

# Certification Test Report

Report Number *HRT-3026-CTR-01*

## Hart InterCivic and Verity Voting 1.0

Certification Test Report Rev 01

February 20<sup>th</sup> 2015

Prepared for:

<b>Vendor Name</b>	<i>Hart InterCivic Inc.</i>
<b>Vendor System</b>	<i>Verity Voting 1.0</i>
<b>EAC Application No.</b>	<i>HRT-Verity-1.0</i>
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Accredited by the National Institute of Standards and Technology (NIST) National Voluntary Lab Accreditation Program (NVLAP), and accredited by the Election Assistance Commission (EAC) for VSTL status.



## Revision History

Release	Author	Revisions
Rev 01	M. Santos	Initial Release; submitted to EAC for approval

### Disclaimer

The Certification Test results reported herein must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Results herein relate only to the items tested.

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The tests referenced in this document were performed in a controlled environment using specific systems and data sets, and results are related to the specific items tested. Actual results in other environments may vary.

### Opinions and Interpretations

There are no opinions or interpretations included in this report.

### Other Labs Performing Hardware Testing

SLI Global Solutions is responsible for all core voting system tests as identified in NIST NVLAP Handbook 150-22 (2008). Regarding non-core hardware testing for this certification test campaign, this report contains data that were produced under subcontract by the following lab(s):

**Table 1 – Labs Performing Hardware Testing**

Laboratory	Address	Test(s)	Date(s)
EMC Integrity, Inc. (NVLAP certified for electromagnetic compatibility and telecommunications)	1736 Vista View Drive Longmont, CO 80504	<b><u>EMC / EMI Tests:</u></b> Radiated Emissions, Conducted Emissions, ESD, Electromagnetic Susceptibility, Electrical Fast Transient, Lightning Surge, Conducted RF Immunity, Magnetic Fields Immunity, Electrical	<b>10/1/14 - 11/4/14</b>



Laboratory	Address	Test(s)	Date(s)
		Power Disturbance	
PTI Professional Testing (EMI), Inc.	1601 N. A. W. Grimes, Suite B  Round Rock, TX 78665, USA	<b><u>Information technology equipment Safety Test:</u></b>  EN 60950-1:2006 + A12:2011	<b>11/4/14 - 11/17/14</b>
Cascade TEK – Front Range  (A2LA certified for mechanical including MIL STD 810)	1530 Vista View Drive Longmont, CO 80504	<b><u>MIL-STD-810D Tests:</u></b>  Bench Handling, Vibration, Low Temperature, High Temperature, Humidity, Temperature/Power Variation, and Reliability	<b>10/13/14 - 11/17/14</b>



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## 1 Introduction

SLI Global Solutions is submitting this report as a summary of the certification testing efforts for the **Hart InterCivic Verity 1.0** voting system, as detailed in the section System Identification. The purpose of this document is to provide an overview of the certification testing effort and the findings of the testing effort for **Hart InterCivic Verity 1.0** voting system.

This effort included documentation review of the Technical Data Package, source code review, and testing of the **Hart InterCivic Verity 1.0** voting system. Testing consisted of the development of a test plan, managing system configurations, executing a subset of test cases based on the Hart testing performed, component and system level tests prepared by SLI, and analysis of results. The review and testing was performed at SLI's Denver, Colorado facility.

### 1.1 References

1. Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG), 2005 Version 1.0. Volumes I and II
2. NIST NVLAP Handbook 150: 2006.
3. NIST NVLAP Handbook and 150-22: 2008.
4. EAC Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 1.0, June 1, 2011
5. SLI VSTL Quality System Manual, 1.16, prepared by SLI, dated December 3, 2013

### 1.2 Document Overview

This document contains:

- The Introduction which discusses the application tested/reviewed
- The Certification Test Background which discusses the testing process
- The System Identification which identifies hardware and software for the Hart InterCivic Verity 1.0 voting system
- The System Overview which discusses the functionality of Hart InterCivic Verity 1.0 voting system software and firmware
- The Certification Tests which are a summary of the testing effort
- The Recommendations section which contains the final analysis of the testing effort
- EAC Certification & Voting System Configuration summarizes the voting system configuration
- Appendices:
  - Appendix A – Test Plan – incorporated by reference
- Attachments which contain:
  - Attachment A – Warrant of Change Control for Verity 1.0
  - Attachment B – Trusted Build records



- Attachment C – List of Source Code Reviewed and Results
- Attachment D1-5 – Accredited Hardware Test Lab Certification
- Attachment E1-11 – PCA Summary
- Attachment F1-3 – Hardware Test Plans
- Attachment G1-6 – Hardware Testing Results from Hardware Test Laboratories

## 2 Certification Test Background

This section provides a brief overview of the EAC Certification Program and the activities involved in order for a voting system to be considered for certification against the 2005 VVSG and the EAC program manual.

### 2.1 PCA - Document and Source Code Reviews

The Physical Configuration Audit (PCA) review of the Hart InterCivic Verity 1.0 documentation, submitted in the requisite Technical Data Package (TDP), was performed in order to verify conformance with the Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG) 2005. Source code was reviewed for each software and firmware application declared within the Verity 1.0 voting system.

