



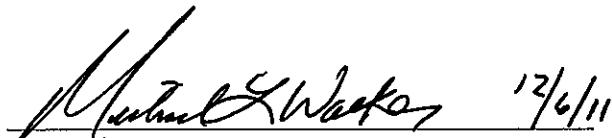
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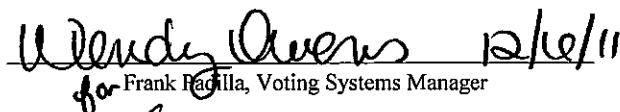
Job No. T57381.01  
Certification Test Plan No. T57381.01-01, Rev. D  
December 6, 2011

## CERTIFICATION TEST PLAN

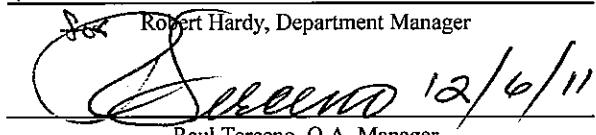
Prepared for:

<b>Manufacturer Name</b>	Dominion Voting Systems
<b>Manufacturer System</b>	Democracy Suite Version 4.0
<b>EAC Application No.</b>	<b>DVS1001</b>
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			<b>REPORT NO.</b> Test Plan T57381.01-01, Rev. D
			<b>DATE</b> December 6, 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”.

			<b>REPORT NO.</b>	Test Plan T57381.01-01, Rev. D
<b>DATE</b>			December 6, 2011	
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.	

			<b>REPORT NO.</b>	Test Plan T57381.01-01, Rev. D
			<b>DATE</b>	December 6, 2011
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.	

			<b>REPORT NO.</b>	Test Plan T57381.01-01, Rev. D
			<b>DATE</b>	December 6, 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.	
D	12-5-11	Sections 1.3.1, 1.3.1.1, 1.3.1.5	Changed project schedule reference to Appendix B.	
D	12-5-11	Sections 1.4.6 and 4.1.1	Added VRT reference.	
D	12-5-11	Section 4.2	Corrected typo from “severs” to “servers”.	
D	12-5-11	Section 6.3.3	Changed formatting.	
D	12-5-11	Section 6.3.3	Added paragraph on audit logs.	

**TABLE OF CONTENTS**

<b>1.</b>	<b>INTRODUCTION.....</b>	<b>1</b>
1.1	References.....	1
1.2	Terms and Abbreviations .....	2
1.3	Testing Responsibilities .....	3
1.3.1	Project Schedule .....	3
1.3.1.1	Owner Assignments .....	3
1.3.1.2	Test Case Development.....	4
1.3.1.3	Test Procedures and Validation.....	4
1.3.1.4	Third-Party Tests.....	4
1.3.1.5	EAC and Manufacturer Dependencies .....	4
1.4	Target of Evaluation Description.....	4
1.4.1	System Overview .....	4
1.4.2	Block Diagram.....	9
1.4.3	System Limits .....	10
1.4.4	Supported Languages.....	12
1.4.5	Supported Functionality.....	13
1.4.6	VVSG .....	13
1.4.7	Beyond VVSG .....	13
<b>2.0</b>	<b>PRE-CERTIFICATION TESTING AND ISSUES .....</b>	<b>13</b>
2.1	Evaluation of Prior VSTL Testing.....	14
2.2	Evaluation of Prior Non-VSTL Testing.....	14
2.3	Known Field Issues.....	14
<b>3.0</b>	<b>MATERIALS REQUIRED FOR TESTING.....</b>	<b>14</b>
3.1	Software .....	15
3.2	Equipment.....	24
3.3	Test Support Materials.....	28
3.4	Deliverable Materials.....	28
<b>4.0</b>	<b>TEST SPECIFICATIONS .....</b>	<b>30</b>
4.1	Requirements (Strategy of Evaluations) .....	31
4.1.1	Mapping of Requirements to Equipment Type and Features .....	32
4.1.2	Rationale for ‘Not Applicable’ Requirements .....	32
4.2	Hardware Configuration and Design .....	33
4.3	Software System Functions.....	34
4.4	Test Case Design .....	34
4.4.1	Hardware Qualitative Examination Design .....	34
4.4.1.1	Mapping of Requirements to Specific Interfaces .....	38
4.4.2	Software Module Test Case Design and Data .....	38
4.4.3	Software Functional Test Case Design and Data.....	39

**TABLE OF CONTENTS (continued)**

4.4.4	System-Level Test Case Design .....	40
4.5	Security Functions .....	41
4.6	TDP Evaluation .....	41
4.7	Source Code Review.....	43
4.8	QA and CM System Review.....	44
<b>5.0</b>	<b>TEST DATA .....</b>	<b>44</b>
5.1	Test Data Recording .....	44
5.2	Test Data Criteria.....	45
5.3	Test Data Reduction.....	45
<b>6.0</b>	<b>TEST PROCEDURE AND CONDITIONS.....</b>	<b>45</b>
6.1	Facility Requirements .....	45
6.2	Test Set-Up .....	46
6.3	Test Sequence .....	51
6.3.1	Hardware Test Description .....	52
6.3.2	Software Test Description.....	54
6.3.3	System Testing.....	55
<b>7.0</b>	<b>TEST OPERATIONS PROCEDURES .....</b>	<b>59</b>
7.1	Proprietary Data.....	59

**APPENDICES**

APPENDIX A	DOMINION VOTING SYSTEMS DEMOCRACY SUITE 4.0 VOTING SYSTEM IMPLEMENTATION STATEMENT .....	A-1
APPENDIX B	DOMINION VOTING SYSTEMS PROJECT SCHEDULE.....	B-1
APPENDIX C	USABILITY REPORTS .....	C-1

## **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 107<sup>th</sup> 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](http://www.eac.gov))
- EAC Notices of Clarification (listed on [www.eac.gov](http://www.eac.gov))
- EAC Quality Monitoring Program residing on:  
[http://www.eac.gov/testing\\_and\\_certification/quality\\_monitoring\\_program.aspx](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**

<b>Term</b>	<b>Abbreviation</b>	<b>Definition</b>
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)**

<b>Term</b>	<b>Abbreviation</b>	<b>Definition</b>
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 B “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 B “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 3<sup>rd</sup> 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 B “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)**

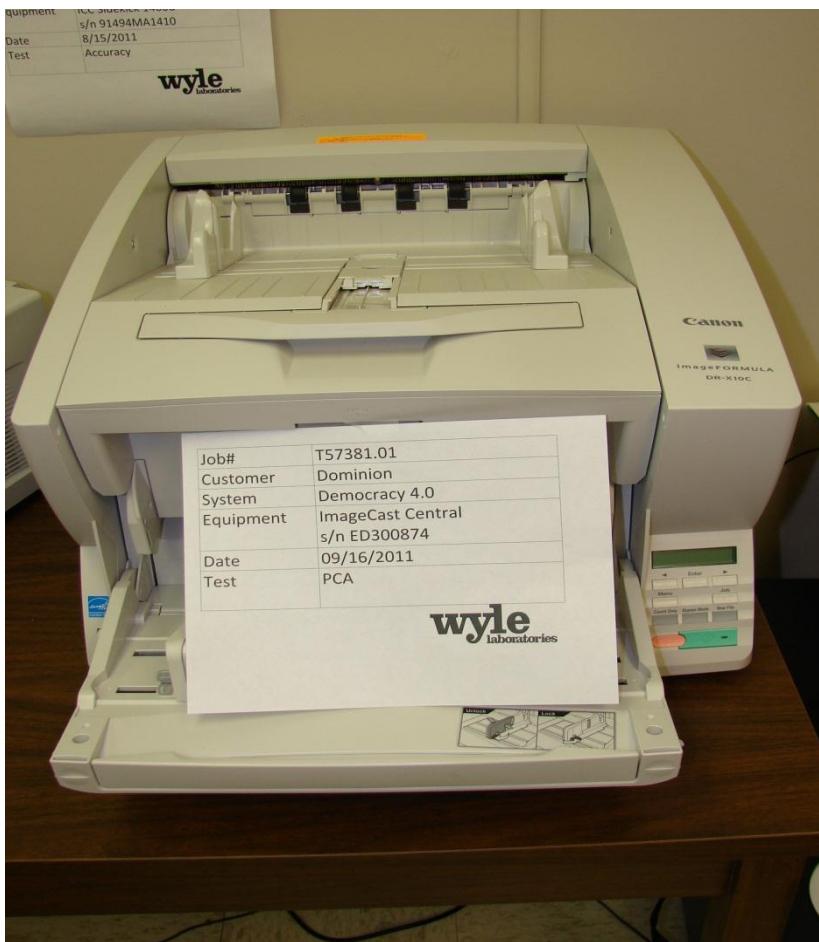
### **1.4 Target of Evaluation Description (continued)**

