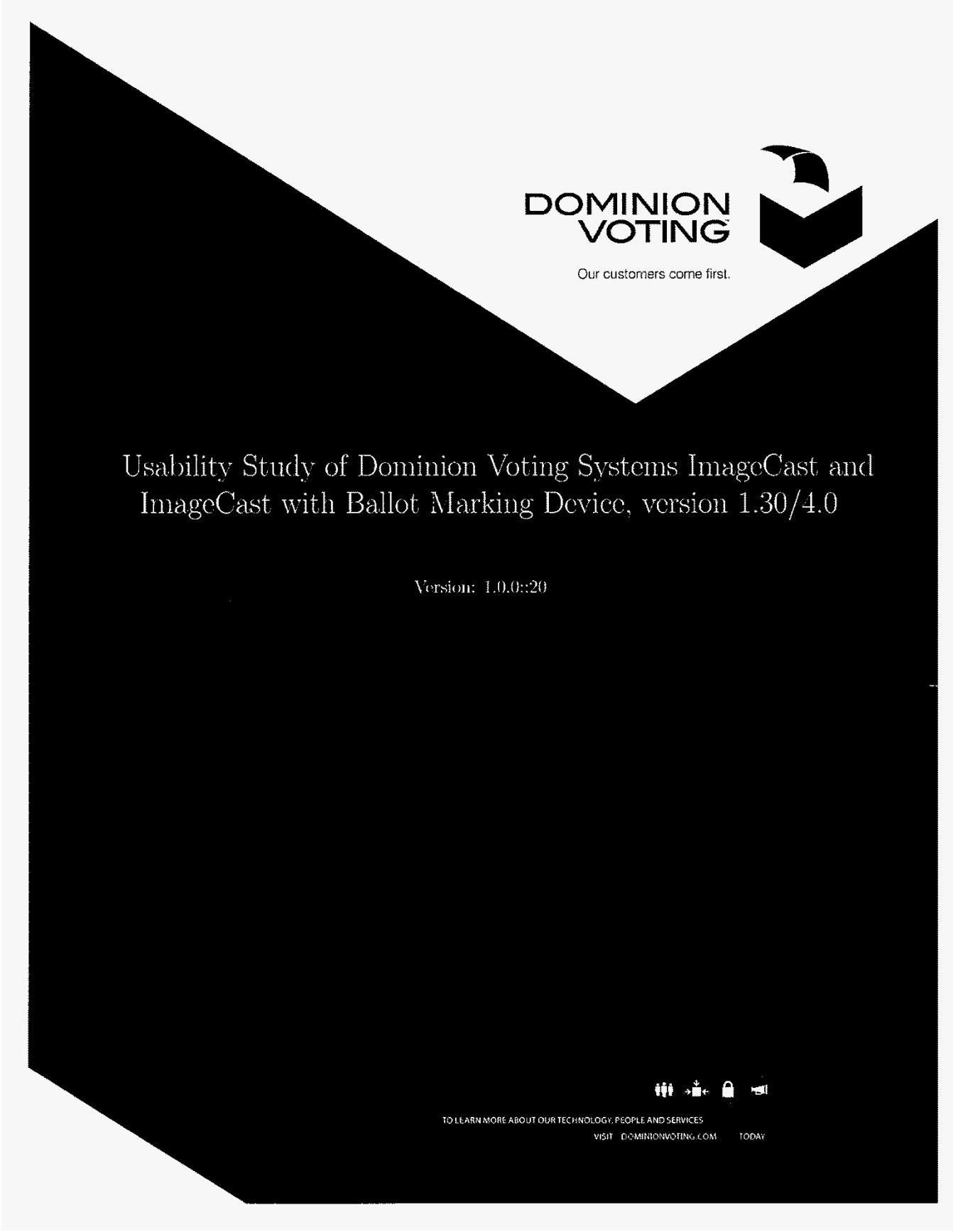


Figure H.1: ICE Usability Testing Location Layout


DOMINION
VOTING
Our customers come first.
Usability Study of Dominion Voting Systems ImageCast and ImageCast with Ballot Marking Device, version 1.30/4.0
Version: 1.0.0::20
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Proprietary Notice

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Revision History

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20	2011-07-26	devan.vandenboomen	Changed title.
19	2011-07-26	devan.vandenboomen	Standard Industry Format changes.
18	2011-07-26	devan.vandenboomen	Created Puerto Rico (PR) branch.
17	2010-07-29	lisa.madokoro	Updated tables.
16	2010-07-29	lisa.madokoro	Updated survey image.
15	2010-07-29	lisa.madokoro	Added new image.
14	2010-07-28	lisa.madokoro	Added percentages to a table.
13	2010-07-28	lisa.madokoro	Added new images.
12	2010-07-28	lisa.madokoro	Added new image.
11	2010-07-28	lisa.madokoro	Added new image and removed incorrect image.
10	2010-07-28	lisa.madokoro	Added new image.
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8	2010-07-28	lisa.madokoro	Added new images.
7	2010-07-28	lisa.madokoro	Added new images.
6	2010-07-28	lisa.madokoro	Converted usability focus group results into new version of ...
5	2010-07-28	lisa.madokoro	Converted old usability document to new version of svn. HIST ...
4	2010-07-28	lisa.madokoro	Edited master.tex and introduction.tex
3	2010-07-27	lisa.madokoro	set svn propset
2	2010-07-27	lisa.madokoro	Updated master.tex file
1	2010-02-24	root	Initial Import

Allowed Authors

Allowed Author	Abbreviation	Position
Firstname LASTNAME	subversionID	TitlePosition

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Chapter 1

Executive Summary

During the usability test, [XX] voters from the general population used the ImageCast in a simulated election. The election consisted of a test ballot with [xx] contests, including:

- Federal, state and local contests
- Partisan and nonpartisan contests
- Partisan and nonpartisan contests
- Single member and multimember contests
- Retention races
- Constitutional amendments
- Referenda and ballot initiatives

The test ballot developed in conjunction with the State of New York Board of Elections was used to simulate the tasks that users will be asked to perform during an election.

This ballot includes a number of tasks that model typical ballots from around the country, including:

- Voting for names at various locations within a list of names
- Voting a partial slate in a multimember contest
- Skipping elements of a ballot
- Write-in votes

During the usability test, participants worked alone and were provided limited assistance or help by the test administrators. Following the conclusion of the testing, the results were analyzed to determine participants effectiveness, efficiency and satisfaction using the ImageCast with and without Ballot Marking Device (BMD). During the usability test, the testing team collected and analyzed the following types of data:

- Number of ballots successfully submitted
- Percent of tasks completed without error
- Time to complete the voting session
- Voters confidence that they had used the system correctly
- Lastly, voters' overall satisfaction with the ImageCast System

1.1 Target Population - Context of Use

The combination ImageCast Ballot Counter and Ballot Marker Device is designed to enable people with disabilities to effectively produce a permanent paper ballot without the use of a pen. Some examples of electors include:

- people with some form of visual impairment
- people who benefit from simultaneous audio and visual communications
- illiterate voters
- voters that are unable to hold a pen
- persons who are quadriplegic or paraplegic

Figure 1.1 depicts a quadriplegic voter voting on the Ballot Marker using a sip & puff device connected to the Audio Tactile Interface. The sip & puff allows the voter to navigate the candidate names and contests without the help of a third party assistant.