All PCA reviews were conducted in accordance with *Volume 2 Section 2* of the EAC VVSG 2005, to demonstrate that the system meets the requirements. Results of the PCA documentation review can be found in section 5.2 of this Certification Test Report. Inconsistencies or errors in documentation were identified to Hart for resolution or comment. Additional details of the PCA documentation review can be found in “Attachment E – PCA Summary”.

All PCA source code reviews were conducted in accordance with *Volume 1 Section 5.2 and Volume 2 Section 5* of the EAC VVSG 2005, to demonstrate that the system meets the requirements. Results of the PCA source code reviews can be found in “Attachment C – List of Source Code Reviewed and Results”. Inconsistencies or errors in the source code were identified to Hart for resolution or comment.

### 2.2 FCA - Functional & System Testing and Sampling

The Functional Configuration Audit (FCA) review of the test documentation submitted by Hart in the TDP was executed in order to verify testing of the voting system requirements defined in *Volume 1 Sections 2, 6, 7, and 9* of the EAC VVSG 2005.

SLI’s standard Test Suites were customized for the **Hart InterCivic Verity 1.0** voting system and conducted in accordance with *Volume 2 Section 6*, in conjunction with the functional testing. Simulations of elections were conducted to demonstrate a beginning-to-end business use case process for the **Hart InterCivic Verity 1.0** voting system.



## 2.2.1 Test Methods

All test methods employed are within the scope of SLI's VSTL accreditation.

The following validated test methods were employed during this test campaign:

**Table 2 – Test Methods**

SLI VSTL Test Method Name	Version Date
TM_Accessibility v1.0.doc	1/14/2014
TM_Accuracy v1.1.doc	12/16/2014
TM_Audit_Record_Data v1.0.doc	1/13/2014
TM_Ballot_and_Program_Installation_and_Control v1.0.doc	1/13/2014
TM_Ballot_Box v1.1.doc	3/28/2014
TM_Ballot_Counter v1.0.doc	1/13/2014
TM_Ballot_Formatting_and_Production v1.0.doc	1/13/2014
TM_Ballot_Rotation v 1.0.doc	1/13/2014
TM_Basic_Election_Components v1.0.doc	1/13/2014
TM_Blanket_Open_Primary_Creation v 1.0.doc	1/13/2014
TM_Closed_Primary_Election_Creation v 1.0.doc	1/13/2014
TM_Closing_the_Polls v 1.0.doc	2/19/2014
TM_Error Message and Recovery v1.2.doc	12/16/2014
TM_HW_Integrity v1.0.doc	1/13/2014
TM_Maintainability v1.0.doc	1/13/2014
TM_Non-Partisan v1.0.doc	1/13/2014
TM_Partisan Offices v1.0.doc	1/13/2014
TM_Performance v1.0.doc	2/21/2014
TM_Pre-Voting_Capabilities v1.0.doc	1/13/2014
TM_Provisional or Challenged Ballots v1.0.doc	1/13/2014
TM_Ranked_Order_Voting v1.0.doc	2/7/2014
TM_Readiness v1.0.doc	1/13/2014
TM_Security_Access_Control v1.0.doc	2/19/2014
TM_Security_Access_Control_Measures v1.0.doc	2/19/2014
TM_Security_Physical_Security_Measures v1.0.doc	2/19/2014
TM_Security_Software_Security v1.0.doc	2/19/2014
TM_Split_Precincts v1.0.doc	1/13/2014
TM_Standard Open Primary Creation v1.0.doc	1/13/2014
TM_Straight_Party_Voting v1.0.doc	1/13/2014
TM_Stress v1.0.doc	2/7/2014





SLI VSTL Test Method Name	Version Date
TM_System_Audit v1.0.doc	2/7/2014
TM_Tally_and_Reporting v1.0.doc	2/7/2014
TM_Usability v1.1.doc	12/16/2014
TM_Volume v1.0.doc	2/7/2014
TM_Vote_for_N_of_M v1.0.doc	2/7/2014
TM_Voting_Ballot_Rotation v1.0.doc	2/7/2014
TM_Voting_Capabilities v1 1.doc	12/16/2014
TM_Voting_Non-Partisan v1.0.doc	2/10/2014
TM_Voting_Partisan_Offices v1.0.doc	2/10/2014
TM_Voting_Precincts_and_Districts v1.0.doc	2/10/2014
TM_Voting_Straight_Party v1.0.doc	2/10/2014
TM_Voting_Vote_for_N_of_M v1.0.doc	2/19/2014
TM_Voting_Write-In v1.0.doc	2/10/2014
TM_Write-In v1.0.doc	2/10/2014

The above listed test methods are implemented in a complementary fashion: modules are employed from various methods to form suites. Suites include a logical sequence of functionality that is used to validate the requirement addressed by each module within the suite.

#### Deviations from, additions to, or exclusions from the test methods

There were no deviations from, additions to, or exclusions from any of the test methods used in this certification test campaign.

### 2.2.2 Sampling of Manufacturer tests

SLI selected a subset of the **Hart InterCivic Verity 1.0** functionality for functional test execution. SLI performed a sampling of the vendor's test cases based on the following guideline:

- Review **Hart InterCivic Verity 1.0** test cases and selected tests from high-risk areas for sampling, including:
  - Security
  - Error and Recovery
  - Audit log
  - Tabulating



### 2.2.3 Terms and Abbreviations

This section details pertinent terms applicable within this report.

