Test Report of
EAC 2005 VVSG Certification Testing
Performed on MicroVote EMS 4.1

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1.0 INTRODUCTION

The purpose of this National Certification Test Report is to document the findings from National Technical Systems, Inc. (NTS) certification testing of the MicroVote General Corporation (MicroVote), herein referred to as manufacturer, Election Management System 4.1 (EMS 4.1) voting 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). The EMS 4.1 voting system is a modification to the previously certified EMS 4.0B voting system (Certification number: MVTEMS40B), and as such, was tested by NTS Huntsville (NTS) based on the "modified system" requirements set forth in section 4.4.2.3 of the EAC Testing and Certification Program Manual, Version 1.0.

1.1. Description of EAC Certified System Being Modified

The following subsections describe the EAC Certified System that is baseline for the submitted modification. All certified commercial off-the-shelf (COTS) hardware and software is included in the aforementioned tables. All information was derived for the Certification Test Report and/or EAC Certificate of Conformance.

1.1.1. Baseline Certified System

The baseline for this modification is the EMS 4.0B voting system. Tables 1-1 and 1-2 describe the proprietary hardware and software/firmware versions as well as the COTS hardware and software. For a complete description of the configuration and description of the EMS 4.0B product, refer to the EMS 4.0B Test Report located on the EAC's website at http://www.eac.gov.

Table 1-1. EMS 4.0B Hardware Components

Component	Model	Hardware Version	Firmware Version
Proprietary			
Infinity	VP-01	Rev C	4.0B
COTS			
Central Count Scanner	Chatsworth ACP 2200	605000-190	N/A
Text-to-Speech Device	DoubleTalk LT	LT RC8650	BIOS 0212
Voting Panel Printer	Seiko	Model DPU-414	N/A
		DPU-3445	N/A
SmartCard Reader	GemPlus	N/A	N/A
EMS Report Printer	Dell	M5200	N/A
EMS Desktop	Dell	DHM	N/A
EMS Laptop	Dell	PP17L	N/A

Table 1-2. EMS 4.0B Software Components

Component	Software Version
Proprietary	
EMS	4.0.26.0
COTS	
Microsoft .Net Framework	1.1
Microsoft Windows XP	SP2
ComponentOne	3.1
Microsoft SQL Server 2000	N/A

1.2. References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines, Volume I, Version 1.0, "Voting System Performance Guidelines," and Volume II, Version 1.0, "National Certification Testing Guidelines," dated December 2005
- Election Assistance Commission Testing and Certification Program Manual, Version 1.0, effective date January 1, 2007
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 1.0, effective date July 2008
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2006 Edition, "NVLAP Procedures and General Requirements (NIST Handbook 150)," dated February 2006
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2008 Edition, "Voting System Testing (NIST Handbook 150-22)," dated May 2008
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Test Guidelines Documents: EMI-001A, "NTS 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"
- Quality Assurance Program Manual, Current Revision
- 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 (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)
- EAC Quality Monitoring Program residing on:
- http://www.eac.gov/testing_and_certification/quality_monitoring_program.aspx
- Wyle Laboratories' Test Report No. T56849-01 Rev. C – National Certification Test Report of the MicroVote General Corporation Election Management System, Version 4.0B (MODIFIED)
- iBeta MicroVote General Corporation Election Management System (EMS) Voting System v. 4.0 VSTL Certification Test Report

1.3. Terms and Abbreviations

Table 1-3 defines all terms and abbreviations applicable to this Test Report.

Table 1-3 Terms and Abbreviations

Term	Abbreviation	Definition
Americans with Disabilities Act of 1990	ADA	ADA is a wide-ranging civil rights law that prohibits, under certain circumstances, discrimination based on disability.
Audio Tactile Interface	ATI	Voter interface designed to not require visual reading of a ballot.
Configuration Management	CM	---
Commercial Off-the-Shelf	COTS	Commercial, readily available hardware devices (such as card readers, printers or personal computers) or software products (such as operating systems, programming language compilers, or database management systems)
Direct Record Electronic	DRE	An electronic voting system that utilizes electronic components for the functions of ballot presentation, vote capture, vote recording, and tabulation which are logically and physically integrated into a single unit. A DRE produces a tabulation of the voting data stored in a removable memory component and in printed hardcopy.
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.
Electromagnetic Compatibility	EMC	A branch of electrical sciences that studies the unintentional generation, propagation, and reception of electromagnetic energy.
Election Management System	EMS	An umbrella term for the software application used to define and report election projects.
Equipment Under Test	EUT	Manufactured product undergoing testing
Functional Configuration Audit	FCA	Exhaustive verification of every system function and combination of functions cited in the manufacturer's documentation.
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.
Notice of Clarification	NOC	Provides further guidance and explanation on the requirements and procedures of the EAC's Voting System Certification or Voting System Testing Laboratory programs.
Operating Procedure	OP	Test Method or Test Procedure.

Table 1-3 Terms and Abbreviations (Continued)

Term	Abbreviation	Definition
Physical Configuration Audit	PCA	Review by accredited test laboratory to compare voting system components submitted for certification testing to the manufacturer's technical documentation, and confirmation the documentation meets national certification requirements.
Quality Assurance	QA	---
Request for Interpretation	RFI	A means by which a registered Manufacturer or Voting System Test Laboratory (VSTL) may seek clarification on a specific Voluntary Voting System Guidelines (VVSG) standard.
Security Content Automation Protocol	SCAP	Method for using commonly accepted standards to enable automated vulnerability management and security policy compliance.
Technical Data Package	TDP	Manufacturer documentation related to the voting system required to be submitted as a precondition of certification testing.
Trusted Build	---	Final build of source code performed by a trusted source and overseen by the manufacturer, which is delivered to the EAC designated repository; also referred to as a "Witness Build".
Voluntary Voting System Guidelines	EAC 2005 VVSG	Published by the EAC, the third iteration of national level voting system standards.
Virtual Review Tool	VRT	Test campaign management software used by the EAC.
Voting System Test Laboratory	VSTL	An independent, non-federal laboratory qualified to test voting systems to Federal standards.

2.0 CERTIFICATION TEST BACKGROUND

NTS Huntsville, an independent testing laboratory, assesses systems and components under harsh environments to include dynamic and climatic extremes and test electronic voting systems. NTS Huntsville holds the following accreditations:

- ISO-9001:2000
- NVLAP Accredited ISO 17025:2005
- EAC Accredited VSTL, NIST 150,150-22
- A2LA Accredited (Certification No.'s 845.01, 845.02, and 845.03)
- FCC Approved Contractor Test Site (Part 15, 18)

2.1. Revision History

Table 2-1 describes the version history of the submitted voting system.

Table 2-1. Revision History

System Version	Certification Type	System Modified	Certification Date	Certification Number
EMS 4.0	New System	Original	02/06/2009	MVTEMS4
EMS 4.0B	Modification	EMS 4.0	08/23/2010	MVTEMS40B
EMS 4.1	Modification	EMS 4.0B	TBD	MVTEMS41

2.2. Scope of Testing

The focus of the MicroVote General Corporation Election Management System (EMS), version 4.1 test campaign was to verify functionality of modifications applied to the previously certified MicroVote EMS v. 4.0B voting system.

This report is valid only for the system identified in Section 1.1 Description of EAC Certified System Being Modified. Any changes, revisions, or corrections not listed in this report or made to the system after this evaluation are required to be submitted to the EAC for assessment.

The full system details for the previous test campaign, including system, performance, security, telecommunication, usability, system verification, and TDP deliverables can be reviewed in the EAC test report "MicroVote General Corporation Election Management System (EMS) Voting System v.4.0 VSTL Certification Test Report Version 5" (listed on www.eac.gov).

2.2.1. Modification Overview

The following modifications were submitted by the manufacturer for testing. The modification overview is organized into three categories, Enhancements, Defects, and Replacement of End-Of-Life Components.

Enhancements

E-01-(EMS) - Added support for 115kB tally smart cards. The increased space allows larger jurisdictions to use the tally card feature instead of the direct connect option.

E-02-(EMS) - Increased undervote manual entry capacity. For elections which contain large numbers of undervoted contests (i.e. a large primary election with a combined absentee precinct), this enhancement will allow a single manual vote entry to input the vote totals eliminating the need to split the entry into smaller pieces.

Defects

Defects one thru three were discovered in EMS 4.0B EAC Test Campaign. The EAC allowed EMS 4.0B to be certified on the condition that the defects were corrected with the next certification. Defect four was discovered in the field and is described in the EMS 4.1 Test Plan.

D-01-(EMS) – Audit reporting is now available within the EMS application as a standard report. Previously this was provided via multiple disk files.

D-02-(EMS) – Database version control has been added to prevent the opening of backup elections containing executable code from other versions of the EMS software.

D-03-(EMS) – Method of inserting ballot objects, informational messages and error trapping and logging for the ballot designer have all been improved to address a previously identified ballot designer deficiency.

D-04-(EMS) – The overall election voter turnout percentage on the Election Summary and All Precincts header are reported incorrectly. A modification was made in COTS generated XML code to correct the deficiency.

2.2.1 Modification Overview (Continued)

Replacement of End-Of-Life Components

EOL-1 - New Infinity Panel processor board/bridge/heat sink assembly (PCM-3336-BRIDGE-A03) to replace current EOL processor board.

EOL-2 – Added a LED panel (KOE SP24V01L0ALZZ Rev. A) to the available configuration for the Infinity Panel VP-01.

EOL-3 - Added the Entrust 1500 External UPS to support battery backup functionality for the Infinity Panel VP-01.

EOL-4 - New USB PC/SC compatible smart card reader support to replace EOL serial port smart card reader attached to EMS computer.

EOL-5 - Upgraded Microsoft .Net Framework to version 3.5 SP1 to replace EOL version 1.1.

EOL-6 - Upgraded OS to Microsoft 7 Professional from EOL Windows XP SP2

EOL-7 - Upgraded ComponentOne library to Ultimate 2013 version 3.1 from EOL Enterprise version.

EOL-8 - Eliminated requirement for EOL Franson Serial Tools assembly as this functionality is built into Visual Studio 2013.

EOL-9 - Upgraded database server to Microsoft SQL Server 2012 Express from EOL Microsoft SQL Server 2000 Desktop Edition (MSDE).

EOL-10 - Added new Dell Latitude E5440 laptop to currently certified laptop and desktop computers.

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2.2.2. Block Diagram

MicroVote General Corporation's EMS 4.1 voting system is a comprehensive suite of vote tabulation equipment and software solutions providing end-to-end election management. Figure 2-1 provides a visual system overview.

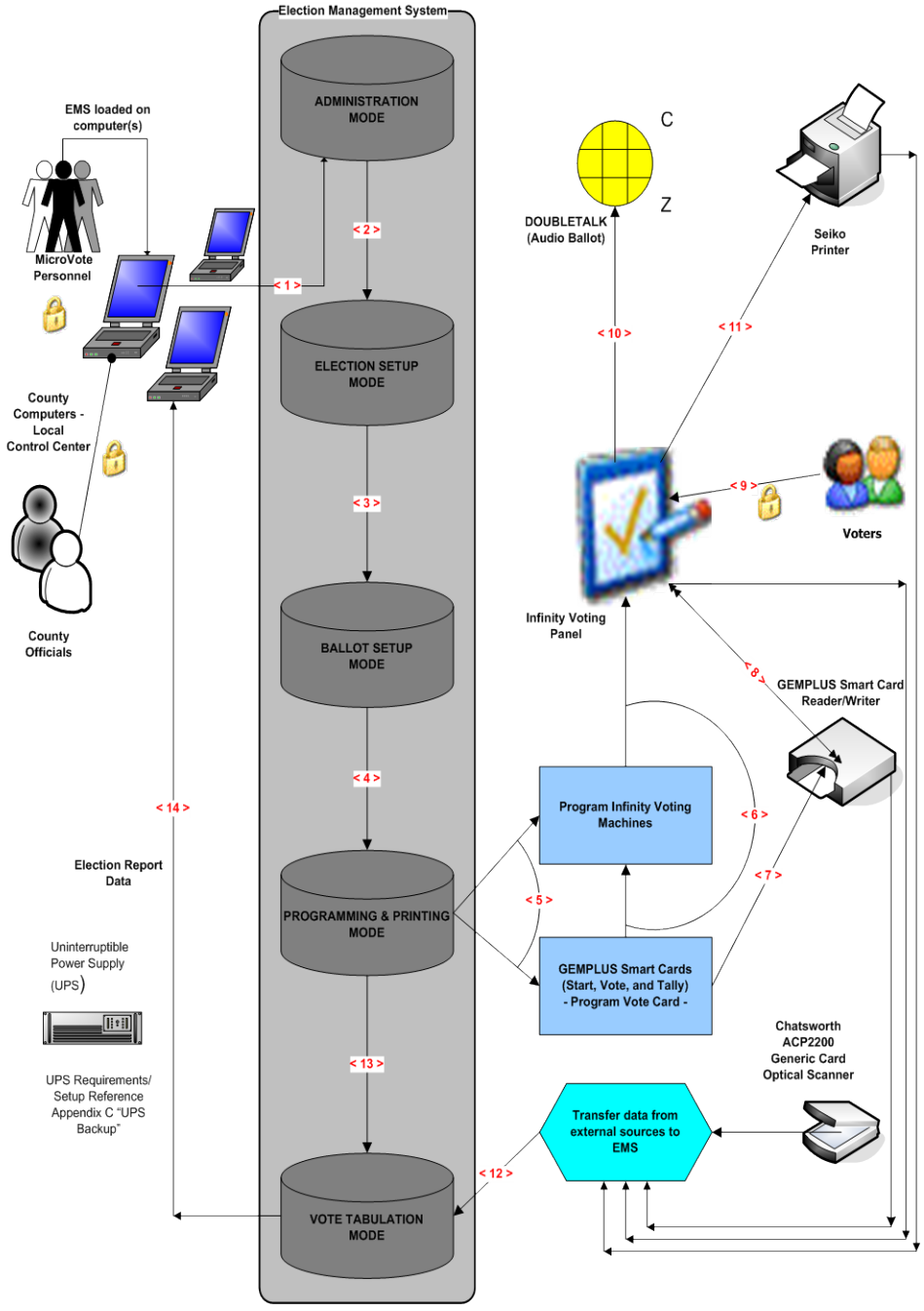

Figure 2-1. System Overview Diagram.

2.2.3. Supported Languages

English and Spanish are the supported languages of the EMS 4.1 voting system.

2.2.4. RFIs

Table 2-2 lists the applicable RFIs the EAC has released as of the date of the Plan as it pertains to this test campaign.

Table 2-2. Applicable RFIs

RFI ID	Name
2007-02	EAC Decision on Variable Names
2007-04	EAC Decision on Presentation of Alternative Languages
2008-01	EAC Decision on Temperature and Power Variation
2008-02	EAC Decision on Battery Backup for Optical Scan Voting Machines
2008-03	EAC Decision on OS Configuration
2008-04	EAC Decision on Supported Languages
2009-04	EAC Decision on Audit Log Events
2010-02	EAC Decision on Coding Conventions
2010-03	EAC Decision on Database Coding Conventions
2010-05	EAC Decision on Testing of Modifications to a Certified System
2010-07	EAC Decision on Module Length
2010-08	EAC Decision on Calling Sequence
2012-04	EAC Decision on Software Setup Validation
2013-03	EAC Decision on Timestamps

2.2.5. NOCs

Table 2-3 lists the applicable NOCs the EAC has released as of the date of the Plan as it pertains to this test campaign.

Table 2-3. Applicable NOCs

NOC ID	Name
2007-001	Timely Submission of Certification Application
2008-003	EAC Conformance Testing Requirements
2009-002	Laboratory Independence Requirement
2009-005	Development and Submission of Test Plans for Modifications to EAC Certified Systems
2012-02	Clarification of System Identification Tool Functionality
2013-01	Discrepancy Listing in Test Report
2013-02	Detailed Description of Changes for Modifications

3.0 TEST FINDINGS

The EMS 4.1 voting system, as identified in Section 1.1 of this report, was subjected to the tests as summarized in this section.