Figure 1.1: A quadriplegic voter using the Ballot Marker

1.2 Full Product Description

This document addresses usability issues for a portable ballot marking system called the ImageCast Ballot Counter and Ballot Marker Device (or BMD). When used for voting, the unit is part of a specially designed ballot box with the following components:

- an ADA[1] voting terminal consisting of an Audio Tactile Interface (ATI) and display screen,

[1] American Disabilities Act

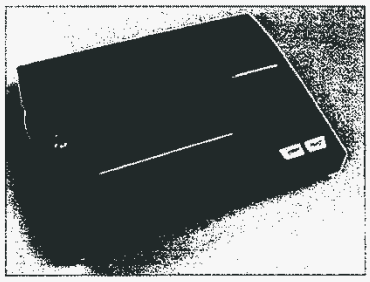


Figure 1.2: ImageCast Precinct Ballot tabulator

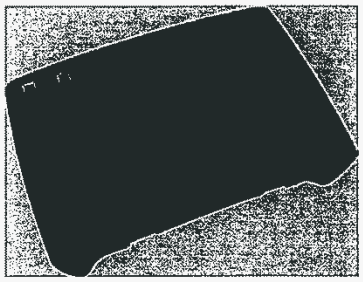


Figure 1.3: Audio Tactile Interface (ATI)

- an electronic ballot printer that prints a ballot for the ADA voter,
- a ballot scanning station for review and accounting of marked ballots,
- a main compartment for storing ballots that have been reviewed and accepted by the voter.

The system uses a composite ballot that has all offices and questions printed on it. The voters may mark their ballots by using either a special marking pen to mark the box(es) corresponding to the candidate(s) of their choice, or by using the ADA interface that prints a paper copy of their marked ballot. The paper ballot is then inserted into the ImageCast Ballot Counter which reads the ballot, reviews ballot selections for the voter, and deposits the ballot into an internal compartment of the ballot box. After the close of voting, the ImageCast prints a results tape that shows the number of votes cast, but does not show any tabulated results. The components which make up the ImageCast Ballot Counter system are depicted in Figures 1.2 through 1.5.

The BMD features interfaces that allow persons with many different types of disabilities to effectively vote independently. These features include a spoken version of the ballot, contrast and zoom controls for the display, and both paddle button and sip & puff access through the ATI. Regardless of the presence or absence of the BMD, audio ballot session presentation and input go through the ATI box to the ImageCast scanner. If the BMD is absent, the voters choices are stored electronically in the ImageCast scanner rather than being turned into a ballot as part of the voters audio voting session.

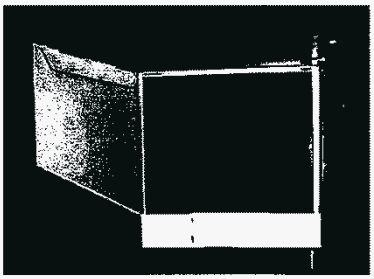


Figure 1.4: The adjustable arm-mounted LCD is shielded with a privacy cowl

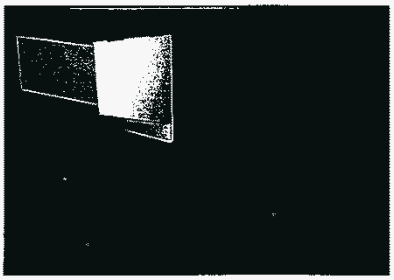


Figure 1.5: Ballot Marking Table and LCD Display with adjustable arm on Ballot Box

1.3 Operational Environment

The election environment for the Ballot Marker is a conventional polling location. In the situation where a BMD is used exclusively for disabled voters, the unit is placed into any available voting booth/station and plugged into a standard AC outlet. The unit needs to be positioned such that the display can be seen by the voter, but at the same time cannot be viewed by other persons walking past the voting station if used in a general polling location.

1.4 Test Objectives - the purpose of the test

The primary objective is to provide people with disabilities the opportunity to test and help improve the usability of the device. The study is designed to collect and capture areas for improvement and to identify to what level the Ballot Marker Device suited the needs of each person. An important object is also to provide feedback to the design team to facilitate final improvements to the Ballot Marker Device. Changes may be performed on existing units, or may be the subject of future enhancements. A further objective is to improve voter and poll worker education efforts. Voter interaction problems may be addressed through improved training and documentation, allowing modifications to operator documentation rather than to the device.

All participants in the test interacted directly with the four major components which make up the Ballot Marker. These included the ATI, the display, the ImageCast Ballot Marker Device and the ImageCast scanner. The collected material will also be contributed to interested parties (independent living centers) as well as regulatory agencies (such as NIST) for consideration in future voting systems standards (such as Election Assistance Commission next generation standards).

Chapter 2

Methods

The summative usability test described here is based on the reports from the Usability Professional's Association 2004 Workshop on Voting and Usability and Common Industry Format [1].

2.1 Participants

The recruiting profile for usability test participants is always a critical factor in conducting a usability test. Participants must be selected carefully.

Younger and older voters are more likely to have usability problems, so they should comprise a large portion of the selected participants (middle aged voters have more voting experience than younger people, and fewer disabilities than older voters (ref Summative Us)). Prior voting experience is an important consideration. This includes the number of years the participant has voted, as well as the type or variety of voting systems the participant has used. In addition, their voter type, or their social relationship to elections, must be considered.

Please see Table 2.1 for a full list of voter types that should be considered in ensuring the full spectrum of election experiences are covered:

Voter Type
Avid
Civic
Issue
Excluded
Apathetic

Table 2.1: Attributes of test participants

Demographic characteristics to be considered in creating the participant profile are listed in Table 2.2.

The participant profile must include a range of disabilities which can be seen in Table 2.3.

Finally, the voter experience should be noted as specified in Table 2.4.

[1] Defining a Summative Usability Test for Voting Systems - A report from the UPA 2004 Workshop on Voting and Usability, September 2004, W. Quesenbery *et al.*

Demographic
Age
Gender
Race/ethnicity
Access of experience with computers and technology
Socio-economic stats
Level of education
Rural/urban
Region of country
Primary language
Low literacy / English proficiency

Table 2.2: Voter demographics

Disability Type	Number of Persons
Physical	
Blind	
Low Vision	
Cognitive	
Mental Health	
Multiple	
Sensory	
None	

Table 2.3: Focus group disability types

2.1.1 Number of Participants

Standard research guidelines suggest 50-100 participants be used per voter segment.

2.2 Context of Product Usage in the Test

2.2.1 Test Facility

Most usability tests are conducted in an artificial environment, though it may simulate aspects of the normal context of use. A polling place is typically set up for an election in a space normally used for other purposes, such as a school gymnasium, a firehouse, a room in a community center, a church or a civic center. The usability test should be conducted in a similar environment, following the best polling place arrangement practices to ensure privacy and accessibility.

Creating a realistic test environment is an important consideration in designing the test.

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	(%)	(%)	(%)
No	(%)	(%)	(%)
Unsure	(%)	(%)	(%)

Table 2.4: Focus group participant experience levels

Standard usability testing procedures for obtaining consent forms and informing participants that their actions will be recorded must be incorporated into the test plan, but this housekeeping can be done outside of the mock polling place.

The physical environment should be similar for all tests. This includes general environmental factors such as:

- Lighting
- Temperature
- Noise level

As well as considerations such as:

- General room layout
- Proximity of individual voting systems
- Traffic corridors around the voting systems
- Number of people in the simulated polling place

2.3 Experimental Design

2.3.1 Procedure

Testing is performed using a range of voters with different abilities.

Time slots of up to 45-minutes are allocated for each participant to cast a ballot. This period provides ample time to interview the participants after voting in order to receive feedback about the use of the machine, as well as any time that was necessary to properly cast a ballot. All comments from participants are gathered and at the end, a group discussion is held. During this time, the collective results of all feedback received from the testers is shared.

The usability goals for a voting system are ones that allow voters to:

- Correctly use the voting system to register their intended selections with minimal errors and easily detect and correct errors when they occur.
- Efficiently complete the voting process in a timely manner and without unproductive, unwanted, incomprehensible, or frustrating interactions with the system.
- Feel confident (1) in the actions they had to perform in order to vote, (2) that their votes were correctly recorded by the system and will be correctly counted, and (3) that their privacy is assured.