**Table 3 – Terms and Abbreviations**

Term	Abbreviation	Description
American Association for Laboratory Accreditation	A2LA	A nonprofit, non-governmental, public service, membership society whose mission is to provide comprehensive services in laboratory accreditation and laboratory-related training.
Ballot Marking Device	BMD	An accessible computer-based voting system that produces a marked ballot (usually paper) that is the result of voter interaction with visual or audio prompts.
Central Count Scanner	CCS	High Speed Digital Scanner is a ballot scanning device typically located at a central count facility and is operated by an automated multi-sheet feeding capability.
Compact Flash card	CF	This is a type of flash memory card in a standardized enclosure often used in voting systems to store ballot and/or vote results data.
Compact Flash AST	CFAST	A compact flash media based on the Serial ATA bus rather than the Parallel ATA bus, used by the original CompactFlash
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)
Election Assistance Commission	EAC	An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program.
Election Management System	EMS	Typically a database management system used to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to layout the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Electromagnetic Compatibility	EMC	The goal of EMC is to validate the correct functioning of different equipment in the same environment and the avoidance of any interference effects between them.



Term	Abbreviation	Description
Functional Configuration Audit	FCA	Exhaustive verification of every system function and combination of functions cited in the vendor's documentation. The FCA verifies the accuracy and completeness of the system's Voter Manual, Operations Procedures, Maintenance Procedures, and Diagnostic Testing Procedures.
Independent Test Authority	ITA	This is a test lab that is not connected with the vendor or manufacturer of the voting system.
Chevron	No Abbreviation	<b>Verity</b> components use workflow chevrons. Workflow chevrons, arranged along the top of the screen, identify the function the user is currently viewing.
Institute of Electrical and Electronics Engineers	IEEE	A non-profit organization, IEEE is the world's leading professional association for the advancement of technology.
National Institute of Standards and Technology	NIST	A non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
National Voluntary Laboratory Accreditation Program	NVLAP	A division of NIST that provides third-party accreditation to testing and calibration laboratories.
Physical Configuration Audit	PCA	The testing activities associated with the physical aspects of the system (hardware, documentation, builds, source code, etc.).
Primary – Blanket		The Blanket Primary election combines all candidates for a given contest, regardless of political affiliation, into the same contest. This is done with the same presentation as in a general election with the one difference being that there may be multiple candidates from each party listed. From the <b>Verity 1.0</b> perspective, this election is treated as if it were a general election.
Primary – Closed		The Closed Primary election segregates each political party onto its own ballot, along with all pertinent non-political contests and referendums.
Primary - Open		The Open Primary election combines all political parties contests onto a single ballot, along with all pertinent non-political contests and referendums.



Term	Abbreviation	Description
Precinct Count Scanner	PCS	A precinct-count optical scanner is a mark sense-based ballot and vote counting device located at a precinct and is typically operated by scanning one ballot at a time.
Request For Information	RFI	A form used by testing laboratories to request, from the EAC, interpretation of a technical issue related to testing of voting systems.
Requirements Matrix	N/A	This is the matrix created by the EAC and maintained by SLI that traces the requirements to the various test modules and test methods.
Standard Lab Procedure	SLP	SLI's quality system documentation is made up of standard lab procedures (SLPs), which are procedures required to ensure a systematic, repeatable and accurate approach to voting systems testing and governing the actual performance of SLI's work.
Technical Data Package	TDP	This is the data package that is supplied by the vendor and includes: Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of each voting system.
Test Method	TM	SLI proprietary documents which are designed to group sets of EAC VVSG requirements in a logical manner that can be utilized to more efficiently validate where and how requirements, or portions of a requirement, are met.
Validation	No Abbreviation	Confirmation by examination and through provision of objective evidence that the requirements for a specific intended use or application have been fulfilled (ISO 9000)
Verification -	No Abbreviation	Confirmation by examination and through provision of objective evidence that specified requirements have been fulfilled (ISO 9000)
Voluntary Voting Systems Guidelines Volumes 1 & 2	VVSG	A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all of the basic functionality, accessibility and security capabilities required of these systems.
Voting System Test Lab	VSTL	This is the lab where the voting system is being tested.



Term	Abbreviation	Description
Voting System Under Test	VSUT	The designation for a voting system that is currently being tested.
Voting Test Specialist	VTS	An SLI employee within the Compliance division that has been qualified to perform EAC voting system certification testing.

### 3 System Identification

The **Hart InterCivic Verity 1.0** voting system was submitted for certification testing with the documentation, hardware and software listed below. No other Hart product was included in this test effort.

