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Test Report for EAC 2005 VVSG Certification Testing
Clear Ballot Group ClearVote 1.4 Voting System

EAC Project Number: CBG1601

Version: Initial Release

Date: 11/17/17

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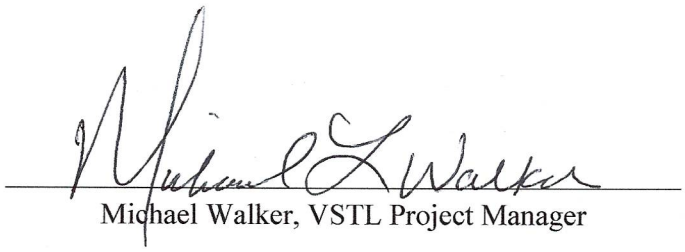
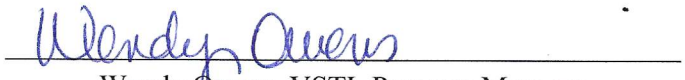
SIGNATURES

Approved by:  11/17/17

Michael Walker, VSTL Project Manager — Date

Approved by:  11/17/17

Wendy Owens, VSTL Program Manager — Date

REVISIONS

Revision	Description	Date
NR	Initial Release	11/17/17

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APPENDICES

1.0 INTRODUCTION

The purpose of this Test Report is to document the procedures that Pro V&V, Inc. followed to perform full certification testing during a new system campaign for the Clear Ballot Group (CBG) ClearVote 1.4 voting system to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Certification testing of the ClearVote 1.4 voting system submitted for evaluation was performed to ensure the applicable requirements of the EAC 2005 VVSG and the EAC Testing and Certification Program Manual, Version 2.0, were met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test were incorporated in the test campaign.

Prior to submitting the voting system for testing, CBG submitted an application package to the EAC for certification of the ClearVote 1.4 voting system. The application was accepted by the EAC and the project was assigned the unique Project Number of CBG1601.

1.1 System Identification and Overview

The ClearVote 1.4 voting system is a paper-based optical scan voting system consisting of the following major components: ClearDesign (ballot design and EMS), ClearCount (central count, tabulation, and election reporting), ClearCast (precinct count and tabulation), and ClearAccess (accessible voting and ballot marking device).

ClearDesign

ClearDesign is an Election Management System consisting of an interactive set of applications which are responsible for all pre-voting activities necessary for defining and managing elections. This includes ballot design, ballot proofing, ballot layout, and ballot production. The ClearDesign system consists of the physical components listed below. All of the components and generation of voting machine election definition file packages are unmodified COTS that are connected via a wired, closed, and isolated network not connected to any other systems or the Internet.

- DesignServer: A laptop or desktop computer running the ClearDesign software and hosting its election database and the web server that serves its election reports.
- DesignStation(s): One or more laptop or desktop used to connect to the DesignServer. A browser is used to perform the necessary tasks. A user with administration privileges will be able to define users and manage the elections.
- Router: Used to connect the DesignStations to the DesignServer using a wired, closed Ethernet-based network.

ClearCount

ClearCount is a central, high-speed, optical scan ballot tabulator coupled with ballot processing applications. The ClearCount software runs on unmodified COTS laptop or desktop computers running the Windows operating system and supports specific models of Fujitsu scanners. The ClearCount central-count system running an Ubuntu Linux operating system, with Ethernet connections to workstations running the Windows operating system consists of the physical components listed below. All of the components are unmodified COTS that are connected via a wired, closed, and isolated network not connected to any other systems or the Internet.

- ScanServer: A laptop or desktop computer running the ClearCount software and hosting its election database and the web server that serves its election reports.
- ScanStation(s): One or more laptop or desktop/scanner pairs used to scan and tabulate ballots.
- Router: Used to connect the ScanStations to the ScanServer using a wired, closed Ethernet.
- Election Administration Station and/or Adjudication Station: One or more Windows laptop or desktop computers installed with browser software, linked by a wired Ethernet connection to the ScanServer using the router. This station can serve multiple uses: user administration, election administration, adjudication, and reporting. This station is also used to consolidate the vote totals from the ClearCast precinct tabulator.

All files that make up the ClearCount software reside on a single ScanServer that is shared by all client ScanStations. The Tabulator software is executed by the ScanStations at run-time from files that reside on the ScanServer. The only software programs that have to be installed on ScanStations, apart from the Windows operating system, are the Fujitsu ScandAll Pro software and drivers required by the scanner hardware.

The ClearCount software consists of the following components:

- Tabulator: The Tabulator application handles ballot tabulation. The Tabulator software is stored on the ScanServer and an instance of Tabulator runs on each ScanStation. The Tabulator program analyzes the incoming image and transfers them to the local output folder named CBGBallotImages. The ScanServer retrieves the images from the folder and uploads them into the Election database.
- Election Database: A centralized election database that resides on the ScanServer and collects the output of each Tabulator.
- Election Reports: A browser-based suite of reports that provides election results and analysis and allows election officials to review individual ballot images. A web server on the ScanServer serves the reports.
- Card Resolutions tool: A web application that allows election officials to review and appropriately resolve unreadable voted ballots.
- User and Election Database Management through web applications: On the User Administration dashboard, the administrator can add, rename, or delete users, assign permissions, and change user passwords. On the Election Administration dashboard, the administrator can create or delete an election, set an election as active, and backup or restore an election.

ClearCast

The ClearCast tabulator is a precinct count ballot scanning solution suitable for early and election in-person voting, including processing ballots printed by the ClearAccess accessible ballot marking device. The ClearCast application runs on the precinct count-based tabulator, and is used to scan, count and tally marked ballots. Its functionality is divided into three essential modes, Election Mode (Early Voting and/or Election Day), which is used to process voter cast ballots, Pre-Election Mode, this occurs prior to Election Mode, and is used to test all system functionality subsequent to the start of the election, and Post-Election Mode, which is used to perform administrative functions following the close of the election.

ClearAccess

ClearAccess is an accessible touchscreen ballot marking device (BMD) used for the creation of paper ballots that can be scanned and tabulated by Clear Cast or ClearCount. Like other components of the ClearVote voting system, ClearAccess uses unmodified off-the-shelf hardware such as laptop and desktop computers, combined with personal assistive devices, printers, and uninterruptible power supplies to form a ballot-marking device.

1.1.1 Software

This subsection lists the proprietary and COTS software provided by the manufacturer as part of the test campaign. The individual components are compiled to create the ClearVote 1.4 voting system (ClearCast 1.4, ClearCount 1.4, ClearDesign 1.4, and ClearAccess 1.4).

Table 1-1. Voting System Software

Firmware/Software	Version
ClearDesign Components, Version 1.4.3	
Windows	10 Pro 1607
Google Chrome	55.0.2883.87
Ubuntu	14.04.4 LTS
MySQL	5.5.55
Apache	2.4.7
libapache2-mod-fcgid	2.3.9
PhantomJS	1.9.0
Usbmount	0.0.22
Unzip	6.0.9
Samba	4.3.11
Python PIP	1.5.4
Zip	3.0.8
Pyinstaller	3.0
Python JSMIN	2.2.1
Python	2.7.6

Table 1-1. Voting System Software (continued)

Firmware/Software	Version
ClearDesign Components, Version 1.4.3	
Python webpy	0.38
Python MySQL DB	1.2.3
SQLAlchemy	1.0.15
Python Pillow	2.3.0
Python Flup	1.0.2
Python DBUtils	1.1
Python XLRD	0.9.4
Python FontTools library	3.0
Python RTF	0.2.1
OpenSSL (FIPS)	2.0.5
OpenSSL	1.0.1f
DataTable	1.10.5
DataTable-TableTools	2.2.3
DataTable-ColVis	1.1.1
DataTable-ColReorder	1.1.2
DataTablePlugins	1.10.10
bootstrap	3.0.0
jquery	1.10.2
jquery-impromptu	5.2.3
jquery-qrcode	1.0
jquery-splitter	0.14.0
jquery-ui	1.10.4
jscolor	1.4.2
tinymce	4.1.9
fastclick	1.0.4
libmp3lame	0.5.0
jszip	3.1.2
papaparse	4.1.2
jsmin	12/4/2003
ClearAccess Components, Version 1.4.1	
Windows	10 Pro 1607
Google Chrome	61.0.3163.100
nsis	3.01
PyInstaller	3.2
Python	2.7.10

Table 1-1. Voting System Software (continued)