3.1. Summary Finding

NTS Huntsville performed system level testing on hardware and software of the MicroVote's EMS 4.1 Voting System due to modifications made to the EMS 4.0B Voting System. Environmental, electromagnetic compatibility and system level tests were performed. There were no anomalies nor additional findings associated with this test campaign. Source Code Review issues are listed in Section 3.1.3 and details of deficiencies are in the Deficiency Report located in Appendix B. There are no State Test Reports included in this test report.

3.1.1. Hardware Testing

Hardware requirements and environmental condition categories applicable to the design and operation of voting systems are detailed in Table 3-1.

Table 3-1. Voting Systems Hardware Requirements and Environmental Conditions

Hardware Requirements	Environmental Conditions (Applicable to Design and Operation)
Shelter	Natural environment: Including temperature, humidity, and atmospheric pressure
Space	Induced environment: Including proper and improper operation and handling of the system and its components during the election processes
Furnishings and fixtures	
Supplied energy	Transportation and storage
Environmental control	Electromagnetic signal environment: Including exposure to and generation of radio frequency energy
External telecommunications services	

Procedural summaries and summary test results within this report verify that the Equipment Under Test (EUT) submitted for certification testing meets the hardware requirements of the 2005 VVSG.

Receipt inspection and evaluation of voting system documentation was conducted prior to the start of the testing sequence. Operational tests/checks to verify system performance and function were performed throughout testing.

Environmental tests were conducted to ensure that climatic and physical occurrences would not affect system structure or functionality. In addition, Electromagnetic Compatibility (EMC) tests were conducted to ensure continued system operation and reliability in the presence of abnormal electrical events.

3.1.1.1. Temperature Power Variation

Temperature and Power Variation testing was performed in accordance with Volume I Section 4.1.2.13 and Volume II Section 4.7.1 of the 2005 VVSG, including considerations for RFI 2008-01 and RFI 2009-06. This test is similar to the procedure of MIL-STD-810D, Method 502.2 and 501.2.

The purpose of this test was to simulate stresses associated with operating the EUT at varying temperatures and voltages. EUTs were placed inside a walk-in environmental test chamber and connected to a variable voltage power source. Operational functions were continuously exercised during the test by the casting of ballots.

Three EUTs were utilized for a period of 64 hours, as described in EAC RFI 2008-01 to achieve the cumulative duration of at least 163 hours. The first 48 hours were conducted in the environmental test chamber where hardware was subjected to temperatures inside the chamber ranging from 50°F to 95°F and voltage varied from 105 VAC to 129 VAC. The remaining 16 hours were operated in ambient conditions.

Summary Findings

The EUT experienced three failures during the temperature power test. The first failure was linked to a faulty clock chip on the AAEON processor board. The second failure was caused by a bad solder connection that occurred during the repair of the clock chip. The third failure was with the CCFL display panel; during the hot cycle, the contest headers became unreadable. Upon correction of the issues and retest the EUT met the requirements of the Temperature/Power Variation Test without any degradation to structure and/or performance capability.

3.1.1.2. Low Temperature

Low Temperature testing was performed in accordance with Volume I Section 4.1.2.14 and Volume II Section 4.6.4 of the 2005 VVSG and is equivalent to MIL-STD-810D, Method 502.2, Procedure I-Storage. The test simulated stresses associated with the storage of voting machines and ballot counters with a minimum temperature of -4°F.

The EUT was placed in an environmental test chamber at standard ambient. The chamber temperature was lowered to -4°F at a rate that did not exceed 10°F per minute. Once temperature stabilization was reached, the test temperature was maintained for four hours. At the conclusion of four hours, the chamber temperature was returned to standard laboratory ambient conditions at a rate not exceeding 10°F per minute.

Summary Findings

The EUT met the requirements of the Low Temperature Test without any degradation to structure and/or performance capability.

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3.1.1.3. High Temperature

High Temperature testing was performed IAW Volume I Section 4.1.2.14 and Volume II Section 4.6.5 of the 2005 VVSG and is equivalent to the procedure of MIL-STD-810D, Method 501.2, Procedure I-Storage. The purpose of this test was to simulate stresses associated with the storage of voting machines and ballot counters with a maximum temperature of 140°F.

The EUT was placed in an environmental test chamber at standard ambient. The chamber temperature was raised to 140°F at a rate that did not exceed 10°F per minute. The temperature was maintained for four hours after temperature stabilization was reached. After four hours at 140°F, the temperature was returned to standard laboratory ambient conditions at a rate not to exceed 10°F per minute.

Summary Findings

The EUT met the requirements of the High Temperature Test without any degradation to structure and/or performance capability.

3.1.1.4. Humidity

Humidity testing was performed in accordance with Volume I Section 4.1.2.14 and Volume II Section 4.6.6 of the 2005 VVSG and is similar to the procedure of MIL-STD-810D, Method 507.2, Procedure I-Natural Hot-Humid. The purpose of the test was to simulate stresses encountered during the storage of voting machines. The EUT was placed in an environmental test chamber and was subjected to a 10-day humidity cycle in accordance with the 24-hour cycle values as shown in Table 3-1.

Table 3-1. Humidity Test Cycle Values

Time	Hot-Humid (Cycle 1)			Time	Hot-Humid (Cycle 1)		
	Temperature		RH		Temperature		RH
	°F	°C	%		°F	°C	%
0000	88	31	88	1200	104	40	62
0100	88	31	88	1300	105	41	59
0200	88	31	88	1400	105	41	59
0300	88	31	88	1500	105	41	59
0400	88	31	88	1600	105	41	59
0500	88	31	88	1700	102	39	65
0600	90	32	85	1800	99	37	69
0700	93	34	80	1900	97	36	73
0800	96	36	76	2000	94	34	76
0900	98	37	73	2100	97	33	85
1000	100	38	69	2200	90	32	85
1100	102	39	65	2300	89	32	88

Summary Findings

The EUT met the requirements of the Humidity without any degradation to structure and/or performance capability.

3.1.1.5. Vibration

Vibration testing was performed in accordance with Volume I Section 4.1.2.14 and Volume II Section 4.6.3 of the 2005 VVSG and is equivalent to the procedure of MIL- STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier. This test simulated stresses faced during the transport of voting machines and ballot counters between storage locations and polling places.

The EUT was secured to an electrodynamics shaker with one control accelerometer affixed to the shaker table. The EUT was subjected to a frequency ranging from 10 to 500 Hz and overall rms levels of 1.04, 0.74, and 0.20 G for durations of 30 minutes in each orthogonal axis.

Summary Findings

The EUT met the requirements of the Vibration Test without any degradation to structure and/or performance capability.

3.1.1.6. Bench Handling

Bench Handling testing was performed in accordance with Volume I Section 4.1.2.14 and Volume II Section 4.6.2 of the 2005 VVSG and is equivalent to the procedure of MIL-STD-810D, Method 516.3, Procedure VI. This test simulated impacts faced during maintenance and repair of voting machines and ballot counters. The EUT was placed on a standard workbench and each edge of the base was raised to a height of four inches above the surface and allowed to drop freely. This was performed six times per edge, for a total of 24 drops.

Summary Findings

The EUT met the requirements of the Bench Handling Test without any degradation to structure and/or performance capability.

3.1.1.7. Electrical Power Disturbance

Electrical Power Disturbance testing was performed in accordance with Volume I Section 4.1.2.5 and Volume II Section 4.8 of the 2005 VVSG. This testing was performed to ensure that the EUT is able to withstand electrical power line disturbances (dips/surges) without disruption of normal operation or loss of data.

The EUT was subjected to the voltage dips and surges detailed in table 3-2. The power input line was subjected to voltage dips ranging from 30% to more than 95% for periods of 10 milliseconds up to 5 seconds and surges of ±15% for up to 8 hours. Table 3-2 lists power line disturbance dip and surge detail.

Table 3-2. Power Line Disturbances

Type	Percentage	Duration
Dip	30%	10ms
Dip	60%	100ms and 1sec
Dip	>95%	5sec
Surge	± 15%	8 Hours (4 Each Polarity)

3.1.1.7. Electrical Power Disturbance (Continued)

Summary Findings

The EUT met the requirements of the Electrical Power Disturbance test without any degradation to structure and/or performance capability.

3.1.1.8. Electrical Fast Transient

Electrical Fast Transient (EFT) testing was performed in accordance with Volume I Section 4.1.2.6 and Volume II Section 4.8 of the 2005 VVSG and RFI 2008-10. This testing was performed to ensure that, should an electrical fast transient event occur on a power line, the EUT would continue to operate without disruption of normal operation or loss of data.

Electrical fast transients of ± 2 kV were applied to external AC power lines and the pulse characteristics are listed in Table 3-3.

Table 3-3. EFT Pulse Characteristics

Pulse Description	Requirements	Units
Pulse Amplitude	+/-2.0	kV peak to peak
Pulse Rise Time	5 ±30%	nanoseconds
Pulse Width	50 ±30%	nanoseconds
Pulse Repetition Rate	100	kHz
Pulse Shape	Double exponential	--
Burst Duration	15	milliseconds
Burst Period	300	milliseconds
Test Duration	60	seconds

Summary Findings

The EUT met the requirements of the Electrical Fast Transient Test without any degradation to structure and/or performance capability.

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3.1.1.9. Lightning Surge

Lightning Surge testing was performed in accordance with Volume I Section 4.1.2.7 and Volume II Section 4.8 of the 2005 VVSG. This testing was performed to ensure that, should a surge event occur on a power line due to a lightning strike, the EUT would continue to operate without disruption of normal operation or loss of data. The power input line was subjected to lightning surge testing at levels of ±0.5, ±1.0 and ±2.0 kV applied to its AC power line per the surge characteristics listed in Table 3-4.

Table 3-4. Surge Characteristics

Pulse Description	Test Level			Units
	A	B	C	
Pulse Amplitude	±0.5	±1.0	±2.0	kV
Pulse Rise Time	1.2 ±30%			microseconds
Pulse Width	50 ±20%			microseconds
Pulse Repetition Rate	1			Per minute
Phase Synchronization (Points)	AC Line at zero-crossing of (0°), (90°), (180°) and (270°).			Degrees
Total Pulse to be Injected	± 5			At each point

Summary Findings

One discrepancy was discovered during this test. During application of the +0.5 kV AC line to neutral at 180˚, normal operation of the EUT was disrupted. The details of the discrepancy and subsequent resolution are described in Appendix B – Deficiency Report.

Upon correction of the discrepancy and retest, the EUT met the requirements of the Lightning Surge Test without any degradation to structure and/or performance capability.

3.1.1.10. Electrostatic Disruption

Electrostatic Disruption (ESD) testing was performed in accordance with Volume I Section 4.1.2.8 and Volume II Section 4.8 of the 2005 VVSG and RFI 2010-01. This testing was performed to ensure that should an electrostatic discharge event occur during equipment setup and/or ballot casting, the EUT would continue to operate normally. Momentary interruption is allowed so long as normal operation is resumed without human intervention or loss of data.

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3.1.1.10 Electrostatic Disruption (Continued)

The EUT was subjected to electrostatic discharges, contact, and air as shown in Table 3-5.

Table 3-5. Electrostatic Discharge Test Levels

Characteristic	Resistance				Capacitance						Unit
Pulse Wave Shape (RC Network)	330				150						Ω / pf
Discharge Types	Air Gap				Direct Contact			Indirect Coupling			
Test Levels	A	B	C	D	A	B	C	A	B	C	
	±2	±4	±8	±15	±2	±4	±8	±2	±4	±8	kV
Number of Discharges	20	20	20	20	20	20	20	20	20	20	10 Discharges each polarity

Discharges were performed at areas typical of those that might be touched during normal operation, including the touch screen, user buttons, cables, connectors, and other points of contact used by the voter or poll worker:

- Power lines and power line returns were configured as required by the system configuration.
- Voter selection buttons were configured as required by the system configuration.
- Capture vote button was configured as required by the system configuration.
-

The EUT was raised approximately 10 cm from the ground using isolated stand-offs. Signal/control test cables were positioned approximately 5 cm (2 in.) above the ground.

Summary Findings

One discrepancy was discovered during this test. The EUT stopped functioning and displayed an error during the horizontal coupling portion of the ESD test due to the SATA cable connection to the Carson daughter. The details of the discrepancy and subsequent resolution are described in Appendix B – Deficiency Report.

Upon correction and retest, the EUT met the requirements of the Electrostatic Disruption Test without any degradation to structure and/or performance capability.

3.1.1.11. Electromagnetic Radiation

Electromagnetic Radiation emissions testing was performed in accordance with Volume I Section 4.1.2.9 and Volume II Section 4.8 of the 2005 VVSG. This testing was performed to ensure that emissions emanating from the EUT do not exceed the limits of 47 CFR Part 15, Subpart B, Class B Limits. Testing was performed at the NTS Huntsville Open Air Test Site 2 (OATS-2) located in Huntsville, AL. The OATS-2 is fully described in reports provided to the Federal Communication Commission (FCC) (FCC Reference 98597) and the site complies with the requirements of ANSI C63.4-2003.

3.1.1.11 Electromagnetic Radiation Test (Continued)

Table 3-7 list the conducted and radiated emission limits of FCC Part 15, Class B emissions.

Table 3-7. Conducted and Radiated Emissions Requirements

Conducted Emissions			Radiated Emissions	
Frequency Range (MHz)	Limits (dBµV)		Frequency Range (MHz)	3 Meter Test Limit (dBµV)
	Quasi-peak[1]	Average		
0.15 to 0.50	66 to 56	56 to 46	30 to 88	40.0
0.50 to 5.0	56	46	88 to 216	43.5
5.0 to 30.0	60	50	216 to 960	46.0
			960 to 1000	54.0

Summary Findings

Two discrepancies were discovered during this test. In both instances, the EUT exceeded the allowable emissions for FCC Part 15, Class B resulting in a failure to meet requirements. The first failure exceeded the limit at frequencies of 72 and 109.4 MHz and the second failure exceeded at frequencies of 42.53 and 64.04 MHz. Details of the discrepancies and subsequent resolutions are described in Appendix B – Deficiency Report.

Upon correction and retest, the EUT met the requirements of the Electromagnetic Radiation Test without any degradation to structure and/or performance capability.

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[1]Agencies governing the electromagnetic interference (EMI) from commercial products require quasi-peak detection to be used. Even if the emission from a device is over a test limit when measured with peak detection, the device will be considered to pass if the quasi-peak level is below the test limit.

Quasi-peak detection is a form of detection where the result of a quasi-peak measurement depends on the repetition rate of the signal. Signals can be classified into two general categories based upon their repetition rate: narrowband or broadband. A narrowband signal is a signal that can be resolved by the spectrum analyzer. An example of a narrowband signal is a continuous wave (CW) signal. A CW signal is one signal at a fixed frequency. A broadband signal is a signal that cannot be resolved by the spectrum analyzer. An example of a broadband signal is a pulse signal. Peak, quasi-peak, and average detection will yield the same amplitude level for a narrowband signal. A broadband signal will yield a quasi-peak level lower than the peak level. The weighting (accounted for through specific charge and discharge time constants in the quasi-peak detector circuit), is a function of the repetition frequency of the signal being measured. The lower the repetition frequency, the lower the quasi-peak level.

3.1.1.12. Electromagnetic Susceptibility

Electromagnetic Susceptibility testing was performed in accordance with Volume I Section 4.1.2.10 and Volume II Section 4.8 of the 2005 VVSG. This testing was performed to ensure that the EUT was able to withstand a moderate level of ambient electromagnetic fields without disruption of normal operation or loss of data.

The EUT was subjected to ambient electromagnetic fields at 10 V/m with an 80% modulated 1 kHz sine wave over a range of 80 MHz to 1000 MHz, as shown in Table 3-8. Testing was conducted utilizing both horizontally and vertically polarized waves. The limits were measured with a maximum scan rate of 1% of the fundamental frequency and the dwell duration was three seconds.