#### 3.1 Documentation

The TDP User/Owner manuals that would be part of the certified system delivered to a purchaser of the system are as follows:

- Verity Build Technical Reference Manual 6600-002 A05.pdf
- Verity Central Technical Reference Manual 6600-003 A04.pdf
- Verity Count Technical Reference Manual 6600-004 A04.pdf
- Verity Build Quick Reference Manual 6620-002 A05.pdf
- Verity Central Quick Reference Manual 6620-003 A04.pdf
- Verity Count Quick Reference Manual 6620-004 A04.pdf
- Verity Polling Place Operations Technical Reference Manual 6610-100-A04.pdf
- Verity Service and Maintenance Operations Technical Reference Manual 6610-001 A05.pdf
- Verity XML Guide Package.zip (this includes Verity XML Import Guide 6600-006 A06.pdf)
- Verity Operational Guide 66400001 A13.pdf

#### 3.2 Software and Firmware

Any and all software/firmware that is to be used by the declared voting system whether directly or indirectly, in a production environment, must be validated during the certification process.

The software and firmware employed by **Hart InterCivic Verity 1.0** consists of 2 types, custom and commercial off the shelf (COTS). COTS applications were verified to be pristine, or were subjected to source code review for analysis of any modifications and verification of meeting the pertinent standards.



Tables 4, 5 and 6 below detail each application employed by the Hart InterCivic Verity 1.0 voting system.

**Table 4 – Hart Verity 1.0 Software and Firmware**

Manufacturer	Application(s)	Version
Verity Build	EMS software	1.0.3
Verity Central	High speed digital scanner software	1.0.3
Verity Count	Central count location accumulation and tallying software	1.0.3
Verity Scan	Digital scanner firmware	1.0.3
Verity Touch Writer	BMD firmware	1.0.3
Verity Device Microcontroller	Firmware for Verity Devices	V17

**Table 5 – COTS Software for Workstations**

Manufacturer	Application	Version	Verity Voting 1.0 Component
<b>Operating system</b>			
<b>Microsoft</b>	<i>Windows Embedded Standard with Service Pack 1, 64-bit</i> Configured for Verity Kiosk Operations	6.1.7601	Build, Central, Count
<b>Supporting Software</b>			
<b>McAfee</b>	Application Control Configured for Verity Kiosk	6.1.2	Build, Central, Count
<b>Microsoft</b>	.NET 4.x Framework Unmodified	4.0.30319 4.5.50709	Build, Central, Count
<b>Microsoft</b>	<i>SQL Server 2012</i> Unmodified	11.0.2100	Build, Central, Count
<b>Microsoft</b>	Visual Studio C++ 2005 redistributables Unmodified	8.0.56336	Build, Central, Count
<b>Microsoft</b>	Visual Studio C++ 2010 redistributables/runtime/shell Unmodified	10.0.40219	Build, Central, Count



**Table 6 – COTS Software and Firmware for Devices**

Manufacturer	Application	Version	Verity Voting 1.0 Component
<b>Operating system</b>			
<b>Microsoft</b>	<i>Windows Embedded Standard 7 with Service Pack 1, 32-bit</i>  Configured for Verity Kiosk Operations	6.1.7601	Scan, Touch Writer
<b>Supporting Software</b>			
<b>McAfee</b>	Application Control  Configured for Verity Kiosk	6.1.2	Scan, Touch Writer
<b>Microsoft</b>	.NET 4.x Framework  Unmodified	4.0.30319 4.5.50709	Scan, Touch Writer
<b>Microsoft</b>	<i>SQL Server Compact</i> <i>Unmodified</i>	11.0.2100	Scan, Touch Writer
<b>Microsoft</b>	Visual Studio C++ 2005 redistributables  Unmodified	8.0.56336	Scan, Touch Writer
<b>Microsoft</b>	Visual Studio C++ 2010 redistributables/runtime/shell/tools  Unmodified	10.0.40219	Scan, Touch Writer

### 3.3 Equipment (Hardware)

The hardware employed by **Hart InterCivic Verity 1.0** consists of 2 types, custom and commercial off the shelf (COTS). COTS hardware was verified to be pristine, or was subjected to review for analysis of any modifications and verification of meeting the pertinent standards.

Tables 7 and 8 below detail each device employed by the **Hart InterCivic Verity 1.0** voting system.

**Table 7 – Hart Verity 1.0 Voting Equipment**

Hardware	Use	Model
<b>Verity Scan</b>	Precinct polling place digital scanner	Revision B



Hardware	Use	Model
Verity Touch Writer	Precinct polling place Ballot Marking Device	Revision B
Verity Key	Security key used within the voting system	N/A
Verity vDrive	Media used for transportation of voting system data	N/A

**Table 8 – COTS Equipment**

Manufacturer	Hardware	Model
OKIDATA (for <b>Verity Build, Verity Central, Verity Touch Writer and Verity Count</b> )	Ballot/Report Printer	B431d
OKIDATA (for <b>Verity Build</b> )	Ballot Printer	C911
OKIDATA (for <b>Verity Build</b> )	Ballot Printer	C831
Various (for <b>Verity Build, Verity Central and Verity Count</b> )	<p><b>Intel-Windows Workstation (Recommended Requirements)</b>            Processor – x86-compatible, 3.0GHz, Quad Core            Memory – 8GB            Hard Drive – 2 x 1 TB RAID-Level 1, Removable w/ key lock            Ethernet Port – 100Mb/1Gb            USB Ports – 4 ports            Video Card - Integrated Graphics            Keyboard - USB Keyboard            Mouse - USB Mouse            NO Wireless technologies allowed: WiFi, Bluetooth, Aircard, etc.</p>	
Various (for <b>Verity Build, Verity Central and Verity Count</b> )	<p><b>Monitor (Recommended Requirements)</b>            Panel Size - 50.8 cm            Aspect Ratio - Widescreen (16:9)            Optimal Resolution - 1600 x 900 at 60 Hz            Contrast Ratio - 1000: 1            Brightness - 250 cd/m<sup>2</sup> (typical)</p>	
Kodak	Ballot Scanner	i5600