Firmware/Software	Version
ClearAccess Components, Version 1.4.1	
webpy	0.38
Python-future	0.15.2
pefile	2016.3.28
pywin	220
jquery	1.10.5
DataTables	1.10.5
ColVis	1.1.1
ColReorder	1.1.2
jsmin	2003-12-04
Brother printer driver	1.0.1.0
Okidata printer driver	1.0.0.0
ClearCast Components, Version 1.4.2	
scanner_control	0.0.28
UPSBatteryMontior	1.0
Ubuntu	14.04.5 LTS
google_chrome	62.0.3202.75-1
zeromq	4.2.0
arduino tools	1.8.0
adafruit tools	1.4.9
pyinstaller	3.2.1
openssl-fips	2.0.10
openssl	1.0.1f
libPDIScan.so	7.1.0
pdi_ps3_drv_scanner.ko	2.0.5
DataTables	1.10.5
JTSage DateBox	4.0.0
jQuery.NumPad	1.4
jQuery	1.10.2
jquery.ui	1.11.3
ClearCount Components, Version 1.4.2	
Windows	10 Pro 1607
Google Chrome	55.0.2883.87
Ubuntu	16.04.1 LTS
Python(part of Ubuntu)	2.7.12
Pillow (part of Ubuntu)	3.1.2

Table 1-1. Voting System Software (continued)

Firmware/Software	Version
ClearCount Components, Version 1.4.2	
MySQLdb (part of Ubuntu)	1.3.7
PyInstaller	3.2.1
PollyReports	1.7.6
OpenSSL	1.0.2g
OpenSSL FIPS Object Module	2.0.10
JavaScript Bootstrap library	2.3.2
JavaScript Chosen library	1.0.0
JavaScript jQuery library	1.10.2
J JavaScript jQuery-migrate library	1.2.1
JavaScript DataTables library	1.9.4
ColVis	1.0.8
JavaScript TableTools library	2.1.5
ZeroClipboard	1.0.4-TableTools2
JavaScript FixedHeader library	2.0.6
JavaScript hotkeys library	1.0
JavaScript tooltip library	1.3
JavaScript pep library	1.0
JavaScript LESS library	1.3.3
Fujitsu fi-6400	PaperStream 1.30.0
Fujitsu fi-6800	10.10.710
Fujitsu fi-7180	PaperStream 1.4.0

1.1.2 Equipment

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

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

Table 1-2. Voting System Equipment

Component	Model	Serial Number
ClearDesign Components		
Dell Latitude Laptop	5580	7L6M3G2
Dell PowerEdge Server	T630	2K5YFK2, JLPYHK2, & JLPXWK2
Dell 24 inch Monitor	SE2416H	FVWV5G2
Dell 22 inch Monitor	E2216HV	36765D2 & 90665D2
Dell Mini Tower	T3620	IHCLXK2 & IHCKXK2
TP-LINK VPN Router	TL-R600VPN	2149342000209, 2166306000413, & 2168351001114
Lenovo USB Portable DVD Burner	LN-8A6NH11B	8SSDX0H33226L1CB7107099
Brother Printer	HL-L2340DW	U63879A7N416353
ClearAccess Components		
Dell OptiPlex AIO	5250	6PW4GK2, BPYXCH2, HGCMGK2, & 6PWZFK2
Dell 15” Inspiron	7000 series	80S1YD2, 7TT1YD2, & 22S1YD2
Brother Laser Printer	HL-L2340DW	U63879M4N62861, U63879M4N628617, U63879A7N416353, & U63879M4N628535
Oki Data Laser Printer	B432dn	AK5B007647A0, AK76030925A0, AK76030928A0, AK62030437A0, AK62030440A0, & AK76030928A0
Storm EZ Access Keypad	EZ08-222013	15000005, 15000007, & 15020478
Origin Instruments Sip/Puff Breeze with Headset	AC-0313-H2	CBG-SP-001, CBG-SP-002, & CBG-SP-003
Hamilton Buhl Over-Ear Stereo Headphones	HA7	CBG-HP-001 & CBG-HP-002
ElectionSource Table Top Voting Booth (Privacy Screen)	VB-60B	CBG-VB-001
APC Smart-UPS	SMT2200	AS1602232215, AS1721142050, AS1638230963, AS1721132721, & AS1625141816
Ergotron Stand for Dell OptiPlex 5250 AIO (portrait mode)	Neo Flex	1274839-0061 & 1358124-0005
ClearCount Components		
Dell Latitude Laptop (multiple units)	5580	2F3L3G2, C9S22G2, CF3L3G2, 90356H2, BDH46H2, 8TM46H2, 4PM46H2, 4QM46H2, 3CH46H2, & FPM46H2
Dell PowerEdge Server	T330	5RRFGK2, 5712JK2, & FHV9RD2

Table 1-2. Voting System Equipment (continued)

Component	Model	Serial Number
ClearCount Components		
Dell OptiPlex AIO	7440	JXDFHH2, JXDFDH2, & 64WPXG2
Dell Precision Workstation	T3620	GW6XHH2 & H0PZFK2
Fujitsu Scanner	fi-7180	A20DC10302, A20DC10378, A20D000798, & A20DC08933
Fujitsu Scanner	fi-6800	A9HCC00543, A9HCC00535, & 100295
Fujitsu Scanner	fi-6400	AKHCC00609, AKHCC00337, & AKHCC00362
Lenovo USB Portable DVD Burner	LN-8A6NH11B	8SSDX0H33226L1CB7107099
Dell 22 inch Monitor	E2216HV	GD965D2
Dell 22 inch Monitor	P2217	7818672
Dell 22 inch Monitor	S2240M	CN-0CFGKT-64180-58B-0X3T
Dell 27 inch Monitor	P2717H	CDMS672 & HPWD072
Cisco Catalyst Switch (1 Gigabit Router or Switch)	2960-X Series	FCW2039B6QF & FCW2110A1E0
TP-LINK Easy Smart Switch (1 Gigabit Router or Switch)	TL-SG108E	216C319009010 & 216C319009012
NetGear ProSafe VPN Firewall (1 Gigabit Router or Switch)	FVS318G	40F266BA00280
APC Smart-UPS	SMT1500	3S1525X07491, 3S1525X07421, & 4B1448P39979
Western Digital External Hard Drive	WDBBGB0040HBK	WCC7K5CHA3DK
EZ Scanning Shelf (fi-6400 or fi-6800)	Model: WorkEZ	CBG-EZ-001, CBG-EZ-002, CBG-EZ-003, & CBG-EZ-004
ClearCast Components		
ClearCast	Model: 1 Version A	Cast0011, Cast0014, Cast0015, Cast0017, Cast0018, and Cast0020
Ballot Box	1224UBB-CB	CBG-BB-001, CBG-BB-002

1.1.3 Block Diagram

The system overview of the submitted voting system is depicted in Figure 1-1.

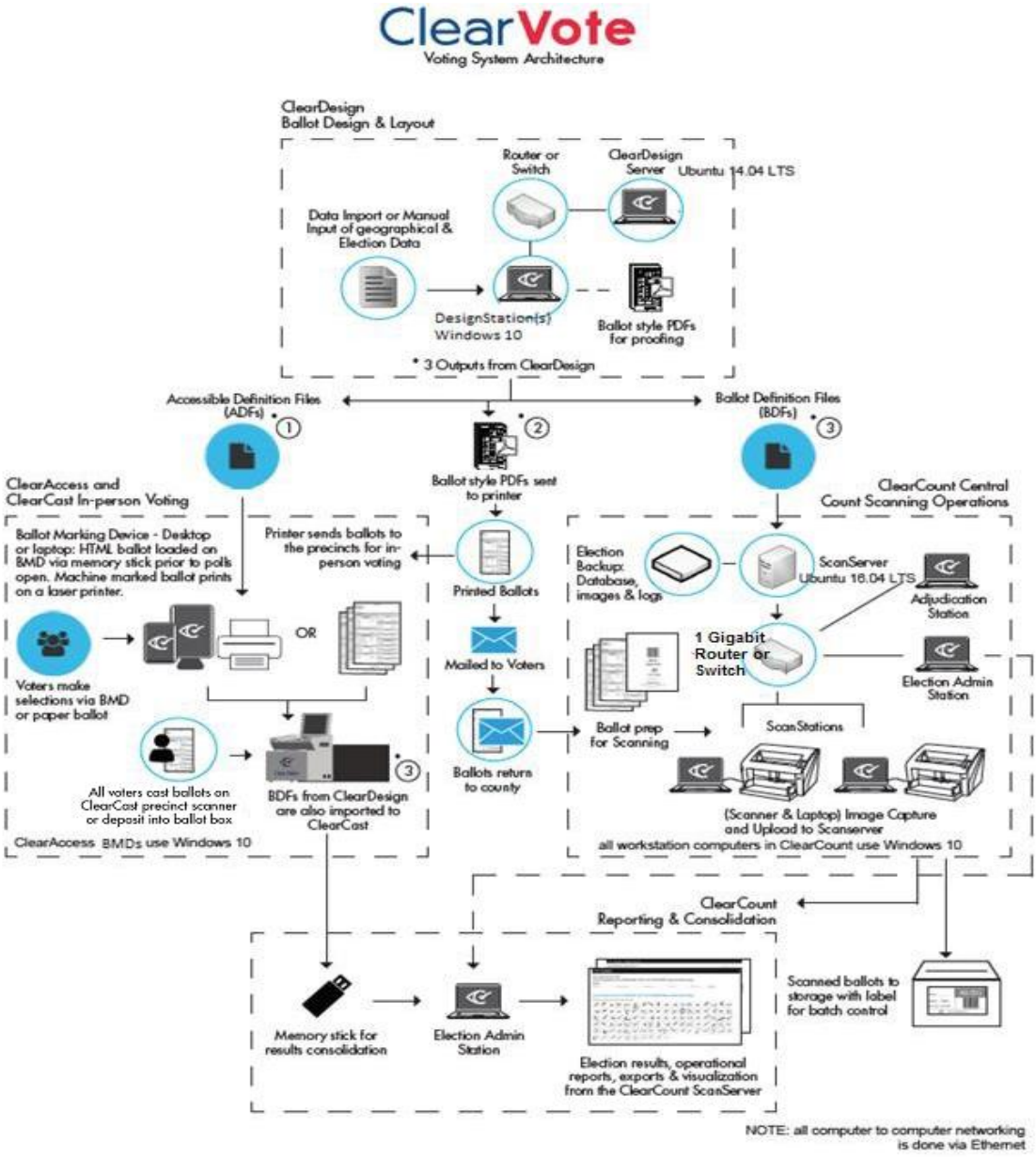


Figure 1-1. ClearVote 1.4 Voting System Overview

1.1.4 System Limits

The system limits that CBG has stated to be supported by the ClearVote 1.4 voting system are listed in the tables below.