#### **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.



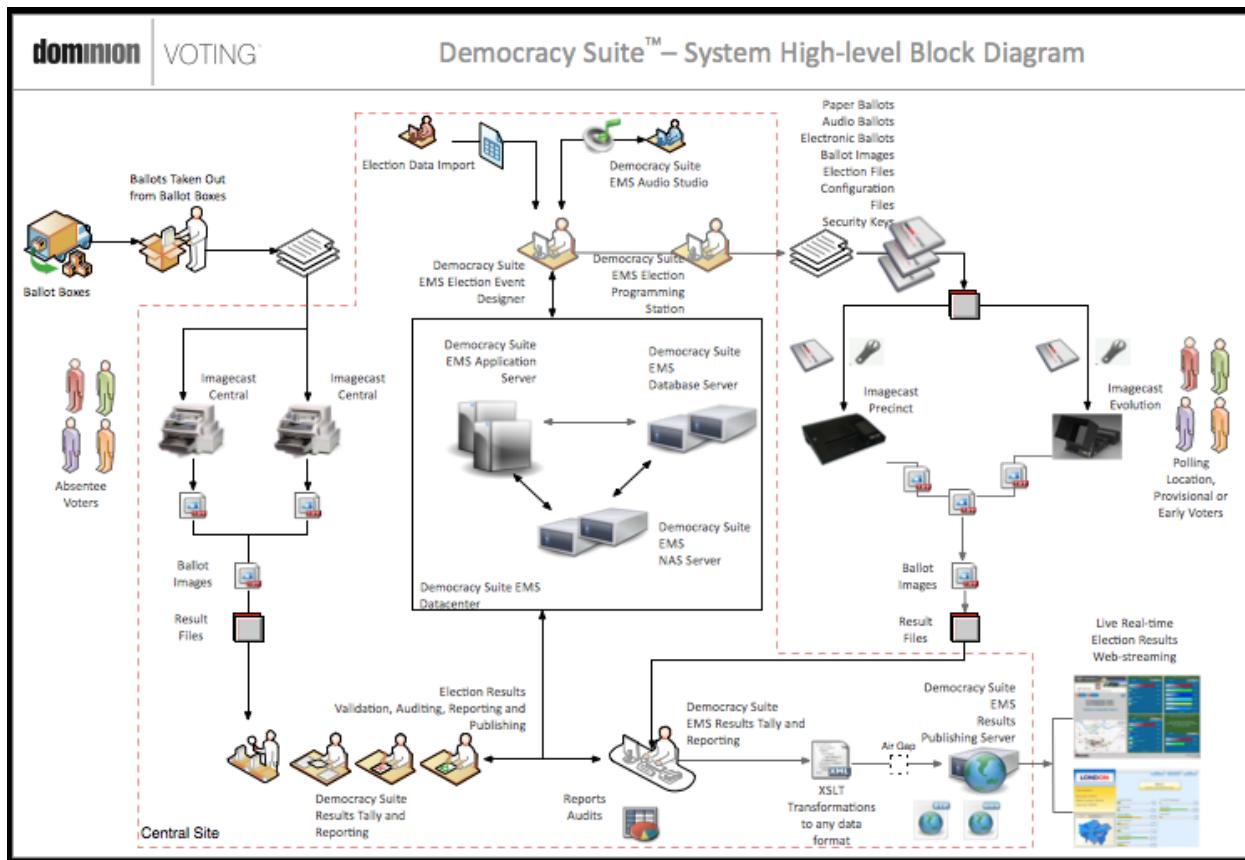
**Photograph 3: ImageCast Central Count (ICC)**

## 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**

<b>Ballot Length</b>	<b>Maximum Positions (Row x Column)</b>
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**

<b>Limit (Maximum Number of)</b>	<b>Value (by configuration)</b>			<b>Limiting Component</b>
	<b>Express</b>	<b>Standard</b>	<b>Enterprise</b>	
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**

<b>Ballot Length</b>	<b>Maximum Positions (Row x Column)</b>
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 EAC online matrix tool (VRT) 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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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: EMSAplicationServer_FED_CERT.Setup.msi EMSAplicationServer_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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
NetAdvantage for .NET Windows Forms 2008 Subscription	2008 Vol.1 CLR 2.0	NetAdvantage_WinForms_20081_CLR2 0_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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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)**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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
jpegsr	v8c	jpegsr.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)**

<b>Software Required For Build</b>	<b>Software Version</b>	<b>Filename</b>
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)**

<b>Software Required For Build</b>	<b>Software Version</b>	<b>Filename</b>
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)**

<b>Software Required For Build</b>	<b>Software Version</b>	<b>Filename</b>
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)**

<b>Software Required For Testing ICC application</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Software Required For Testing</b>	<b>Software Version</b>	<b>Filename</b>
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**

<b>Equipment</b>	<b>Manufacturer</b>	<b>Version/Model</b>	<b>Specifications</b>	<b>Serial Number</b>
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	61YMM1
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)**

<b>Equipment</b>	<b>Manufacturer</b>	<b>Version/Model</b>	<b>Specifications</b>	<b>Serial Number</b>
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**

<b>Test Material</b>	<b>Make</b>	<b>Model</b>	<b>Quantity</b>	<b>Serial Number</b>
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**

<b>Test Material</b>	<b>Make</b>	<b>Model</b>	<b>Quantity</b>	<b>Serial Number</b>
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**

<b>Equipment</b>	<b>Description</b>	<b>Serial Numbers</b>
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**

<b>Test Material</b>	<b>Quantity</b>	<b>Make</b>	<b>Model</b>
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**

<b>Deliverable Material</b>	<b>Version</b>	<b>Description</b>
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)**

<b>Deliverable Material</b>	<b>Version</b>	<b>Description</b>
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**

Please refer to the EAC online matrix tool (VRT) for further reference.

#### **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**

<b>EAC 2005 VVSG Volume I Section</b>	<b>Rationale for ‘Not Applicable’</b>
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/servers. Wyle has determined that these COTS PC/laptops/servers are not subject to hardware testing per the EAC 2005 VVSG. The provided PC/laptops/servers 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**

#### **ICP Testing**

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**

<b>Test/EAC 2005 VVSG Section</b>	<b>Procedure/Description</b>	<b>Configuration Tested</b>	<b>Status</b>
<i>Logic and Accuracy/4.1.1</i>	Ensure the unit can process 1,549,703 consecutive ballot positions correctly within the allowable target error rate.	ICP	Accept
<i>Usability/3.1</i>	Measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users	ICP	Accept
<i>Accessibility/3.2</i>	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
<i>Security/7</i>	Tests the ability of the system to detect, prevent, log, and recover from a broad range of security risks identified.	ICP	Accept
<i>Maintainability/4.3.4</i>	Tests the ease in which preventative and corrective maintenance actions can be performed based on design, software, and documentation.	ICP	Accept
<i>Availability/4.3.5</i>	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: $A_i = (MTBF) / (MTBF + MTTR)$	ICP	Accept
<i>Safety/4.3.8</i>	UL 60950-1 product safety review	ICP	Accept*
<i>Electrical Supply/4.1.2.4</i>	Meets voltage and power requirements of EAC 2005 VVSG Vol. 1 Section 4.1.2.4	ICP	Accept
<i>Electromagnetic Radiation/4.1.2.9</i>	FCC Part 15 Class B for both radiated and conducted emissions	ICP	Accept
<i>Electromagnetic Susceptibility/4.1.2.10</i>	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)**

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

<b>Democracy Suite 4.0 TDP Documents</b>	<b>System</b>	<b>Version</b>	<b>Date</b>	<b>Document Number</b>
<i>Documents describing overall system performance:</i>				
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
<i>Documents describing functionality, hardware, software design, maintenance, and operation:</i>				
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)**

<b>Democracy Suite 4.0 TDP Documents</b>	<b>System</b>	<b>Version</b>	<b>Date</b>	<b>Document Number</b>
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 conduct 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 an 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 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 an 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 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 IEC 61000-4-11 (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**

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

Wyle will verify the audit log records for error and exception activity to verify proper documentation and recovery action for all functional tests performed. A details listing of all audit log entries shall be provided by Dominion. During testing, audit log entries will be compared to this list to ensure that all expected events were recorded. 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**

<b>Test</b>	<b>Description</b>	<b>Procedure</b>	<b>Test Level</b>	<b>Specimen</b>	<b>Election Data</b>
<i>Technical Data Package (TDP) Review</i>	Documentation review for compliance, correctness, and completeness	WHVS07.1 WOP 3	Document	TDP package	---
<i>Physical Configuration Audit</i>	Audit hardware and software models and versions	WHVS07.3 WOP 25	Component & System	System hardware and software	---
<i>Functional Configuration Audit</i>	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)**

<b>Test</b>	<b>Description</b>	<b>Procedure</b>	<b>Test Level</b>	<b>Specimen</b>	<b>Election Data</b>
<i>Telecommunication</i>	Test of telecommunication technology of the system for accuracy and correctness	WHVS07.6 WOP 31	Integration & System	System	Gen-01 Volume & Stress
<i>Usability/ Accessibility</i>	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
<i>Volume, Stress, &amp; Reliability Test</i>	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
<i>Security</i>	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
<i>Logic and Accuracy</i>	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
<i>System Integration Test</i>	Test of all system hardware, software and peripherals.	WOP 30	System	System	Gen-01-03 Prim-01&03
<i>Trusted Build</i>	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- Count Optical Scanner (CCOS)

Vendor Name: Dominion Voting  
Date Prepared: August 22, 2011

Preparer: Ed Smith

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. I 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)	I.MS Comments
<i>Voter Verified Paper Audit Trails</i>			
VVPAT			
Accessibility (vol. I, sect. 3.2)	<input checked="" type="checkbox"/>		
Forward Approach	<input checked="" type="checkbox"/>		
Parallel (Side) Approach	<input checked="" type="checkbox"/>		
Closed Primary (vol. I, sect. 2.1.7.2) Primary: Closed	<input checked="" type="checkbox"/>	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. I, sect. 2.1.7.2) Primary: Open Standard (provide definition of how supported)		Voter choice of party with	

Supported Functionality Declaration  
Template Ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 1

**Page No. A-3 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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