Table 3-8. Electromagnetic Susceptibility Test Levels

EN61000-4-3 Radiated Immunity				
Frequency (Hz)	**Polarity**		**Dwell Duration**	**Angle (Degree)**
80MHz - 1GHz (80% modulated 1 kHz sine wave)	Vertical	Horizontal	3 seconds	0
				90
				180
				270

Summary Findings

One discrepancy was discovered during this test. The EUT failed to communicate with the D: drive when recording a vote session between the ranges of 550MHz and 710MHz on the vertical axis. The details of the discrepancy and subsequent resolution are described in Appendix B – Deficiency Report.

Upon correction and retest, the EUT met the requirements of the Electromagnetic Susceptibility Test without any degradation to structure and/or performance capability.

3.1.1.13. Conducted RF Immunity

Conducted RF Immunity testing was performed in accordance with Volume I Section 4.1.2.11.a and Volume II Section 4.8 of the 2005 VVSG. Section 4.1.2.11.b of Volume I was not applicable because the EUT did not have signal/control lines greater than three meters. This testing was performed to ensure that the EUT was able to withstand conducted RF energy onto its power lines without disruption of normal operation or loss of data.

The EUT was subjected to conducted RF energy of 10 V rms applied to its power lines over a frequency range of 150 kHz to 80MHz.

Summary Findings

The EUT met the requirements of the Conducted RF Immunity test without any degradation to structure and/or performance capability.

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3.1.1.14. Electrical Supply

Electrical Supply testing was performed in accordance with Volume I Section 4.1.2.4 of the 2005 VVSG including considerations for RFI 2008-02 and RFI 2008-06.

The test was performed to ensure that the EUT would continue to operate a minimum of two hours when power is lost. It was required that the voting system perform a successful shutdown without loss or degradation of the voting and audit data and allow voters to resume voting once the voting system had reverted back to primary power.

To perform the test, both components were configured for normal operation. The components were then operated as designed for fifteen minutes prior to the removal of the AC input power. Once AC power was interrupted, the EUT was continuously operated for a minimum period of two hours. At the conclusion of two hours, the EUT was powered down. The AC power was restored and the EUT was operated for an additional fifteen minutes.

Summary Findings

The EUT met the requirements of the Electrical Supply Test without any degradation to structure and/or performance capability.

3.1.2. System Level Testing

System-level testing examines the ability of proprietary software, hardware, and peripherals in addition to the COTS software, hardware, and peripherals to operate as a complete system. NTS Huntsville utilizes test cases designed to ensure that integrated components function as specified by the manufacturer's documentation and meet the requirements of the VVSG.

3.1.2.1. Technical Data Package Review

NTS Huntsville qualified personnel performed TDP reviews of the modified MicroVote EMS 4.1 System TDP. The TDP review was performed as part of the testing activities. The TDP review only included the revised and new documents submitted for this testing campaign. The documents were reviewed for accuracy, completeness, and compliance to the 2005 VVSG. The review results were recorded in a worksheet that provided the pass/fail compliance to each applicable 2005 VVSG requirement.

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3.1.2.1 Technical Data Package Review (Continued)

The documents listed in Table 3-9 comprise the EMS 4.1 voting system TDP.

Table 3-9. EMS 4.1 Voting System TDP

Document Title	Version	Document Number
System Overview	1.12	DO1.12TDP
System Functionality Description	1.2	DO1.2TDP
Software Design Specification	2.8	DO2.8TDP
System Security Specification	1.8	DO1.8TDP
System Maintenance Procedures	1.9	DO1.9TDP
Personal Deployment and Training Requirements	1.1	DO1.1TDP
Configuration Management Plan	1.5	DO1.5TDP
Infinity Panel Manual	4.0	DO4.0TDP
Infinity Firmware Functional Specification	4.0	DO4.0TDP
COTS Specifications	1.5	DO1.5TDP -
Glossary of Terms	1.1	DO1.1TDP
Voting Variations	1.5	DO1.5TDP
ACP2200 Readme	1.0	DO1.0TDP
ACP2200 Manual	1.0	DO1.0TDP
Seiko 3445 Manual	1.0	DO1.0TDP
Seiko 414 Manual	1.0	DO1.0TDP
DoubleTalk Manual	1.0	DO1.0TDP
StarTech USB Card Reader Manual	1.0	DO1.0TDP
Appendix P – Checklist	1.0	DO1.0TDP
GUI Specifications	1.6	DO1.6TDP
Poll Workers Manual	1.9	DO1.9TDP
User Manual	2.9	DO2.9TDP
Machine Technician Manual	0.2	DO0.2TDP
MicroVote System Identification Tool	1.6	DO1.6TDP
App	1.5	DO1.5TDP
Apptblcont.doc	1.5	DO1.5TDP
AppAppA_test cases	1.5	DO1.5TDP
AppAppB_Carson_Mfg_Docs	1.5	DO1.5TDP
AppAppE_COTSTestForms	1.5	DO1.5TDP
AppAppH_ACP2200_README	1.5	DO1.5TDP
AppAppI_ACP2200_Manual	1.5	DO1.5TDP
AppAppJ_Seiko3445_Manual	1.5	DO1.5TDP
AppAppK_Seiko414_Manual	1.5	DO1.5TDP
AppAppN_DOUBLETALK _Manual	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card Reader	1.5	DO1.5TDP
AppAppP_Checklists	1.5	DO1.5TDP
AppAppQ_Defect_Tracking	1.5	DO1.5TDP
AppAppW_CountyInvoice	1.5	DO1.5TDP
AppAppX_SourceCode_List	1.5	DO1.5TDP
AppDO0.2TDP-Z.doc	1.5	DO1.5TDP
AppDO1.1TDP-D.doc	1.5	DO1.5TDP
AppDO1.1TDP-G.doc	1.5	DO1.5TDP
AppDO1.2TDP-T.doc	1.5	DO1.5TDP
AppDO1.5TDP-C.doc	1.5	DO1.5TDP
AppDO1.5TDP-F.doc	1.5	DO1.5TDP
AppDO1.6TDP-AA.DOC	1.5	DO1.5TDP

3.1.2.1 Technical Data Package Review (Continued)

Table 3-9. EMS 4.1 Voting System TDP (Continued)

Document Title	Version	Document Number
AppDO1.6TDP-R.doc	1.5	DO1.5TDP
AppDO1.9TDP-U.DOC	1.5	DO1.5TDP
AppDO2.6TDP-Y.doc	1.5	DO1.5TDP
AppDO2.9TDP-V.doc	1.5	DO1.5TDP
AppAppA_test casesExecuted Test Cases1ST Passt.txt	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB1_Infinity_Manual	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB2_QA	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB3_Firmware_Spec	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB4_Communications_Spec	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB5_Encryption_Algorithm	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB7_Infinity_Smart_Card_Spec	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB8_Aaeon_Processor_Assembly	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsDO0.6TDP-Btblcont.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB1_Infinity_ManualDO0.8TDP-B1.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB1_Infinity_ManualDO0.8TDP-B1cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB2_QADO0.1TDP-B2.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB2_QADO0.2TDP-B2cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB3_Firmware_SpecDO0.5TDP-B3.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB3_Firmware_SpecDO0.6TDP-B3cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB4_Communications_SpecDO0.1TDP-B4.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB4_Communications_SpecDO0.2TDP-B4cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB5_Encryption_AlgorithmDO0.1TDP-B5.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB5_Encryption_AlgorithmDO0.1TDP-B5cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408De Minimis FINAL- MicroVote ECN 103.pdf	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408DO0.3TDP-B6-Addendum.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408DO0.3TDP-B6cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408ECN103 - Large flash drives in early voting panels.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408ECN103 - Large flash drives in early voting panels.pdf	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408ECN1408.pdf	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB6_Technical_Bulletin_ECN1408Technical Bulletin - ECN1408 Field Implementation.pdf	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB7_Infinity_Smart_Card_SpecDO1.3TDP-B7.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB7_Infinity_Smart_Card_SpecDO1.3TDP-B7cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB8_Aaeon_Processor_AssemblyDO0.1TDP-B8cvr.doc	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB8_Aaeon_Processor_AssemblyECN #1505.pdf	1.5	DO1.5TDP-
AppAppB_Carson_Mfg_DocsAppB8_Aaeon_Processor_AssemblyECN #1510.pdf	1.5	DO1.5TDP-
AppAppE_COTSTestFormsDO1.0TDP-E.PDF	1.5	DO1.5TDP-

3.1.2.1 Technical Data Package Review (Continued)

Table 3-9. EMS 4.1 Voting System TDP (Continued)

Document Title	Version	Document Number
AppAppE_COTSTestFormsDO1.1TDP-Ecvr.doc	1.5	DO1.5TDP-
AppAppH_ACP2200_READMEDO1.0TDP-H.PDF	1.5	DO1.5TDP-
AppAppH_ACP2200_READMEDO1.1TDP-Hcvr.doc	1.5	DO1.5TDP-
AppAppI_ACP2200_ManualDO1.0TDP-I.pdf	1.5	DO1.5TDP-
AppAppI_ACP2200_ManualDO1.1TDP-Icvr.doc	1.5	DO1.5TDP-
AppAppJ_Seiko3445_ManualDO1.0TDP-J.pdf	1.5	DO1.5TDP-
AppAppJ_Seiko3445_ManualDO1.1TDP-Jcvr.doc	1.5	DO1.5TDP-
AppAppK_Seiko414_ManualDO1.0TDP-K.pdf	1.5	DO1.5TDP-
AppAppK_Seiko414_ManualDO1.1TDP-Kcvr.doc	1.5	DO1.5TDP-
AppAppN_DOUBLETALK _ManualDO1.0TDP-N.pdf	1.5	DO1.5TDP-
AppAppN_DOUBLETALK _ManualDO1.0TDP-N.txt	1.5	DO1.5TDP-
AppAppN_DOUBLETALK _ManualDO1.1TDP-Ncvr.doc	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO1_CardReaderSpec	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO2_CardReader_Manual	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderDO1.1TDP-Otblcont.doc	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO1_CardReaderSpecDO1.0TDP-O1.pdf	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO1_CardReaderSpecDO1.0TDP-O1cvr.doc	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO1_CardReaderSpecDO1.1TDP-O1cvr.doc	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO2_CardReader_ManualDO1.0TDP-O2.pdf	1.5	DO1.5TDP
AppAppO_BAY 7-IN-1 USB 2.0 Flash Card ReaderAppO2_CardReader_ManualDO1.1TDP-O2cvr.doc	1.5	DO1.5TDP
AppAppP_ChecklistsAppP3_Infinity_Prog_Chklst	1.5	DO1.5TDP
AppAppP_ChecklistsDO1.1TDP-P1.doc	1.5	DO1.5TDP-
AppAppP_ChecklistsDO1.1TDP-P2.doc	1.5	DO1.5TDP
AppAppP_ChecklistsDO1.1TDP-P4.doc	1.5	DO1.5TDP
AppAppP_ChecklistsDO1.1TDP-Ptblcont.doc	1.5	DO1.5TDP
AppAppP_ChecklistsAppP3_Infinity_Prog_ChklstDO1.0TDP-P3.doc	1.5	DO1.5TDP
AppAppP_ChecklistsAppP3_Infinity_Prog_ChklstDO1.1TDP-P3cvr.doc	1.5	DO1.5TDP
AppAppQ_Defect_TrackingDO0.2TDP-Q.mdb	1.5	DO1.5TDP
AppAppQ_Defect_TrackingDO0.3TDP-Qcvr.doc	1.5	DO1.5TDP
AppAppW_CountyInvoiceDO1.0TDP-W.PDF	1.5	DO1.5TDP
AppAppW_CountyInvoiceDO1.1TDP-Wcvr.doc	1.5	DO1.5TDP
AppAppX_SourceCode_ListDO1.1TDP-X.xls	1.5	DO1.5TDP
AppAppX_SourceCode_ListDO1.2TDP-Xcvr.doc	1.5	DO1.5TDP

Summary Findings

There were no discrepancies reported to MicroVote. The TDP complied with the applicable TDP standards in the 2005 VVSG.

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3.1.2.2. Volume and Stress Test

The EMS 4.1 voting system was subjected to a modified Volume and Stress Test. Volume and stress testing assesses the system's response to transient overload conditions and its ability to maintain data without failure or degradation in performance. The purpose of the test was to verify that the new 115k Tally smart card was capable of recording results from large elections. The test election contained 529 precincts. Due to the architecture of the system, it was only necessary to cast a single ballot in each precinct. In addition, the Tally card was subjected to conditions that attempted to overload the system's capacity to process, store, and report data. A test election was designed that would exceed the system's ability to write the data to the Tally card.

Summary Findings

The Infinity Panel successfully wrote results data to the Tally card when the size of the data was less than the capacity of the card. In instances where the results data exceeded the capacity of the Tally card the system notified the user and directed them to connect the Infinity Panel directly to the EMS.

At the conclusion of the Volume and Stress Test re-test, it was determined that the EUT successfully met the test requirements.

3.1.2.3. System Integration Test

System Integration Testing was performed to test all system hardware, software, and peripherals. System Integration Testing focused on the complete system, including all proprietary and COTS software, hardware, and peripherals configured as described in the MicroVote-submitted TDP for the EMS 4.1 voting system. To perform the System Integration Testing, NTS developed specific procedures and test cases designed to test the system as a whole. These procedures demonstrated compliance of the modified EMS 4.1 to Sections 2, 3, 4, 5, and 6 of Volume I of the VVSG.

In order to verify compatibility between the system in scope, ballots were presented across the system and all results verified against the expected results matrix. The created test deck for system integration included hand marked ballots and ADA generated ballots.

The two election definitions exercised during the System Integration Testing are listed below:

- GEN-01. The Gen-01 is 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 fourteen 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.
- PRIM-01. The Prim-01 is a closed primary election in two precincts (one precinct is a split), 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.

3.1.2.3 System Integration Test (Continued)

Summary Findings

Through System Integration Testing, it was demonstrated that the system performed as documented with all components performing their intended functions. The system experienced three discrepancies that are outlined below.

- The system did not support pictographic based languages due to voting system incapability, which caused a discrepancy during test.
- The EMS program shutdown without an error message causing a discrepancy which required the implementation of a variety of software changes to provide a new serial object for stabilization.
- Mislabeled buttons caused a discrepancy during test and the Infinity firmware was modified to allow the buttons to operate as designed.

Further details regarding the discrepancies are noted in Appendix B (ID 128, 129, and 130). Testing and necessary retests due to discrepancies were completed and the system met the requirements of the 2005 VVSG.

3.1.2.4. Data Accuracy

The modified EMS v. 4.1 was subjected to a Data Accuracy Test in accordance with the requirements of Section 4.7.1.1 of the Volume II of the VVSG. Per the VVSG, data accuracy is defined in terms of ballot position error rate. This rate applies to the voting functions and supporting equipment that capture, record, store, consolidate, and report the selections (or absence thereof) made by the voter for each ballot position. To meet the requirements of this test, the voting system must be subjected to the casting of a large number of ballots to verify vote recording accuracy, i.e. at least 1,549,703 ballot positions correctly read and recorded. An accuracy test was performed on the Infinity Panel VP-01. In an effort to achieve this and to verify the proper functionality of the units under test, the following methods will be used to test components of the voting system:

- 85% of the necessary ballots will be cast using an external auto casting tool. The tool uses a script to mimic the actions of the voter. This reduces the risk of human error.
- 15% of the votes will be cast via user interface.
-

During the Data Accuracy Test, the EMS (with autovote capabilities) was connected to the Infinity Panel and transmitted a defined set of “button selections” to the Infinity Panel via a serial connect. This simulation mimicked the “button selections” for candidate selection and screen navigation. The Infinity Panel cast a total of 6,400 autovote ballots and 5,168 user interface ballots containing 134 ballot positions each to verify vote recording accuracy. Testing was performed by exercising an election definition developed specifically to test for logic and accuracy.

Summary Findings

The EUT successfully met the requirements of the Data Accuracy Test by scanning and processing a minimum of 1,549,703 ballot positions.