Table 1-3. System Limits for ClearDesign

Characteristic	Limit
Precincts in an election	3200
Contests in an election	3200
Candidates/Counters in an election	3200
Ballot Styles in an election	3200
Contests in a ballot style	60
Candidates in a contest	300
Ballot styles in a precinct	50
Number of political parties	50
"vote for" in a contest	50
Supported languages in an election	15
Number of write-ins	50

Table 1-4. Maximum Oval Positions for ClearDesign

Ballot Size	Oval positions per side
5 inch	60
11 inch	180
14 inch	240
17 inch	300
19 inch	360
22 inch	420

Table 1-5. System Limits for ClearCount

Scanner Model	Sustained (not burst speed) ballots per hour						
	8.5x5	8.5x11	8.5x14	8.5x17	8.5x19	8.5x22	Typical county size (central count)
fi-6400	5592	3624	2928	2448	2350	2236	Large (>100k voters)
fi-6800	7822	5508	4155	3352	3000	2800	Large (>100k voters)
fi-7180	3396	2040	1692	1400	1300	1200	Small (<25k voters)
ClearCount can have a maximum of 10 ScanStation/Scanner pairs							

1.1.5 Supported Languages

The submitted voting system supports:

- English
- Spanish
- Chinese
- Korean
- Vietnamese
- Danish
- Dutch
- Flemish
- French
- German
- Italian
- Japanese
- Norwegian
- Portuguese
- Swedish

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

For the character based language the ballot was created by Pro V&V and voted utilizing both paper ballots and ADA voting devices along with all applicable peripherals. The Chinese Language for the ballot was created using a readily available online translation tool. The Chinese characters displayed in the ballot preview were then compared to the characters generated by the online translation tool, to ensure that the characters matched. The ballots were then generated and printed, and the election was loaded onto the tabulators and the BMD units. The Chinese characters displayed on both the printed ballots and displayed on the BMD units, were both compared to the original Chinese Characters generated by the online translation tool, to verify that the characters match.

1.1.6 Supported Functionality

The ClearVote 1.4 voting system is designed to support the following voting variations:

- General Election
- Closed Primary
- Open Primary
- Early Voting
- Partisan/Non-Partisan Offices
- Write-In Voting
- Primary Presidential Delegation Nominations
- Straight Party Voting
- Split Precincts
- Vote for N of M
- Ballot Rotation
- Provisional or Challenged Ballots

1.1.7 Deliverable Materials

This subsection lists the materials identified by the manufacturer as materials deliverable to the end user for the system being tested.

Table 1-6. Voting System Deliverables

Material	Version	Description
ClearDesign	1.4.3	EMS Software
ClearAccess	1.4.1	BMD software
ClearCount	1.4.2	Central Count and Tabulation Software
ClearCast	1.4.2	Precinct Count Software
ClearAccess 1.4 Acceptance Test Checklist	1.0.1	TDP Document
ClearAccess 1.4 Build Procedures	1.0.4	TDP Document
ClearAccess 1.4 Functionality Description	1.5	TDP Document
ClearAccess 1.4 Hardware Specification	1.4	TDP Document
ClearAccess 1.4 Installation Guide	1.4	TDP Document
ClearAccess 1.4 Maintenance Guide	1.5	TDP Document
ClearAccess 1.4 Poll Worker Guide	1.6.2	TDP Document
ClearAccess 1.4 Security Specification	1.4.2	TDP Document
ClearAccess 1.4 Software Design and Specification	1.4.1	TDP Document
ClearAccess 1.4 Supervisor Guide	1.7.3	TDP Document
ClearAccess 1.4 System Identification Guide	1.0.1	TDP Document
ClearAccess 1.4 System Overview	1.5.1	TDP Document
ClearAccess 1.4 Voter Guide	1.1	TDP Document

Table 1-6. Voting System Deliverables (continued)

Material	Version	Description
ClearAccess Poll Worker Instructions Multi Day Voting (poster)	10010	TDP Document
ClearAccess Poll Worker Instructions (poster)	10010	TDP Document
ClearAccess Simplified Voter Instructions (poster)	10010	TDP Document
ClearCast 1.4 Acceptance Test Checklist	1.1.1	TDP Document
ClearCast 1.4 Approved Parts List	1.1	TDP Document
ClearCast 1.4 Build Procedures	1.0.1	TDP Document
ClearCast 1.4 Functionality Description	1.4	TDP Document
ClearCast 1.4 Hardware Specification	1.3	TDP Document
ClearCast 1.4 Installation Guide	1.1.1	TDP Document
ClearCast 1.4 Maintenance Guide	1.5.1	TDP Document
ClearCast 1.4 Poll Worker Guide	1.5.1	TDP Document
ClearCast 1.4 Security Specification	1.3	TDP Document
ClearCast 1.4 Software Design and Specification	1.3.1	TDP Document
ClearCast 1.4 Supervisor Guide	1.6.1	TDP Document
ClearCast 1.4 System Identification Guide	1.0.1	TDP Document
ClearCast 1.4 System Overview	1.3.2	TDP Document
ClearCast Tabulator Quick Start Guide (poster)	10010	TDP Document
ClearCast Troubleshooting Guide (poster)	10010	TDP Document
ClearCount 1.4 Acceptance Test Checklist	1.0.3	TDP Document
ClearCount 1.4 Build Procedures	1.4.1	TDP Document
ClearCount 1.4 Database Specification	1.0.2	TDP Document
ClearCount 1.4 Election Administration Guide	1.0.9	TDP Document
ClearCount 1.4 Election Preparation and Installation Guide	1.2	TDP Document
ClearCount 1.4 Functionality Description	1.0.5	TDP Document
ClearCount 1.4 Hardware Specification	1.0.5	TDP Document
ClearCount 1.4 Maintenance Guide	1.0.6	TDP Document
ClearCount 1.4 Reporting Guide	1.0.5	TDP Document
ClearCount 1.4 Scanner Operator Guide	1.1	TDP Document
ClearCount 1.4 Security Specification	1.0.6	TDP Document
ClearCount 1.4 Software Design and Specification	1.0.7	TDP Document
ClearCount 1.4 System Identification Guide	1.0.1	TDP Document
ClearCount 1.4 System Operations Procedures	1.0.5	TDP Document
ClearCount 1.4 System Overview	1.0.6	TDP Document
ClearDesign 1.4 Acceptance Test Checklist	1.0.3	TDP Document
ClearDesign 1.4 Administration Guide	1.0.5	TDP Document
ClearDesign 1.4 Build Procedures	1.0.3	TDP Document
ClearDesign 1.4 Database Specification	1.0.3	TDP Document
ClearDesign 1.4 Functionality Description	1.0.8	TDP Document
ClearDesign 1.4 Hardware Specification	1.0.6	TDP Document
ClearDesign 1.4 Installation Guide	1.0.16	TDP Document
ClearDesign 1.4 Maintenance Guide	1.0.7	TDP Document
ClearDesign 1.4 Security Specification	1.0.8	TDP Document

Table 1-6. Voting System Deliverables (continued)

Material	Version	Description
ClearDesign 1.4 Software Design and Specification	1.0.9	TDP Document
ClearDesign 1.4 System Identification Guide	1.0.8	TDP Document
ClearDesign 1.4 System Overview	1.0.8	TDP Document
ClearDesign 1.4 User Guide	1.11	TDP Document
ClearVote 1.4 Approved Parts List	1.0.10	TDP Document
ClearVote 1.4 Ballot Stock and Printing Specification	1.0.3	TDP Document
ClearVote 1.4 Configuration Management Plan	1.0.8	TDP Document
ClearVote 1.4 Glossary	1.0.4	TDP Document
ClearVote 1.4 Personnel Deployment and Training Plan	1.0.5	TDP Document
ClearVote 1.4 Quality Assurance Program	1.0.6	TDP Document
ClearVote 1.4 Security Policy	1.0.6	TDP Document
ClearVote 1.4 System Overview	1.0.9	TDP Document
ClearVote 1.4 Test and Verification Specification	1.0.5	TDP Document