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

Supported Functionality Declaration  
Template ver 05-01  
Huntsville Facilities

Saved date 8/22/2011 14:08:00 PM  
Page 2

**Page No. A-4 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

**2005 VVSG Supported Functionality Declaration rev05-01 (Dominion Version 2.1 20110822)**

Voting Variations/Functionality & Languages Vol. I 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	Required description(s)	Supported	EMS Comments
Rotation of Names within an Office; define all supported rotation methods for location on the ballot and vote tabulation/reporting		<input checked="" type="checkbox"/>	Top down by precinct, others (bottom up)?
<i>Straight Party Voting:</i> (vol. I. sect. 2.1.7.2)			
Straight Party: A single selection for partisan races in a general election		<input checked="" type="checkbox"/>	Supported.
Straight Party: Vote for each candidate individually		<input checked="" type="checkbox"/>	Supported.
Straight Party: Modify straight party selections with crossover votes		<input checked="" type="checkbox"/>	Supported.
Straight Party: A race without a candidate for one party		<input checked="" type="checkbox"/>	Supported.
Straight Party: “N of M race (where “N”>1)		<input checked="" type="checkbox"/>	Supported.
Straight Party: Excludes a partisan contest from the straight party selection.		<input checked="" type="checkbox"/>	Supported.
<i>Cross-Party Endorsement:</i> (vol. I. sect. 2.1.7.2)			
Cross party endorsements, multiple parties endorse one candidate*		<input checked="" type="checkbox"/>	QA to verify.
<i>Split Precincts:</i> (vol. I. sect. 2.1.7.2)			
Split Precincts: Multiple ballot styles		<input checked="" type="checkbox"/>	Supported.
Split Precincts: P & M system support splits with correct contests and ballot identification of each split		<input checked="" type="checkbox"/>	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.
<i>Vote N of M:</i> (vol. I. sect. 2.1.7.2)			

Supported Functionality Declaration  
Template Ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 3

**Page No. A-5 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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

Voting Variations Functionality & Languages Vol. I 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.	<input checked="" type="checkbox"/>		Supported.
Vote for N of M: Invalidates all candidates in an overvote (paper)	<input checked="" type="checkbox"/>		Supported.
<i>Recall Issues, with options:</i> (vol. I. sect. 2.1.7.2)			We do not have correlation between these two contests.
Recall Issues with Options: Simple Yes/No with separate raceelection. (Vote Yes or No Question)	<input checked="" type="checkbox"/>		If it is "vote for 1", than it is regular contest supported.
Recall Issues with Options: Retain is the first option, Replacement candidate for the second or more options (Vote 1 of M)	<input checked="" type="checkbox"/>		
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 2 <sup>nd</sup> contest.)			Overturned - US District Court 7/29/03: CA Election Code sect. 11383
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 2 <sup>nd</sup> contest)			
<i>Cumulative Voting</i> (vol. I. 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.			
<i>Ranked Order Voting</i> (vol. I. sect. 2.1.7.2)			

Supported Functionality Declaration  
Template ver 05-01

Saved date 8/22/2011 14:08:09 PM  
Page 4

**Page No. A-6 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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

Voting Variations Functionality & Languages Vol. I 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 counted 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.			
<i>Provisional or Challenged Ballots (vol. I. sect. 2.1.7.2.)</i>			
Provisional/Challenged Ballots: A voted provisional ballots is identified but not included in the tabulation, but can be added in the central count.	<input checked="" type="checkbox"/>	Provisional ballots are not included in tabulation.	

Supported Functionality Declaration  
Template ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 5

**Page No. A-7 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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**2005 VVSG Supported Functionality Declaration rev05-01 (Dominion Version 2.1.20110822)**

Voting Variations Functionality & Languages Vol. I 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) I.MS 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.	<input checked="" type="checkbox"/>	No connection is made between the voter and the cast ballot.
<i>Overtime (vol. I. sect. 5.4.4)</i>	<i>Must support for specific type of voting system</i>	
Overtime: P & M: Overvote invalidates the vote. Define how overvotes are counted.	<input checked="" type="checkbox"/>	If a contest is overvoted the number of overvotes always equals the M number. Overvotes are stored per contest
Overtime: DRE: Prevented from or requires correction of overvoting.		
Overtime: If a system does not prevent overvotes, it must count them. Define how overvotes are counted.		
Overtime: DRE systems that provide a method to data enter absentee votes must account for overvotes.		
<i>Undervotes (vol. I. sect. 5.4.4)</i>	<i>Must support</i>	
Undervotes: System counts undervotes cast for accounting purposes	<input checked="" type="checkbox"/>	Undervotes are always counted.
<i>Blank Ballots (vol. I. sect. 2.3.3.3, 4.1.5.1.b, 4.1.5.1.d, &amp; 5.4.4)</i>		
Totally Blank Ballots: Any blank ballot alert is tested.	<input checked="" type="checkbox"/>	Supported.

Supported Functionality Declaration  
Template ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 6

**Page No. A-8 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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**2005 VVSG Supported Functionality Declaration rev05-01 (Dominion Version 2.1 20110822)**

Voting Variations Functionality & Languages Vol. I 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	<input checked="" type="checkbox"/>		Supported.
Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution.	<input checked="" type="checkbox"/>		
<i>Display/Printing Multi-Lingual Ballots (vol. I. sect. 2.2.1.3.a)</i>		<i>Must support one</i> <input checked="" type="checkbox"/>	
Spanish	<input checked="" type="checkbox"/>		
Alaska Native (Other Group specified)			
Aleut			
Athabascan			
Eskimo			
Native (Other Group Specified)			
Chinese	<input checked="" type="checkbox"/>		
Filipino*		CA	
Japanese*		CA	
Korean*		CA	
Vietnamese*		CA	
Apache		AZ	
Cent/So American			
Cheyenne			
Chickasaw			
Choctaw			
Navajo		AZ	

Supported Functionality Declaration  
Template ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 7

**Page No. A-9 of 10**  
**Certification Test Plan T57381.01-01, Rev. B**

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**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

EMIS Comments

Required Description(s)

Supported

Other Tribe-Specified	L.A., NM	French, Jicarilla, Keres, Navajo, Towa).	EMIS Comments
Paiute			
Pueblo	FL		
Seminole			
Shoshone			
Sioux			
Tohono O'Odham			
Tribe not specified	CO		
Ute			
Yaqui	AZ		
Yuman			
<i>Demonstrates the voting system capability to handle the designated language groups. (vol. I sect. 2.2.1.3.a)</i>			
Default language (English),	<input checked="" type="checkbox"/>		Supported.
Secondary language using a Western European font	<input checked="" type="checkbox"/>		Supported.
Ideographic language (such as Chinese or Korean),	<input checked="" type="checkbox"/>		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	<input checked="" type="checkbox"/>		Supported.

NOTE: System supports all ISO approved languages.

Supported Functionality Declaration  
 Template ver 05-01

Saved date 8/22/2011 14:08:00 PM  
 Page 8

**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 >	

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**End of Supported Functionality Declaration**

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Supported Functionality Declaration  
Template ver 05-01

Saved date 8/22/2011 14:08:00 PM  
Page 9

**APPENDIX B**  
**DOMINION VOTING SYSTEMS PROJECT SCHEDULE**

**Page No. B-2 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

ID	Task Name	Start	Finish	Predecessors
1	EAC Application	Fri 3/19/10	Fri 3/19/10	
2	EAC Kickoff Meeting	Tue 5/18/10	Fri 5/21/10	
3	Technical Data Package Review	Mon 3/15/10	Mon 1/22/11	
4	Partial Document Submission	Mon 3/15/10	Tue 3/16/10	
5	Document Review for VVSG Requirements	Mon 3/15/10	Mon 10/10/14	
6	Document Discrepancy Report	Mon 10/10/11	Mon 10/17/15	
7	Dominion Review of Report and Correct Documents	Mon 10/17/11	Mon 10/31/16	
8	Document Re-Review	Mon 10/31/11	Mon 11/14/17	
9	Final Report TDP Review	Mon 11/14/11	Mon 11/21/18	
10	Source Code Review	Mon 5/3/10	Mon 11/7/11	
11	Review EMS	Mon 5/17/10	Fri 10/7/11	
12	Initial Submission of EMS Coding Standards	Mon 5/17/10	Tue 5/18/10	
13	Initial Review of EMS Coding Standards	Tue 5/18/10	Thu 5/20/10 12	
14	Submission of EMS Coding Standards	Tue 9/21/10	Wed 9/22/10	
15	Review EMS Coding Standards	Wed 9/22/10	Thu 9/23/10 14	
16	EMS Source Code Submission	Mon 6/14/10	Tue 6/15/10	
17	EMS Source Code Review	Mon 6/14/10	Fri 10/7/11	
18	Wyle Source Code Review	Mon 6/14/10	Mon 7/26/10	
19	Wyle Report	Mon 7/26/10	Wed 7/28/10 18	
20	Manufacturer Review	Wed 7/28/10	Tue 12/14/10 19	
21	Wyle Receives Revised Code	Tue 12/14/10	Wed 12/15/10 20	
22	Wyle Source Code Review	Wed 12/15/10	Tue 1/4/11 21	
23	Wyle Report	Tue 1/4/11	Wed 1/5/11 22	
24	Manufacturer Review	Wed 1/5/11	Tue 1/28/11 23	
25	Wyle Receives Revised Code 4.0.8	Tue 1/28/11	Wed 2/9/11 24	
26	Wyle Source Code Review	Wed 2/9/11	Tue 3/29/11 25	
27	Wyle Report	Tue 3/29/11	Wed 3/23/11 26	
28	Manufacturer Review	Wed 3/23/11	Mon 4/4/11 27	
29	Wyle Receives Revised Code 4.0.10	Mon 4/4/11	Tue 4/5/11 28	
30	Wyle Source Code Review	Tue 4/5/11	Tue 5/3/11 29	
31	Wyle Report	Tue 5/3/11	Wed 5/4/11 30	
32	Manufacturer Review	Wed 5/4/11	Thu 8/4/11 31	
33	Wyle Receives Revised Code 4.6.00	Thu 8/4/11	Fri 8/5/11 32	
34	Wyle Source Code Review	Fri 8/5/11	Fri 8/12/11 33	
 <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> External Milestone <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Inactive Task <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Manual Summary <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Start-only <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Finish-only <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Progress <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Duration-only <span style="display: inline-block; width: 15px; height: 15px; background-color: black; border: 1px solid black;"></span> Deadline				
Project: Certification Revised Schedule Date: Wed 11/30/11		Task Split	External Milestone	Manual Summary Rollup
Milestone Summary Project Summary External Tasks		Milestone Summary Project Summary External Tasks	Inactive Task Inactive Milestone Manual Task	Manual Summary Start-only Finish-only Progress Duration-only Deadline