3.1.2.5. Physical Configuration Audit

A Physical Configuration Audit (PCA) of the EMS 4.1 voting system was performed as part of the testing activities in accordance with Volume II, Section 6.6 of Volume II of the EAC 2005 VVSG. The PCA compares the voting system components submitted for certification with the vendor's technical documentation and confirms that the documentation submitted meets the requirements of the Guidelines. The PCA included the following activities:

- Establishing 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;
- Verifying 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;
- Reviewing drawings, specifications, technical data, and test data associated with system hardware, and to establish system baseline;
- Reviewing 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.

The PCA performed consisted of inspecting the following:

- Infinity Panel VP-01 software platform
- Infinity Panel VP-01 Rev. C
- Infinity Panel VP-01 Rev. D04
- MinuteMan Entrust 1500
- Chatsworth ACP2200

Summary Findings

A PCA was performed to baseline the system's hardware and software components that were used during the test campaign. It was determined that the Infinity Panel VP-01 Rev. C and Chatsworth ACP2200 were unmodified from the certified version.

One discrepancy was discovered. MicroVote failed to meet the requirements of Volume I Section 9.3.2 and 9.4 of the 2005 VVSG. The 2005 VVSG requires that all components and subsequent modifications to components be uniquely numbered or otherwise identified by version. The modified submission of the Infinity Panel VP-01 retained the original certified classification of Rev. C. MicroVote corrected this issue by changing the revision number of the modified Infinity Panel VP-01 to Rev. D. With this correction, MicroVote met the PCA requirements.

3.1.2.6. Functional Configuration Audit (FCA)

A Functional Configuration Audit of the EMS 4.1 was performed in accordance with Section 6.7 of Volume II of the VVSG. The purpose of the FCA was to verify that the EMS 4.1 system under scope performed as documented in the manufacturer supplied technical documentation during pre-voting, voting, and post-voting activities and validated that the EMS 4.1 meets the requirements of the EAC 2005 VVSG. The FCA tests were designed to ensure compatibility of voting machine functions using the referenced firmware. During the FCA, both normal and abnormal data was input into the system to attempt to introduce errors and test for error recovery.

Summary Findings

The FCA was conducted without incident and produced no anomalies or discrepancies.

3.1.2.7. Security Testing

EMS 4.1 was subjected to a Security Content Automation Protocol (SCAP) Security review. The review was conducted to verify that the operating environment (Windows 2007) was configured to match industry recognized security protocol. The MicroVote TDP was utilized during this portion of testing to ensure the proper configuration of the operating environment.

Summary Findings

NTS determined that the submitted voting system is compliant with the security requirements of the EAC 2005 VVSG.

3.1.2.8. Quality Assurance/Configuration Management Test

As part of the modification, NTS Huntsville personnel conducted a QA/CM review to verify that the manufacturer correctly followed their documented processes for a modified system. The QA/CM requirements were spot checked and limited to only the changes included within this modification. NTS Huntsville provided MicroVote a quality assurance audit list in which MicroVote was required to complete and deliver within 24 hours. The quality assurance audit utilized the following guidelines as the focus of the review:

The basis of this examination is to ensure:

- Conformance with the requirements to provide information on vendor practices required by these Guidelines.
- Conformance of system documentation and other information provided by the vendor with the documented practices for quality assurance and configuration management.
-

3.1.2.8 Quality Assurance/Configuration Management Test (Continued)

The focus of this examination is to assess whether the vendor's quality assurance program provide:

- Clearly measurable quality standards.
- An effective testing program throughout the system development life cycle.
- Application of quality assurance program to external providers of the system components and supplies.
- Comprehensive monitoring of system performance in the field and diagnosis of system failures
- Effective record keeping of system failures to support analysis of failure patterns and potential causes
- Effective processes for notifying customers of system failures and corrective measures are taken
-

Summary Findings

MicroVote supplied NTS Huntsville with the requested documentation and answers within the allowed 24-hour window. NTS Huntsville determined that MicroVote's QA and CM programs did not meet the requirements of 2005 VVSG after a review of the information provided. Further details regarding the discrepancy are noted in Appendix B (ID 175).

3.1.3. Source Code Review

As part of testing activities, the source code submitted for the modified EMS 4.1 System was compared to the baseline version included in the EMS 4.0B System. Any code changes were reviewed by NTS to determine its compliance to the 2005 VVSG and manufacturer coding standards.

Summary Findings

Three software suites were examined: EMS, ICE, and ICP. This is a summary of the issues discovered.

EMS:		Infinity:	
Header Inputs or Outputs	3	Header Inputs or Outputs	1
Units Called	12	Header Revision History	2
Header Revision History	1	Header Globals Missing	4
Units Called	3	Units Called	6
		Inconsistent Indenting	3
		Records With Comments	1
		Inconsistent Indenting	1

All identified source code issues were resolved prior to the conclusion of the source code review process.

3.2. Anomalies and Resolutions

No anomalies occurred during testing of the MicroVote EMS 4.1 voting system.

3.3. Deficiencies and Resolutions

Seventeen discrepancies were discovered during testing of the EMS 4.1 Voting System. NTS defines a discrepancy as any issue (functional, physical, test error, etc.) encountered during testing that was not the expected result as defined by the test case. Discrepancies are placed into the NTS discrepancy tracking system (Mantis) and the EAC's Virtual Review Tool (VRT) for disposition and resolution.

The discrepancies generated are summarized in the summary findings below their respected section of the test report and their resolutions are presented in their entirety in Appendix B of this report. Two deficiency, ID 131 and 175, were not corrected prior to completion of testing and remains as an outstanding deficiency that was accepted by the EAC to be addressed in a later test campaign. All other discrepancies encountered during testing were successfully resolved prior to test completion.

4.0 RECOMMENDATION FOR CERTIFICATION

NTS Huntsville performed conformance testing on all modifications submitted for the MicroVote General Corporation Election Management System, identified as version 4.1. The submitted modifications met the requirements of the 2005 VVSG with the following exceptions:

- EMS 4.1 does not support the use of pictographic based languages as required by Volume I Section 2.2.1.3 of the 2005 VVSG
- MicroVote's QA and CM programs did not meet the requirements of Volume I Sections 8 and 9 of the 2005 VVSG

Per Volume 2 Appendix B.5 "…any uncorrected deficiency that does not involve the loss or corruption of voting data shall not necessarily be cause for rejection." Therefore, NTS Huntsville recommends the EAC grant the EMS 4.1 voting system certification to the EAC 2005 VVSG.

Any changes, revisions, or corrections made to the system after this evaluation are required to be submitted to the EAC to determine if the modified system requires a new application, or can be submitted as a modified system. The scope of testing required will be determined based upon the degree of modification.

Due to the varying requirements of individual jurisdictions, it is recommended by the EAC 2005 VVSG that local jurisdictions perform acceptance tests on all systems prior to their use in an election within their jurisdiction.

APPENDIX A - ADDITIONAL FINDINGS

This page INTENTIONALLY LEFT BLANK as there were no ADDITIONAL FINDINGS associated with this Test Report.

APPENDIX B – DEFICIENCY REPORT

Appendix B - Deficiency Report

Table B-1 describes the deficiencies and resolutions discovered during the MicroVote EMS 4.1 test campaign.

Table B-1. Deficiency Report

EAC VRT ID[2]	Deficiency Summary	Resolution
82	A failure of the initially supplied battery backup unit to adequately protect an Infinity voting panel against a simulated lightning surge electrical disruption	MicroVote submitted the MinuteMan Entrust 1500 UPS as the new battery backup solution. Upon retest, NTS found that the Infinity Panel successfully completed the lightning surge test.
83	The Infinity Panel, Rev D, exceeded the radiated emission limits of FCC Part B. In the vertical antenna polarization, radiated radiofrequency emissions exceeded the limit at the frequencies of 72 and 109.4 MHz at a maximum of 6dbµV/m	MicroVote submitted revision D03 of the Infinity Panel to NTS for retest. MicroVote introduced a new baseboard to the Infinity panel. Upon retest, NTS found that the revision D03 version of the Infinity Panel successfully completed electromagnetic emissions testing.
85	The Infinity Panel, Rev D02, exceeded the radiated emission limits of FCC Part 15 Class B. In the vertical antenna polarization, radiated RF emissions exceeded the limit at the frequencies of 42.53 and 64.04 MHz at a maximum of 1dbµV/m and 13dbµV/m respectively	MicroVote submitted revision D03 of the Infinity Panel to NTS for retest. MicroVote introduced a new baseboard to the Infinity panel. Upon retest, NTS found that the revision D03 version of the Infinity Panel successfully completed electromagnetic emissions testing.
123	The Infinity Panel, Rev D03, failed to remain functional during the electromagnetic susceptibility test. There were two hardware configurations submitted for this testing. •Infinity Panel with the new universal baseboard, new processor, and LED screen. •Infinity Panel with the new universal baseboard, new processor, and CCFL screen. Between the ranges of 550mhz and 710mhz, on the vertical axis, the unit would fail to communicate with the D: drive when recording a vote session. This caused the unit to freeze. Power cycling was required to return the unit to a functional state	MicroVote made the following modifications to the system BIOS: •Disabled the Direct Memory Access. •Enabled the CPU throttle functions. ◦CPU throttle setting was configured to 25% Upon retest, the Infinity Panel Rev D03 successfully completed the electromagnetic susceptibility test.

[2] The ID numbers may not be sequential. The discrepancy tracking system (VRT) that is utilized by the EAC creates unique ID numbers based on overall entries within the database and not within individual projects.

EAC VRT ID[2]	Deficiency Summary	Resolution
125	During the horizontal coupling portion of the ESD test the Infinity Panel stopped functioning and displayed the following error: "Unknown unit error writing drive D. Abort, Retry, Fail?" The unit was positioned on an insulating pad 10cm distant from the front edge of the table with the unit rotated counter clockwise by 90 degrees from the normal voting position	The issue was traced to the SATA cable that connects the processor assembly to the Carson daughter. MicroVote submitted an ECO for the SATA cable. This ECO added EMI Foil shielding and a heat shrink rubber sleeve to the cable. Upon retest, the Infinity Panel Rev D03 successfully completed the electromagnetic susceptibility test.
126	During preparation for the Temperature Power test, the Infinity Panel experienced a hardware failure. At random times during the autovoting session the panel would freeze and display the message "Not ready error reading drive C." The issue is not present on any of the other 3 panels	MicroVote determined the root cause to be a defective chip on the Aaeon motherboards. The defective chips were replaced and NTS was able to complete the Temperature Power test preparations.
127	During preparation for the Temperature Power test, the Infinity Panel Rev D03 experienced a hardware failure. Portions of the LED panel stopped functioning properly	NTS Replaced the LED panel and the issue was resolved.
128	During preparation for System Integration, an anomaly was discovered. When selecting the Libertarian straight party option the Republican candidate for President is selected. This only occurs in Precinct 1 and only for the Libertarian selection	The issue was caused by re-sequencing the candidates on the Candidate Filing screen for President And Vice President and re-sequenced the candidates. When attempting to alter the filing sequence a message box opens informing the operator that the ballot styles need to be re-saved. All of the styles were re-saved (for the other precincts) except ballot style 001. The ballot style was re-saved and the issue was resolved.
129	During preparation for System Integration, an anomaly was discovered. Upon booting, the Infinity Panel beeped three times and froze on a solid brownish screen. The Unit was power cycled. When the unit reached the start screen the message "fatal error" was displayed. The unit was power cycled again and the message reappeared.	The BIOS system settings within the old processor board for one or both of the two serial ports were corrupted or lost during the "three beep" power-on event. The BIOS was accessed and the settings for Serial Port 1 and Serial Port 2 were refreshed. Upon restart the fatal error did not appear.
130	During preparation for System Integration, the message "fatal error" was displayed during the initial boot process.	The issue was linked to a defective internal smart card reader. The reader was replaced and the system booted.
131	The EMS 4.1 voting system does not support pictographic based languages as required by Volume I Section 2.2.1.3 of the 2005 VVSG.	This issue was not resolved prior to test campaign completion.

EAC VRT ID[2]	Deficiency Summary	Resolution
168	During preparations for System Integration the EMS program crashed. The OMR reader was started without the central count scanner attached. This cause an error message to appear notifying the user that the scanner is not attached. The scanner was attached and the error message accepted. When the first ballot was processed the EMS program crashed without presenting an error	The Microsoft drivers for the serial port were causing the system to become unstable while opening and closing the port during the detected (intentional) error and crashing the program. Various software changes were implemented to instantiate a new serial object that prevents recurrence and allows the physical port to remain stable. Upon retest the issue did not re-appear.
169	During the hot cycle (95 degrees F) between runs 39 and 40, the Infinity Panel displayed a fatal error. According to the log, the error happened approximately 30 minutes after the last user action. The unit was power cycled. Upon restart, the unit froze on the infinity splash screen. The unit was power cycled again. Upon restart, the fatal error message appeared again.	Root cause analysis by Aaeon determined that when the processor board was previously repaired to replace a defective clock chip the hand repaired solder joint failed. The clock chip was repaired and the testing was completed.
170	During the hot cycle (95 degrees F), testers noticed that the contest headers were becoming unreadable on the KOE SP24V001 Rev. E CCFL display. By then end of the 12 hr cycle the contests headers were unreadable. As the chamber switched to the cold cycle (50 degrees F) the contest headers became viable again as the temperature dropped	KOE SP24V001 Rev. E CCFL displays were removed from Infinity Rev. D hardware configuration.
171	During the root cause assessment for discrepancy ID 170, NTS discovered that the "Lighten" and "Darken" buttons on the Infinity Panel were mislabeled	Infinity firmware was modified to reverse the functionality of the buttons so they operate as expected.
172	The contest headers did not meet the 3:1 contrast ratio requirement for all text and informational graphics intended for the voter	Contest headers modified through the Infinity firmware to remove the background color of the contest header.
175	MicroVote supplied NTS Huntsville with the requested documentation and answers within the allowed 24-hour window. NTS Huntsville determined that MicroVote's QA and CM programs did not meet the requirements of 2005 VVSG after a review of the information provided.	This issue was not resolved prior to test campaign completion.

APPENDIX C - ANOMALY REPORT

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APPENDIX D - TEST PLAN

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Job No. T71571.01
Test Plan No. T71571.01 Rev B
May 28, 2015

CERTIFICATION TEST PLAN-AS RUN

Prepared for:

Manufacturer Name	MicroVote
Manufacturer System	EMS 4.1
EAC Application No.	MVT1401
Manufacturer Address	6366 N. Guilford Ave. Indianapolis, IN 46220

NVLAP LAB CODE 200771-0

EAC Lab Code 0704

Page No. i
Certification Test Plan T71571.01 Rev B

NTS HUNTSVILLE			REPORT NO.: Test Plan No. T71571.01 Rev A DATE: June 30, 2014
REV	**DATE**	**PAGE OR PARAGRAPH AFFECTED**	**DESCRIPTION OF CHANGES**
---	05-12-14	Entire Document	Original Release
A	06-26-14	Pg 2. Sec 1.2	Added D-04 based on MicroVote submission of anomaly. Moved issues from section 2.2 to this section
A	06-26-14	Pg 3. Sec 1.3	Clarified the meaning of "limited FCA"
A	06-26-14	Pg 10. Sec 2.2	Added the one know field issue
A	06-26-14	Pg 11. Sec 3.0	Corrected spelling and tense
A	06-26-14	Pg 12 & 13 Sec. 3.3	Added document numbers to the document titles
A	06-26-14	Pg 15 Sec 4.2	Corrected "touch-screen" to "touch-button"
A	06-26-14	Pg 16 Sec 4.4.1	Added the NTS determination for engineering changes
A	06-26-14	Pg 17 Sec 4.4.1	Added maintainability to the reuse table
A	06-26-14	Pg 20 Sec 4.5	Corrected the security test description to limit testing to just the modified operating system
A	06-26-14	Pg 21 Sec 4.7	Remove the reference to manufacturer supplied coding standards
A	06-26-14	Pg 33 Sec 6.3.2	Remove reference to table
A	06-26-14	Pg 33 Sec 6.3.2	Remove the automate source code review language
B-As Run	5-28-15	Pg 2 & 3 Sec 1.2	Updated modifications list
B-As Run	5-28-15	Pg 8	Updated Software Versions

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1.0 INTRODUCTION

The purpose of this National Certification Test Plan (Test Plan) is to document the procedures that National Technical Systems, Inc. (NTS) will follow to perform certification testing of the MicroVote EMS 4.1 Voting 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, MicroVote submitted an application to the EAC for certification of the EMS 4.1 Voting System modification to the previously-certified EMS 4.0B (Certification Number: MVTEMS40B) Voting System. This test plan follows Notice of Clarification 09-005: Development and Submission of Test Plans for Modifications to EAC Certified Systems and Notice of Clarification 13-02: Detailed Description of Changes for Modifications.