1.2 References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, "Voting System Performance Guidelines", and Volume II, "National Certification Testing Guidelines"
- Election Assistance Commission Testing and Certification Program Manual, Version 2.0
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 2.0
- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2016 Edition, "NVLAP Procedures and General Requirements (NIST Handbook 150)", dated July 2016
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2016 Edition, "Voting System Testing (NIST Handbook 150-22)", dated July 2016
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Pro V&V, Inc. Quality Assurance Manual, Revision 7.0
- Election Assistance Commission "Approval of Voting System Testing Application Package" letter dated May 04, 2016
- EAC Requests for Interpretation (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)
- Clear Ballot Group's Technical Data Package *(A listing of the ClearVote 1.4 voting system documents submitted for this test campaign is listed in Section 3.1.2.2 of this Test Report)*

1.3 Terms and Abbreviations

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

"ADA" – Americans with Disabilities Act 1990

"BMD" – Ballot Marking Device

"CBG" – Clear Ballot Group

"CM" – Configuration Management

"COTS" – Commercial Off-The-Shelf

"DRE" – Direct Record Electronic

"EAC" – United States Election Assistance Commission

"EMS" – Election Management System

"FCA" – Functional Configuration Audit

"HAVA" – Help America Vote Act

"ISO" – International Organization for Standardization

"NOC" – Notice of Clarification

"PC" – Personal Computer

"PCA" – Physical Configuration Audit

"QA" – Quality Assurance

"RAM" – Random Access Memory

"RFI" – Request for Interpretation

"TDP" – Technical Data Package

"UPS" – Uninterruptible Power Supply

"VSTL" – Voting System Test Laboratory

"VVSG" – Voluntary Voting System Guidelines

2.0 CERTIFICATION TEST BACKGROUND

2.1 Revision History

The ClearVote 1.4 voting system is a new voting system that has not previously been tested in the EAC Program; therefore, full functional and hardware testing was performed on the entire ClearVote 1.4 voting system configuration.

2.2 Implementation Statement

The Implementation Statement document for the ClearVote 1.4 voting system is contained in the application submitted for certification testing

3.0 TEST FINDINGS AND RECOMMENDATION

To evaluate the ClearVote 1.4 voting system test requirements, each section of the EAC 2005 VVSG was analyzed in conjunction with a preliminary TDP review to determine the applicable tests. The preliminary TDP review was performed to gather information concerning the system under test and its capabilities or design intentions. Additionally, a TDP review was performed throughout the test campaign. The TDP Review included the Initial Review, the Regulatory/Compliance Review, and the Final Review. This review was conducted to determine if the submitted technical documentation meets the regulatory, customer-stated, or end-user requirements which includes reviewing the documents for stated functionality review and verification.

The EAC 2005 VVSG Volume I Sections, along with the strategy of evaluation, are described below:

Section 2: Functional Requirements

The requirements in this section were tested during the FCA and System Integration Test. This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data.

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

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

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

Section 3: Usability and Accessibility Requirements

The requirements in this section were tested during the Usability and Accessibility Testing. This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data.

The usability testing focused on the usability of the system being tested. Usability was defined generally as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks. In the context of voting, the primary user is the voter, the product is the voting system, and the task is the correct recording of the voter ballot selections. Additional requirements for task performance are independence and privacy: the voter should normally be able to complete the voting task without assistance from others, and the voter selections should be private. Accessibility evaluates the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B).

Additionally, Pro V&V reviewed the results of summative usability testing on the ClearVote 1.4, voting system to verify that the submitted test results were in Common Industry Format.

Section 4: Hardware Requirements

The hardware tests specified in the VVSG are divided into two categories: non-operating and operating. The non-operating tests apply to the elements of the system that are intended for use at poll site locations and are intended to simulate the storage and transport of equipment between the storage facility and the polling location. The Operating tests apply to the entire system, including hardware components that are used as part of the voting system telecommunications capability, and are intended to simulate conditions that the voting system may encounter during operation. Prior to and immediately following each required non-operating and operating test, the system was subjected to an operational status check. An operational status check is a rapid visual and operational test (for example, powering on the unit, casting a ballot) to ensure the system component under test is in fact functioning and ready for the next step of the test.

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

Section 5: Software Requirements

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

To perform the source code review, Pro V&V reviewed the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V verified that the submitted documentation was sufficient to enable: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met. The source code review included a compliance build and a trusted build of the submitted source code.

Section 6: Telecommunications Requirements

The requirements set forth for telecommunications represent acceptable levels of combined telecommunications hardware and software function and performance for the transmission of data that is used to operate the system and report election results.

The requirements addressed in this section are intended to complement the network security requirements identified in Section 7, which include requirements for voter and administrator access, availability of network service, data confidentiality, and data integrity.

The telecommunications components the voting system were tested during various aspects of the test campaign, such as accuracy, durability, reliability, maintainability, and availability.

The requirements in this section were tested utilizing baseline test cases as well as specifically designed test cases.

Section 7: Security Requirements

The requirements in this section were tested during the source code review, security tests, and FCA.

To evaluate the integrity of the system, Pro V&V developed specifically designed test cases in an attempt to defeat the access controls and security measures documented in the system TDP as well as verifying compliance to EAC RFI 2012-05. The Clear Ballot matrix of addressed threats was reviewed to evaluate the identified risks and vulnerabilities. An evaluation of the system was accomplished by utilizing a combination of functional testing, source code review, and automated vulnerability scanners.

During the security testing, the system was inspected for various controls and measure that are in place to meet the objectives of the security standards which include: protection of the critical elements of the voting system; establishing and maintaining controls to minimize errors; protection from intentional manipulation, fraud and malicious mischief; identifying fraudulent or erroneous changes to the voting system; and protecting the secrecy in the voting process.

Section 8: Quality Assurance Requirements

The requirements in this section were tested throughout the test campaign. This testing utilized a TDP Review in conjunction with the Source Code Review and PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the Clear Ballot Group technical documentation. The review of the Quality Assurance documentation focused on Clear Ballot Group's adherence to its stated QA processes.

Section 9: Configuration Management Requirements

The requirements in this section were tested throughout the test campaign. This testing utilized a TDP Review in conjunction with the Source Code Review and PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the Clear Ballot Group technical documentation. The review of the Configuration Management documentation focused on Clear Ballot Group's adherence to its stated CM processes.

Throughout the test campaign, Pro V&V personnel maintained a test log identifying the system and equipment under test and any records of deviations to the test plan along with the rationale for performing the deviations. Pro V&V also utilized an internal bug tracking system to record and track all issues and/or discrepancies noted during the test campaign.

3.1 Summary of Findings and Recommendation

3.1.1 Hardware Testing

The ClearVote 1.4 voting system hardware consists of the following major components: ClearAccess ADA BMD, ClearCast precinct scanner, ClearCount central count scanner, and ClearDesign EMS.

ClearAccess - All components of ClearAccess are COTS.

ClearCast – ClearCast is comprised of off the shelf parts, however it is a proprietary component.

ClearCount - All components of ClearCount are COTS.

ClearDesign - All components of ClearDesign are COTS.

The ClearVote 1.4 voting system was evaluated as a new system; therefore the full suite of hardware and electrical testing, as detailed in the 2005 VVSG, was required. These tests are listed below:

Electrical Tests:

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

Environmental Tests:

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

Pro V&V utilized third party testing during the performance of hardware testing. All hardware testing was performed at the NTS Longmont facility located in Longmont, Colorado with the exception of Safety Testing which was performed at TUV located in Toronto, Ontario, Canada.

All testing was witnessed on-site by Pro V&V personnel, with the exception of Temperature Power Variation in which Pro V&V qualified staff executed all testing at the NTS Longmont facility, with NTS personnel providing only support services for this test.