Page No. B-3 of 12  
Certification Test Plan T57381.01-01, Rev. B

ID	Task Name	Start	Duration	Finish	Predecessors
35	Wyle Report	Fri 8/21/11	1 day	Mon 8/15/11 13:34	
36	Manufacturer Review	Mon 8/5/11	9 days	Fri 8/26/11 13:35	
37	Wyle Receives Revised Code 4.6.02	Fri 8/26/11	1 day	Mon 8/29/11 13:36	
38	Wyle Source Code Review	Mon 8/29/11	6 days	Tue 9/6/11 13:37	
39	Wyle Report	Tue 9/6/11	1 day	Wed 9/7/11 13:38	
40	Manufacturer Review	Wed 9/7/11	5 days	Thu 9/14/11 13:39	
41	Wyle Receives Revised Code 4.6.03	Thu 9/15/11	1 day	Fri 9/16/11 14:00	
42	Wyle Source Code Review	Fri 9/16/11	1 day	Mon 9/19/11 14:41	
43	Wyle Report	Mon 9/19/11	1 day	Tue 9/20/11 14:42	
44	Manufacturer Review	Tue 9/20/11	5 days	Tue 9/27/11 14:43	
45	Wyle Receives Revised Code 4.6.04	Thu 9/22/11	1 day	Tue 9/27/11 14:44	
46	Wyle Source Code Review	Tue 9/27/11	0 days	Wed 9/28/11 14:45	
47	Wyle Report	Wed 9/28/11	5 days	Wed 9/28/11 14:46	
48	Manufacturer Review	Wed 9/28/11	2 days	Wed 10/5/11 14:47	
49	Final Review	Wed 10/5/11	2 days	Fri 10/7/11 14:48	
50	Review ICP FIRMWARE	Mon 5/17/10	381 days	Mon 11/17/11	
51	Submission of ICP Coding Standards	Mon 5/17/10	1 day	Tue 5/18/10	
52	Review ICP Coding Standards	Wed 7/7/10	2 days	Fri 7/9/10 05:51	
53	ICP Code Submission	Fri 6/4/10	0 days	Fri 6/4/10	
54	ICP Source Code Review	Mon 6/21/10	356 days	Mon 11/17/11 15:53	
55	Wyle Source Code Review	Mon 6/21/10	19 days	Fri 7/16/10	
56	Wyle Report	Fri 7/16/10	2 days	Tue 7/20/10 05:55	
57	Manufacturer Review	Wed 7/21/10	63 days	Mon 10/18/10 05:56	
58	Wyle Receives Revised Code	Mon 10/18/10	1 day	Tue 10/19/10 05:57	
59	Wyle Source Code Review	Tue 10/19/10	13 days	Fri 11/5/10 05:58	
60	Wyle Report	Fri 11/5/10	2 days	Tue 11/9/10 05:59	
61	Manufacturer Review	Tue 11/9/10	50 days	Mon 12/4/11 06:00	
62	Wyle Receives Revised Code 4.014	Mon 12/4/11	1 day	Tue 12/5/11 06:01	
63	Wyle Source Code Review	Tue 12/5/11	21 days	Wed 2/23/12 06:02	
64	Wyle Report	Wed 2/23/11	1 day	Thu 2/24/11 06:03	
65	Manufacturer Review	Thu 2/24/11	13 days	Tue 3/5/11 06:04	
66	Wyle Receives Revised Code 4.016	Tue 3/15/11	1 day	Wed 3/16/11 06:05	
67	Wyle Source Code Review	Wed 3/16/11	4 days	Tue 3/22/11 06:06	
68	Wyle Report	Tue 3/22/11	1 day	Wed 3/23/11 06:07	
	Task	External Milestone	◆	Manual Summary Rollup	
	Split	Inactive Task	◆	Manual Summary	
	Milestone Summary	Inactive Milestone	◆	Start-only	
	Project Summary	Inactive Summary	◆	Finish-only	
	External Tasks	Manual Task	◆	Progress	
		Duration-only	◆	Deadline	

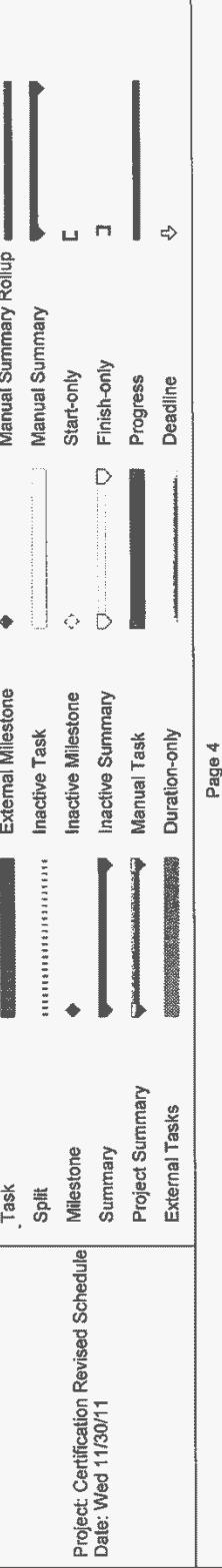
## **WYLE LABORATORIES, INC. Huntsville Facilities**

Page No. B-4 of 12  
Certification Test Plan T57381.01-01, Rev. B

ID	Task Name	Duration	Start	Finish	Predecessors
68	Manufacturer Review	14 days	Wed 3/23/11	Tue 4/12/11 168	
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	Fri 5/6/11 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	Fri 8/26/11	Thu 8/23/11 87	
89	Manufacturer Review	7 days	Thu 8/23/11	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	Fri 9/9/11	Thu 9/8/11 90	
92	Wyle Source Code Review	7 days	Thu 9/8/11	Tue 9/20/11 91	
93	Wyle Report	1 day	Fri 9/19/11	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 10/3/11 96	
98	Manufacturer Review	7 days	Thu 10/3/11	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	

**Page No. B-5 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

ID	Task Name	Start	Duration	Finish	Predecessors
103	Final Review	Tue 11/1/11	4 days	Mon 11/7/11 102	
104	Review ICC Firmware	Fri 8/26/11	340 days	Mon 5/3/10	
105	Submission of ICC Coding Standards	Tue 5/17/10	1 day	Mon 5/17/10	
106	Review ICC Coding Standards	Tue 5/18/10	2 days	Thu 5/20/10 105	
107	Central Count Code Submission	Mon 5/3/10	0 days	Mon 5/3/10	
108	ICC Source Code Review	Wed 7/14/10	288 days	Fri 8/26/11	
109	Wyle Source Code Review	Wed 7/14/10	14 days	Tue 8/3/10	
110	Wyle Report	Tue 8/3/10	4 days	Mon 8/9/10 109	
111	Manufacturer Review	Mon 8/9/10	155 days	Fri 3/18/11 110	
112	Wyle Receives Revised Code 4.0.12	Fri 3/18/11	1 day	Mon 3/21/11 111	
113	Wyle Source Code Review	Mon 3/21/11	11 days	Tue 4/5/11 112	
114	Wyle Report	Tue 4/5/11	1 day	Wed 4/6/11 113	
115	Manufacturer Review	Wed 4/6/11	10 days	Wed 4/20/11 114	
116	Wyle Receives Revised Code 4.0.14	Wed 4/20/11	0 days	Wed 4/20/11 115	
117	Wyle Source Code Review	Mon 4/25/11	3 days	Mon 4/25/11 116	
118	Wyle Report	Mon 4/25/11	1 day	Tue 4/26/11 117	
119	Manufacturer Review	Tue 4/26/11	19 days	Mon 5/23/11 118	
120	Wyle Receives Revised Code 4.0.17	Mon 5/23/11	0 days	Mon 5/23/11 119	
121	Wyle Source Code Review	Mon 5/23/11	1 day	Tue 5/24/11 120	
122	Wyle Report	Tue 5/24/11	1 day	Wed 5/25/11 121	
123	Manufacturer Review	Wed 5/25/11	26 days	Thu 6/30/11 122	
124	Wyle Receives Revised Code 4.0.22	Thu 6/30/11	1 day	Fri 7/1/11 123	
125	Wyle Source Code Review	Fri 7/1/11	7 days	Tue 7/12/11 124	
126	Wyle Report	Tue 7/12/11	1 day	Wed 7/13/11 125	
127	Manufacturer Review	Wed 7/13/11	9 days	Tue 7/26/11 126	
128	Wyle Receives Revised Code 4.0.25	Tue 7/26/11	1 day	Wed 7/27/11 127	
129	Wyle Source Code Review	Wed 7/27/11	4 days	Tue 8/2/11 128	
130	Wyle Report	Tue 8/2/11	0 days	Tue 8/2/11 129	
131	Manufacturer Review	Tue 8/2/11	1 day	Tue 8/3/11 130	
132	Wyle Receives Revised Code 4.0.28	Wed 8/3/11	0 days	Wed 8/3/11 131	
133	Wyle Source Code Review	Wed 8/3/11	1 day	Thu 8/4/11 132	
134	Wyle Report	Thu 8/4/11	0 days	Thu 8/4/11 133	
135	Manufacturer Review	Thu 8/4/11	1 day	Fri 8/5/11 134	
136	Wyle Receives Revised Code 4.0.27	Fri 8/5/11	1 day	Mon 8/8/11 135	