Manufacturer	Hardware	Model
(for Verity Central)		
Canon (for Verity Central)	Ballot Scanner	DR-G1100
Canon (for Verity Central)	Ballot Scanner	DR-G1130

### 3.4 Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, and any other materials used in testing.

- Ballots & Blank Ballot grade paper
- Thumb Drives
- Ballot marking pens
- Printer paper rolls

### 3.5 TDP Documents Used to Support Testing

The vendor documents used to support Certification Testing are listed below:

#### Verity Trace - System Functionality

- Verity 1.0 Technical Data Package Overview
- Airgap Interface for Portable Electronic Media Technical Reference
- Verity XML Import Guide (plus 8 Templates and 3 Sample Elections)
- Verity Voting Verity Operational Environment
- Verity Software Architecture & Design Technical Documentation
- System Description Technical Document
- Verity Voting Performance Characteristics
- File Manifests for Validation:
  - Build-Client, BuildCount-Client, BuildCount-Server, Build-Server, Central-Client, Central-Server, Count-Client, Count-Server, Scan-Device, Touch-Device
- Voting Systems Acronyms
- Voting Systems Glossary

#### Verity Trace - System Hardware Specifications

- Test Reports
  - Verity\_Safety\_Report\_PTI-1411085-000\_TRF\_iec60950\_ALL
  - Verity\_Safety\_Report\_NRTL\_Certificate\_72101270\_CERT



- TUV audit report of TS3
- Hart InterCivic Verity Scan Environmental Test Report - Professional Testing (EMI), Inc.
- Hart InterCivic Verity Touch Writer Environmental Test Report - Professional Testing (EMI), Inc.
- Hart InterCivic Verity Scan, Verity Touch Writer, Ballot Box, Booth Standard, Booth Accessible Environmental Test Report - Professional Testing (EMI), Inc.
- Verity\_Scan\_FCCB\_Conducted\_Emissions\_16Sept2014
- Verity\_Scan\_FCCB\_Radiated\_Emissions\_15Sept2014
- Verity\_Writer\_FCCB\_Conducted\_Emissions\_16Sept2014
- Verity\_Writer\_FCCB\_Radiated\_Emissions\_17Sept2014
- Bill of Materials
  - Scan BOM - file name 3005350B-Scan\_Indented\_BOM+AVL\_Pre-EAC
  - TouchWriter BOM - file name 3005352B-TouchWriter-Indented\_BOM+AVL\_Pre-EAC
  - BallotBox BOM - file name 3005357A-Ballot-Box\_Indented\_BOM+AVL
  - Standard Booth BOM - file name 3005358A-Standard-Booth\_Indented\_BOM+AVL
  - Accessible Booth BOM - file name 3005359A-Accessible-Booth\_Indented\_BOM+AVL
  - Drawings and Schematics: 3005210 - Verity Access (2 files)
  - Drawings, Schematics, Review Dispositions: 3005350 - Verity Scan (19 files)
  - Drawings, Schematics, Review Dispositions: 3005352 - Verity Touch Writer (20 files)
  - Drawings: 3005357-BallotBox (2 files)
  - Drawings and Review Dispositions: 3005358-Standard-Booth (5 files)
  - Drawings and Review Dispositions: 3005359-Accessible-Booth (5 files)
  - Verity System Design Specification (file name Verity Base Station Microcontroller Specification 4005462)
- Verity System Design Verity Electronics Specification
- COTS Equipment
  - Verity 1.0.0 COTS Baseline and Plan
  - QuickSpecs HP Z230 Tower Workstation
  - QuickSpecs HP ProDisplay P231 23-inch LED Backlit Monitor
  - Canon imageFORMULA DR-G1130 DR-G1100 User Manual
  - Kodak i5000 Series Scanners User's Guide
  - OKI\_B411-B431\_Manual
  - OKI User's Manual Advanced C831n/dn, C841n/dn, ES8431/8441
  - OKI User's Manual Advanced C911dn, C931dn, C941dn, ES9411dn, ES9431dn, ES9541dn
  - Eaton 5P 1500 Tower UPS User Guide
  - HART 3S2P NCR18650A Battery Pack Preliminary Specification - Totex



- CERTIFICATE OF COMPLIANCE UL 20130910-MH29443 TOTEX MFG INC Rechargeable Battery Packs, Models: U80327 and 1005015
- AC-DC 85-250 Watts AHM Series Specification - filename XP\_Power\_AHM85PS24
- Certification of Conformity CE AC/DC adaptor XP Power AHM85PS12, AHM85PS24, Test Rpt # CE990712C14A
- CE EMS Test Report CE990712C14A XP Power AHM85PS12, AHM85PS24
- Hart Secure Ballot Stock Specification
- Verity Voting System Limits