Summary Findings

Electrical Testing was performed on the components listed above. The procedures and results for this testing are included in NTS Longmont EMC Test Report File#: ETR-PR066470, presented in Appendix A. The test results from this testing are summarized below:

Table 3-1. Electrical Hardware Test Results

Standard/Method	Description	Criteria	Class/Level	Result
FCC 15.107 ICES-003 VVSG Vol. 1 4.1.2.9	Power Line Conducted Emissions	N/A	Class B	Pass
FCC 15.109 ICES-003 VVSG Vol. 1 4.1.2.9	Radiated Emissions	N/A	Class B	Pass *
EN61000-4-11 VVSG Vol. 1 4.1.2.5	Electrical Power Disturbance	Normal Operation & No Data Loss	Various	Pass
EN61000-4-4 VVSG Vol. 1 4.1.2.6	Electrical Fast Transient	Normal Operation & No Data Loss	±2kV - Mains	Pass
EN61000-4-5 VVSG Vol. 1 4.1.2.7	Lightning Surge	Normal Operation & No Data Loss	±2kV Line - Line ±2kV Line - Ground	Pass
EN61000-4-2 VVSG Vol. 1 4.1.2.8	Electrostatic Disruption	Normal Operation & No Data Loss	±8kV Contact ±15kV Air	Pass **
EN61000-4-3 VVSG Vol. 1 4.1.2.10	Electromagnetic Susceptibility	Normal Operation & No Data Loss	10 V/m, 80 MHz – 1 GHz	Pass ***
EN61000-4-6 VVSG Vol. 1 4.1.2.11	Conducted RF Immunity	Normal Operation & No Data Loss	10 Vrms, 150 kHz – 80 MHz	Pass
EN61000-4-8 VVSG Vol. 1 4.1.2.12	Magnetic Immunity	Normal Operation & No Data Loss	30 A/m	Pass

* During test performance, an issue was detected with the ClearCast unit. Clear Ballot was notified of the issue and performed an analysis of the occurrence and implemented a corrective action by removing the Display Port to the HDMI adapter. This configuration was successfully tested and regression testing was performed on the system to verify that the change did not adversely impact previous test results.

*During test performance, an issue was detected with ClearAccess (Dell AIO and the Oki Printer). Clear Ballot was notified of the issue and performed an analysis of the occurrence and implemented a corrective action by adding a ferrite (Wurth 742-716-33S) to the printer USB cable on the computer end. This configuration was successfully tested and regression testing was performed on the system to verify that the change did not adversely impact previous test results.

** During test performance, an issue was detected with ClearAccess components, Oki Printer and the APC UPS. Clear Ballot was notified of the issues and performed an analysis. The LCD display on both the printer and UPS went out during the 15 kV Air. Both the printer and UPS continued to fully function during the issues. Clear Ballot implemented a corrective action of adding a plastic cover over the LCDs and copper tape around the LCDs. This configuration was successfully tested and regression testing was performed on the system to verify that the change did not adversely impact previous test results.

*** During test performance, an issue was detected with ClearAccess (Dell AIO and the Brother Printer). Clear Ballot was notified of the issue and performed an analysis of the occurrence and implemented a corrective action by adding a ferrite (Wurth 742-712-22S) to both ends of the printer power cable. This configuration was successfully tested and regression testing was performed on the system to verify that the change did not adversely impact previous test results.

Environmental Testing was performed on the components listed above. The procedures and results for this testing are included in NTS Longmont Report/Quotation Number: PR062172, PR066470, & PR069771 in addition to the TUV located in Toronto, Ontario, Canada Safety Testing Report Number: 7169003341-000, presented in Appendix A. The test results from this testing are summarized below:

Shock - Bench Handling (MIL-STD-810D, 516.3, I-3.8)

The ClearAccess and ClearCast system components were subjected to Shock – Bench Handling Testing. Using one edge as a pivot, the opposite edge of the chassis of each unit was lifted until the face reached 45° with horizontal bench top, or 4 inches above bench top (whichever occurred first). This was repeated with each practical edge, of the same horizontal face. At the conclusion of testing, the components were subjected to a visual inspection and an operational status check was performed.

Test Result – Pass

Vibration – Basic Transportation (MIL-STD-810D, 514.3, I-3.2.1)

The ClearAccess and ClearCast system components were subjected to Vibration – Basic Transportation Testing. Testing was performed at ambient/room temperature (20ºC +/-3 ºC) in the X, Y and Z axis at the levels identified in Figure 3-1. At the conclusion of testing, a visual inspection and an operational status check was performed.

Test Result – Pass

Low Temperature - Storage (MIL-STD-810D, 502.2, II-3)

The ClearAccess and ClearCast system components were subjected to Low Temperature – Storage Testing. Samples were subjected to a temperature of -4ºF (-20ºC +/-3 ºC) for a duration of 4 hours, after which operation was confirmed by Pro V&V. Samples were not powered, and were left in their packaging for the duration of the test. They were removed from the boxes for operational verification after the test. At the conclusion of testing, a visual inspection of the components and the packaging, and an operational status check was performed.

Test Result – Pass

High Temperature - Storage (MIL-STD-810D, 501.2, I-3.2)

The ClearAccess and ClearCast system components were subjected to High Temperature – Storage Testing. Samples were subjected to a temperature of 140ºF (60ºC +/-3 ºC) for a duration of 4 hours, after which operation was confirmed by Pro V&V. Samples were not powered, and were left in their packaging for the duration of the test. They were removed from the boxes for operational verification after the test. At the conclusion of testing, a visual inspection of the components and the packaging, and an operational status check was performed.
Test Result – Pass

Humidity – Hot/Humid (MIL-STD-810D, 507.2, I-3.2)

The ClearAccess and ClearCast system components were subjected to Humidity – Hot/Humid Testing. Samples were subjected as per Table 507.2-I, Hot-Humid (Cycle 1), for a duration of 240 hours (10 days), after which operation was confirmed by Pro V&V. Samples were not powered/operational, and were left in their packaging for the duration of the test, and were removed from the boxes for operational verification. At the conclusion of testing, a visual inspection of the components and the packaging, and an operational status check was performed.

Test Result – Pass

Temp-Power Variation Testing (MIL-STD-810D, 501.2/502.2)
The ClearAccess, ClearCast, and ClearCount system components were subjected to Temperature/Power Variation Testing. Samples completed 85 hours per the following environment profile:

The ClearAccess, ClearCast, and ClearCount system components were powered and being operated by Pro V&V for the duration of the environmental profile, to confirm operation. Two issues were encountered during test performance, as described below:

- The Temperature Power Variation test was conducted for 85 hours as allowed by the EAC based on two components being under test. One of the ClearCast units under test emitted a "popping" sound and the Pro V&V personnel recognized a burning smell from the general area of the component. The unit was still operating, but Pro V&V verified the unit was operating under battery power only. Pro V&V continued the test processing 100 ballots per hour while on battery back-up power without issue. Pro V&V notified the Clear Ballot Technical Representative of the issue. After the hourly run was performed, the test was halted to allow the Technical Representative to enter the test chamber to observe the unit, confirm operation on battery back-up, and to investigate potential causes.

After the initial investigation, the Technical Representative vacated the test chamber to allow testing to continue. Testing the resumed on all units. After several hours, the ClearCast unit that emitted a "popping" sound ran out of battery power and both ClearCast units were removed from the test chamber. The remainder of the items under test were allowed to continue until completion of the 85 hours. The ClearCast unit was turned over to the Technical Representative to perform a deeper analysis in which a Root Cause Analysis was required and provided by Clear Ballot to Pro V&V and the EAC. Upon completion of the analysis, mitigation including replacement of the power supply, and review of the Root Cause Analysis three ClearCast units including the original unit which observed the failure were provided to Pro V&V to repeat the test in which the test was completed successfully without further issue.

- The ClearAccess HP printer under test was experiencing a lost connection during testing. The unit was restarted and all connections were verified. The unit passed the pre-operational status check without issue. The HP printer was able to resume, but only for a short period of time until connection was lost again. The issues were logged into the engineering notebook and Ed Smith of Clear Ballot was notified of the issue. After the hourly run was performed the test was halted for a short period of time to allow the Clear Ballot Technical Representative to enter the test camber to observe the activity and after discussion Clear Ballot determined it was in the best interest to remove the HP printer from the test chamber and from the system configuration submitted for this test campaign. The HP unit was removed from the test chamber and returned to Clear Ballot.

Test Result – Pass

3.1.2 System Level Testing

System Level testing was implemented to evaluate the complete system. This testing included all proprietary components and COTS components (software, hardware, and peripherals) of the ClearVote 1.4 voting system. For software system tests, the tests were designed according to the stated design objective without consideration of its functional specification. The system level hardware and software test cases were prepared independently to assess the response of the hardware and software to a range of conditions. Pro V&V reviewed the manufacturer's program analysis, documentation, and module test case design and evaluated the test cases for each module with respect to flow control parameters and entry/exit data.

System Level Testing included the evaluations of the following test areas: PCA, TDP Review, Security Review, Source Code Review, FCA, Volume & Stress Testing, Accuracy Testing, System Integration Testing, Usability & Accessibility, and QA & CM System Review. Each of these areas is reported in detail in the subsections that follow.

Component Level Testing was implemented during the FCA for each component and subcomponent. During the source code review, compliance builds, and security testing, Pro V&V utilized limited structural-based techniques (white-box testing). Additionally, specification-based techniques (black-box testing) were utilized for the individual software components.

Pro V&V defined the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performed as expected, the results were accepted. If the system did not perform as expected, an analysis was performed to determine the cause. If needed, the test was repeated in an attempt to reproduce the results.

If the failure could be reproduced and the expected results were not met, the system was determined to have failed the test. If the results could not be reproduced, the test continued. All errors encountered were documented and tracked through resolution.