Page No. B-6 of 12  
Certification Test Plan T57381.01-01, Rev. B

ID	Task Name	Start	Duration	Finish	Predecessors
137	Wyle Source Code Review	Mon 8/8/11	1 day	Tue 8/9/11	
138	Wyle Report	Tue 8/9/11	0 days	Tue 8/9/11	
139	Manufacturer Review	Tue 8/9/11	1 day	Wed 8/10/11	
140	Wyle Receives Revised Code 4.6.2	Wed 8/10/11	1 day	Thu 8/11/11	
141	Wyle Source Code Review	Thu 8/11/11	1 day	Fri 8/12/11	
142	Wyle Report	Fri 8/12/11	0 days	Fri 8/12/11	
143	Manufacturer Review	Fri 8/12/11	5 days	Fri 8/19/11	
144	Final Review	Fri 8/19/11	5 days	Fri 8/26/11	
145	Review ICE Firmware	Tue 10/4/11	367 days	Mon 5/3/10	
146	Submission of ICE Coding Standards	Mon 5/3/10	1 day	Mon 5/24/10	
147	Review ICE Coding Standards	Mon 5/24/10	2 days	Tue 5/25/10	
148	ICE Code Submission	Tue 5/25/10	0 days	Mon 5/31/10	
149	ICE Source Code Review	Mon 5/31/10	322 days	Mon 7/5/10	
150	Wyle Source Code Review	Mon 7/5/10	20 days	Mon 8/2/10	
151	Wyle Report	Mon 8/2/10	4 days	Mon 8/9/10	
152	Manufacturer Review	Mon 8/9/10	60 days	Mon 11/10/15	
153	Wyle Receives Revised Code 1.0.8	Mon 11/10/15	1 day	Tue 11/11/10	
154	Wyle Source Code Review	Tue 11/11/10	37 days	Tue 11/2/10	
155	Wyle Report	Tue 11/2/10	1 day	Wed 12/29/10	
156	Manufacturer Review	Wed 12/29/10	87 days	Thu 12/30/10	
157	Wyle receives Revised Code 1.0.16	Thu 12/30/10	1 day	Mon 5/2/11	
158	Wyle Source Code Review	Mon 5/2/11	15 days	Tue 5/3/11	
159	Wyle Report	Tue 5/3/11	1 day	Tue 5/24/11	
160	Manufacturer Review	Tue 5/24/11	47 days	Wed 5/26/11	
161	Wyle receives Revised Code 4.1.3.2	Wed 5/26/11	1 day	Fri 7/29/11	
162	Wyle Source Code Review	Fri 7/29/11	8 days	Mon 8/1/11	
163	Wyle Report	Mon 8/1/11	1 day	Thu 8/11/11	
164	Manufacturer Review	Thu 8/11/11	26 days	Fri 8/12/11	
165	Wyle receives Revised Code 4.6	Fri 8/12/11	1 day	Fri 9/16/11	
166	Wyle Source Code Review	Fri 9/16/11	2 days	Tue 9/20/11	
167	Wyle Report	Tue 9/20/11	2 days	Mon 9/19/11	
168	Manufacturer Review	Mon 9/19/11	5 days	Wed 9/21/11	
169	Wyle receives Revised Code 4.6.2.1	Wed 9/21/11	0 days	Wed 9/14/11	
170	Wyle Source Code Review	Wed 9/14/11	3 days	Thu 9/15/11	
	Task Split	Task	External Milestone	Manual Summary / Rollup	
	Milestone Summary	Split	Inactive Task	Manual Summary	
	Project Summary	.....	Inactive Milestone	Start-only	
	External Tasks	◆	Inactive Summary	Finish-only	
		◆	Manual Task	Progress	
		◆	Deadline	Duration-only	

**Page No. B-7 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

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

Project: Certification Revised Schedule  
 Date: Wed 11/30/11

**Page No. B-8 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

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

Project: Certification Revised Schedule  
Date: Wed 11/30/11

**Page No. B-9 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

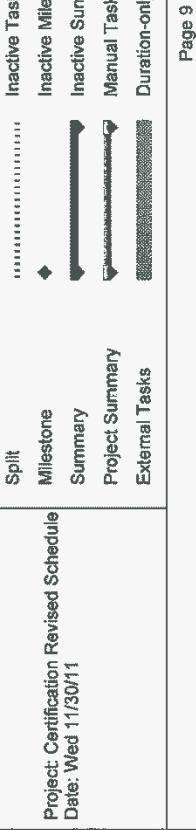
ID	Task Name	Duration	Start	Finish	Predecessors
239	Report Usability	3 days	Fri 10/7/11	Wed 10/12/11 237	
240	Hardware Testing	148 days	Thu 5/26/11	Tue 12/20/11	
241	Electrical Tests ICP	42 days	Thu 5/26/11	Mon 7/25/11	
242	Electromagnetic Radiation (FCC)	2 days	Thu 5/26/11	Mon 5/30/11	
243	Electromagnetic Susceptibility	2 days	Tue 6/7/11	Thu 6/9/11	
244	Environmental Transportation Tests ICE	13 days	Wed 6/1/11	Mon 6/20/11	
245	Bench Handling	1 day	Fri 6/7/11	Mon 6/20/11	
246	Vibration	1 day	Fri 6/7/11	Mon 6/20/11	
247	Low Temperature	1 day	Mon 6/7/11	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 7/9/11	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	1 day	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	Fri 10/20/11	Fri 10/21/11 272	
270	Low Temperature	1 day	Fri 9/20/11	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	
 External Milestone  Inactive Task  Inactive Milestone  Manual Summary  Start-only  Finish-only  Manual Task  Duration-only  Deadline					

Project: Certification Revised Schedule  
 Date: Wed 11/30/11

Page 8

**Page No. B-10 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

ID	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 - IGC/ICE	4 days	Tue 12/1/11	Mon 12/9/11 275	
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 - IGC-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 12/20/11 273,286,267	
282	System Level Performance Testing	57.5 days	Thu 10/27/11	Wed 11/8/12	
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 12/11/11 291	
301	Exploration Phase	2 days	Mon 12/11/11	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 12/23/11 302	
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	
	Task Split	External Milestone	◆	Manual Summary Rollup	→
	Milestone Summary	Inactive Task	◆	Manual Summary	→
	Project Summary	Inactive Milestone	◆	Start-only	█
	External Tasks	Inactive Summary	◆	Finish-only	█
		Manual Task	█	Progress	█
		Duration-only	█	Deadline	█

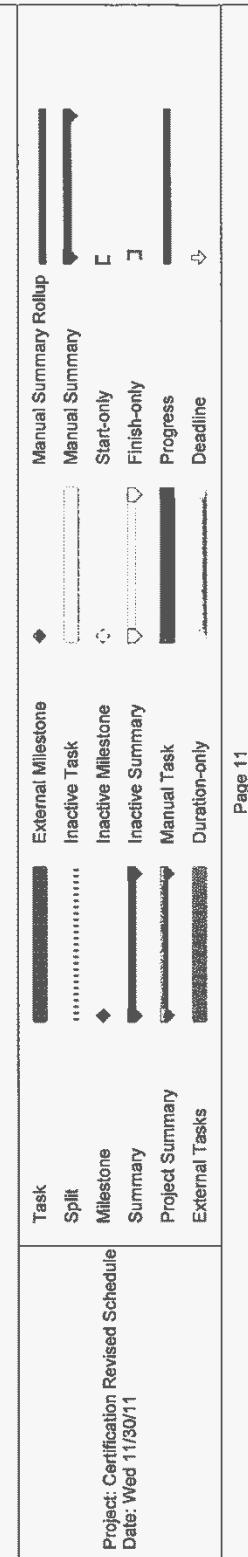


**Page No. B-11 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

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	
309	Execute Telecom Testing	4 days	Tue 12/20/11	Tue 12/27/11	
310	Report Telecom Testing	1 day	Tue 12/27/11	Wed 12/28/11	
311	Completion of Telecom Test	0 days	Wed 12/28/11	Wed 12/28/11	
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	
315	GEN 01 Execution	1 day	Fri 1/6/12	Mon 1/9/12	
316	GEN 01 Complete	1 day	Mon 1/9/12	Tue 1/10/12	
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	
319	GEN 02 Execution	1 day	Wed 1/11/12	Thu 1/12/12	
320	GEN 02 Complete	1 day	Thu 1/12/12	Fri 1/13/12	
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	
323	GEN 03 Execution	1 day	Mon 1/16/12	Tue 1/17/12	
324	GEN 03 Complete	1 day	Tue 1/17/12	Wed 1/18/12	
325	PRIM 01 - Closed Primary, Split Precinct, Multiple Ballot Styles, and Audio Ballot	3 days	Wed 1/18/12	Tue 1/10/12	
326	PRIM 01 Setup	1 day	Thu 1/5/12	Fri 1/6/12	
327	PRIM 01 Execution	1 day	Fri 1/6/12	Mon 1/9/12	
328	PRIM 01 Complete	1 day	Mon 1/9/12	Tue 1/10/12	
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	
332	PRIM 03 Complete	1 day	Fri 1/13/12	Mon 1/16/12	
333	Completion of System Integration Testing	0.5 days	Mon 1/16/12	Wed 1/18/12	
334	Final Report System Integration Tests	0.5 days	Wed 1/18/12	Wed 1/18/12	
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	Thu 1/19/12	Thu 1/19/12	
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	Tue 1/31/12	Mon 1/30/12	
			External Milestone	Manual Summary Rollup	
			Inactive Task	Manual Summary	
			Milestone	Start-only	
			Summary	Finish-only	
			Project Summary	Progress	
			External Tasks	Deadline	