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

1.1 Established Baseline System

The baseline system for this modification is the EMS 4.0B voting system. Tables 1-1, 1-2, and 1-3 describe the certified equipment and firmware versions. For full details about the EMS 4.0B test campaign refer to NTS-Huntsville's Test Report No. T56849-01 Rev. C posted on the EAC website.

Table 1-1 EMS 4.0B Voting System Hardware Components

Component	Hardware Version	Firmware Version
Infinity Voting Panels	VP-1 Rev C	4.00B
Chatsworth ACP 2200	605000-190	4.0.26.0
DoubleTalk LT	LT RC8650	BIOS 0212
Seiko Printer	Model DPU-414	N/A
Seiko Printer	DPU-3445	N/A

Table 1-2 EMS 4.0B Voting System Software Components

Component	Version
MicroVote EMS	4.0.26.0

Table 1-3 EMS 4.0B Voting System EMS Components

Equipment	Description	Serial Number
Desktop PC	Dell DHM	SDBFL61
Laptop PC	Dell PP17L	CN-06G834-48643-65R-3140
Dell Printer	Report Printer	CN-0P0137-48734-5B0-119T
GemPlus card reader	Smart Card Reader	R04304113302427

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1.0 INTRODUCTION (Continued)

1.2 Scope of Modification

The purpose of this modification is to introduce new hardware to provide new functionality, address defects discovered in EMS 4.0B, and replace end-of-life (EOL) components. The below scope represents Microvote's submission to the EAC.

Enhancements

E-01-(EMS) - Added support for 115kB tally smart cards. The increased space allows larger jurisdictions to use the tally card feature instead of the direct connect option.

E-02-(EMS) - Increased undervote manual entry capacity. For elections which contain large numbers of undervoted contests (i.e. a large primary election with a combined absentee precinct), this enhancement will allow a single manual vote entry to input the vote totals eliminating the need to split the entry into smaller pieces.

Defects

Defects one thru three were discovered in EMS 4.0B. The EAC allowed EMS 4.0B to be certified on the condition that they were corrected with the next certification. Defect four was discovered in the field and is also described in section 2.2 Known Filed Issues,

D-01-(EMS) – Audit reporting is now available within the EMS application as a standard report. Previously this was provided via multiple disk files.

D-02-(EMS) – Database version control has been added to prevent the opening of backup elections containing executable code from other versions of the EMS software.

D-03-(EMS) – Method of inserting ballot objects, informational messages and error trapping and logging for the ballot designer have all been improved to address a previously identified ballot designer deficiency.

D-04-(EMS) – The overall election voter turnout percentage on the Election Summary and All Precincts header are reported incorrectly. A modification was made in COTS generated XML code to correct the deficiency.

Replacement of End-Of-Life Components

EOL-1 - New Infinity Panel processor board/bridge/heat sink assembly (PCM-3336-BRIDGE-A03) to replace current EOL processor board. This creates Infinite Panel Rev D. New Infinity firmware is compatible with both the current and new processor boards. Due to the new power requirements, the Infinity Panel Rev D requires the use of a UPS to support battery backup functionality.

EOL-2 - Added a LED panel (KOE SP24V01L0ALZZ Rev. A) to the available configuration for the Infinity Panel VP-01.

EOL-3 - Added the Entrust 1500 External UPS to support battery backup functionality for the Infinity Panel VP-01.

1.0 INTRODUCTION (Continued)

1.2 Scope of Modification (Continued)

EOL-4 - New USB PC/SC compatible smart card reader support to replace EOL serial port smart card reader attached to EMS computer.

EOL-5 - Upgraded Microsoft .Net Framework to version 3.5 SP1 to replace EOL version 1.1.

EOL-6 - Upgraded OS to Microsoft 7 Professional from EOL Windows XP SP2.

EOL-7 - Upgraded ComponentOne library to Ultimate 2013 version 3.1 from EOL Enterprise version.

EOL-8 - Eliminated requirement for EOL Franson Serial Tools assembly as this functionality is built into Visual Studio 2013.

EOL-9 - Upgraded database server to Microsoft SQL Server 2012 Express from EOL Microsoft SQL Server 2000 Desktop Edition (MSDE).

EOL-10 - Added new Dell Latitude E5440 laptop to currently certified laptop and desktop computers.

Replacement of End-Of-Life Components (Continued)

1. Upgraded ComponentOne library to Ultimate 2013 version 3.1 from EOL Enterprise version.
2. Eliminated requirement for EOL Franson SerialTools assembly as this functionality is built into Visual Studio 2013.
3. Upgraded database server to Microsoft SQL Server 2012 Express from EOL Microsoft SQL Server 2000 Desktop Edition (MSDE).
4. Upgraded project installation to Advanced Installer Enterprise Edition V11.1 from EOL Microsoft InstallShield.
5. Added new Dell Latitude E5440 laptop to currently certified laptop and desktop computers.

1.3 Initial Assessment

After analyzing the scope of changes to the EMS and Infinity software, NTS personnel determined that accuracy, system integration, and a limited Functional Configuration Audit will be required to verify that the voting system still meets the 2005 VVSG requirements. Limited in this instance refers to only functional changes that were made in this modification (new features, changes to functions, etc.) or functions that have not changed but may be impacted by the modification.

NTS determined that the hardware changes to the Infinity Panel, hardware revision D will require all hardware testing except product safety. Infinity Panel hardware revision C will not require any hardware testing based on the changes submitted. The details of this analysis can be found in section 2.1 and 4.4.1.

The software utilized for the EMS 4.1 campaign will be comprised of the new EMS software and changes to the Infinity Panel software. All source code will be compared to the EAC certified EMS

1.0 INTRODUCTION (Continued)

1.2 Scope of Modification (Continued)

4.0B version to determine the extent of the source code review required. Based on this examination, NTS personnel will perform software code review to ensure that all applicable VVSG requirements

are met and changes to the software do not introduce any new functions or features outside of the modifications in Section 1.2.

An initial assessment has been performed on the TDP submitted by MicroVote for EMS 4.1. The TDP is constructed with the EMS4.0B certified TDP and the EMS 4.1 changes to the certified documents. The submitted TDP will be reviewed to ensure that all EMS 4.1 changes are properly documented and comply with the 2005 VVSG.

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1.0 INTRODUCTION (Continued)

1.4 References

The documents listed below were used in the development of the test plan and will be utilized to perform certification testing.

- Election Assistance Commission 2005 Voluntary Voting System Guidelines, Volume I, Version 1.0, "Voting System Performance Guidelines," and Volume II, Version 1.0, "National Certification Testing Guidelines," dated December 2005
- Election Assistance Commission Testing and Certification Program Manual, Version 1.0, effective date January 1, 2007
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 1.0, effective date July 2008
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2006 Edition, "NVLAP Procedures and General Requirements (NIST Handbook 150)," dated February 2006
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2008 Edition, "Voting System Testing (NIST Handbook 150-22)," dated May 2008
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Test Guidelines Documents: EMI-001A, "NTS 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"
- Quality Assurance Program Manual, Current Revision
- 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 (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)
- EAC Quality Monitoring Program residing on:

  http://www.eac.gov/testing_and_certification/quality_monitoring_program.aspx
- Wyle Laboratories' Test Report No. T56849-01 Rev. C – National Certification Test Report of the MicroVote General Corporation Election Management System, Version 4.0B (MODIFIED)
- iBeta MicroVote General Corporation Election Management System (EMS) Voting System v. 4.0 VSTL Certification Test Report

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1.0 INTRODUCTION (Continued)

1.5 Terms and Abbreviations

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

Table 1-4 Terms and Abbreviations

Term	Abbreviation	Definition
Americans with Disabilities Act 1990	ADA	ADA is a wide-ranging civil rights law that prohibits, under certain circumstances, discrimination based on disability.
Configuration Management	CM	---
Commercial Off the Shelf	COTS	Commercial, readily available hardware or software.
Direct Record Electronic	DRE	An electronic voting system that utilizes electronic components for the functions of ballot presentation, vote capture, vote recording, and tabulation which are logically and physically integrated into a single unit. A DRE produces a tabulation of the voting data stored in a removable memory component and in printed hardcopy.
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.
Equipment Under Test	EUT	Refers to the individual system component or multiple piece of the same component.
Functional Configuration Audit	FCA	Verification of system functions and combination of functions cited in the manufacturer's documentation.
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.
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.
Personal Computer	PC	Computer component of the EMS 4.1 voting system.
Quality Assurance	QA	--
System Under Test	SUT	Refers to the system as a whole (all components).
Technical Data Package	TDP	Manufacturer documentation related to the voting system required to be submitted as a precondition of certification testing.
Trusted Build	---	Final build of source code performed by a trusted source and overseen by the manufacturer which is delivered to the EAC designated repository; also referred to as a "Witness Build".
Underwriters Laboratories Inc.	UL	---
Uninterruptible Power Supply	UPS	---

1.0 INTRODUCTION (Continued)

1.5 Terms and Abbreviations (Continued)

Table 1-4 Terms and Abbreviations (Continued)

Term	Abbreviation	Definition
Operating Procedure	OP	NTS Test Method or Test Procedure.
Voting System Test Laboratory	VSTL	NTS
Voluntary Voting System Guidelines	VVSG	2005 EAC Voluntary Voting System Guidelines V 1.0.0.

1.6 Testing Responsibilities

Prior to the development of this test plan, NTS evaluated test results from the previous test campaign performed by Wyle Laboratories: EMS 4.0B. The purpose of this evaluation was to determine the scope of testing required for system certification. Based on this evaluation, NTS determined that testing from previous test campaigns could be utilized to satisfy some requirements of this test campaign. Sections 2.1 and 4.4.1 contain additional details of this evaluation. All other core and non-core software and hardware certification testing shall be conducted under the guidance of qualified NTS personnel.

1.6.1 Project Schedule

This information is contained in a NTS-generated Microsoft Project schedule. This schedule is presented in Appendix A, "MicroVote Project Schedule." The dates on the schedule are not firm dates but planned estimates presented for informational purposes.

1.6.2 Test Case Development

NTS will utilize the "NTS Baseline Test Cases" augmented with specially designed test cases tailored to the EMS 4.1 voting system for the Functional Configuration Audit (FCA), and System Integration Tests. In addition, NTS has designed specific election definitions and test cases for the Operational Status Check and the Accuracy Tests.

1.6.3 Test Procedure Development and Validation

NTS will utilize the NTS Operating Procedures (OPs) during the duration of this test program.

1.6.4 Third-Party Tests

NTS will not utilize any 3rd party testing during performance of the EMS 4.1 test campaign.

1.7 Target of Evaluation Description

The following sections address the design methodology and product description of the EMS 4.1 Voting System as taken from the MicroVote technical documentation.

1.0 INTRODUCTION (Continued)

1.7.1 System Overview

The MicroVote EMS 4.1 voting system is a comprehensive suite of vote tabulation equipment and software solutions providing end-to-end election management. Tables 1-5 and 1-6 detail the EMS 4.1 Voting System with the following core system components.

Table 1-5 EMS 4.1 Voting System Hardware Components

Component	Hardware Version	Firmware Version
Infinity Voting Panel	VP-1 Rev C	4.10-983
Infinity Voting Panel	VP-1 Rev D	4.10-983
Chatsworth ACP 2200	605000-190	N/A

Table 1-6 EMS 4.1 Voting System Software Components

Component	Version
MicroVote EMS	4.1.20.0

1.7.2 System Hardware

The EMS 4.1 Voting System consists of the following hardware components:

Precinct DRE Tabulator: Infinity Panel

The Infinity Voting Panel is a DRE voting device that presents a visual ballot on an LCD panel with a text-to-speech voice synthesized audio ballot option.

Photograph 1: Infinity Panel

1.0 INTRODUCTION (Continued)

1.7.2 System Hardware (Continued)

Central Tabulator: Chatsworth ACP2200

The functionality of the EMS software Central Count is to support vote capture and tabulation of paper ballots (standard data cards) read by the Chatsworth COTS central count dual-sided ACP2200 OMR.

Photograph 2: Chatsworth ACP2200

1.7.3 System Software

The EMS 4.1 Voting System EMS is an application that allows for ballot design, DRE programming, central scanning, and results processing.

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1.0 INTRODUCTION (Continued)

1.7 Target of Evaluation Description (Continued)

1.7.4 System Operational Concept

The operational flow and low-level system interfaces for the EMS 4.1 voting system is illustrated in Figure 1-1.

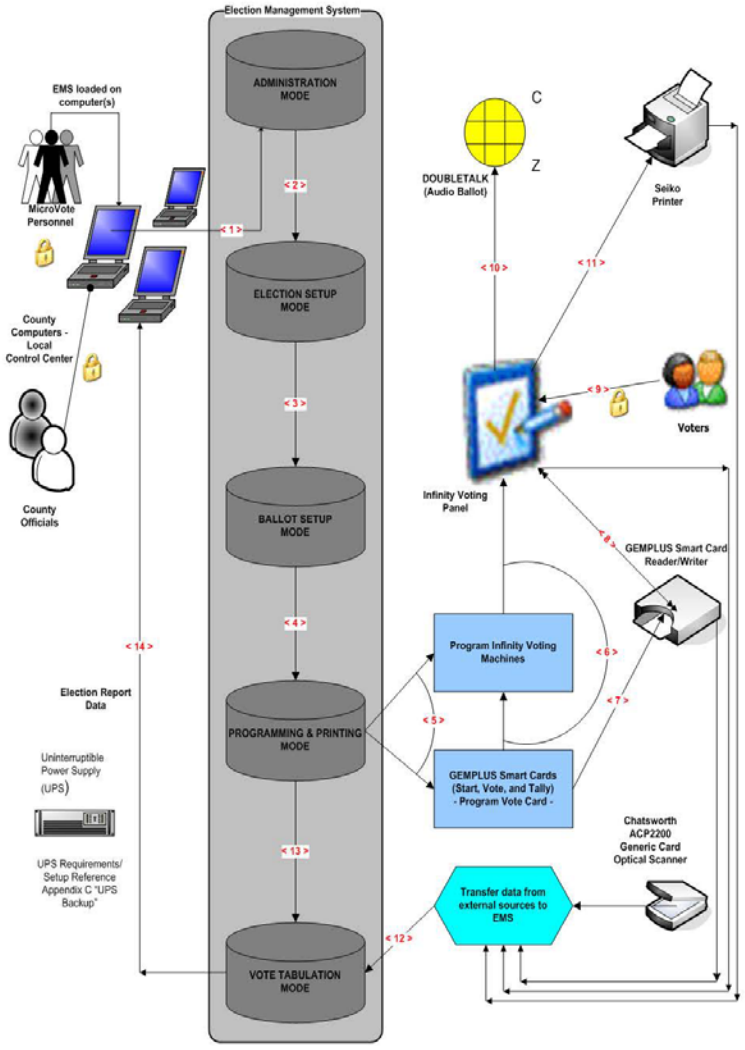

Figure 1-1
System Overview Diagram

2.0 PRE-CERTIFICATION TESTING AND ISSUES

NTS has conducted a pre-certification review, and findings indicate that all system changes are consistent with the change items documented in the EAC Application MVT1401.