3.1.2.1 Physical Configuration Audit (PCA)

The physical configuration audit compares the voting system components submitted for qualification to the manufacturer's technical documentation, and included the following activities:

- Establish a configuration baseline of software and hardware to be tested; confirm whether manufacturer's documentation is sufficient for the user to install, validate, operate, and maintain the voting system
- Verify software conforms to the manufacturer's specifications; inspect all records of manufacturer's release control system; if changes have been made to the baseline version, verify manufacturer's engineering and test data are for the software version submitted for certification
- If the hardware is non-COTS, Pro V&V reviewed drawings, specifications, technical data, and test data associated with system hardware to establish a system hardware baseline associated with software baseline
- Review the 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

Summary Findings

During execution of the test procedure, the components of the ClearVote 1.4 voting system were documented by component name, model, serial number, major component, and any other relevant information needed to identify the component. For COTS equipment, every effort was made to verify that the COTS equipment had not been modified for use. Additionally, each technical document submitted in the TDP was recorded by document name, description, document number, revision number, and date of release. At the conclusion of the test campaign, test personnel verified that any changes made to the software, hardware, or documentation during the test process were fully and properly documented.

3.1.2.2 Technical Data Package (TDP) Review

In order to determine full compliance with the EAC 2005 VVSG, three phases of TDP review were conducted:

- Initial TDP Review: The first review was performed to determine whether the TDP submitted was adequate enough to perform TDP review. This was an abbreviated review. Documents were read to determine whether they provided enough description of the submitted voting system components and whether it at least generically addressed VVSG requirements. The results of the review were used in determining contractual requirements for the test campaign.

- Compliance Review: This review was conducted on a document-by-document basis to determine if every Federal, State, or manufacturer-stated requirement had been met based on the context of each requirement. The review was more complex than the initial TDP review. Results of the review of each document were entered on the TDP Review Checklist and were reported to the manufacturer for disposition of any anomalies. This process was ongoing until all anomalies were resolved.

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

- Consistency/Completeness Review: This review was to determine whether information included in the TDP documents was consistent across documents. This review was performed in parallel with and corresponding to the Functional Configuration Audit (FCA). Through use, the FCA testing verified the accuracy and completeness of the utilized TDP. Any anomalies were reported to the manufacturer for resolution, if required. The TDP review continued until all identified anomalies had been satisfactorily resolved.

A listing of all documents in the ClearVote 1.4 voting system TDP is provided in Table 3-2.

Table 3-2. TDP Documents

Material	Version	Description
ClearAccess 1.4 Acceptance Test Checklist	1.0.1	TDP Document
ClearAccess 1.4 Build Procedures	1.0.4	TDP Document
ClearAccess 1.4 Functionality Description	1.5	TDP Document
ClearAccess 1.4 Hardware Specification	1.4	TDP Document
ClearAccess 1.4 Installation Guide	1.4	TDP Document
ClearAccess 1.4 Maintenance Guide	1.5	TDP Document
ClearAccess 1.4 Poll Worker Guide	1.6.2	TDP Document
ClearAccess 1.4 Security Specification	1.4.2	TDP Document
ClearAccess 1.4 Software Design and Specification	1.4.1	TDP Document
ClearAccess 1.4 Supervisor Guide	1.7.3	TDP Document
ClearAccess 1.4 System Identification Guide	1.0.1	TDP Document
ClearAccess 1.4 System Overview	1.5.1	TDP Document
ClearAccess 1.4 Voter Guide	1.1	TDP Document
ClearAccess Poll Worker Instructions Multi Day Voting (poster)	10010	TDP Document
ClearAccess Poll Worker Instructions (poster)	10010	TDP Document
ClearAccess Simplified Voter Instructions (poster)	10010	TDP Document
ClearCast 1.4 Acceptance Test Checklist	1.1.1	TDP Document
ClearCast 1.4 Approved Parts List	1.1	TDP Document
ClearCast 1.4 Build Procedures	1.0.1	TDP Document
ClearCast 1.4 Functionality Description	1.4	TDP Document
ClearCast 1.4 Hardware Specification	1.3	TDP Document

Table 3-2. TDP Documents (continued)

Material	Version	Description
ClearCast 1.4 Installation Guide	1.1.1	TDP Document
ClearCast 1.4 Maintenance Guide	1.5.1	TDP Document
ClearCast 1.4 Poll Worker Guide	1.5.1	TDP Document
ClearCast 1.4 Security Specification	1.3	TDP Document
ClearCast 1.4 Software Design and Specification	1.3.1	TDP Document
ClearCast 1.4 Supervisor Guide	1.6.1	TDP Document
ClearCast 1.4 System Identification Guide	1.0.1	TDP Document
ClearCast 1.4 System Overview	1.3.1	TDP Document
ClearCast Tabulator Quick Start Guide (poster)	10010	TDP Document
ClearCast Troubleshooting Guide (poster)	10010	TDP Document
ClearCount 1.4 Acceptance Test Checklist	1.0.3	TDP Document
ClearCount 1.4 Build Procedures	1.4.1	TDP Document
ClearCount 1.4 Database Specification	1.0.2	TDP Document
ClearCount 1.4 Election Administration Guide	1.0.9	TDP Document
ClearCount 1.4 Election Preparation and Installation Guide	1.2	TDP Document
ClearCount 1.4 Functionality Description	1.0.5	TDP Document
ClearCount 1.4 Hardware Specification	1.0.5	TDP Document
ClearCount 1.4 Maintenance Guide	1.0.6	TDP Document
ClearCount 1.4 Reporting Guide	1.0.5	TDP Document
ClearCount 1.4 Scanner Operator Guide	1.1	TDP Document
ClearCount 1.4 Security Specification	1.0.6	TDP Document
ClearCount 1.4 Software Design and Specification	1.0.7	TDP Document
ClearCount 1.4 System Identification Guide	1.0.1	TDP Document
ClearCount 1.4 System Operations Procedures	1.0.5	TDP Document
ClearCount 1.4 System Overview	1.0.6	TDP Document
ClearDesign 1.4 Acceptance Test Checklist	1.0.3	TDP Document
ClearDesign 1.4 Administration Guide	1.0.5	TDP Document
ClearDesign 1.4 Build Procedures	1.0.3	TDP Document
ClearDesign 1.4 Database Specification	1.0.3	TDP Document
ClearDesign 1.4 Functionality Description	1.0.8	TDP Document
ClearDesign 1.4 Hardware Specification	1.0.6	TDP Document
ClearDesign 1.4 Installation Guide	1.0.16	TDP Document
ClearDesign 1.4 Maintenance Guide	1.0.7	TDP Document
ClearDesign 1.4 Security Specification	1.0.8	TDP Document
ClearDesign 1.4 Software Design and Specification	1.0.9	TDP Document
ClearDesign 1.4 System Identification Guide	1.0.8	TDP Document
ClearDesign 1.4 System Overview	1.0.8	TDP Document
ClearDesign 1.4 User Guide	1.11	TDP Document
ClearVote 1.4 Approved Parts List	1.0.10	TDP Document
ClearVote 1.4 Ballot Stock and Printing Specification	1.0.3	TDP Document
ClearVote 1.4 Configuration Management Plan	1.0.8	TDP Document
ClearVote 1.4 Glossary	1.0.4	TDP Document

Table 3-2. TDP Documents (continued)

Material	Version	Description
ClearVote 1.4 Personnel Deployment and Training Plan	1.0.5	TDP Document
ClearVote 1.4 Quality Assurance Program	1.0.6	TDP Document
ClearVote 1.4 Security Policy	1.0.6	TDP Document
ClearVote 1.4 System Overview	1.0.8	TDP Document
ClearVote 1.4 Test and Verification Specification	1.0.5	TDP Document

Summary Findings

- Initial TDP Review: The first review (Initial TDP Review) was performed to determine whether the TDP for the submitted system was complete enough to perform TDP review. Although this was an abbreviated review, it was determined that the TDP, as submitted, contained adequate information that was necessary to begin the Compliance Review.
- Regulatory/Compliance Review: This review was conducted on a document-by-document basis to determine if every regulatory or customer-stated requirement had been met based on the context of each requirement. The review was more complex than the initial TDP review. Any discrepancies noted were reported to ClearBallot for resolution. During the test campaign, any revised documents were viewed and any discrepancies noted were reported to ClearBallot for disposition.
- Complete/Final Review: This review was performed to determine whether the information contained in the documents was described consistently throughout documents (as described above). Some consistency issues were noted, and these were reported to ClearBallot for resolution. All outstanding reported issues were resolved during the TDP review.

Examples of issues noted and resolved: documentation which required more detailed information included software documentation which initially did not include granular details, Configuration Management Plan did not meet the VVSG requirement concerning third-party manufacturers (for ClearAccess component), and Quality Assurance Program document which did not fully detail the ClearBallot quality assurance program. Consistency issues included discrepancies between documents concerning details of system limits, descriptions of hardware components, listing of voting variations supported, and discrepancies between required supplies as described in the maintenance documents and those described in the approved parts list.

3.1.2.3 Source Code Review

Pro V&V reviewed the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards using both Automated Source Code Review and Manual Review methods. Prior to initiating the software review, Pro V&V verified that the submitted documentation is sufficient to enable: (1) a review of the source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met.