**Page No. B-12 of 12**  
**Certification Test Plan T57381.01-01, Rev. B**

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 1/20/12 336	
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	



**APPENDIX C**  
**USABILITY REPORTS**

**DOMINION  
VOTING**



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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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## 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
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2	2011-10-31	devan.vandenboomen	Added files and set keywords.
1	2011-10-31	root	Initial Import

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# Contents

Notice of Confidentiality and Nondisclosure	i
Revision History	ii
Allowed Authors	iii
List of Figures	v
List of Tables	vi
VVSG Trace Listing	vii
1 Executive Summary	1
2 Introduction	3
2.1 Full Product Description . . . . .	3
2.2 Test Objectives . . . . .	4
3 Method	5
3.1 Participants . . . . .	5
3.2 Context of Use in the Test . . . . .	6
3.2.1 Tasks . . . . .	6
3.2.2 Test Location . . . . .	7
3.2.3 Voting Environment . . . . .	8
3.2.3.1 Display Devices . . . . .	8
3.2.3.2 Audio Devices . . . . .	8
3.2.3.3 Input Devices . . . . .	8
3.2.4 Test Administrator Tools . . . . .	9
3.3 Experimental Design . . . . .	9
3.3.1 Procedure . . . . .	10
3.3.2 Participant General Instructions . . . . .	10
3.3.3 Participant Task Instructions . . . . .	10
3.4 Usability Metrics . . . . .	10
3.4.1 Effectiveness . . . . .	11
3.4.1.1 Completion Rate . . . . .	11
3.4.1.2 Errors . . . . .	11
3.4.1.3 Assists . . . . .	11
3.4.2 Efficiency . . . . .	11
3.4.2.1 Time on Task . . . . .	11
3.4.3 Satisfaction . . . . .	12
3.4.3.1 Confidence Rating . . . . .	12

**CONTENTS**

**CONTENTS**

3.4.3.2    Satisfaction Rating . . . . .	12
<b>4 Results</b>	<b>13</b>
4.1 Data Analysis . . . . .	13
4.2 Presentation of Results . . . . .	13
4.2.1 Performance Results . . . . .	14
4.2.2 Satisfaction Results . . . . .	14
<b>5 Conclusion</b>	<b>15</b>
5.1 Ongoing Usability Testing . . . . .	15
<b>Appendices</b>	<b>16</b>
<b>A Participant Demographics</b>	<b>17</b>
<b>B Informed Consent Agreement</b>	<b>18</b>
<b>C Instructions for Participants</b>	<b>19</b>
<b>D Demonstration Ballot for Voters</b>	<b>21</b>
<b>E Results</b>	<b>24</b>
<b>F Demographic Questionnaire</b>	<b>27</b>
<b>G Post-Test Satisfaction Questionnaire</b>	<b>30</b>
<b>H Voting Location</b>	<b>32</b>

## List of Figures

E.1	Results from scenario 1 (Using the ICE to review and cast a manually marked ballot) . . .	25
E.2	Results from scenario 2 (Accessible ballot marking with the ICE accessible voter interfaces)	26
G.1	Post Test Satisfaction Questionnaire . . . . .	31
H.1	ICE Usability Testing Location Layout . . . . .	32

## List of Tables

1.1	Usability testing dates, locations, and ICE firmware version tested.	1
3.1	Participants For Each Targeted User Group. Note that user group characteristics intersect.	5
3.2	Participant Gender	5
3.3	Participant Age Group	6
3.4	Participant Voting Experience	6
A.1	Summary of All Participant Demographics	17

## VVSG Trace Listing

## 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.

**Page No. C-12 of 85**  
**Certification Test Plan T57381.01-01, Rev. B**

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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 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

Gender	
Men	7
Women	7
<b>TOTAL (participants)</b>	<b>14</b>

Table 3.2: Participant Gender

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

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

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
<b>TOTAL (participants)</b>	<b>14</b>

Table 3.4: Participant Voting Experience

Please see Appendix 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.

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Rev: 1.0.0:35

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

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Rev: 1.0.0;35

- 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™ or Peets™. 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<sup>TM</sup>, 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<sup>TM</sup> 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**

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

19

## **VOTER INSTRUCTIONS**

Please vote the ballot as shown:

FAMOUS NAMES		DOMINION VOTING			
Demonstration Ballot					
To VOTE: Completely fill in the oval <input type="radio"/> , 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 <small>(Vote for ONE)</small>		STATE SENATOR 37th DISTRICT <small>(Vote for ONE)</small>		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?	
				<input type="radio"/>	<input checked="" type="radio"/> YES
CHARLES CURTIS OHIO PARTY		ANDREW CARNEGIE OHIO PARTY		<input type="radio"/>	<input type="radio"/> NO
JOHN HANCOCK CALIFORNIA PARTY		FRANCIS SCOTT KEY CALIFORNIA PARTY		<input type="radio"/>	<input type="radio"/>
Write-In		Write-In		<input type="radio"/>	<input type="radio"/>
UNITED STATES REPRESENTATIVE <small>(Vote for ONE)</small>		NONPARTISAN OFFICES		BOARD OF EDUCATION <small>(Vote for ONE)</small>	
WILLIAM B. WILSON VIRGINIA PARTY				BOOKER T. WASHINGTON	
				<input type="radio"/>	<input checked="" type="radio"/>
ROBERT LA FOLLETTE OHIO PARTY		ALBERT EINSTEIN		THOMAS ALVA EDISON	
				<input type="radio"/>	<input type="radio"/>
W.C. REDFIELD CALIFORNIA PARTY		HELEN KELLER		Write-In	
				<input type="radio"/>	<input type="radio"/>
Write-In		Write-In		<input type="radio"/>	<input type="radio"/>

- 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!**

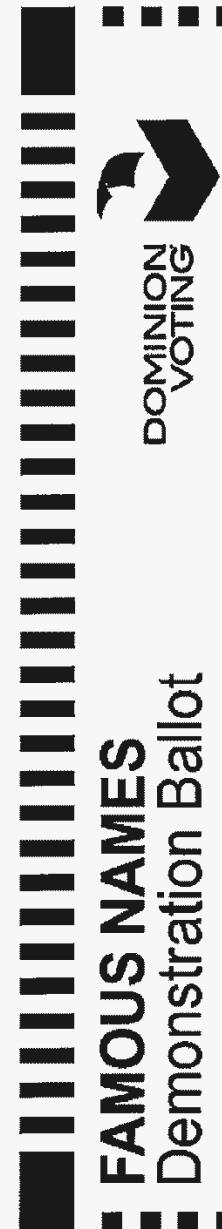
Date: 2011-11-29 21:27:55Z  
Rev: 1.0.0::35

20

## **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

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	<input type="radio"/> FLORENCE NIGHTINGALE VIRGINIA PARTY	<input type="radio"/>	Shall the President of the United States be elected for no more than three terms?	<input type="radio"/> YES	<input type="radio"/> NO
CHARLES CURTIS OHIO PARTY	<input type="radio"/> ANDREW CARNEGIE OHIO PARTY	<input type="radio"/>		<input type="radio"/> YES	<input type="radio"/> NO
JOHN HANCOCK CALIFORNIA PARTY	<input type="radio"/> FRANCIS SCOTT KEY CALIFORNIA PARTY	<input type="radio"/>		<input type="radio"/> YES	<input type="radio"/> NO
Write-in	<input type="radio"/> Write-in	<input type="radio"/>		<input type="radio"/> YES	<input type="radio"/> NO

<b>UNITED STATES REPRESENTATIVE</b> (Vote for ONE)		<b>NONPARTISAN OFFICES</b>	
<b>WILLIAM B. WILSON</b> VIRGINIA PARTY	<input type="radio"/>	<b>BOARD OF EDUCATION</b> (Vote for ONE)	
<b>ROBERT LA FOLLETTE</b> OHIO PARTY	<input type="radio"/>	<b>BOOKER T. WASHINGTON</b>	<input type="radio"/>
<b>W.C. REDFIELD</b> CALIFORNIA PARTY	<input type="radio"/>	<b>ALBERT EINSTEIN</b>	<input type="radio"/>
<b>Write-in</b>		<b>THOMAS ALVA EDISON</b>	<input type="radio"/>
		<b>HELEN KELLER</b>	<input type="radio"/>
		<b>Write-in</b>	<input type="radio"/>

## 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

**Page No. C-35 of 85**  
**Certification Test Plan T57381.01-01, Rev. B**

Participant Number	Successful Completion Time (Seconds)	Attempts Cast per Instruction	Most Needed Support	Unnecessary Difficulty	Easy to Use	Awkward to Use	Notes Recorded During the Participant's Voting Session					
							3A - Voter Requests Assistance	3B - Would Need Support	3C - Most People Can Learn to Use It	3D - Unnecessary Difficulty	3E - Easy to Use It	3F - Awkward to Use It
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: "like the touch screen"	
											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.	
4	Yes	198	4/5	1	5	2	4	1	4	1		
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	Voter had difficulty holding and marking the ballot, but was able to successfully feed it into the tabulator.	
8	Yes	372	5/5	0	4	1	4	1	4.5	1	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."	
10	Yes	214	5/5	0	5	1	5	1	5	1	Voter found it easier to vote ballot on lap than to use a voting booth.	
11	Yes	152	5/5	0	4	1	5	1	5	1	Voter needed to hold ballot to face (<5 cm) to see.	
12	Yes	100	5/5	0	4	1	5	1	5	1		
13	Yes	81	5/5	0	5	1	5	1	5	1	Comment: "Was there an audio confirmation of ballot acceptance?"	
14	Yes	81	5/5	0	4.77	1.46	4.38	1.15	4.85	1.23	Informed voter that there was a audio tone at ballot acceptance.	
Average	100%	170	4.9/5	0	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)