2.1 Evaluation of Prior VSTL Testing

MicroVote submitted the following test reports to NTS for reuse consideration. The reports and items requested for reuse are as follows:

- Wyle Laboratories' Test Report No. T56849-01 Rev. C – National Certification Test Report of the MicroVote General Corporation Election Management System, Version 4.0B
  - Electromagnetic Radiation
  - Electrostatic Disruption
  - Electromagnetic Susceptibility

- iBeta MicroVote General Corporation Election Management System (EMS) Voting System v. 4.0 VSTL Certification Test Report
  - Electrical Power Disturbance
  - Electrical Fast Transient
  - Lightning Surge
  - Conducted RF Immunity
  - Magnetic Fields Immunity
  - Product Safety Review, UL60950-1
  - Temperature Power
  - High/Low Temperature
  - Humidity
  - Vibration
  - Bench Handling

For details of the acceptance of the above items, refer to Section 4.4.1 of this test plan.

2.2 Known Field Issues

The EMS 4.1 Voting System is a modification to the EMS 4.0B Voting System. EMS 4.0B has one known field issues that was reported by MicroVote to the EAC on May 16, 2014.

1. A variance in the reporting of the voter turnout percentage where by the reported overall voter turnout percentage was the turnout percentage from the first precinct. The overall election voter turnout percentage should be calculated by dividing the total public count by the total registered voters for all precincts (multiplied by 100 with a '%' sign) and is reported on the Election Summary report and the first page of the All Precincts report. Instead the two reports are displaying the voter turnout percentage for the lowest precinct in the sort order (usually Precinct 1), which may or may not match the actual overall percentage.

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3.0 MATERIALS REQUIRED FOR TESTING

The materials required for certification testing of the EMS 4.1 Voting System were shipped directly to NTS by MicroVote. The materials are described below in sections 3.1 and 3.2.

3.1 Software

Table 3-1 lists 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 the software used for testing accuracy and system integration; as well as supporting software required for the test environment. All COTS software is listed in Appendix C.

Table 3-1 EMS 4.1 Software Submitted for Testing

Software Required For Testing	Software Version
Proprietary Software	
MicroVote EMS	4.1
Infinity Panel	4.1

3.2 Equipment

This subsection categorizes the equipment the manufacturer submitted for testing listed in Table 3-2. Each test element is included in the list of equipment required for testing of that element, including system hardware, general purpose data processing and communications equipment, and any required test instrumentation.

Table 3-2 EMS 4.1 Voting System Equipment Description

Equipment	Description	Serial Numbers/Designation
Infinity Panel HW: C FW: 4.1	DRE precinct count/accessible voting station	02355 02356
Infinity Panel HW: D FW 4.1	DRE precinct count/accessible voting station	10294 02357
Chatsworth ACP2200	Central Count Scanner	CDT011401258
EMS PC	Dell OptiPlex 3010	JZ8JCY1 JZ8QBY1
EMS Laptop	Dell Latitude E5440	BT2DYZ1
Report Printer	Dell 0P0137	GF5SQ71
Headphones	Radio Shack	T71571-HP-001
DoubleTalk LT Audio Device	Text-to-speech converter	T71571-AudioBox-001
Seiko DUP-5445	Thermal Report Printer	1014953A
Seiko DUP-414	Thermal Report Printer	3025742B
Gemalto	IDBridge CT30 Smart Card Reader	I13101316600189
UPS	MinuteMan Entrust 1500	AE58131000778 AE58131000790
Serial Switch	Serial Data Transfer Switch	T71571SB1
Serial Adapter Card	Startech EC1S952 Serial Adapter Card	T71571SAC1
Voting Booth	Infinity Panel Voting Booth	T71571VB1 T71571VB2
Smart Card: Start Card	Infinity Panel Start Card	NTS-assigned
Smart Card: Vote N Card	Infinity Panel Vote N Card	NTS-assigned

3.0 MATERIELS REQUIRED FOR TESTING (Continued)

3.2 Equipment (Continued)

Table 3-2 EMS 4.1 Voting System Equipment Description (Continued)

Equipment	Description	Serial Numbers/Designation
Smart Card: Vote Card	Infinity Panel Vote Card	NTS-assigned
Smart Card: Tally Card 16k	Infinity Panel Tally Card 16k	NTS-assigned
Smart Card: Tally Card 115K	Infinity Panel Tally Card 115k	NTS-assigned

3.3 Deliverable Materials

The materials listed in Table 3-3 are to be delivered as part of the EMS 4.1 Voting System to the users.

Table 3-3 Deliverable Materials

Deliverable Material	Version	Description
EMS Software	4.1	Election management software
Infinity Panel	Firmware 4.1.0.0; Hardware C or D	DRE precinct count/accessible voting station
Chatsworth Central Count Scanner	ACP2200	Central Count Scanner
Dell Printer	0P0137	Laser Report Printer
Gemalto IDBridge	CT30	Smart Card Reader
MinuteMan UPS	Entrust 1500	UPS
Serial Data Transfer Switch		Serial Data Transfer Switch
Serial Adapter Card	Startech EC1S952	Serial Adapter Card
Headphones	Radio Shack	Stereo Headphones
DoubleTalk LT Audio Device	T71571-AudioBox-001	Text-to-speech converter
Seiko Printer	DUP-5445 or DUP-414	Thermal Report Printer
System Overview (DO1.1TDP-2.1)	1.12	TDP Document
System Functionality Description (DO1.1TDP-2.2)	1.2	TDP Document
Software Design Specification (DO1.1TDP-2.5)	2.8	TDP Document
System Security Specification (DO1.1TDP-2.6)	1.8	TDP Document
System Maintenance Procedures (DO1.1TDP-2.9)	1.9	TDP Document
Personal Deployment and Training Requirements (DO1.1TDP-2.10)	1.1	TDP Document
Configuration Management Plan (DO1.1TDP-2.11)	1.5	TDP Document
Infinity Panel Manual (DO0.8TDP-B1)	4.0	TDP Document
Infinity Firmware Functional Specification (DO0.5TDP-B3)	4.0	TDP Document
COTS Specifications (DO1.6TDP-C)	1.5	TDP Document
Glossary of Terms (DO1.1TDP-D)	1.1	TDP Document
Voting Variations (DO1.5TDP-F)	1.5	TDP Document
ACP2200 Readme (DO1.0TDP-H)	1.0	TDP Document
ACP2200 Manual (DO1.0TDP-I)	1.0	TDP Document

3.0 MATERIELS REQUIRED FOR TESTING (Continued)

3.3 Deliverable Materials (Continued)

Table 3-3 Deliverable Materials (Continued)

Deliverable Material	Version	Description
Seiko 3445 Manual (DO1.0TDP-J)	1.0	TDP Document
Seiko 414 Manual (DO1.0TDP-K)	1.0	TDP Document
DoubleTalk Manual (DO1.0TDP-N)	1.0	TDP Document
StarTech USB Card Reader Manual (DO1.0TDP-O2)	1.0	TDP Document
Appendix P – Checklist (DO1.0TDP-P3)	1.0	TDP Document
GUI Specifications (D1.6TDP-R)	1.6	TDP Document
Poll Workers Manual (DO1.9TDP-U)	1.9	TDP Document
User Manual (DO2.9TDP-V)	2.9	TDP Document
Machine Technician Manual (DO0.2TDP-Z)	0.2	TDP Document
MicroVote System Identification Tool (DO1.6TDP-AA)	1.6	TDP Document

4.0 TEST SPECIFICATIONS

NTS personnel will perform modification testing of the EMS 4.1 in the configuration submitted to the EAC in application ESS1401. NTS personnel will ensure that all certification testing conducted on the manufacturer's voting system follows NTS procedures for testing and specific test cases are used to ensure the requirements of the EAC 2005 VVSG and EAC Testing and Certification Program Manual are met.

All RFI's and NOC's applicable as of the date of this document shall apply to this test campaign unless otherwise noted.

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 requirements, 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 tests utilizing the "NTS Baseline Test Cases" along with test cases specially designed for the MicroVote EMS 4.1 per sections 4.4.3 and 4.4.4. The data input during these tests 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 NTS personnel per sections 4.4.1 and 6.3.1.

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.

Section 7: Security Requirements – The requirements in this section will be tested during source code review, FCA, and Security Tests.

4.0 TEST SPECIFICATIONS (Continued)

4.1 Requirements (Strategy of Evaluation) (Continued)

Section 8: Quality Assurance (QA) Requirements – The requirements in this section shall be tested throughout the test campaign using various methods. A TDP review shall be performed on MicroVote QA documentation to determine compliance to EAC 2005 VVSG requirements. All source code shall be checked to ensure that proper QA documentation has been completed. All equipment received for initial testing and follow-up testing shall be checked against MicroVote documentation to ensure their QA process is being followed. NTS 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 NTS personnel to physically examine documents at MicroVote's location or conduct an external evaluation utilizing equipment, documents, and support information provided by MicroVote during the test campaign. NTS may also choose to interview MicroVote's QA staff for further evaluation.

Section 9: Configuration Management (CM) Requirements – The requirements in this section shall be tested throughout the test campaign. The TDP review shall be performed on the MicroVote configuration management documentation to determine EAC 2005 VVSG compliance and to further determine whether MicroVote is following its documented CM requirements within the TDP.

NTS personnel shall maintain a test log of the procedure(s) employed. This log identifies the system and equipment by model and serial number. In the event that the project engineer deems it necessary to deviate from NTS Test Cases or NTS Operating Procedures (OP) pertaining to the test environment, the equipment arrangement and method of operation, the specified test procedure, or the provision of test instrumentation and facilities shall be recorded in the test log. A discussion of the reasons for the deviation and the effect of the deviation on the validity of the test procedure shall also be completed by the Project Engineer and Program Manager.

NTS personnel utilize an internal bug tracking system in order to capture and track all issues and discrepancies found during the testing campaign. This allows for all issues and discrepancies to be monitored for reoccurrence, tracks the root cause analysis, and provides a resolution status. NTS personnel shall verify all items logged into the bug tracking system are resolved prior to the completion of testing and before any recommendation may be made for certification.

The specific NTS OPs to be used during testing include the following:

OP 1 Operations Status Checks	OP 16 Hardware Testing – Bench Handling
OP 2 Receipt Inspection	OP 17 Hardware Testing – Vibration Test
OP 3 Technical Data Package Review	OP 18 Hardware Testing – Low Temperature Test
OP 4 Test Plan Preparation (This document)	OP 19 Hardware Testing – High Temperature Test
OP 5a-d Source Code Review	OP 20 Hardware Testing – Humidity Test
OP 6a-d Security	OP 21 Environmental Temperature Power Variation
OP 7 Trusted Build	OP 25 Physical Configuration Audit

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4.0 TEST SPECIFICATIONS (Continued)

4.1 Requirements (Strategy of Evaluation) (Continued)

OP 8 Electrical Power Disturbance	OP 26 Functional Configuration Audit
OP 9 Electromagnetic Emissions	OP 27 Maintainability
OP 10 Electrostatic Disruption	OP 28 Availability
OP 11 Electromagnetic Susceptibility	OP 29 Electrical Supply
OP 12 Electrical Fast Transient	OP 30 System Integration Test
OP 13 Lightning Surge	OP 34 Test Report
OP 14 Conducted RF Immunity	OP 36 Vote Recording Requirements
OP 15 Magnetic Fields Immunity	OP 41 Logic & Accuracy

4.2 Hardware Configuration and Design

The EMS 4.1 Voting System is a DRE-based precinct voting system using touch-button technology to capture voter intent, provide voter-assisted ballots, and tabulate precinct results. The precinct counting device is the Infinity Voting Panel which is responsible for capturing and tabulating voter selections. The Chatsworth ACP2200 central count is a digital scanner that processes paper ballots at a central location. All EMS functions are handled by proprietary software running on COTS PC/laptops/servers which are listed in section 3.2. NTS has determined that these COTS PC/laptops/servers are not subject to hardware testing per the EAC 2005 VVSG, because all contained CE, UL, and FCC labeling.

Each unit will be loaded with the Operational Status Check 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.

4.3 Software System Functions

The EMS 4.1 Voting System software is comprised of single application that manages all ballot design, DRE programming, and results processing.

4.4 Test Case Design

NTS Laboratories 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." NTS's test approach is to incorporate the use of both "Verification" and "Validation". There are four basic levels of testing in the V-Model Life Cycle: Component, Integration, System, and Acceptance. NTS will be evaluating the MicroVote EMS 4.1 to all four levels.

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4.0 TEST SPECIFICATIONS (Continued)

4.4 Test Case Design (Continued)

4.4.1 Hardware Qualitative Examination Design

MicroVote submitted the results of the previous testing in the form of the following test reports:

- MicroVote General Corporation Election Management System (EMS) Voting System v. 4.0 VSTL Certification Test Report (iBeta Report)
- Wyle Laboratories' Test Report No. T56849-01, Rev. C, National Certification Test Report for Certification Testing of the MicroVote General Corporation Election Management System, Version 4.0B

NTS personnel performed a hardware qualitative examination to 1) assess if the testing was performed under the guidelines of the EAC program, 2) assess if the tests were performed per the EAC 2005 VVSG, and 3) determine if engineering changes were implemented since test performance that would cause testing to be repeated. The results from this examination deemed that the hardware testing performed under the iBeta Report and T56849-01 Rev. C, were tested to the EAC 2005 VVSG and in accordance with the EAC Testing and Certification Program Manual. In addition, NTS determined that there were no engineering changes that would require the Infinity Panel C to repeat testing. NTS recommends that reuse be approved for all hardware test requirements for Infinity Panel C and that prior product safety testing be approved for the Infinity Panel D.

The summary of acceptable testing is provided in Table 4-1. All system version numbers in the table refer back to the two reports described earlier in this section. NTS will verify all hardware during the PCA and those results will determine if the hardware is compliant with the previous tested versions. All testing that is deemed rejected shall be performed by NTS personnel under this test campaign. The details of those tests are presented in Section 6.0.

Table 4-1 Hardware Test Examination Results

Test/EAC 2005 VVSG Section	Procedure/Description	EMS 4.1 Infinity Panel	
		Infinity Panel C	Infinity Panel D
Electromagnetic Radiation/4.1.2.9	FCC Part 15 Class B for both radiated and conducted emissions	Accept 4.0B	N/A
Low Temperature/4.1.2.14	MIL-STD-810D minimum temperature shall be -4°F	Accept 4.0	N/A
Vibration/4.1.2.14	MIL-STD-810D, Method 514.3 physical shock and vibration during handling and transport	Accept 4.0	N/A
Lightning Surge/4.1.2.7	IEC 61000-4-5 (1995-02)	Accept 4.0	N/A
High Temperature/4.1.2.14	MIL-STD-810D, Method 501.2 maximum temperature shall be 140°F	Accept 4.0	N/A
Bench Handling	MIL-STD-810D, Method 516.3 Procedure VI six 4" drops on each edge totaling 24 drops	Accept 4.0	N/A
Electrical Fast Transient/4.1.2.6	IEC 61000-4-4 (2004)	Accept 4.0	N/A
Humidity Test/4.1.2.14	MIL-STD-810D, Method 501.2 ten 24 hour humidity cycles	Accept 4.0	N/A

4.0 TEST SPECIFICATIONS (Continued)

4.4 Test Case Design (Continued)

4.4.1 Hardware Qualitative Examination Design (Continued)

Table 4-1 Hardware Test Examination Results (Continued)

Test/EAC 2005 VVSG Section	Procedure/Description	EMS 4.1 Infinity Panel	
		Infinity Panel C	Infinity Panel D
Electrostatic Disruption/4.1.2.8	IEC 61000-4-2 (1995-01) 15kV air discharge and 8kV contact discharge	Accept 4.0B	N/A
Electromagnetic Susceptibility/4.1.2.10	IEC 61000-4-3 (2006) electromagnetic field of 10V/m modulated by a 1kHZ, 80% AM modulation at 80MHz to 1000MHz frequency	Accept 4.0B	N/A
Conducted RF Immunity/4.1.2.11	IEC 61000-4-6 (1996-04) conducted radio frequency energy	Accept 4.0	N/A
Magnetic Fields Immunity/4.1.2.12	IEC 61000-4-8 (1993-06) AC magnetic fields of 30 A/m at 60Hz	Accept 4.0	N/A
Electrical Power Disturbance/4.1.2.5	IEC 61000-4-11 (1994-06) power surges and dips	Accept 4.0	N/A
Temperature/Power Variation/4.1.2.13	MIL-STD-810D, Method 502.2 and Method 501.2 163 hours at 50°F to 95°F	Accept 4.0	N/A
Safety/4.3.8	UL 60950-1 product safety review	Accept 4.0	Accept 4.0
Maintainability	NTS OP 27	Accept 4.0	Accept 4.0

4.4.2 Hardware Environmental Test Case Design

The EMS 4.1 Voting System hardware will be tested by NTS's EMI, Dynamics, and Environmental test facilities for testing to the hardware requirements in accordance with NTS's A2LA certifications 845.01-.03. All EMI testing will be performed, per the following NTS Test Guidelines Documents: EMI-001A, "NTS 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." 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. All pre/post tests will be conducted by qualified NTS personnel at the NTS Huntsville, AL, facility.