Summary Findings

CBG submitted four components source code packages as part of the ClearVote 1.4 voting system. These packages were ClearAccess, ClearCast, ClearCount, and ClearDesign. Each package was reviewed using automated tools with a proprietary configuration. Pro V&V reviewed the configuration files that were in clear text to determine if any false positive suppression violated the EAC 2005 VVSG.

All tools ran successfully, and no violations of the EAC 2005 VVSG or the PEP 8 coding standard were noted. After execution of the automated tools Pro V&V conducted a manual review of 10% of all comments and headers to ensure the commenting convention followed the EAC 2005 VVSG Volume I Section 5.2. All source code was found to be in compliance.

At the conclusion of the test campaign, Pro V&V conducted a Trusted Build of the submitted source code and third party products in accordance with Section 5.6 of the EAC Voting System Testing and Certification Program Manual Version 2.0. The products of these builds are listed below with their SHA-256 hash values.

Component	SHA-256 hash value
ClearAccess 1.4.1 Installer.exe	
ClearCastInstall_1421463_20171113.sh	
ClearCount.iso	
ClearDesign-1.4.2.zip	

3.1.2.4 Security Functions

The objective of the security testing was to evaluate the effectiveness of the voting system in detecting, preventing, recording, reporting, and recovering from security threats and to determine the overall security posture of each system component. During the security evaluation of the system, test cases were specifically designed to evaluate the following:

- confirm compliance with Telecommunication and Security Sections of the VVSG 1.0 (2005), including EAC RFI 2012-05 and EAC RFI 2008-03
- verify depth, breadth, completeness, clarity, and conformance in the manufacturer's TDP System Security Specification
- verify implementation of the security mechanisms specified in the TDP System Security Specification on each system component
- attempt to defeat the access controls and security measures documented in the system TDP

The evaluation of the system was accomplished by utilizing a combination of documentation review, functional testing, source code review, automated network and vulnerability scanners, as well as manual inspection. Test cases were developed in an attempt to defeat the access controls and security measures documented in the system TDP. Tests conducted verified that the security mechanisms specified in the TDP Security Specification were implemented and adequately protect the system.

During the execution of these test procedures physical, technical, and administrative security controls were evaluated to determine if the security posture of the system components meet the objectives of the security standards which include: protection of the critical elements of the voting system; establishing and maintaining controls to minimize errors; protection from intentional manipulation, fraud and malicious mischief; identifying fraudulent or erroneous changes to the voting system; and protecting the secrecy in the voting process.

The security evaluation was conducted by a credentialed security expert utilizing voting system components that had been configured during other phases of their certification process. The security assessor evaluated the voting system for use and functionality to verify that the documented controls were in place, adequate, and met the stated requirements.

Physical Security was tested by setting up the system as described in the TDP and then examining the effectiveness and comprehensiveness of physical security measures.

Administrative Security was tested by examining the system's documented security instructions and procedures for effectiveness and breadth.

Logical Security was tested as part of FCA by conducting the following tests on system components: Vulnerability Scans, SCAP Scans, and Physical Bypass Attempts.

Summary Findings

Configuration Compliance Checking:
Clear Ballot products running on Windows were examined using the SCAP Compliance Checker (SCC) version 4.2 tool with the following Security Technical Implementation Guide (STIG) content:
U_Windows_10_V1R4_STIG_SCAP_1-1_Benchmark
U_Windows_Firewall_V1R5_STIG_SCAP_1-1_Benchmark
U_Microsoft_DotNet_Framework_4_V1R4_STIG_SCAP_1-1_Benchmark
U_Google_Chrome_Current_Windows_V1R1_STIG_SCAP_1-1_Benchmark

Clear Ballot products running on Ubuntu were manually examined for compliance with the guidelines presented in the CIS_Ubuntu_Linux_14.04_LTS_Benchmark_v2.0.0 published by the Center for Internet Security.

All products were found to have an adequate level of compliance in accordance with the published guidelines.

FIPS 140-2 / EAC RFI 2012-05 Compliance – Cryptography: An analysis was performed to verify if libraries providing cryptographic functions were compliant to EAC RFI 2012-05. This was evaluated by verifying providers of documented cryptographic functions, examining source code and system settings as configured per the manufacturer's documentation. Testing determined that the system and components used are fully compliant to VVSG 1.0, Section 7 and RFI 2012-05. Examination verified that Clear Ballot products running on Ubuntu use OpenSSL FIPS version 2.0.5, which is certified under CMVP certificate #1747. The library was also confirmed to be built in conformance with the security policy defined in the certification process. Examination verified that Clear Ballot products running on Windows 10 use the cryptographic system provided by the Windows 10 operating system which is verified by CMVP certificate #2605. Windows 10 group policy settings were also verified to ensure the enforcement of FIPS Mode at the operating system layer.

3.1.2.5 Functional Configuration Audit (FCA)

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 as a system. The FCA is a verification of every system function cited in the manufacturer's documentation. It verifies the accuracy and completeness of the system Technical Data Package (TDP). In addition to functioning according to the manufacturer's documentation, tests were conducted to insure all applicable EAC 2005 VVSG requirements are met. Also the various options of software counting logic that are claimed in the manufacturer's documentation were tested during the system-level FCA.

Generic test ballots or test entry data for voting, representing particular sequences of ballot-counting events, were used in conjunction with other testing to examine the counting logic during this audit. The error recovery capabilities of the system were assessed to ensure that the voting system could recover from a non-catastrophic failure of a device or any error or malfunction within the operator's ability to correct. The voting systems' error messaging was also assessed to ensure that the voting system generated error messages, logged them, and reported them to the user. This assessment verified that the error messaging provided to the user described the error condition, provided clear messaging regarding the error encountered, and instructed the user on what actions to take to address the error condition.

Copies of all of the manufacturer's test cases generated for module or unit testing, integration testing, and system testing were submitted to the VSTL for review. Relevant FCA results also acted as exploratory assessments for other testing.

For this campaign FCA testing included several exhaustive paths applied in concert:

- FCA-VVSG Testing: Each component of the system was evaluated against a standardized test-case suite centered upon requirements stated in the VVSG and administered through a test-management software tool. All applicable tests-cases were performed while any non-applicable test-cases (e.g. VVPAT requirements, etc.) were logged as "n/a" for substantiation. The system operations and functional capabilities were categorized in the tool as follows by the phase of election activity in which they are required:
    - Pre-voting Capabilities: These functional capabilities are used to prepare the voting system for voting. They include ballot preparation, the preparation of election-specific software (including firmware), the production of ballots, the installation of ballots and ballot counting software (including firmware), and system and equipment tests.
    - Voting System Capabilities: These functional capabilities include all operations conducted at the polling place by voters and officials including the generation of status messages.
    - Post-voting Capabilities: These functional capabilities apply after all votes have been cast. They include closing the polling place; obtaining reports by voting machine, polling place, and precinct; tabulation of paper ballots at the central location; accumulation of results from all voting methods; obtaining consolidated reports; and obtaining reports of audit trails.
- FCA-Limits Testing: System limits as defined in the TDP and/or COTS manuals were tested verified.
- FCA-Claims Testing: System user instructions and procedures found in the TDP were followed to verify their accuracy and completeness. In addition any functional claims discovered in the TDP that were not specifically examined in other areas or that were items of interest were also tested.
- FCA-Mapping: All functional paths (buttons, dropdowns, etc.) were mapped by qualified VSTL personnel, to help ensure all functional options had been noted and exercised. Any items of interest were examined and/or tested.

Issues found during these efforts were tracked using an issue tracking software program and issue tracking spreadsheets.

Summary Findings

All functional tests were eventually successfully executed. During execution of the test procedure, it was verified that the ClearVote 1.4 voting system successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results. At the conclusion of the test campaign, it was determined that all issues had been communicated to Clear Ballot and had been successfully addressed.

3.1.2.6 Volume & Stress

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

Summary Findings

Volume and stress testing was successfully performed on the Clear Ballot 1.4 voting system. No issues were encountered during the test.

3.1.2.7 Accuracy

The accuracy test ensured that each component of the voting system could each process 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy test was 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 was 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, such as the ClearVote 1.4 voting system, 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 were used to test components of the voting system:

The accuracy requirements for the ClearCast and ClearCount were met by the execution of the standard accuracy test utilizing pre-marked ballots of each ballot length supported and ClearAccess produced ballots. For the accuracy test, voting sessions were started using manual session activation.

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

Summary Findings

The ClearVote 1.4 voting system under test successfully passed the accuracy test. No functional issues were noted during the execution of this test and all results were imported, tabulated, and validated via the ClearCount reporting function.

3.1.2.8 System Integration

System Integration is a system level test for the integrated operation of both hardware and software. Compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment, were determined through functional tests integrating the voting system software with the remainder of the system. During performance of the System Integration, the ClearVote 1.4 voting system was configured as it would be for normal field use. This included connecting all supporting equipment and peripherals including ballot boxes, voting booths (regular and accessible), and any physical security equipment such as locks and ties. Pro V&V personnel configured and tested the system by following the procedures detailed in the ClearVote 1.4 voting system technical documentation.