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

Participant Number	Successful Completion Time (Seconds)	Assists Cast per Instruction	Would Need Support	User Confidence	Needs Readable	Easy to Use	Awkward to Use	Notes Recorded During the Participant's Voting Session	
								3A - Voter Confidence	3B - Would Need Support
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.	
5 Yes 428 5/5 0 5 1 4 1 4 1								Voter was instructed to press the left arrow button to move to the next contest.	
6 Yes 424 4/5 1 4 2 4 2 4 1								Comment: "The instructions after selecting a candidate, to move to the next office, are not clear."	
7 Yes 577 5/5 0 4 2 4 3 4 1								Request for assistance: "Help I'm Stuck"	
8 Yes 434 5/5 0 5 1 4 2 5 2								Instructional Assist: Voter was instructed to press the left arrow button to move to the next contest.	
9 Yes 644 5/5 0 4 2 5 2 3.5 2								Comment: "The multiple voices were hard to understand."	
10 Yes 416 5/5 0 5 1 3 1 5 2									
11 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 4.915 0.16 4.36 1.82 3.82 2.27 3.95 2.09									
<b>Usability Score Contribution:</b>								<b>Total: 14.59 - Multiply by 5 for Usability Score = 73/100</b>	
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**

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

27



## 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.

<b>QUESTIONNAIRE</b>					
<b>DOMINION VOTING</b> 					
<b>Please complete the following questionnaire</b>					
<b>1. To the best of my ability, I followed the instructions telling me how to vote.</b>					
<input type="checkbox"/> Yes <input type="checkbox"/> No					
<b>2. I am confident I was able to vote this ballot exactly as instructed.</b>					
<input type="checkbox"/> Agree <input type="checkbox"/> Disagree <input type="checkbox"/> Don't Know					
<b>3. Place an "X" in the choice that describes your reaction to each statement.</b>					
	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.					
<b>Thank You!</b>					

Figure G.1: Post Test Satisfaction Questionnaire

## Appendix H

### Voting Location

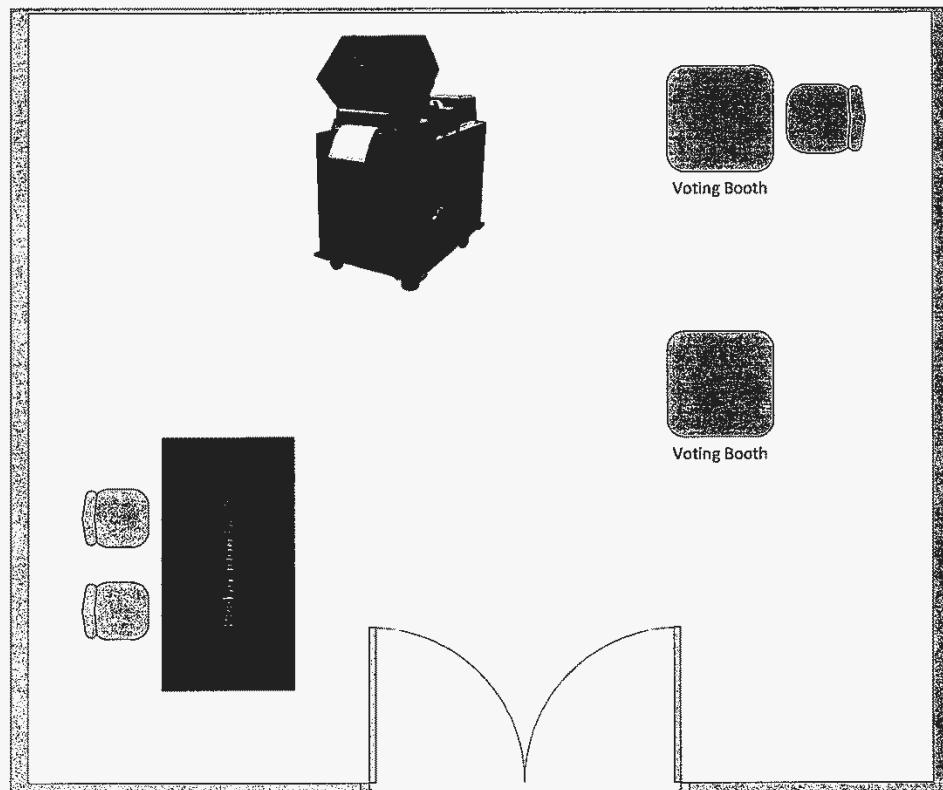


Figure H.1: ICE Usability Testing Location Layout

**DOMINION  
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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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Denver, Colorado, 80202

Telephone: 1-866-654-8683  
Facsimile: 1-416-762-8663

## 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.
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9	2010-07-28	lisa.madokoro	Added images to Introductory chapter.
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

## Contents

Notice of Confidentiality and Nondisclosure	i
Revision History	ii
Allowed Authors	iii
List of Figures	vi
List of Tables	vii
VVSG Trace Listing	viii
<b>1 Executive Summary</b>	<b>1</b>
1.1 Target Population - Context of Use . . . . .	2
1.2 Full Product Description . . . . .	2
1.3 Operational Environment . . . . .	5
1.4 Test Objectives - the purpose of the test . . . . .	5
<b>2 Methods</b>	<b>6</b>
2.1 Participants . . . . .	6
2.1.1 Number of Participants . . . . .	7
2.2 Context of Product Usage in the Test . . . . .	7
2.2.1 Test Facility . . . . .	7
2.3 Experimental Design . . . . .	8
2.3.1 Procedure . . . . .	8
2.3.2 Tasks and Activities for Test Participants . . . . .	8
2.4 Data Collected or Measured During the Test - Usability Metrics . . . . .	9
2.4.1 Interfaces Used . . . . .	10
2.4.2 Correctness . . . . .	10
2.4.3 Overall Performance . . . . .	10
2.4.4 Time Study . . . . .	10
2.4.5 Independent and Private Use Survey . . . . .	11
<b>3 Results</b>	<b>13</b>
3.1 Data Analysis . . . . .	13
3.1.1 Data Scoring . . . . .	13
3.1.2 Data Reduction . . . . .	14
3.1.3 Statistical Analysis . . . . .	14
3.2 Presentation of Results . . . . .	14
3.2.1 Performance Results . . . . .	14
3.2.2 Satisfaction Results . . . . .	15

**CONTENTS**

**CONTENTS**

<b>4 Individual Study Results</b>	<b>17</b>
4.1 Westchester, Newburgh Focus Groups - July 7-8, 2008 . . . . .	17
4.1.1 Overview . . . . .	17
4.1.2 Participants . . . . .	17
4.1.3 Ballot Details . . . . .	18
4.1.4 Interfaces Used . . . . .	18
4.1.5 Overall Performance . . . . .	18
4.1.6 Time Study . . . . .	18
4.1.7 Independent and Private Use . . . . .	19
4.1.8 User Comments . . . . .	19
4.2 Syracuse, Watertown and Utica Focus Groups - June 23-25, 2008 . . . . .	23
4.2.1 Overview . . . . .	23
4.2.2 Participants . . . . .	23
4.2.3 Ballot Details . . . . .	23
4.2.4 Interfaces Used . . . . .	23
4.2.5 Overall Performance . . . . .	24
4.2.6 Time Study . . . . .	24
4.2.7 Independent and Private Use . . . . .	24
4.2.8 User Comments . . . . .	25
4.3 NYSILC Testing - March 2008 . . . . .	28
4.3.1 Overview . . . . .	28
4.3.2 Participants . . . . .	29
4.3.3 Interfaces Used . . . . .	29
4.3.4 Overall Performance . . . . .	29
4.3.5 Time Study . . . . .	29
4.3.6 Independent and Private Use . . . . .	30
4.3.7 User Comments . . . . .	30
4.4 Oshawa Testing - June 2007 . . . . .	32
4.4.1 Overview . . . . .	32
4.4.2 Participants . . . . .	32
4.4.3 Interfaces Used . . . . .	32
4.4.4 Overall Performance . . . . .	32
4.4.5 Time Study . . . . .	33
4.4.6 User Comments . . . . .	33

## List of Figures

1.1	A quadriplegic voter using the Ballot Marker . . . . .	2
1.2	ImageCast Precinct Ballot tabulator . . . . .	3
1.3	Audio Tactile Interface (ATI) . . . . .	3
1.4	The adjustable arm-mounted LCD is shielded with a privacy cowl . . . . .	4
1.5	Ballot Marking Table and LCD Display with adjustable arm on Ballot Box . . . . .	4
2.1	VotingMachineSurvey . . . . .	12
3.1	Table of satisfaction measurements. . . . .	16
3.2	Table of performance measurements. . . . .	16