2.3.2 Tasks and Activities for Test Participants

The basic task of a usability test of a voting system is to cast a vote. The test activities are very simple and simulate a typical voting process as closely as possible. In a mock polling place, each participant in the test goes through a complete voting process, including:

- identifying themselves and signing the elections register
- receiving their ballot paper or any other materials required to vote

- receiving any instructions that are part of the normal voting process
- voting as instructed

To ensure that the full functionality of the machine is exercised during the test and to control for the expected results, the participants should be given specific instructions about how to vote, including the candidates or answers to ballot questions. (This is similar to a logic and accuracy test sample set). However, whether the choice of how to vote is left to the participant or dictated to them, the selection must be done in a format that does not directly copy the ballot layout format, for example, use a voter information brochure or other material.

During the test, no attempt is made to interview participants to understand their cognitive or emotional interaction with the voting system. While the voters are in the mock polling place, especially the voting booth, they are not interviewed, given test instructions, or prompted to talk aloud. This is especially important with regards to measuring efficiency, especially as the actual task of voting is relatively short. Any observation should be done remotely (for example, through a discrete camera), rather than with a second person in the voting booth with the participant. Any test instructions, questionnaires or debriefing interviews take place outside of the mock polling place (much as news reporters, campaigners, and others are kept outside of a 50 foot radius from most polls). In order for the usability test to be repeatable, the activities and scripts must be detailed and precise. Although it might seem artificial to read from a script, it is important that every participant receive exactly the same instructions (outside of any differences in the details of their task assignments). This includes:

- any pre-test information or general instructions,
- the format, delivery methods and wording of task assignments,
- any instructions given for how to complete the usability test,
- any instructions, training, or practice on how to vote that are given to all participants,
- availability of sample ballots,
- any additional instruction, training, or practice offered on the voting system before the participant begins to use the system to vote, and
- any assistance or additional instructions available during the test, with the same answers, instruction or help given for each question that the test participants may ask.

This test uses a single voting device, but might include a range of ballots, ranging from a very simple (few races, with a single selection in each race, first-past-the-post rules) to more complex ballots (including straight party voting, multiple selections in a race, a mix of partisan and non-partisan races, ballot issues, and schemes such as preferential voting).

2.4 Data Collected or Measured During the Test - Usability Metrics

There are three main categories of data collected during the test, corresponding to the three broad usability requirements: Interfaces Used, Overall Performance and Time Studies.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle
Frequency						

Table 2.5: Frequency of use of voting interfaces. Total participants = x

2.4.1 Interfaces Used

Each participant is asked to cast one complete ballot using the Ballot Marker Device. Depending on the type of disability or level of assistance required by each voter, a different set of interfaces are employed. The breakdown of how each interface was employed is detailed in Table 2.5.

2.4.2 Correctness

Unlike a real election (where the vote is secret), the test is set up so that the voter can be discretely observed, and their actions inside the voting booth recorded. This allows the test observers to collect information about the voters actions and to compare the vote as cast to the intended vote. This ability to observe is relevant to assessing whether voter confidence in the system is warranted.

There are several different outcomes of the voting activity for each participant.

- The participant voted as intended.
- A vote was cast, but there was an error of some kind:
  - The participant did not vote as intended.
  - The ballot was invalid in some way: unintentionally undervoted, overvoted, a spoiled write-in, or some other voter error
- The participant did not succeed in casting a vote. The usability test report should include an enumeration of each outcome, as well as the specific types of failures when a vote is cast.

2.4.3 Overall Performance

Each participant is asked to rate the overall effectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are collected and seen in Table2.6:

	Score
Spread	to
Average	

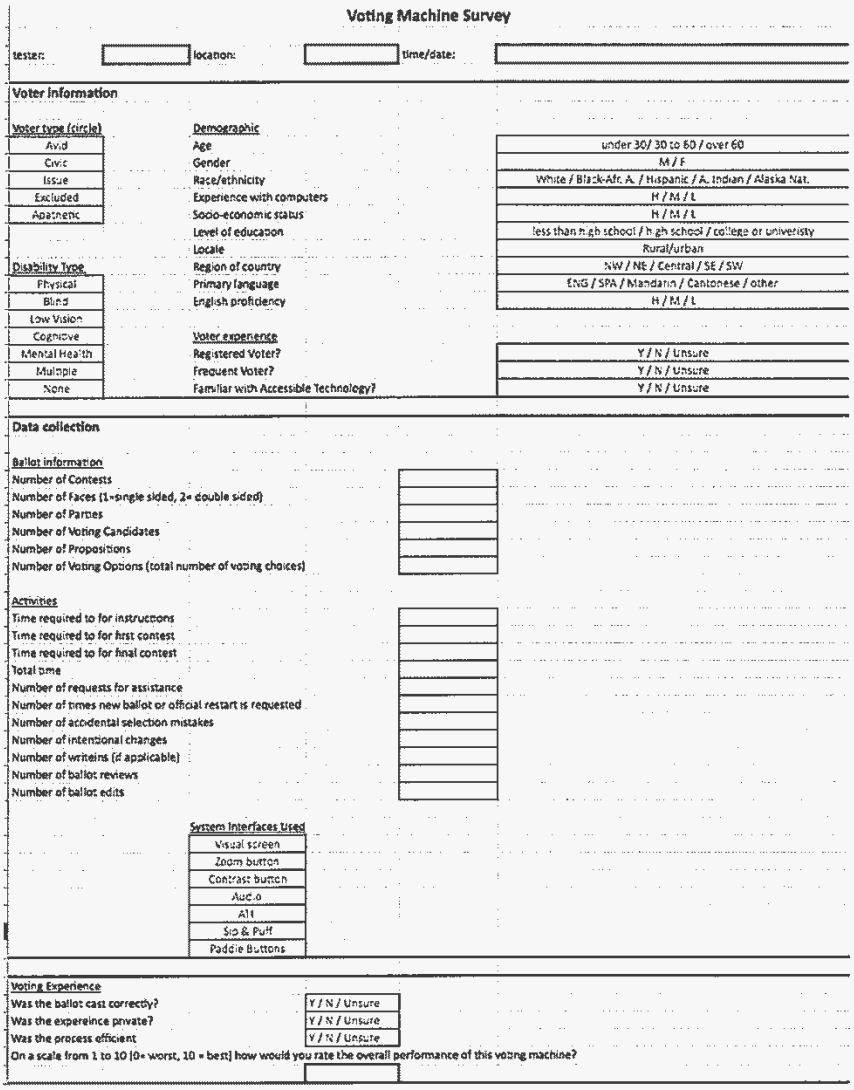
Table 2.6: Likert Scale Performance Data

2.4.4 Time Study

Actual ballots are used for the purposes of this study, and all participants may not use the same ballot with the same candidate names and contests.

The size of the ballot may influence the ratings, so details on the ballots are collected in Table 2.7 below.

The effectiveness of the unit can be determined by several other factors, which are seen in Table 2.8 below.