4.4.3 Software Module Test Case Design and Data

NTS personnel implements Component Level Testing during the FCA for each component and subcomponent exercising the functionality of each as designed and documented. NTS will utilize limited structural-based techniques (white-box testing) mainly in the area of Source Code Review, Compliance Builds, and Security Testing and Review. NTS will depend heavily on specification-based techniques (black-box testing) for the individual software components. The most common specification-based techniques applied to the MicroVote EMS 4.1 during software testing will be "equivalence partitioning" and "boundary value testing."

4.0 TEST SPECIFICATIONS (Continued)

4.4 Test Case Design (Continued) (Continued)

4.4.3 Software Module Test Case Design and Data (Continued)

- "Equivalence partitioning" will be used to evaluate specific software functions and data entry points of the EMS 4.1 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.

NTS personnel 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 manufacturer and VSTL will determine the root cause of the error. If the root cause has been corrected and the SUT performs as expected, then the results will be accepted. If the root cause cannot be determined, the problem has not been corrected, or the SUT still does not perform as expected, the SUT will have failed the test.

NTS personnel will document the error and track the error through resolution. NTS personnel 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.

4.4.4 Software Functional Test Case Design and Data

The test approach to be used for the MicroVote EMS 4.1 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 NTS personnel at the Integration Level is "Use Case." The actors that have been identified to use the MicroVote EMS 4.1 are:

- 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 Infinity Panels. This actor also runs diagnostic test and maintains the units.

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4.0 TEST SPECIFICATIONS (Continued)

4.4 Test Case Design (Continued) (Continued)

4.4.4 Software Functional Test Case Design and Data (Continued)

- Poll Worker - The actor at the precinct location to set up and close down the Infinity Panels on Election Day.
- Voter - The actor who physically casts the ballot on Election Day.
- 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 result post-election day.

"Use Case" will be utilized 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 and Usability.

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 shall be documented and tracked through resolution. Engineering analysis shall 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.

4.4.5 System Level Test Case Design

During system level testing, NTS personnel will test the ability of proprietary software, hardware, and peripherals in addition to the COTS software, hardware, and peripherals as a complete system in a configuration of the systems for intended use. The EMS 4.1 voting system is intended to support both large and small jurisdictions. NTS personnel's approach for the EMS 4.1 Voting System will be to execute System Level Testing with a variety of elections that include various combinations of jurisdictions, parties, and ballot styles.

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) no errors are found, or 2) an error is encountered but the system continues to operate and engineering analysis determines that the root cause does not affect system testing. REJECT is when an error is encountered and the system is too unstable to continue or engineering analysis determines the root cause could affect further testing. If an error occurs during system level testing, the error shall be documented. If the EMS 4.1 voting system is able to recover and continue, the test will continue. If the error causes the system to become unstable, the test shall be halted. All errors documented during System Level Testing shall be tracked through resolution.

An engineering analysis shall be performed to determine what effect the resolution has on the system. A determination shall be made by NTS senior level engineers whether regression testing shall be sufficient or a complete re-test is necessary.

4.0 TEST SPECIFICATIONS (Continued)

4.4 Test Case Design (Continued)

4.4.5 System Level Test Case Design (Continued)

NTS personnel will implement 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 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 functions supported by the EMS 4.1 voting system have been tested. The EAC 2005 VVSG requirements will be checked against the test data to ensure all applicable requirements are met. Items not supported by the EMS 4.1 Voting System will be documented. Any issues documented during testing will be resolved or annotated in the test report.

NTS personnel will test every EAC 2005 VVSG requirement impacted by the EMS 4.1 Voting System modification. NTS personnel will report all issues discovered during this test campaign to MicroVote and the EAC. If NTS Laboratories determines there is not enough data to ensure a requirement was met, the test plan will be altered and further testing will be done. The EAC has the final decision as to whether the system meets all the requirements for an EAC-certified system. NTS will either recommend approval, if the system meets all applicable sections of the VVSG, or recommend disapproval if the system does not meet all applicable sections of the VVSG.

4.5 Security Functions

The purpose of security testing shall be to evaluate the effectiveness of the EMS 4.1 Voting System in detecting, preventing, logging, reporting, and recovering from any security risks identified by simulating attacks on the system; NTS personnel have developed internal operating procedures to evaluate the EMS 4.1 Voting System to the security requirements set forth in the EAC 2005 VVSG. These procedures have been specifically tailored to assess the EMS 4.1 Voting System to the applicable requirements. NTS personnel will attempt to defeat the access controls and physical security measures documented in the MicroVote technical data package. The exterior housing of the Infinity remained unchanged in Revision D and will not be reviewed for physical security. The change from Windows XP to Windows 7 will be reviewed to ensure that all security provisions for Windows 7 are being addressed.

NTS personnel will utilize a combination of functional testing, source code review, and Fortify SCA to evaluate the EMS 4.1 Voting System. NTS personnel will report all issues discovered during this test campaign to MicroVote and the EAC. A report containing all findings shall be issued to the EAC as an addendum to the final test report.

4.6 TDP Evaluation

NTS qualified personnel will perform a comprehensive review of the MicroVote TDP to determine compliance to the EAC 2005 VVSG requirements and MicroVote specific requirements.

NTS qualified personnel utilize a TDP Review Matrix which lists every EAC 2005 VVSG requirement pertaining to TDP review. NTS qualified personnel will record the results of the review of each document to the applicable requirements listed in the TDP Review Matrix.

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4.0 TEST SPECIFICATIONS (Continued)

4.6 TDP Evaluation (Continued)

During the TDP review process, each document will be reviewed for completeness, clarity, correctness, and continuity. The review results will be formally reported to MicroVote. 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, a Discrepancy 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 EMS 4.1 Voting System TDP is provided in Appendix D.

4.7 Source Code Review

The strategy for evaluating EMS 4.1 will be based on the source code of the previously identified modifications to the system. All code changes from EMS 4.0B will be reviewed to the EAC 2005 VVSG coding standards.

As the source code is received, a SHA256 hash value will be created for each source code file. NTS source code team will conduct a visual scan of each line of source code for an initial review and every line of modified source code for acceptance for all languages. This is done to verify compliance of EAC 2005 VVSG coding standards. Each identified violation shall be recorded by making notes of the standards violation along with directory name, file name, and line number

A technical report of all identified violations will be sent to MicroVote for resolution on a regular basis. All revised source code will be checked for corrections until the final issue is resolved. At the end of the Source Code review process, a Discrepancy Report will be issued listing all non-compliances, to the EAC and MicroVote. The results will be included in the final test report.

A "Compliance Build" shall be performed by NTS qualified personnel from the reviewed source code using the Compliance Build Procedure throughout the test campaign. This process follows the documented procedures of a "Trusted Build" in the EAC Testing and Certification Program Manual, Version 1.0, but differs from a Trusted Build with two exceptions: The image products will not be submitted to the EAC, and no manufacturer representative shall be required to be present or on-site for these builds. The final step in the source code review shall be to create a Trusted Build from the reviewed source code. The Trusted Build will be performed by completing the following tasks in the order listed:

1. Clean the build machine of existing software
2. Retrieve the compliant source code
3. Construct the build environment
4. Create digital signatures of the build environment
5. Load the compliant source code into the build environment
6. Create a digital signature of the pre build environment
7. Create a disk image of the pre-build environment
8. Build executable code

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4.0 TEST SPECIFICATIONS (Continued)

4.7 Source Code Review (Continued)

9. Create a digital signature of executable code
10. Create a disk image of the post-build environment
11. Build installation media
12. Create a digital signature of the installation media
13. Install executable code onto the system and validate the software/firmware
14. 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 the EAC Approved Repository.

The "Trusted Build" for the MicroVote EMS 4.1 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 SHA256 from the software supplier, and picture and sound files in binary format provided by MicroVote. 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 appropriate operating system will then be loaded and the applications from the VSTL reviewed source files 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

Both the MicroVote QA Plan and CM Plan will be reviewed. The review will be limited to only the changes within this modification 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 MicroVote documentation. Also, the MicroVote TDP documentation package will be reviewed to determine if the MicroVote QA Plan and the CM Plan are being followed. The results of the TDP review shall be entered on a spreadsheet as previously described in Section 4.6 of this test plan. The results of the TDP review, including the QA and CM compliance results of the Technical Data Package Review, will 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 shall be listed on the Instrumentation Equipment Sheet for each test. The output test data shall be recorded in an appropriate manner as to allow for data analysis. For source code and TDP reviews, results shall be compiled in output reports and submitted to MicroVote for resolution.

Additionally, all test results, including functional test data, will be recorded on the relevant NTS Operating Procedure and Test Cases. Results will also be recorded real-time in engineering log books. Incremental reports will be submitted to MicroVote and the EAC at the completion of major test areas to communicate progress and results as deemed necessary by the stakeholders.

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5.0 TEST DATA (Continued)

5.2 Test Data Criteria

NTS personnel will evaluate all test results against the MicroVote provided technical documentation for EMS 4.1 and the requirements set forth in the EAC 2005 VVSG. The acceptable range for system performance and the expected results for each test case shall be derived from the EMS 4.1 documentation. Per the EAC 2005 VVSG, these parameters shall encompass the test tolerances and samples to define 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. The parameters will also include events with criteria defining 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 processed and recorded in the relevant NTS 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 NTS Laboratories Huntsville, AL facility unless otherwise annotated. Environmental non-operating (storage) and operating hardware testing will be conducted utilizing an adequately sized environmental test chamber or dynamic vibration (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 NTS 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: 68 to 75 degrees Fahrenheit
- Relative Humidity: 20 to 90%
- Atmospheric Pressure: Local Site Pressure

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.1 Facility Requirements (Continued)

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

- Time ± 5%
- Temperature ± 3.6°F (2°C)
- Vibration Amplitude ± 10%
- 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 responsible test laboratory 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 NTS Receiving Ticket (WL-218, Nov. '85) and proper QA procedures. When voting system hardware is received, NTS personnel will notify NTS QA personnel. With NTS 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, photographed, and the MicroVote Representative shall be notified. NTS 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 MicroVote representative for resolution. All TDP and source code modules received will be inventoried and maintained by the NTS Project Engineer assigned to testing.

For test setup, the system will be configured as it would for normal field use. This includes connecting all supporting equipment and peripherals. NTS personnel will properly configure and initialize the system, and verify that it is ready to be tested by following the procedures detailed in the EMS 4.1 voting system technical documentation. NTS personnel will develop an Operational Status Check to be performed prior to and immediately following each hardware test. NTS personnel will develop the system performance levels to be measured during operational tests.

NTS personnel have developed eight election definitions that shall be used during this test campaign:

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

Operational Status Check

This election definition will exercise the operational status of the equipment during the operational tests and prior to and immediately following the non-operational hardware tests.

Accuracy

The accuracy test ensures that each component of the voting system can 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 measured 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.

General Election: GEN-01

The Gen-01 is 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 fourteen 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: Yes
- Straight Party voting: Yes
- Cross-party endorsement: No
- Split Precincts: Yes
- Vote for N of M: Yes
- Recall issues, with options: No

6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

General Election: GEN-01 (Continued)

- Cumulative voting: No
- Ranked order voting: No
- Provisional or challenged ballots: Yes
- Early Voting: No

In addition to the parameters listed above, the following will also be tested:

- Audio input in an alternative language for basic voting pattern using an ADA device
- Audio input for write-in voting using an ADA device
- Spanish language input for a basic voting pattern
- Input for write-in voting using Spanish language

General Election: GEN-02

The Gen-02 is 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

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

General Election: GEN-02 (Continued)

- Recall issues, with options: Yes
- Cumulative voting: No
- Ranked order voting: Yes
- Provisional or challenged ballots: No
- Early Voting: Yes

In addition to the parameters listed above, the following will also be tested:

- Early voting election with at least one unit in all precincts
- Voting options for over-voting
- Voting options for under-voting
- Spanish language ballots
- Audio ballots utilizing ADA capabilities

General Election: GEN-03

The Gen-03 is 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

6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

General Election: GEN-03 (Continued)

- 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

In addition to the parameters listed above, the following will also be tested:

- Spanish language ballot with a basic voting pattern and write-in candidates
- Spanish audio input to simulate ADA device with write-in option
- Character based language with basic voting pattern
- Character based language utilizing an ADA option
- Binary input to support ADA option
- Binary input to support ADA audio device

Primary Election: PRIM-01

The Prim-01 is a closed primary election in two precincts (one precinct is a split), 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: Yes
- Open Primary: No
- Partisan offices: Yes
- Non-Partisan offices: Yes
- Write-in voting: Yes
- Primary presidential delegation nominations: No
- Ballot Rotation: No

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

Primary Election: PRIM-01 (Continued)

- 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

In addition to the parameters listed above, the following will also be tested:

- Alternative language utilized with a write-in option
- ADA audio device utilized with a write-in option

Primary Election: PRIM-03

The Prim-03 is 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 party 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.

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

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.2 Test Set-Up (Continued)

Primary Election: PRIM-03

- 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

In addition to the parameters listed above, the following will also be tested:

- Spanish ballot with basic voting pattern and write-in option
- Spanish language ballot using ADA audio device with write-n option
- Character based language ballot with basic voting pattern
- Character based language utilizing ADA device
- Binary input to support ADA option
- Binary input to support ADA audio device

6.3 Test Sequence

The components of the EMS 4.1 voting system will undergo testing to verify that the modification performs as described by MicroVote and meets the requirements of the 2005 VVSG. The following sections provide a list of each test and a brief description of each test. NTS personnel will utilize a combination of functional testing and TDP reviews to evaluate the system performance. (The tests are not in a specific sequence.)

6.3.1 Hardware Test Descriptions

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 shall be subjected to an operational status check.

6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.3 Test Sequence (Continued)

6.3.1 Hardware Test Descriptions (Continued)

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.

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.

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.

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.

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

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).

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.3 Test Sequence (Continued)

6.3.1 Hardware Test Descriptions (Continued)

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

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

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

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

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

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

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

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

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.3 Test Sequence (Continued)

6.3.2 Software Test Descriptions

The software tests include the following:

Source Code Compliance Review – NTS qualified 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 the EAC 2005 VVSG Volumes I and II.

Compliance Build of the System Software, Firmware, and Utilities – Before testing can begin, compliance builds of all the applications will be constructed by NTS personnel using the build environment, build documentation, and reviewed source code. This is to ensure 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, database management systems, and web browsers) are not subject to the detailed examinations specified in this section; however, NTS personnel will examine such software to ensure that the specific version of software being used is identical to the design specification in order to confirm that the software has not been modified. NTS will verify by downloading the software directly from the manufacturer site, verifying against NRSL, or by being provided original OEM discs.

NTS qualified personnel 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. For purposes of code analysis, the COTS units shall be treated as unexpanded macros.