#### Verity Trace - Software Design & Spec

- All-In-One Code Framework Coding Standards [Microsoft]
- Software Design and Development Procedure
- Software Verification and Validation Process
- Verity Coding Standard Standards Document
- Verity Application Programming Interface Specification Technical Document
- Pre-voting EMS Technical Requirements Document
- Verity Central Technical Requirements Document
- Verity Count Technical Requirements Document
- Election Management Technical Requirements Document
- Electronic Voting Devices Technical Requirements Document
- Polling Place Device Suite Technical Requirements Document
- Verity Precinct Scanner Technical Requirements Document
- Verity Security Requirements Document
- Verity Key Design Technical Document
- Verity Logging Design Technical Document
- Verity Logging Technical Requirements Document
- Verity vDrive Design Technical Document
- Workflow, Design and Wireframe docs:
  - Election Management UI workflow
  - ElectionOfficeUIWorkflow
  - PCApplicationSuiteWorkflow
  - PrecinctScannerUIWorkflow
  - Shared Device Wireframes
  - TouchWriterUIWorkflow
  - User Management UI workflow
  - Verity Desktop UI Workflow
  - VerityBuildUIWorkflow
  - VerityCentralUIWorkflow
  - VerityCountUIWorkflow



- Verity Database
  - Verity Desktop Database Schema
  - Verity Device Database Schema
  - Verity Workstation Datastore Filelist
  - Verity Database Attributes
- Verity Trusted\Witness Build Process
  - The Creation And Configuration Of The Trusted Build Environment
  - The Verity Access Firmware Build Procedure
  - The Verity MCU Firmware Build Procedure
  - Device WES7 Creation Process Document
  - Device OS Creation And Configuration Process Document
  - Device Configuration Process Document
  - Workstation WES7 Creation Process Document
  - Workstation Manufacturing Process Document
  - Workstation Configuration Process Document
- License
  - Microsoft Software License Terms Microsoft SQL Server 2012 Standard For Embedded Systems
  - Indirect Authorized OEM License Agreement [filename McAfee & Hart Indirect OEM License 6\_24\_14 rev 1]
  - Neodynamic End User License Agreement [filename Barcode Professional OEM License EULA-v7]

#### Verity Trace - System Security Specification

- Verity Risk Assessment
- Verity Security Requirements Document

#### Verity Trace - System Operations Procedures

- Verity Build Technical Reference Manual
- Verity Build Quick Reference Manual
- Verity Central Technical Reference Manual
- Verity Central Quick Reference Manual
- Verity Count Technical Reference Manual
- Verity Count Quick Reference Manual
- Verity Service and Maintenance Manual
- Verity Polling Place Operations Manual
- Verity Operational Guide
- Verity Trace - System Maintenance
- Verity Service and Maintenance Manual



### Verity Trace - Personnel Deployment-Training

- Assisting Persons With Disabilities Training Agenda
- Verity Build Training Agenda
- Verity Central Training Agenda
- Verity Count Training Agenda
- Management and Best Practices Training Agenda
- Polling Place Operations Training Agenda
- Support Procedures Training Agenda
- Train-the-Trainer Training Agenda
- Assisting Persons With Disabilities [Presentation]
- Verity Build [Presentation]
- Verity Central [Presentation]
- Verity Count [Presentation]
- Verity Management & Best Practices [Presentation]
- Polling Place Operations [Presentation]
- Verity Support Procedures [Presentation]
- Verity Train the Trainer [Presentation]

### Verity Trace - Configuration Management Plan

- Verity - Operations PRD Ops/Services/Supply Chain Planning Document
- Configuration Management Processes
- Document Control Procedure
- Software Versioning Procedure
- Voting System Implementation And Maintenance Process Document

### Verity Trace - Quality Assurance

- Classification & Signature Matrix for CCB PLM Process
- Continual Improvement Process
- Control of Nonconforming Product Procedure
- Hardware Design and Development Procedure
- Hardware Verification and Validation Process
- Product Requirements Procedure
- Quality Manual
- Records Retention Matrix
- Software Production Procedure
- Software Test Design and Development Procedure
- Supplier Qualification and Management Procedure
- TDP Document Control Guide



- VSTL Product Submission Procedure

Verity Trace - System Test-Verification Specification

- Hart Requirements Management Requirements Management Process
- Verity Voting Summative Usability Test Plan
- Usability Test Report of Verity Touch/Touch Writer and Verity Scan
- Security Test Cases
- Verity Voting National Certification Test Specification

**3.5.1 Excluded Requirements**

In this section we identify VVSG requirements that do not pertain to the declared system being certified. For this certification project Hart has elected to not support their **Verity Touch** (DRE) implementation, **Verity Controller** which is used for linking multiple **Verity Touch** devices in a chain, **Verity Print** which is a ballot on demand device, nor **Verity Relay** transmission capabilities. As such, the table below enumerates the requirements that are not subject to verification for this project.