Voting Machine Survey

tester: _____ location: _____ time/date: _____

Voter Information

Voter type (circle)	Demographic	
Avid	Age	under 30/ 30 to 60 / over 60
Civic	Gender	M / F
Issue	Race/ethnicity	White / Black-Afr. A. / Hispanic / A. Indian / Alaska Nat.
Excluded	Experience with computers	H / M / L
Apathetic	Socio-economic status	H / M / L
	Level of education	less than high school / high school / college or university
	Locale	Rural/urban
Disability Type	Region of country	NW / NE / Central / SE / SW
Physical	Primary language	ENG / SPA / Mandarin / Cantonese / other
Blind	English proficiency	H / M / L
Low Vision		
Cognitive	Voter experience	
Mental Health	Registered Voter?	Y / N / Unsure
Multiple	Frequent Voter?	Y / N / Unsure
None	Familiar with Accessible Technology?	Y / N / Unsure

Data collection

Ballot information	
Number of Contests	
Number of Faces (1=single sided, 2= double sided)	
Number of Parties	
Number of Voting Candidates	
Number of Propositions	
Number of Voting Options (total number of voting choices)	

Activities	
Time required to for instructions	
Time required to for first contest	
Time required to for final contest	
Total time	
Number of requests for assistance	
Number of times new ballot or official restart is requested	
Number of accidental selection mistakes	
Number of intentional changes	
Number of writeins (if applicable)	
Number of ballot reviews	
Number of ballot edits	

System Interfaces Used
Visual screen
Zoom button
Contrast button
Audio
All
Sip & Puff
Paddle Buttons

Voting Experience	
Was the ballot cast correctly?	Y / N / Unsure
Was the expereince private?	Y / N / Unsure
Was the process efficient	Y / N / Unsure

On a scale from 1 to 10 (0= worst, 10 = best) how would you rate the overall performance of this voting machine? _____

Figure 2.1: VotingMachineSurvey

	Score
Number of Contests	
Number of Faces (1=single sided, 2= double sided)	
Number of Parties	
Number of Voting Candidates	
Number of Propositions	
Number of Voting Options (total number of voting choices)	

Table 2.7: Collecting the ballot parameters

	Score
Time required to for instructions	
Time required to for first contest	
Time required to for final contest	
Total time required	
Number of requests for assistance	
Number of times the voter requests a new ballot or requires an official restart a ballot	
Number of accidental selection mistakes	
Number of intentional changes	
Number of write-ins (if applicable)	
Number of ballot reviews	
Number of ballot edits	

Table 2.8: Collecting the voting parameters

The results of the time study are collected using Table 2.9 below.

	Range		
	Min	Max	Average
Voting			
Ballot Print/Mark			
Verification			
Total			

Table 2.9: Time study values for various voting functions (measured in minutes)

2.4.5 Independent and Private Use Survey

Participants are asked whether or not they felt that their voting session was independent and private.

A copy of the survey used to gauge the performance of the Ballot Marker is provided on page 12. The survey is generic in nature and thus intended to be all-encompassing.

Chapter 3

Results

Usability metrics are the key indicators of a successful voting system. The information collected in each focus group is analyzed using a set of measurements and data mining operations.

3.1 Data Analysis

Data analysis is performed by compiling a set of scores, reducing data into subcategories for comparison, and performing statistical analysis on the scores and data reductions.

3.1.1 Data Scoring

Data scoring is the overall observations and calculations form the scoring set. The scoring set consists of measurements of overall satisfaction, efficiency and ease of use factors, usability, and voter experience.

The most important metric is the overall satisfaction (high low average) as measured on the Likert Scale. This value covers the entire voting system for all users.

Considerations for efficiency are important to voters and election providers. Time factor measurements are:

- Time per selection (seconds)
- Average time spent on instructions (minutes)

There are also scores for overall usability:

- Requests for assistance (average number per session)
- Accidental selections (average number per person)
- Average time for first contest (minutes) *this identifies how quickly the voter can get started*
- Average time for last contest (minutes) *this reveals how quickly the voters learns during the first ballot*
- Mistaken selections (average number per person) *does the voting interface have anything which may lead to accidental selections?*

Finally, the voting experience scores are critical in understanding the confidence levels of voters using the system:

- Percentage agreeing system is private
- Percentage agreeing system is correct
- Percentage agreeing system is efficient

3.1.2 Data Reduction

While overall scores are important, they do not provide the specific information required to improve the voting experience. For instance, a process might be acceptable for some but not all voters. Without breaking the data into small groups, this information cannot be determined.

Data is reduced and produced for:

- Satisfaction rate based on each user type (Blind, Cognitive, Low Vision, Mental Health, None, Physical, Sensory, Multiple, Unsure)
- Satisfaction rate based on age groups (under 30, 30 to 60, above 60)
- Satisfaction rate based on registered voter status (yes, no, unsure)
- Satisfaction rate based on voter frequency status (Avid, Civic, Issue, Excluded, Apathetic)
- Satisfaction rate based on accessibility skills (yes, no, unsure)
- Satisfaction rate for each voting interface (Visual Screen, Zoom, Contrast, Audio, ATI, Sip & Puff, Paddle Buttons, Pen, Other)

3.1.3 Statistical Analysis

Statistical analysis will consist of comparative analysis between user groups of the metrics listed above. Each focus group will form on set of data which will be compared within a tabular format. The results are presented below.

3.2 Presentation of Results

3.2.1 Performance Results

Performance results are reported for all events. The chart is presented on the following page.

Performance results are reported for all events. The chart is presented on the following page. Initial measurements indicate that while most users (more than 94%) consider the system private and correct, not all users found the system efficient. This is partially a result of all voters types participating in the study, including those that would normally mark a paper ballot with a pen (denoted as disability=none).

Also presented in the chart is the average time with instructions, the average number of requests for assistance, and the average time per selection. These data can be used to predict Election Day usage. Of note is a measurement of the ratio of time required to complete the first contest, to the time required to complete the final contest.

If the voters become more comfortable with the device during the completion of the ballot, the voters will complete the last contest faster than the first. The higher the number, the faster the voter appears to be learning. The first measurement of the value was 1.8, meaning that voters are nearly twice as fast at the end of the ballot as at the beginning. This indicates fast learning on the device.

3.2.2 Satisfaction Results

Satisfaction results are reported for all events. The chart is presented on the following page.

Preliminary results indicate that user satisfaction is highest for voters who report blindness, physical, and multiple disabilities, but lower for those with partial vision or no disability. This is to be expected, as the interface is not designed for those who can complete a ballot using a pen and paper. For voters with low vision, alternatives using optical magnifiers will be introduced in the next rounds of focus groups. The other user group which could be improved is the cognitive group. Improved voter orientation instructions were successful to better explain the process to these voters. A complete introductory script will be added to all user manuals.

Early testing was very experimental, often asking people to try new interfaces in order to test the limits of the device. While this provides good suggestions for future developments, it alters the accuracy and repeatability of the data. The processes was changed for the Westchester/Newburgh study, and encouraging people to utilize their preferred assistive device, not ones that are new to them, was a definite factor in improving the Likert Rating.

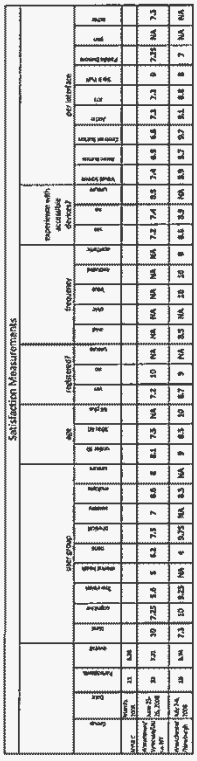


Figure 3.1: Table of satisfaction measurements.

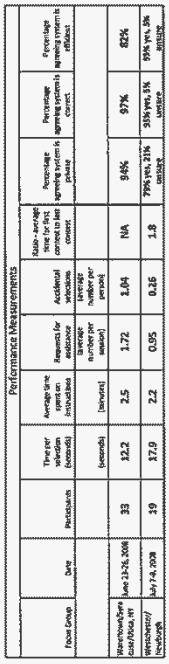


Figure 3.2: Table of performance measurements.

Chapter 4

Individual Study Results

4.1 Westchester, Newburgh Focus Groups - July 7-8, 2008

4.1.1 Overview

The testing took place over a two day period. Participants cast ballots on a first come first served basis, which permitted ample time to interview the participants after voting. All data and comments from participants were entered directly into a laptop computer by an observer who would not be present in an actual election.