The portions of COTS software that have been modified by the manufacturer in any manner are subject to review. Source code generated by a COTS package and embedded in software modules for compilation or interpretation will be provided in human readable form to NTS personnel to enable review.

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

Security Source Code Review – The security source code review is a detailed review of the functionality of the source code that has been submitted. A manual line by line review will be performed for all submitted code.

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.3 Test Sequence (Continued)

6.3.2 Software Test Descriptions (Continued)

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 EMS 4.1 Voting System Software Test Sequence

Test	Description	Procedure	Test Level	Specimen
Technical Data Package (TDP) Review	Documentation review for compliance, correctness, and completeness	WHVS07.1 OP 3	Document	TDP package
Compliance Source Code Review	Source code review for compliance	WHVS07.2 OP 5a	Component	Source Code
Physical Configuration Audit	Audit hardware and software models and versions	WHVS07.3 OP 25	Component & System	System hardware and software
Compliance Build	Using the build documents and source code to construct the EMS	WHVS07.3 OP 25	Component	Source Code
Functional Configuration Audit	Functional testing to the system documentation and EAC 2005 VVSG requirements	WHVS07.4 OP 26 OP30a	Component & Integration	System
Source Code COTS Review	Source code review to examine 3rd party products for modification and versions	WHVS07.2 OP 5d	Component	COTS Source Code
Baseline OS	RFI 2008-03 OS Configuration	WHVS07.3 OP 25	Component	NIST SCAP FDCC Checklist
Source Code Functional Review	Source code review for functionality and high level software design	WHVS07.2 OP5b	Component & Integration	Source Code
Source Code Security Review (manual)	Source code review for specific security concerns augmented by an automated review	WHVS07.2 OP5d OP 6a	Component & Integration	Source Code
Trusted Build	Creation and installation of the final system software	WHVS07.6 OP 7, OP 7a	Component	System software

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6.0 TEST PROCEDURES AND CONDITIONS (Continued)

6.3 Test Sequence (Continued)

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
- If the hardware is non-COTS, NTS will review drawings, specifications, technical data, and test data associated with system hardware to establish system hardware baseline associated with software baseline
- Review manufacturer's documents of user acceptance test procedures and data against system's functional specifications; resolve any discrepancy or inadequacy in manufacturer's plan or data prior to beginning system integration functional and performance tests
- Subsequent changes to baseline software configuration made during testing, as well as system hardware changes that may produce a change in software operation are subject to re-examination

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 in 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. This testing is accomplished through a process called sequencing.

Sequencing is the act of navigating through the user interface to verify that the system performs as described by the manufacturer and does not violate any of the VVSG requirements. The path that the tester navigates follows the logical flow of accomplishing task required to conduct an election. For example, a task in conducting an election is to add a candidate. The tester will follow the flow of the user interface to add the candidate to a contest. If there are multiple ways to achieve this, then each method will be tested. This process will continue until all tasks for conducting an election are completed. Any paths, or combination of paths, that are determined to be at risk for failure that are outside of the normal flow of the interface will be tested on an individual basis.

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.

6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (Continued)

6.3.3 System Testing (Continued)

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 MicroVote 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.

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

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

- 85% of the necessary ballots will be cast using an external auto casting tool. The tool uses a script to mimic the actions of the voter. This reduces the risk of human error.
- 15% of the votes will be manually cast.

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.

Additionally, the system shall be configured exactly as it would for normal field use. This includes connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties. NTS personnel will properly configure and test the system by following the procedures detailed in the EMS 4.1 voting system technical documentation.

Regression Testing - Regression Testing will be performed on all system components to verify all functional and firmware modifications made during the test campaign did not adversely affect the system and its operation.

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6.0 TEST PROCEDURES AND CONDITIONS (CONTINUED)

6.3 Test Sequence (Continued)

6.3.3 System Testing (Continued)

NTS will verify the audit log records for error and exception activity to verify proper documentation and recovery action for all functional tests performed. A detailed listing of all audit log entries shall be provided by MicroVote in the TDP submitted. During testing, audit log entries will be compared to this list to ensure that all expected events are 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.

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.

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APPENDIX A

PROJECT SCHEDULE

Page No. A-2 of 2
Certification Test Plan T71571.01 Rev B

Test Plan	**35 days**	**Mon 5/5/14**	**Tue 6/24/14**
Test Plan Submitted to EAC	0 days	Mon 5/5/14	Mon 5/5/14
EAC Test Plan Review	20 days	Mon 5/5/14	Mon 6/2/14
Test Plan Revision	5 days	Tue 6/3/14	Tue 6/10/14
Test plan Re-Submission	0 days	Tue 6/10/14	Tue 6/10/14
EAC Re-Review	10 days	Wed 6/11/14	Tue 6/24/14
TDP Review	**50 days**	**Mon 4/21/14**	**Tue 7/1/14**
Source Code	**3 days**	**Mon 5/5/14**	**Wed 5/7/14**
Review Complete	0 days	Mon 5/5/14	Mon 5/5/14
Source Code Build	3 days	Mon 5/5/14	Wed 5/7/14
System Setup	**3 days**	**Thu 5/8/14**	**Mon 5/12/14**
Hardware Testing EMI	**10 days**	**Wed 4/30/14**	**Tue 5/13/14**
Lightning Surge	1 day	Wed 4/30/14	Wed 4/30/14
Electromagnetic Radiation	1 day	Thu 5/1/14	Thu 5/1/14
Electromagnetic Susceptibility	2 days	Fri 5/2/14	Mon 5/5/14
Electrostatic Disruption	1 day	Tue 5/6/14	Tue 5/6/14
Conducted RF Immunity	1 day	Wed 5/7/14	Wed 5/7/14
Electrical Fast Transient	2 days	Thu 5/8/14	Fri 5/9/14
Magnetic Fields Immunity	1 day	Mon 5/12/14	Mon 5/12/14
Electrical Power Disturbance	1 day	Tue 5/13/14	Tue 5/13/14
Hardware Testing ENV	**13 days**	**Wed 4/23/14**	**Fri 5/9/14**
Vibration	1 day	Wed 4/23/14	Wed 4/23/14
Bench Handling	1 day	Thu 4/24/14	Thu 4/24/14
High Temperature	1 day	Fri 4/25/14	Fri 4/25/14
Low Temperature	1 day	Mon 4/28/14	Mon 4/28/14
Humidity	264 hrs	Mon 4/28/14	Fri 5/9/14
Temperature Power	**85 hrs**	**Tue 5/13/14**	**Sat 5/17/14**
FCA	**5 days**	**Wed 6/25/14**	**Tue 7/1/14**
Security	**14 days**	**Wed 6/25/14**	**Mon 7/14/14**
SCAP Checklist	14 days	Wed 6/25/14	Mon 7/14/14
System ST&E	5 days	Wed 6/25/14	Tue 7/1/14
Electrical Supply Test	**3 days**	**Mon 5/19/14**	**Wed 5/21/14**
Accuracy	**5 days**	**Wed 7/2/14**	**Tue 7/8/14**
Maintainability	**3 days**	**Wed 6/25/14**	**Fri 6/27/14**
System Intgration	**5 days**	**Wed 7/9/14**	**Tue 7/15/14**
Regression	**5 days**	**Wed 7/16/14**	**Tue 7/22/14**
Build and Tool Verification	**5 days**	**Wed 7/23/14**	**Tue 7/29/14**
Test Report	**43 days**	**Wed 7/23/14**	**Mon 9/22/14**
Test Report Creation	5 days	Wed 7/23/14	Tue 7/29/14
Test Report to MicroVote	2 days	Wed 7/30/14	Thu 7/31/14
Test Report Update	3 days	Fri 8/1/14	Tue 8/5/14
Report Submitted to EAC	0 days	Tue 8/5/14	Tue 8/5/14
EAC Review	20 days	Wed 8/6/14	Wed 9/3/14
Report Corrections	3 days	Thu 9/4/14	Mon 9/8/14
EAC Re-Review	10 days	Tue 9/9/14	Mon 9/22/14

APPENDIX B

CHANGE NOTES

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Item Number	Module Affected	Modification
E-01	EMS	The revised system will support variable size Tally smart cards.
D-01	EMS	Audit reporting is now available within the EMS application as a standard report. Previously this was provided via multiple disk files.
D-02	EMS	Database version control has been added to prevent the opening of backup elections containing executable code from other versions of the EMS software.
EOL -1	Infinity Panel	New Infinity processor board/bridge/heat sink assembly (PCM-3336-BRIDGE-A03) to replace current EOL processor board. New Infinity firmware is compatible with both the current and new processor boards.
EOL -2	GEMPLUS	New USB PC/SC compatible smart card reader support to replace EOL serial port smart card reader attached to EMS computer.
EOL -3	Visual Studio	Upgraded EMS development environment to Visual Studio 2013 to replace EOL Visual Studio 2003.
EOL -4	.Net Framework	Upgraded Microsoft .Net Framework to version 3.5 SP1 to replace EOL version 1.1.
EOL -5	Windows XP	Upgraded OS to Microsoft 7 Professional from EOL Windows XP SP2 and installed latest security patches.
EOL -6	ComponentOne	Upgraded ComponentOne library to current Ultimate version from EOL Enterprise version.
EOL -7	Franson SerialTools	Eliminated requirement for EOL Franson SerialTools assembly as this functionality is built into Visual Studio 2013.
EOL -8	SQL Server 2012	Upgraded database server to Microsoft SQL Server 2012 Express from EOL Microsoft SQL Server 2000 Desktop Edition (MSDE).
EOL -9	Microsoft InstallShield	Upgraded project installation to Advanced Installer Enterprise Edition V11.0 from EOL Microsoft InstallShield
EOL - 10	EMS Laptop	Added new Dell Latitude E5440 Series laptop in addition to currently certified laptop and desktop computers.

APPENDIX C

COTS SOFTWARE TABLE

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The EMS 4.1 System includes the following COTS software which has been delivered by MicroVote:
* NOTE: All hashes for COTS software were obtained from the COTS provider and then verified by NTS. All propriety software developed by the manufacture is built by NTS and the hashes are provided by NTS.

Software Product	Software Version	Filename	SHA256 Hash Value
Microsoft Windows	7 SP1	TBD	TBD
Microsoft SQL Server Express 2012	TBD	TBD	TBD
2013 ComponentOne library Ultimate edition	3.1	TBD	TBD
AVG Free Edition	TBD	TBD	TBD
Advanced Installer Enterprise Edition	V11.1	TBD	TBD
Visual Studio 2013	TBD	TBD	TBD
Microsoft .Net Framework to version	3.5 SP1	TBD	TBD

File name	Assembly version	Company	File version	Internal Name	Product Name	Product Version	SHA256 Hash Value
C1.C1Report.2.dll	2.6.20141.54717 (or greater)	GrapeCity, Inc.	2.6.20141.54717 (or greater)	C1.C1Report.2.dll	ComponentOne Reports for .NET	2.6.20141.54717 (or greater)	TBD
C1.Win.C1Command.2.dll	2.0.20141.19608 (or greater)	GrapeCity, Inc.	2.0.20141.19608 (or greater)	C1.Win.C1Command.2.dll	ComponentOne C1Command	2.0.20141.19608 (or greater)	TBD
C1.Win.C1FlexGrid.2.dll	2.6.20141.822 (or greater)	GrapeCity, Inc.	2.6.20141.822 (or greater)	C1.Win.C1FlexGrid.2.dll	ComponentOne C1FlexGrid	2.6.20141.822 (or greater)	TBD
C1.Win.C1Input.2.dll	2.0.20133.33332 (or greater)	GrapeCity, Inc.	2.0.20133.33332 (or greater)	C1.Win.C1Input.2.dll	ComponentOne C1Input	2.0.20133.33332 (or greater)	TBD
C1.Win.C1List.2.dll	2.1.20141.248 (or greater)	GrapeCity, Inc.	2.1.20141.248 (or greater)	C1.Win.C1List.2.dll	ComponentOne C1List	2.1.20141.248 (or greater)	TBD
C1.Win.C1Report.2.dll	2.6.20141.54717 (or greater)	GrapeCity, Inc.	2.6.20141.54717 (or greater)	C1.Win.C1Report.2.dll	ComponentOne Reports for .NET	2.6.20141.54717 (or greater)	TBD
Microsoft.visualbasic.dll	n/a	Microsoft	8.0.50727.5420	N/A	N/A	N/A	TBD
Mscorlib.dll	n/a	Microsoft	2.0.50727.5477	Mscorlib.dll	.Net Framework	2.0.50727.5477	TBD
System.core.dll	n/a	Microsoft	3.5.30729.5420	System.core.dll	.Net Framework	3.5.30729.5420	TBD
System.data.dll	n/a	Microsoft	2.0.50727.5459	System.data.dll	.Net Framework	2.0.50727.5459	TBD
System.dll	n/a	Microsoft	2.0.50727.5467	System.dll	.Net Framework	2.0.50727.5467	TBD
System.drawing.dll	n/a	Microsoft	2.0.50727.5467	System.drawing.dll	.Net Framework	2.0.50727.5467	TBD
System.speech.dll	n/a	Microsoft	3.0.6920.1109	System.speech.dll	Windows Speech Library	3.0.6920.0	TBD
System.windows.forms.dll	2.0.50727.5468	Microsoft	2.0.50727.5468	System.windows.forms.dll	.Net Framework	2.0.50727.5468	TBD
System.xml.dll	2.0.50727.5476	Microsoft	2.0.50727.5476	System.xml.dll	.Net Framework	2.0.50727.5476	TBD

APPENDIX D

TECHNICAL DATA PACKAGE

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DO1.2TDP - System Functionality Description	1.2
DO2.8TDP - Software Design Specification	2.8
DO1.8TDP - System Security Specification	1.8
DO1.9TDP - System Maintenance Procedures	1.9
DO1.1TDP - Personal Deployment and Training Requirements	1.1
DO1.5TDP - Configuration Management Plan	1.5
DO4.0TDP - Infinity Panel Manual	4.0
DO4.0TDP - Infinity Firmware Functional Specification	4.0
DO1.5TDP - COTS Specifications	1.5
DO1.1TDP - Glossary of Terms	1.1
DO1.5TDP - Voting Variations	1.5
DO1.0TDP - ACP2200 Readme	1.0
DO1.0TDP - ACP2200 Manual	1.0
DO1.0TDP - Seiko 3445 Manual	1.0
DO1.0TDP - Seiko 414 Manual	1.0
DO1.0TDP - DoubleTalk Manual	1.0
DO1.0TDP - StarTech USB Card Reader Manual	1.0
DO1.0TDP - Appendix P – Checklist	1.0
DO1.6TDP - GUI Specifications	1.6
DO1.9TDP - Poll Workers Manual	1.9
DO2.9TDP - User Manual	2.9
DO0.2TDP - Machine Technician Manual	0.2
DO1.6TDP - MicroVote System Identification Tool	1.6
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DO1.5TDP-AppAppB_Carson_Mfg_Docs	1.5
DO1.5TDP-AppAppE_COTSTestForms	1.5
DO1.5TDP-AppAppH_ACP2200_README	1.5
DO1.5TDP-AppAppI_ACP2200_Manual	1.5
DO1.5TDP-AppAppJ_Seiko3445_Manual	1.5
DO1.5TDP-AppAppK_Seiko414_Manual	1.5
DO1.5TDP-AppAppN_DOUBLETALK_Manual	1.5
DO1.5TDP-AppAppO_BAY 7-IN-1 USB 2.0 Flash Card Reader	1.5
DO1.5TDP-AppAppP_Checklists	1.5
DO1.5TDP-AppAppQ_Defect_Tracking	1.5
DO1.5TDP-AppAppW_CountyInvoice	1.5
DO1.5TDP-AppAppX_SourceCode_List	1.5
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DO1.5TDP-AppDO1.5TDP-C.doc	1.5
DO1.5TDP-AppDO1.5TDP-F.doc	1.5
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DO1.5TDP-AppDO1.9TDP-U.DOC	1.5
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APPENDIX E - STATE TEST REPORTS

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