Summary Findings

Three General Elections and three Primary Elections were successfully exercised on the voting system, as described below:

Three general elections with the following breakdowns:

- General Election GEN-01: A basic election held in 4 precincts, one of which is a split precinct. This election contains 19 contests compiled into 4 ballot styles. 5 of the contests are in all 4 ballot styles. The other 15 contests are split between at least 2 of the precincts with a maximum of 4 different contest spread across the 4 precincts.
- General Election GEN-02: A basic election held in 3 precincts. This election contains 15 contests compiled into 3 ballot styles. 10 of the contests are in all 3 ballot styles with the other five split across the 3 precincts.
- General Election GEN-03: A basic election held in 2 precincts. This election contains 8 contests and compiled into 2 ballot styles. 4 of the contests are in both ballot styles. The other 4 contests are split between the two precincts. This election is 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.

Three primary elections with the following breakdowns:

- Primary Election PRIM-01: Open Primary Election in two precincts. This election contained thirty contests compiled into five ballot styles. Each ballot style contains 6 contests.
- Primary Election PRIM-02: Open Primary Election held in two precincts. This election contained thirteen contests compiled into three ballot styles. One contest is in all three ballot styles; all other contests are independent.
- Primary Election PRIM-03: A basic election held in 2 precincts. This election contains 10 contests and is compiled into 2 ballot styles. 2 of the contests are in both ballot styles. The other 8 contests are split between the two parties' ballots. This Primary Election is 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 ClearVote 1.4 voting system successfully passed the System Integration Test. All deficiencies encountered during the System Integration test, which are noted in Table 3-3, were successfully resolved. During execution of the test procedure, it was verified that the ClearVote 1.4 voting system successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results.

3.1.2.9 Usability & Accessibility

Usability & Accessibility testing was performed to evaluate the ClearVote 1.4 voting system to the applicable requirements. The usability testing focused on the usability of the ClearVote 1.4 voting system. Usability was defined generally as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks. The Accessibility portion of testing evaluated the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B).

During test performance, the ClearVote 1.4 voting system was configured as per the Clear Ballot TDP. The configured system was tested to the VVSG 1.0 requirements utilizing TestLink which maintains all applicable test cases. Utilization of both negative and positive inputs were entered into the system and documented into TestLink to allow for traceability and reproducibility. All components were evaluated for applicable requirements in which all deficiencies were documented within TestLink and Mantis for tracking purposes. Regression testing was performed on all identified issues to ensure resolution and compliance to the requirements.

Summary Findings

The ClearVote 1.4 voting system successfully met the requirements of the Usability & Accessibility evaluation. All deficiencies encountered during testing, which are noted in Table 3-3, were successfully resolved.

3.1.2.10 QA & CM System Review

The Clear Ballot Quality and Configuration Management Manuals were reviewed for their fulfillment of Volume I, Sections 8 and 9, and the requirements specified in Volume II, Section 2. The requirements for these sections establish the quality assurance and configuration standards for voting systems to which manufacturers must conform and require voting system manufacturers to implement a quality assurance and configuration management program that is conformant with portions of the recognized ISO standards. As part of the review process, the revised Clear Ballot TDP documents were reviewed to determine if the stated policies were being followed.

Summary Findings

An assessment of the CM/QA processes and procedures was performed for the ClearVote 1.4 voting system. The assessment showed that the voting system and the associated development process followed the stated processes and procedures.

3.2 Anomalies & Resolutions

When a result is encountered during test performance that deviates from what is standard or expected, a root cause analysis is performed. Pro V&V considers it an anomaly if no root cause can be determined. In instances in which a root cause is established, the results are then considered deficiencies. A root cause was determined for each anomaly, which made them deficiencies.

3.3 Correction of Deficiencies

Any violation of the specified requirement or a result encountered during test performance that deviates from what is standard or expected in which a root cause is established was considered to be a deficiency. Deficiencies were logged throughout the test campaign into the Pro V&V tracking system (Mantis) for disposition and resolution. All deficiencies encountered during the ClearVote 1.4 voting system test campaign were successfully resolved. In each instance, the resolutions were verified to be resolved through all required means of testing (regression testing, source code review, and TDP update) as needed.

The noted deficiencies are listed in Table 3-3.

Table 3-3. Noted Deficiencies

ID#	Test Category	Deficiency	Resolution
384	FCA	ClearAccess: Cannot print all audit records	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
389	FCA	ClearCast: Not displaying all affected contests onscreen	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
390	FCA	ClearCast: Unit does not shut down	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
391	FCA	ClearAccess: Voter is not informed of an undervote in the review vote's screen.	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
395	FCA	ClearDesign: Syntax being shown & read when importing text	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
394	FCA	ClearAccess: Cannot skip or go backwards in text using EZ access keypad	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.

Table 3-3. Noted Deficiencies (continued)

ID#	Test Category	Deficiency	Resolution
385	FCA	ClearAccess: No audio For character selection under write-in candidate	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
398	System Integration	ClearAccess: Write-in candidate's name duplicated when ballot printed.	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
402	System Integration	ClearCast: ClearCast holds multiple selections	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
401	System Integration	ClearAccess: Contest header not being read after an undervote	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
400	FCA	ClearAccess: All special characters that are used by the system have to be repeated back to the voter.	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
399	FCA	ClearAccess: During ADA session the text input field loses focus.	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
393	Accuracy	ClearCast: Results report missing votes & header	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
388	FCA	ClearCount: Allowed username to be edited using incorrect combination of characters.	This issue was addressed using a source code update. Functional regression testing was performed to verify issue resolved.
392	Accuracy	ClearCast: Stuck Ballots	This issue was addressed with a TDP update instructing poll workers and supervisors to place a blank sheet of paper in the bottom of the ballot bag.
408	Hardware	Temp Power: The ClearCast component failed the Temperature Power Variation Test, Attempt 1	This issue was resolved by the replacement of the power supply. The Temperature Power Variation Test was performed a second time and the ClearCast component successfully completed the test.

Table 3-3. Noted Deficiencies (continued)

ID#	Test Category	Deficiency	Resolution
409	Hardware	Temp Power: The ClearAccess HP Printer failed the Temperature Power Variation Test, Attempt 1	This issue was resolved by removal of the HP printer from the system configuration under test.
410	Hardware	Radiated Emissions: ClearCast failure; ClearAccess – AIO and OKI printer failure	These issues were resolved by removing the Display Port to HDMI adapter from the ClearCast Unit and adding a ferrite on the Oki Printer
411	Hardware	Electromagnetic Susceptibility: OKI printer and APC UPS	This issue was resolved by adding a ferrite on the Brother Printer
412	Hardware	Electrostatic Disruption: ClearAccess AIO and Brother printer failure	This issue was resolved by adding a plastic cover over the Oki and UPS LCDs and a copper tape around the LCDs.
413	Security	Pro V&V does not have the correct locks and seals to properly secure the components and proper TDP guidance to apply at polling location.	The issue was resolved by receipt of the proper security locks and seals in addition to TDP update for application.

4.0 RECOMMENDATION FOR CERTIFICATION

The ClearVote 1.4 voting system, as presented for testing, successfully met the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Additionally, Pro V&V, Inc. has determined that the ClearVote 1.4 voting system functioned as a complete system during System Integration Testing. Based on the test findings, Pro V&V recommends the EAC grant the ClearVote 1.4 voting system certification to the EAC 2005 VVSG.

APPENDIX A

HARDWARE TEST REPORTS

(Provided Separately)

NTS – Longmont Emissions Test Report

NTS – Longmont Immunity Test Report

NTS – Longmont Environmental ClearCast Only

NTS – Longmont Environmental All Other

NTS – Longmont Temp Power ClearCast Only

TUV – ClearCast Product Safety

APPENDIX B

WARRANT OF ACCEPTING CHANGE CONTROL RESPONSIBILITY

November 15, 2017

Mr. Jack Cobb
ProVandV
700 Boulevard S SW #102
Huntsville, AL 35802

Re: Clear Ballot Group Warrant of Accepting Change Control Responsibility as defined in Appendix B of the EAC VSTL Program Manual and NOC 09-004

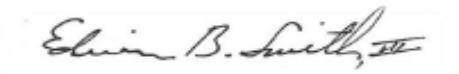
Dear Mr. Cobb:

In accordance with the above referenced US Election Assistance Notice of Clarification:

Clear Ballot Group warrants that any and all changes made to the ClearVote 1.4 voting system during the test campaign will be incorporated to any deployed voting system and its components prior to the application of any sort of mark of EAC Certification to that deployed system or its components.

Do not hesitate to contact me if you have any questions with respect to this Warrant.

Sincerely,



Edwin B. Smith, III
Vice President, Product

APPENDIX C

TRUSTED BUILD

(TBD)

APPENDIX D

AS-RUN TEST PLAN

(Provided Separately)

CBG ClearVote 1.4 Test Plan TP-CBG-2016-01.01 As-Run