Usability results were analyzed to determine gaps in the system or poll worker instructions by comparing this focus group with previous ones. No changes were made to the system, but a better voter orientation session was used to introduce the election process to the voter. The script of this orientation will be added to the user manual.

A new ballot was used for the study. Previous ballots began with a vote for 6 contest, and not only was this quite confusing to voters, but also is not a typical ballot used during any election.

4.1.2 Participants

A total of 19 individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables 4.1 and 4.2.

Disability Type	Number of Persons
Physical	4
Blind	3
Low Vision	4
Cognitive	3
Mental Health	0
Multiple	4
Sensory	0
None	1

Table 4.1: Focus group disability types - Westchester and Newburgh

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	15 (79%)	13 (68%)	10 (53%)
No	4 (21%)	6 (32%)	9 (47%)
Unsure	0 (0%)	0 (0%)	0 (0%)

Table 4.2: Focus group participant experience levels - Westchester and Newburgh

4.1.3 Ballot Details

The ballot was a general ballot. The ballot details are shown in Table ??.

	Score
Number of Contests	8
Number of Faces (1=single sided, 2= double sided)	2
Number of Parties	4
Number of Voting Candidates	23
Number of Propositions	1
Number of Voting Options (total number of voting choices)	25

Table 4.3: Collecting the ballot parameters - Westchester and Newburgh

4.1.4 Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.4.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	7	3	17	17	2	1

Table 4.4: Frequency of use of voting interfaces - Westchester and Newburgh - Total participants = 19

4.1.5 Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.5.

All ratings were between 7 and 10 except for one person who was deaf. This voter's rating was 4. Deafness is not included as a VVSG disability type, and this voter could have voted using a pen and paper. However, it was pointed out that deafness could be combined with another disability type and should be considered.

4.1.6 Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of eight contests. The results of the time study are shown in Table 4.6.

	Score
Spread	4 to 10
Average	8.74

Table 4.5: Likert Scale Performance Data - Westchester and Newburgh

	Range		
	Min	Max	Average
Total	6	17	9.68

Table 4.6: Time study values for various voting functions (measured in minutes)- Westchester and Newburgh

4.1.7 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 79% of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. The other 4 voters replied to this question with "unsure". No voter responded that their voting session compromised the privacy, condentiality, or secrecy of their selections.

Voter choices, errors, and adjusted choices are shown below in Table 4.7. The results show both higher involvement in the ballot process and a lower rate of changes than previous focus groups, largely due to better verbal instructions.

Adjustment	Count
Number of requests for assistance	18
Number of times new ballot or official restart is requested	0
Number of accidental selection mistakes	5
Number of intentional changes	1
Number of write-ins (if applicable)	1
Number of ballot reviews	12
Number of ballot edits	6

Table 4.7: Number of voter choices and adjustments - Westchester and Newburgh

4.1.8 User Comments

General comments about using the Dominion Voting Ballot Marker Device

- No recommendations (for future changes). [The test unit] would be the right machine.
- Educational process needs to be reiterated beforehand. Take a test run beforehand instead of just listening to instructions. For example, give people 1-2 days before election to test out machine and become familiar. Simplify language instructions for audio because not everyone will understand. Instructions should be balanced depending on demographic background and area you are coming from (e.g.: rural versus urban).
- Voter was able to cast ballot independently.

- Voter was given and taught the ATI before beginning his voting session. Yet, once his voting session began he scrolled through the entire ballot without making any selections. Poll worker decided to give him the paddle buttons instead, which he used during ballot edit mode. He found the paddle buttons much easier to use and marked the entire ballot in ballot edit mode. His time greatly increased when using the paddle buttons again. Although his entire voting session lasted 18 minutes, it only took him 6 minutes to complete the ballot when using the paddle buttons. It only took him 30 seconds to vote in the rst contest, whereas it took him 45 seconds when using the ATI even though he did not make any selections. It is also important to note that this blind voter cannot read Braille so was solely relying on the shape of the buttons on the ATI to orient himself.
- Successfully cast ballot.

"Things I liked"

- Very easy. Directions easy to understand.
- It's better than the touch screen.
- I have spastic movement and sometimes I touch a candidate I do not want. I have more control with the ATI because I have to touch it. And then the review is helpful. I always needed an aid before. I refused to have an absentee ballot, which made them upset. There was no privacy. This time I was able to do the whole thing myself. The audio was good and allowed you to follow along, and told you when you made a mistake and allowed you to correct it.
- Poll worker instructing voter beforehand would be necessary because audio instructions alone would be confusing.
- Good tone, liked human voice. It was cool. Female voice better than male's voice but I can deal with either.
- The verbal instructions are necessary because I have a hard time ltering things out, so the audio and visual helps me focus. Efficient, gave you a little more time. Other voting processes don't allow you to change your vote, you're just done. I liked the ballot review option. The zoom option made the font large enough to read.
- Used to audio and found it easy to follow along. Voter most used to audio and would probably still use audio even if greater magnication available.
- Found it very easy and simplistic. Audio easy to follow along with.
- Very clear. Audio was easy to follow along with. Audio was good. Speed increase good because allowed me to navigate quickly. Once you get used to everything, you want to speed it up.
- Machine is totally awesome. Audio and text good. Voice was kind of cute.
- Buttons. Audio. Best thing they could have done for the handicapped.
- Zoom and contrast buttons made it easier to read. Machine reading to you made me more sure of names and instructions. Instructions from poll workers at beginning made it easier as well.
- Audio. Buttons. Gives me the ability to vote independently. It's long overdue.
- Being able to vote independently.
- Black background with white lettering instructions were very cool. Easy to read. Just used audio to vote for candidates because couldn't read the names. Liked the combination of audio and visual. Audio conrms what voter thought they saw. Liked removing privacy screen so could get closer. Felt claustrophobic otherwise. Now blind/low vision people can vote on their own.

- Audio and visual complimented each other well. ATI very easy to use, very helpful.

"I want poll workers to know the following when working with someone with my disability"

- Poll workers should be educated on how to use body language. For example, a quadriplegic could use their eyes to signal answers to questions. Also, before people begin to vote, poll worker should ask them what he/she should look for if they need help, e.g.: a certain body movement. All eectiveness of the machine depends on poll workers - their training and willingness.
- Make person feel comfortable from the beginning, adjust the machine to their abilities and preferences. Both the poll worker and voter should have the freedom to adjust the machine before beginning.
- Assistance - explain machine at beginning of use with more information than is included on audio instructions.
- Ability of ease would vary depending on mental capability of voter.
- Just be patient. If we're asking questions it's not because we're trying to give a hard time.
- Speak directly to the person. We deserve the same rights and respects as an able-bodied person gets.
- To be patient. It's good for voters to know they should feel free to remove the privacy screen so they don't feel claustrophobic.
- Patience. Realize you're talking to a human being. Instructions explained in person made it easier to understand so able to skip audio instructions.

Items for future enhancement

- I'd like more zoom settings. Multiple zoom levels would be useful instead of just two because there is a vast dierence between the two zoom levels.
- Allow for a larger magnication.
- Some large words in sentences on machine. Some voters may have diculty understanding. A lower register word might be better instead of owery language, e.g.: "choose" instead of "select."
- Perhaps a close button would be better instead of having to go through each remaining contest, ballot edit and ballot review.
- How it automatically goes into the contests in ballot edit mode caused concern.
- Voter wasn't using audio, so pressed buttons during audio, causing selection to go unrecognized and vote(s) cleared.
- Proposition button direction is confusing. It looks like you use yellow arrows to navigate "yes" and "no", but that causes you to skip the proposition. The "yes" and "no" should be above and below each other.
- A common suggestion was that dierent users get dierent interactions. This will be considered for future systems.
  - Both audio and video instructions made it confusing to follow. Wasn't sure what to do when skipping an office. Confused with write-in because there were a lot of instructions at once. A sip and pu user would need help.