## List of Tables

2.1	Attributes of test participants . . . . .	6
2.2	Voter demographics . . . . .	7
2.3	Focus group disability types . . . . .	7
2.4	Focus group participant experience levels . . . . .	7
2.5	Frequency of use of voting interfaces. Total participants = x . . . . .	10
2.6	Likert Scale Performance Data . . . . .	10
2.7	Collecting the ballot parameters . . . . .	11
2.8	Collecting the voting parameters . . . . .	11
2.9	Time study values for various voting functions (measured in minutes) . . . . .	11
4.1	Focus group disability types - Westchester and Newburgh . . . . .	17
4.2	Focus group participant experience levels - Westchester and Newburgh . . . . .	18
4.3	Collecting the ballot parameters - Westchester and Newburgh . . . . .	18
4.4	Frequency of use of voting interfaces - Westchester and Newburgh - Total participants = 19	18
4.5	Likert Scale Performance Data - Westchester and Newburgh . . . . .	19
4.6	Time study values for various voting functions (measured in minutes)- Westchester and Newburgh . . . . .	19
4.7	Number of voter choices and adjustments - Westchester and Newburgh . . . . .	19
4.8	Focus group disability types - Syracuse, Watertown and Utica . . . . .	23
4.9	Focus group participant experience levels - Syracuse, Watertown and Utica . . . . .	23
4.10	Collecting the ballot parameters - Syracuse, Watertown and Utica . . . . .	24
4.11	Frequency of use of voting interfaces - Syracuse, Watertown and Utica - Total participants = 33 . . . . .	24
4.12	Likert Scale Performance Data - Syracuse, Watertown and Utica . . . . .	24
4.13	Time study values for various voting functions (measured in minutes)- Syracuse, Watertown and Utica . . . . .	25
4.14	Number of voter choices and adjustments - Syracuse, Watertown and Utica . . . . .	25
4.15	Focus group disability types - NYSILC . . . . .	29
4.16	Focus group participant experience levels - NYSILC . . . . .	29
4.17	Frcquency of use of voting interfaces - NYSILC - Total participants = 11 . . . . .	29
4.18	Likert Scale Performance Data - NYSILC . . . . .	30
4.19	Time study values for various voting functions (measured in minutes)- NYSILC . . . . .	30
4.20	Focus group disability types - Oshawa . . . . .	32
4.21	Focus group participant experience levels - Oshawa . . . . .	32
4.22	Frequency of use of voting interfaces - Oshawa - Total participants = 7 . . . . .	32

## VVSG Trace Listing

## **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<sup>1</sup> voting terminal consisting of an Audio Tactile Interface (ATI) and display screen,

<sup>1</sup>American Disabilities Act

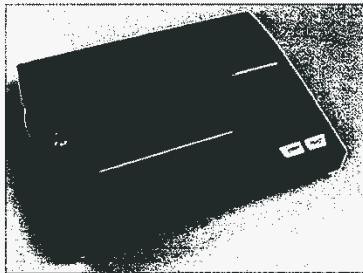


Figure 1.2: ImageCast Precinct Ballot tabulator

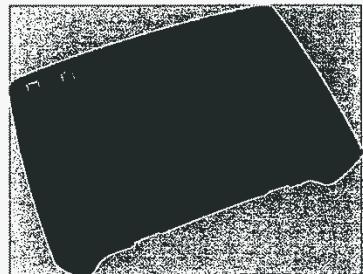


Figure 1.3: Audio Tactile Interface (ATI)

- 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.

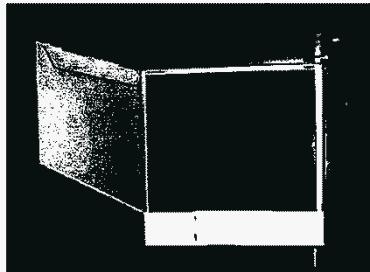


Figure 1.4: The adjustable arm-mounted LCD is shielded with a privacy cowl

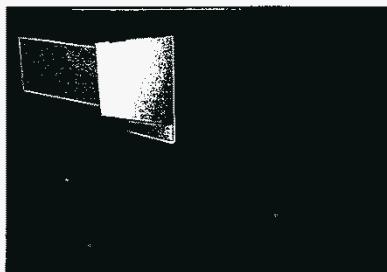


Figure 1.5: Ballot Marking Table and LCD Display with adjustable arm on Ballot Box

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### **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<sup>1</sup>.

### 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.

<sup>1</sup>Defining a Summative Usability Test for Voting Systems - A report from the UPA 2004 Workshop on Voting and Usability, September 2004, W. Quesenberry *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

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- 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 Table 2.6:

	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.

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**Page No. C-62 of 85**  
**Certification Test Plan T57381.01-01, Rev. B**

Voting Machine Survey						
testee:	location:	time/date:				
<b>Voter Information</b>						
<input type="checkbox"/> Avd <input type="checkbox"/> Civic <input type="checkbox"/> Issue <input type="checkbox"/> Excluded <input type="checkbox"/> Apathetic	<b>Demographic</b> Age: under 30/ 30 to 60 / over 60 Gender: M / F Race/ethnicity: White / Black-Afr. A. / Hispanic / A. Indian / Alaska Nat. Experience with computers: H / M / L Socio-economic status: H / M / L Level of education: less than hgh school / hgh school / college or university Locale: Rural/urban Region of country: SW / NE / Central / SE / SW Primary language: ENG / SPA / Mandarin / Cantonese / other English proficiency: H / M / L					
	<b>Voter experience</b> Registered Voter?: Y / N / Unsure Frequent Voter?: Y / N / Unsure Familiar with Accessible Technology?: Y / N / Unsure					
	<b>Data collection</b>					
	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)					
<b>Activities</b>						
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						
<b>System Interfaces Used</b>						
<input type="checkbox"/> Visual screen <input type="checkbox"/> Zoom button <input type="checkbox"/> Contrast button <input type="checkbox"/> Auc.o <input type="checkbox"/> Alt <input type="checkbox"/> Sip & Puff <input type="checkbox"/> Paddle Buttons						
<b>Voting Experience</b>						
Was the ballot cast correctly? Was the experience private? Was the process efficient? On a scale from 1 to 10 [0= worst, 10 = best] how would you rate the overall performance of this voting machine?	Y / N / Unsure					
	Y / N / Unsure					
	Y / N / Unsure					

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 voter 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 one 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.

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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.

Satisfaction Measurements		Score (0-100)		Reliability?		Productivity		Experiments with different parameters		Efficiency	
		Age	Gender	Male	Female	1	2	3	4	5	6
1	Age	25	Male	85	88	80	82	84	86	88	90
2	Gender	Female	Female	88	90	82	84	86	88	90	92
3	Score	85	88	80	82	84	86	88	90	92	94
4	Productivity	80	82	78	80	82	84	86	88	90	92
5	Efficiency	82	84	78	80	82	84	86	88	90	92
6	Reliability	88	90	82	84	86	88	90	92	94	96
7	Score (0-100)	85	88	80	82	84	86	88	90	92	94
8	Productivity	80	82	78	80	82	84	86	88	90	92
9	Efficiency	82	84	78	80	82	84	86	88	90	92
10	Reliability	88	90	82	84	86	88	90	92	94	96
11	Score (0-100)	85	88	80	82	84	86	88	90	92	94
12	Productivity	80	82	78	80	82	84	86	88	90	92
13	Efficiency	82	84	78	80	82	84	86	88	90	92
14	Reliability	88	90	82	84	86	88	90	92	94	96
15	Score (0-100)	85	88	80	82	84	86	88	90	92	94
16	Productivity	80	82	78	80	82	84	86	88	90	92
17	Efficiency	82	84	78	80	82	84	86	88	90	92
18	Reliability	88	90	82	84	86	88	90	92	94	96
19	Score (0-100)	85	88	80	82	84	86	88	90	92	94
20	Productivity	80	82	78	80	82	84	86	88	90	92
21	Efficiency	82	84	78	80	82	84	86	88	90	92
22	Reliability	88	90	82	84	86	88	90	92	94	96
23	Score (0-100)	85	88	80	82	84	86	88	90	92	94
24	Productivity	80	82	78	80	82	84	86	88	90	92
25	Efficiency	82	84	78	80	82	84	86	88	90	92
26	Reliability	88	90	82	84	86	88	90	92	94	96

Figure 3.1: Table of satisfaction measurements.

Performance Measurements							
Focus Group	Date	Participants	Time per vehicle (seconds)	Average time on task (seconds)	Mean error rate	Accidental injuries	Percentage agreeable to place
Group A (n=10)	May 27, 2018	33	12.2	2.5	1.72	1.04	94%
Group B (n=10)	July 7, 2018	19	17.9	2.2	0.95	0.26	95% (n=18) 94% (n=1)

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 contests, 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
Blnd	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 different 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 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 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.

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Score	
Spread	4 to 10
Average	8.74

Table 4.5: Likert Scale Performance Data - Westchester and Newburgh

Range		
	Min	Max
Total	6	17
		Average 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, confidentiality, 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 first 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 hearing 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 magnification 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 confirms 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 effectiveness 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 difference between the two zoom levels.
- Allow for a larger magnification.
- Some large words in sentences on machine. Some voters may have difficulty understanding. A lower register word might be better instead of flowery 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 different users get different 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 different 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 effect (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 reflected in the comments below which conflict 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 finished, 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 different.

## **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 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 (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 different 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

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 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 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 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.

- Effort 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 first 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 magnifiers.
- 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 first because didn't realize all the candidates were part of the first 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.
- Magnification 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 magnifiers to the polling places, which she could advertise in her newsletter. Offer 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. confirm using a push] 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 magnification needed.
- Proposition questions not left on screen long enough to read when text is magnified. 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 effect (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 reflected in the comments below which conflict with the interpretation of regulations.
  - Tedious write-in. I tried to speed it up but the voice rate was only selected. Perhaps use a count for the write-in, so if the voter hits the button five times, the count will advance five 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 a 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 first. 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 fits 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 different 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 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 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 verification 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 tester's 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 flexible 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 magnification worked, but would have been better if it was somewhat larger in size. Also, the magnification 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 identified 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 identified 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 magnification 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 identified 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 difficulty with the first 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 magnification 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 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.

### 4.4.2 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

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

### 4.4.4 Overall Performance

Measurements of the overall effectiveness 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 finished 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 - Confirmation 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 identified with right/left, top/bottom of the ATI device in all recorded instructions. Overall good. No difficulties. [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])

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