DRE Related Requirements Not Under Test	Transmission Related Requirements Not Under Test
1.5.2.2	2.1.9
1.5.2.3	2.4.4
2.1.2.f	4.1.2.15
2.1.4.k,l	6.1
2.3.1.3	6.2
2.3.2	7.5
2.3.3.3	7.6
3.1.2.f,g	7.7
4.1.1.b	7.9
4.1.4.3	
4.1.6.2	
4.3.5.b	
5.4.3.b.iv	
5.5	



DRE Related Requirements Not Under Test	Transmission Related Requirements Not Under Test
6.2.5	
7.8	
7.9	
3.2.1.c	
Vol. 2 , 4.7.4.c	

### 3.5.2 Additional Functionality/Requirements

As per 2005 VVSG, volume 2 section 3.2.2, review of the Hart Technical Requirements Documentation (TRDs) resulted in SLI’s determination that **Hart** has some functionality/requirements that are considered beyond the scope of the VVSG, but since they are in the declared system, will require review and verification. Additional functionality/requirements to be audited within the scope of this certification are detailed below.

#### Verity Security Requirements 4005464 A03

- 3.2.4 Verity Desktop Systems that store critical election data shall be connectable to an Uninterruptable Power Supply that will provide sufficient power to allow the use to shutdown the system gracefully.
- 3.3.3.4 Verity shall not allow simultaneous access by the same user.
- 3.3.7.1 The secure BIOS shall verify the chain of trust before allowing the system to boot.
- 3.3.7.1.1 BIOS Verification
- 3.3.7.1.1.1 The BIOS shall store a hash computed over the entire BIOS executable stored in persistent memory.
- 3.4.1 Electronic keys shall work for one and only one election
- 3.10.1 The user must not be able to open multiple Verity Voting applications at the same time on a single computer.
- 3.10.2 The following requirements shall apply to Verity Count. These requirements may be applied to other desktop applications.
  - 3.10.2.1 The user must not be able to start, open, or access any other applications on the computer while the Verity application is open.
  - 3.10.2.2 The user must not be able to access Operating System functionality while the Verity application is open.



### Verity Central TRD 4005453 A01

- 5.3.2.2.1.2.1 The application shall NOT allow two users to access an individual ballot simultaneously [VCS PRD 4.4.5.9.1].
- 5.3.2.2.2 The application shall support up to 4 simultaneous client workstations per server.
- 5.3.2.3 Each workstation connected to the server shall be required to have a unique Workstation Name [VCS PRD 4.4.2.2.4].
- 5.11.7.2.1 Before initiating scanning, the system shall verify that there is sufficient free space available to save and process all ballot images from the scan batch.
- 5.17.1.8.5 The application shall allow the user to protect a contest, which when protected does not allow manual or automatic resolution actions to be performed on the contest during the adjudication process [VCS PRD 4.4.5.6.8.2].
  - 5.17.1.8.5.1 Protected contests shall not allow manual resolution actions.
  - 5.17.1.8.5.2 Protected contests shall not be affected by the automatic resolution feature.
- 5.17.1.8.6 The application shall allow the user to remove protection from a contest.
- 5.19.2 The application shall include an interface for creating Recovery Media.

### Verity Polling Place Device Suite TRD 4005457 A03

- 3.12.3.1.1 The title of the report shall be “Configuration Readiness Report”.
- 3.12.3.1.7 The report shall include a barcode.
  - 3.12.3.1.7.1 The barcode shall contain the following data:
    - 3.12.3.1.7.1.1 The assigned polling place.
    - 3.12.3.1.7.1.2 The device serial number.
    - 3.12.3.1.7.1.3 The Election Media Device identifier.

## 4 System Overview

### 4.1 Scope of the Hart InterCivic Verity Voting 1.0 Voting System

This section provides a description of the scope of **Hart InterCivic Verity Voting 1.0** voting system components:

- The **Hart Verity Voting 1.0** voting system represents a set of software applications for pre-voting, voting and post-voting election project activities for jurisdictions of various sizes and political division complexities. **Verity Voting 1.0** functions include:
  - Defining the political divisioning of the jurisdiction and organizing the election with its hierarchical structure, attributes and associations.
  - Defining the election events with their attributes such as the election name, date and type, as well as contests, candidates, referendum questions, voting locations and their attributes.





- Preparing and producing ballot for polling place and absentee voting.
  - Preparing media for precinct voting devices and central count devices
  - Configuring and programming the Verity Scan digital scanners
  - Configuring and programming the Verity Touch Writer BMD devices
  - Producing the election definition and auditing reports.
  - Providing administrative management functions for user, database, networking and system management.
  - Import or manual data entry of the Cast Vote Records from Verity Scan devices and Verity Central.
  - Preview and validation of the election results.
  - Producing election results tally according to voting variations and election system rules.
  - Producing a variety of reports of the election results in the desired format.
  - Publishing of the official election results.
  - Auditing of election results including ballot images and log files.
- The **Verity Scan** is a digital scan ballot counter (tabulator) that is used in conjunction with an external ballot box. The unit is designed to scan marked paper ballots, interpret and record voter marks on the paper ballot and deposit the ballots into the secure ballot box.
  - The **Verity Touch Writer** is a standalone precinct level Ballot Marker Device (BMD) which also includes an Audio Tactile Interface (ATI), which allows voters who cannot complete a paper ballot to generate a machine-readable and human readable ballot, based on vote selections made, using the ATI.
  - **Verity Election Management** allows users with the Administrator role to import and manage election definitions. Imported election definitions are available through the Elections chevron in Build. Users can also delete, archive, and manage the election definitions.
  - **Verity User Manager** enables users with the correct role and permissions to create and manage user accounts within the Verity Voting system for the local workstation in a standalone configuration, or for the network in a networked configuration.
  - **Verity Election Manager** enables users, with the correct roles, to import election defining import files into the Verity voting system. This application also supports archiving, restoring and deleting elections.
  - **Verity Desktop** enables user, with the correct roles, to set the workstations date and time, gather Verity application hash codes (in order to validate the correctness of the installed applications), and access to Windows desktop.
  - **Verity Build** opens the election to proof data, view reports, print ballots, configuring and programming the **Verity Scan** digital scanners, **Verity Touch Writer** BMD devices as well as producing the election definition and auditing reports
  - **Verity Central** is a high-speed, central digital ballot scanning system used for high-volume processing of ballots (such as vote by mail).. The unit is based on COTS scanning hardware coupled with the custom **Hart** developed ballot processing application software.