  - Instructions for dierent interfaces should be broken up, it is confusing otherwise.
  - A "No Audio" button so deaf people don't have to wait for audio and can go more quickly through the ballot. Change help button to red, it will be more clear that way. Perhaps add ASL instructions at beginning on top of the English ones because some deaf people have problems with English. (note: this is a reference to a voter who would use sign language in addition to audio)

- There were also continued comments about the rate of button selecting - the function of the unit is directly related to two requirements of the federal voting standard 1) no button is to have any repetitive eect (not common practice for electronic interfaces), and 2) audio and video must be simultaneous (creating a lag between instantaneous visual information and slower audio communications). These two requirements lead to reduced usability which is reected in the comments below which conict with the interpretation of regulations.
  - Tedious if you don't want to continue through ballot.
  - Used to using a computer where everything is much quicker. Rating would have been a 10 if there wasn't such a lag time. Sometimes button didn't respond when pushed. Too much delay between button response time. Had to increase rate because growing impatient. Once you know the candidates you are going to vote for, it would be easy to be able to press button x number of times and land on what you want.
  - A bit slow when it moves across the ballot. Confusing when you reach the last contest and it just sits there. I didn't know if I did something wrong or if I was supposed to sit there. Better if it said "one moment please."
  - A little slow. The ballot review moved slowly. If you were more familiar with it beforehand it may make it easier. Perhaps put machine in a community center for people to try out before election.
  - Better response time. If I knew what it was going to say I'd press the button ahead of time, but it would wait.
  - Slow response time between pressing the button and response.
  - Continuously tried to press button before audio was nished, which caused voter to sometimes have to wait because machine hadn't registered her selection even though she thought it had.

The system can be adapted to eliminate the issues listed above. Continued examination of these requirements will be performed in order to determine if voters prefer the system as described/required by standards, or would prefer a system with better usability.

Items that are operational or impossible to address due to regulations

- Voter expressed concerns about privacy regarding the physical set up of the machine on election day.
- Once voter was able to get very close to the monitor, she was able to see much better.
- Proper training of the poll workers required to ensure BMD set up correctly to ensure privacy is maintained.
- May make people using it feel self-conscious. Maybe better to put it in its own room because may bother people to have to be so visibly dierent.

4.2 Syracuse, Watertown and Utica Focus Groups - June 23-25, 2008

4.2.1 Overview

The testing took place over a three day period. Participants cast ballots on a rst come rst served basis which permitted ample time to interview the participants after voting. All data and comments from participants were entered directly into a laptop computer by an observer who would not be present in an actual election (some voters commented that the test voting did not seem private due to this obvious intrusion).

4.2.2 Participants

A total of 33 individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables ?? and 4.9.

Disability Type	Number of Persons
Physical	9
Blind	2
Low Vision	5
Cognitive	6
Mental Health	1
Multiple	4
Sensory	2
None	4

Table 4.8: Focus group disability types - Syracuse, Watertown and Utica

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	39 (97%)	28 (85%)	20 (61%)
No	1 (3%)	3 (9%)	11 (33%)
Unsure	0 (0%)	2 (6%)	2 (6%)

Table 4.9: Focus group participant experience levels - Syracuse, Watertown and Utica

4.2.3 Ballot Details

The ballot was a general ballot and is known as the Cicero ballot because it is an actual ballot used in 2004. Unusually, it begins with a 'vote for 6' contest which is very atypical. The ballot details are shown in Table 4.10.

4.2.4 Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.11.

	Score
Number of Contests	7
Number of Faces (1=single sided, 2= double sided)	2
Number of Parties	6
Number of Voting Candidates	49
Number of Propositions	2
Number of Voting Options (total number of voting choices)	66

Table 4.10: Collecting the ballot parameters - Syracuse, Watertown and Utica

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	13	3	31	22	2	5

Table 4.11: Frequency of use of voting interfaces - Syracuse, Watertown and Utica - Total participants = 33

4.2.5 Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.12.

	Score
Spread	1 to 10
Average	7.31

Table 4.12: Likert Scale Performance Data - Syracuse, Watertown and Utica

4.2.6 Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of seven contests. For one contest with many candidate names, each voter was asked to vote for a total of six (6) candidates out of a possible twenty-four (24). For a second contest, the voters were asked to vote for a total of two (2) out of a possible seven (7). The results of the time study are shown in Table 4.19.

4.2.7 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 94% of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. Three participants answered that they were not sure. One voter responded that the test observer compromised privacy. Another user who did not feel the vote was private was listed as being a voter with 'no disability'. This person also stated their overall satisfaction was low (Likert $\bar{3}$) and questioned why the device was needed. This person may not have understood the purpose of the device, legal requirements, or the purpose of the test.

Voter choices, errors, and adjusted choices are shown in Table 4.14.

NOTE: The three ballot restarts seen in Table ?? resulted from an accidental selection of Spanish as the audio language - these counties do not support Spanish on the ballot so the voters would not have been aware that a ballot may have more than one language.

	Range		
	Min	Max	Average
Voting	NA	NA	NA
Ballot Print/Mark	NA	NA	NA
Verification	NA	NA	NA
Total	6	33	13.46

Table 4.13: Time study values for various voting functions (measured in minutes)- Syracuse, Watertown and Utica

Adjustment	Count
Number of requests for assistance	38
Number of times new ballot or official restart is requested	3
Number of accidental selection mistakes	24
Number of intentional changes	2
Number of write-ins (if applicable)	6
Number of ballot reviews	15
Number of ballot edits	3

Table 4.14: Number of voter choices and adjustments - Syracuse, Watertown and Utica

4.2.8 User Comments

General comments about using the Dominion Voting Ballot Marking Device

- Able to vote.
- Somewhat confusing for user, but generally okay.
- Large print font is good, but zoom confusing (re: entire ballot).
- Lot of good attention from poll worker. Hopes county election aides will be the same.
- Other than no privacy sleeve, fairly simple to use.
- Easier to use than Auto Mark.
- Better than the old-fashioned current ones, which are useless.
- Positive.

"Things I liked"

- Found it easier to use than other accessible machines used
- Push buttons
- Easy, audio, buttons
- Reviewing the ballot for any race you didn't vote for allowed me to vote in the race I intentionally left blank.
- I liked the clear voice, and how I was able to turn volume up and down and change the rate of speech. I liked the practice in the instructions.

- Eort being made to make voting process accessible.
- Paddle buttons
- Loved the audio, easiest to follow along with.
- Sip and pu easy to use even though it was my rst time using a sip and pu.
- Ability to change font sizes.
- I really appreciate the improvements done to the machine. Audio voice is easy to understand and friendly, especially for people with sensory issues (react to voices, etc). Screen and audio were helpful.
- Clear speech.
- Privacy screen useful to read monitor because it blocks the glare of light. Magnifying text and changing the contrast makes it easier to read text, especially when a candidate or contest is highlighted green. The voice combined with large print is helpful.
- Clear audio. Good instructions. Good Braille. Straightforward. Ability to review your ballot. Used the rate button and liked that.
- Buttons better than straw. Audio.
- Audio was useful.
- Audio was useful to follow along with. Likes the ATI because plays a lot of video games. Liked the screen. Very innovative, I liked it.
- Enjoyed the ballot review.
- Reviews. Privacy, giving disabled people the ability to vote alone.
- Sitting is good.

"I want poll workers to know the following when working with someone with my disability"

- Be direct, use simple language, repeat instructions.
- Poll workers should explain where the ballot will come out, that the ballot will have a privacy sleeve over it, and what the voter should do when the ballot comes out because there are no audio instructions for these steps.
- Legally blind people tend to be over 65 and experience a loss of vision due to aging. These people are not used to using technology, and thus must use magniers.
- Just to be patient
- This machine will help out a lot of people with disabilities.
- Learn to work together, be patient with each other. Poll workers can ask questions of the disabled. It is a learning curve for everyone.
- Be patient.
- Poll workers will need to be very well trained.
- Voter used Braille on ATI to orient herself. Had to ask poll worker how to select candidates and move through ballot after listening to the audio instructions.

Items that have subsequently been corrected Procedural changes (instructions or addition of peripheral devices) have been made addressing these items.

- Mount box somewhere for people to rest the ATI.
- Confusing at rst because didn't realize all the candidates were part of the rst contest.
- Instructions for each device would be helpful. Instructions tell you to select one of the paddle buttons, but doesn't specify if button should be red or green. For example, "red button on the left" would be more helpful for people who need sensory clues.
- Magnication is not large enough. Low vision voter can't get close enough to the screen to see so instead remove privacy screen, turn and lean in as close as possible to read the monitor.

Items that are actionable

- Volume [of human voice recording in a studio] could be more consistent
- Continuous training needed for voter to become accustomed with the machine. Perhaps put it in a disability center and allow voters to practice on it every day for six months so they will be familiar with it by election day.
- Suggested voters with low vision bring their own magniers to the polling places, which she could advertise in her newsletter. Oer training sessions for people with low vision and hearing prior to voting day to make process easier and more familiar.
- Privacy issues a slight concern. Voter was told how BMD would be set up in a normal polling place, but she still expressed concerns about privacy.

Items that are future enhancements

- A scanning option [understood to be a continuous run mode] may be better as opposed to using the next and previous buttons to navigate ballot, where the voter will hit a switch [i.e. conrm using a pu] to mark selection when scanner lands on the candidate they want to vote for.
- Use an on-screen keyboard for write-in selection.
- Increased ballot magnication needed.
- Proposition questions not left on screen long enough to read when text is magnied. Doesn't tell you party affiliations on the audio review.
- Adjustable keyboard or controller mount, including zoom and contrast buttons. Make buttons better so people can hit them.
- Sip and pu mounted on a board to place in lap.
- Make the control box (ATI) bigger.
- Up and down arrows for volume and rate buttons on ATI were slightly confusing. Perhaps make the buttons in the shape of up and down arrows.
- Touch screen would make process quicker, would avoid listening for prompts. ATI could become a bit confusing for certain voters, a prompt throughout ballot would help, e.g.: a blue arrow beside the contest to vote for.
- For contests where you can vote for more than one candidate, audio tells you how many you can vote for, but doesn't tell you how many choices there are to choose from.

- Braille for the candidate buttons is very close to the top of the triangle button, making it hard to read.
- There should be instructions at the beginning about where the space selection comes in the alphabet.
- There were also many comments about the rate of button selecting - the function of the unit is directly related to two requirements of the federal voting standard 1) no button is to have any repetitive eect (not common practice for electronic interfaces), and 2) audio and video must be simultaneous (creating a lag between instantaneous visual information and slower audio communications). These two requirements lead to reduced usability which is reected in the comments below which conict with the interpretation of regulations.
  - Tedious write-in. I tried to speed it up but the voice rate was only aected. Perhaps use a count for the write-in, so if the voter hits the button ve times, the count will advance ve letters.
  - Lag time between audio and response of the buttons. If voter goes too fast for write in, system lags, which is very frustrating.
  - The lag time (button response time) is very slow, screen moves around the ballot very slowly.
  - A little slow, lag time in between button response.
  - Lag time between buttons made it a bit frustrating, wanted to zoom through it once familiar with the ATI.
  - Sluggish key pad and slow response time.

The system can be adapted to eliminate the issues listed above. Continued examination of these requirements will be performed in order to determine if voters prefer the system as described/required by standards, or would prefer as system with better usability.

Items that are operational or impossible to address due to regulations

- Size of the squares too small. Instructions are a little complicated.
- Tiny type on actual ballot.
- You will need someone manning the BMD to show people how to use it at rst. Voter usually reviews ballot at library the day before election, so right now machine is not familiar to use so voter doesn't like it. Have BMD available in a public place like a library so people can become familiar with voting.
- Size of font not large enough, magnify so one candidate ts on screen at a time.

4.3 NYSILC Testing - March 2008

4.3.1 Overview

The testing took place over a two day period. Time slots of up to 45-minutes were allocated for each participant to cast a ballot. This period permitted both ample time to interview the participants after voting in order to receive feedback about the use of the machine in addition to any time that was necessary to properly cast a ballot. All comments from participants were entered directly into a laptop computer. At the end of the second day, a group discussion was held where the collective results of all feedback received from the testers was shared with attendees.

4.3.2 Participants

A total of eleven individuals were involved in the focus group used to test the Dominion Voting Ballot Marker. Details about these participants are outlined in Tables 4.15 and 4.16.

Disability Type	Number of Persons
Physical	3
Blind	1
Low Vision	3
Cognitive	1
Mental Health	0
Multiple	3
None	1

Table 4.15: Focus group disability types - NYSILC

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	11 (100%)	9 (82%)	7 (64%)
No	0 (0%)	1 (9%)	2 (18%)
Unsure	0 (0%)	1 (9%)	2 (18%)

Table 4.16: Focus group participant experience levels - NYSILC

4.3.3 Interfaces Used

Each participant was asked to cast one complete ballot using the Ballot Marker. Depending on the type of disability or level of assistance required by each voter, a dierent set of interfaces were employed to cast each ballot. The breakdown of how each interface was employed is detailed in Table 4.22.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	7	3	9	9	2	0

Table 4.17: Frequency of use of voting interfaces - NYSILC - Total participants = 11

4.3.4 Overall Performance

Each participant was asked to rate the overall eectiveness of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best). The results of this rating are shown in Table 4.18.

4.3.5 Time Study

An actual ballot was used for the purposes of this study. All participants used the same ballot with the same candidate names and contests. The ballot consisted of seven contests. For one contest with many candidate names, each voter was asked to vote for a total of ten (10) candidates out of a possible twenty-four (24). For a second contest, the voters were asked to vote for a total of three (3) out of a possible seven (7). The results of the time study are shown in Table ??.

	Score
Spread	2.5 to 8
Average	6.36

Table 4.18: Likert Scale Performance Data - NYSILC

	Range		
	Min	Max	Average
Voting	8	25	18
Ballot Print/Mark	2	3	2
Verification	2	4	3
Total	11	33	23

Table 4.19: Time study values for various voting functions (measured in minutes)- NYSILC

4.3.6 Independent and Private Use

Participants were asked whether or not they felt that their voting session was independent and private. A total of 73% (8 out of 11) of the participants believed that their voting session provided both independence and privacy for the voter using the assisting technology. Two voters felt that the system required more privacy because of the fact that the ImageCast Ballot Tabulator could be used while a ballot was being cast using the Ballot Marker on the other end of the unit. One participant answered that they were 'not sure' because a hardware failure was experienced while their ballot was being printed.

4.3.7 User Comments

Items that have subsequently been corrected

- The handheld tactile device worked well, but there were places where the prompts could be better or places where there were no prompts at all (i.e., like for write in candidates).
- Eliminate reference to 'chevron' which is confusing and stick with more familiar reference to 'arrows' (up, down, left, and right).
- A write in candidate vote was registered as an undervote during the verication process. It needs to be adjusted to record it as a vote.
- Audio/headset with sip and pu device was okay but not needed. Sip and pu device was utilized with sight of choices on monitor. While the sip and pu device worked, the tube would come out of the testers mouth on occasion and have to be reinserted. At the start of the session, it also increased the build up of saliva which blocked the tube.
- Second sip and pu user found the tethered line with a headset to be too intrusive and the control of the device unstable. Tester recommends they scrap the present device and replace it with a sip and pu device that is a stationary tube, attached to a exible and adjustable arm, so a voter can position themselves under it and have more control.
- The screen contrast, audio feedback and headset and handheld tactile device features were functional. The text magnication worked, but would have been better if it was somewhat larger in size. Also, the magnication and contrast buttons were unmarked and on the cart. They should at least be marked in bold print for the voter on the card. Some might argue that they should be buttons under the control of the voter on the handheld tactile device.

- The pale color used to highlight the candidate choice being considered is not obvious enough. It should be brighter. Note: A national expert identied during the group discussion that, to better address color blindness concerns, the frame of the cell should be highlighted in bold black.

Items that are actionable

- Audio was rudimentary and slow.
- Left arrow should say 'contest' and right arrow should say 'candidate' using Grade 2 Braille, which is standard for adults. Note: A national expert identied during the group discussion that Grade 1 Braille is more appropriate for all users.
- No instructions were provided in how to verify a ballot. The process would be more private if the voter received instructions from the system. Also, due to the separation of the scanner unit from the ballot marker device, there is a need for a curtain to increase privacy.
- For audio instructions, it should tell the voter how many candidates are in the list they are about to select from. Difficulty skipping to the next contest from manual write-in mode.
- Instructions for the use of all interfaces need to be standardized. Right now, the vendor only provides the user with instructions for the use of the handheld tactile device. They need to provide instructions for how to use magnication and contrast, the audio and headset, sip and pu device, and rocker panels.

Items that are future enhancements

- There are too many symbols on the machine. The symbols on the handheld tactile device need to be more direct. What are the orange buttons at the top for? Tester was not aware of the contrast feature. It needs to be identied at the beginning of the session. Perhaps it was missed due to the lack of labeling and/or instructions.
- Audio instructions were too long and distracting. For handheld tactile device distinguish buttons by shape AND color in a consistent manner through out instructions.
- Would be a lot easier if the monitor had touch screen capability. Need more basic instructions for how to use the handheld tactile device. Found the red/green two button panels easier to use than the handheld tactile device. Need instructions for how to use the red/green two button panels.

Items that are operational or impossible to address

- The doubled-sided ballot printing tray broke during use and had to be dismantled. Fortunately, the ballot being used was only one-sided and printed for the remaining testers.
- 'The scanning device had some diculty with the rst ballot, but eventually worked successfully.
- More time could be saved during the ballot printing function if it could mark a pre-printed ballot.
- Was able to read from screen with magnication and able to vote using audio feedback/headset and handheld tactile device. Could not read the actual printed ballot. Font too small.

4.4 Oshawa Testing - June 2007

4.4.1 Overview

The testing took place over a two day period. Time slots of up to 45-minutes were allocated for each participant to cast a ballot. This period permitted both ample time to interview the participants after voting in order to receive feedback about the use of the machine in addition to any time that was necessary to properly cast a ballot. All comments from participants were enterred directly into a laptop computer. At the end of the second day, a group discussion was held where the collective results of all feedback received from the testers was shared with attendees.

4.4.2 Participants

A total of eleven individuals were involved in the focus group. The voters used a NY style ballot, which was not familiar to any of them. Details about these participants are outlined in Tables 4.20 and 4.21.

Disability Type	Number of Persons
Physical	2
Blind	5
Low Vision	0
Cognitive	0
Mental Health	0
Multiple	0
None	0

Table 4.20: Focus group disability types - Oshawa

Response	Registered Voter?	Frequent Voter?	Familiar with Accessible Technology?
Yes	0 (0%)	0 (0%)	7 (100%)
No	7 (100%)	0 (0%)	0 (0%)
Unsure	0 (0%)	7 (100%)	0 (0%)

Table 4.21: Focus group participant experience levels - Oshawa

4.4.3 Interfaces Used

Each participant was asked to cast one complete ballot using the ATI units only (there was no screen display). The breakdown of how each interface was employed is detailed in Table 4.22.

	LCD Magnification	LCD Contrast	Audio	ATI	Sip & Puff	Paddle Buttons
Frequency	NA	NA	7	7	0	0

Table 4.22: Frequency of use of voting interfaces - Oshawa - Total participants = 7

4.4.4 Overall Performance

Measurements of the overall eectiveness rate of the voting machine on a Likert Scale from 0 to 10 (0 being the worst and 10 being the best) were not collected.

4.4.5 Time Study

Time measurements were not collected.

4.4.6 User Comments

Items that have subsequently been corrected

- Introduction - After explanation of each button give the user the chance to press it.
- Introduction - Instructions should be uniform (always referring to the name as well as description of physical characteristics of the button in question. Example "Please, press Next button Right pointing chevron on the right side of the ATI device".
- Introduction - The Help button color is wrong.
- Introduction - Use shape of the button in the next step descriptions instead of the currently used names ("press Next button" and "press previous button" - Which one is which?)
- Introduction - The user was not clear how to end ATI device introduction and start an election process. [Instructions have been improved]
- Voting - A user perceived a sequence of the contests as "a loop" he did not know how to break. For him, announcements like "Now you have nished making your choices, please, proceed to review" would improve the situation considerably. [Instructions have been improved]
- Voting - The user was not clear about beginning and the end of the individual contests. [Instructions have been improved]
- Voting - No explanations how to make a choice follow a candidate name in individual contests. Just a pause. The user did not know what to do next when he wanted to accept the candidate. [Instructions have been improved]
- Voting - Conrmation of the selection made while doing it. You have selected "Name Name."
- Voting - Ability to change the choices per office individually. At the moment, a user has to go through the entire election, essentially rejecting all previous choices.
- Voting - The user was not clear about the beginning and end of the voting process. [Instructions have been improved]
- Review - Not clear from instructions which button to press during choices review. [Instructions have been improved]
- Review - More clear instructions on how to navigate to review section after voting. [Instructions have been improved]
- Controls use - X button was hard to press on its sides. [xed]
- Controls use - Buttons were clickable only in the center. It would be easier if a user could click anywhere on the buttons. [xed]
- Controls use - ATI unit should have an option to be attached to the table or something like it. Sliding of the unit is distracting. [xed]
- Controls use - It is unclear how to deselect choices.

- Controls use - For the better navigation locations of the buttons should be clearly identied with right/left, top/bottom of the ATI device in all recorded instructions. Overall good. No diculties. [Instructions have been improved]

Items that are actionable

- Introduction - Deeper voices are better perceived by blind people.
- Introduction - Blind people need to know the location so description of positions of the ballots scanner and ATI should be part of explanations before voting.
- Introduction - "... right chevron on the left.." makes the user's hand automatically move to the right side of ATI device.
- Controls use - Hard to read Braille for volume and help buttons
- Review -The choices review was confusing creating an impression that another round of election is started.

Items that are future enhancements

- Voting - Up/Down buttons appear more logical for yes/no type of choices.
- Controls use - Y/N buttons would make referendum questions easier to answer.
- Voting - Enumerate candidates before announcement of their names. Example "3 candidates are competing for Senator office. 1st candidate from Republican party name name. 2nd.from..".
- Controls use - The word "Race" in Brail should be replaced with something closer in meaning to "Contest".
- Controls use - Buttons do not response distinctly enough.
- Voting - Functions of ATI device buttons should be clearly explained while a user makes his choices as well.
- Controls use - Buttons use was acceptable but larger size of the ATI unit and the buttons on it would be a plus. Volume control was especially difficult.

Items that are operational or impossible to address

- Controls use - Too many buttons (some of the functions could be combined. -/+ buttons are too small. [The ATI has the minimum number of buttons required by VVSG]