- **Verity Count** is an application that tabulates election results and generates reports. **Verity Count** can be used to collect and store all election logs from every Verity component/device used in the election, allowing for complete election audit log reviews.

## 4.2 System Review

This section provides a more in-depth description of the workings of the **Hart Verity Voting 1.0** voting system and will assist the reader with understanding the flow of the voting system.

### 4.2.1 Verity Build

**Verity Voting 1.0** is initially entered through the **Verity Build** application. New election data is imported into the system, the sub-application **Election Manager**, via an XML file that is populated outside of the certified system. Existing election data (previously imported) can be re-used within the Build application.

Once the **Verity Build** application is entered, and an election is imported, via the sub-application **Election Manager**, the normal path will take the user through the chevron workflow, which includes the Proof, Configure and Create chevrons.

#### 4.2.1.1 Proof Chevron

The Proof chevron has four tab functions within it, Data Validation, Ballot Preview, Reports, and Proof Audio.

The Data Validation tab is where the imported data is validated. This allows the user to review all aspects of an election data set.

Once the data is validated, the ballots are previewed, in the Ballot Preview tab, where users can preview the details for any selected ballot. Details that can be previewed include: ballot by language, ballot by type, sorted precinct and style lists, as well as filtered precinct and style lists.

The Reports tab enables users to generate and print reports. The Reports screen contains a list of all of the reports available in **Verity Build**. From the Reports screen, users can generate, view, customize, and print selected reports.

The Proof Audio tab provides users with a way to proof audio items for their ballots. Audio items are those recordings used to create accessible audio ballots. Users proof audio items for each language in the election.

#### 4.2.1.2 Configure Chevron

The Configure chevron and its tabs of functionality follow the Proof chevron in the **Verity Voting 1.0** system of election definition creation. The Configure workflow chevron contains two tabs: Election Settings, and Accept Election.

The Election Settings tab has six sub-tabs, Printed Ballots, Voting Type Setup, Device Reports, Device Passcodes, Scan and Touch Writer.

The Printed Ballots sub-tab allows the user to set printed ballot settings.



The Voting Type Setup sub-tab allows users to set rules for specific voting, such as early voting, absentee voting as well as Election Day voting types, and associated parameters for each.

The Device Reports sub-tab allows users to control the sort order for choices on device reports, such as: Report results at the [select level] which allows users to control the level of detail on device reports; Zero report, which allows users to control whether the Zero Report shows only totals for the device or totals by precinct and precinct split; and Ballot count report, which allows users to control whether the Ballot Count Report shows only totals for the device or totals by precinct and precinct split.

The Device Passcodes sub-tab is where passcodes are defined and maintained. Passcodes are defined for **Verity** user types and for opening, suspending, and closing the polls by voting type.

The Scan sub-tab is where users can configure the ballot processing rules for scanning ballots. The four scanning exceptions are Undervote, Overvote, Invalid Vote, and Blank Ballot. In Build, each jurisdiction defines how these exceptions are to be treated.

The Touch Writer sub-tab is where the BMD can be configured to specify the number of minutes the voter access code is active.

The Accept Election tab represents the final step in the proofing process. On the Accept Election screen, users can do one of two things: accept the election, or navigate away from this screen.

Elections must be secured for security and consistency purposes. In Build, the Accept function locks election data against further edits. This step effectively defines all of the ballot styles for the election. After that, the entire formatted election definition is transferred to **Verity vDrives**. The election definition is then carried forward on **Verity vDrives** throughout the election process.

#### 4.2.1.3 Create Chevron

The Create chevron is dimmed, indicating that it is unavailable, until the election has been accepted in the **Configure** workflow. The Create chevron has three tabs: Ballots, **Verity vDrives**, and **Verity Keys**. The Ballots tab is used to configure ballots for printing.

Printing options available for each ballot include: Quantity, where users can type or use the dial to select a quantity of ballots; Type, where users can click to select either the Official, Test, or Sample ballot; Ballot serial numbers, which can be enabled; and Include ballot stub, where users can click to select the check box to include ballot stubs on printed ballots.

A **Verity vDrives** is a removable media device that carries election data throughout the election process.

The vDrives tab, which is used to create and read **Verity vDrives**, allows users to choose a Device Type, specify the quantity of **Verity vDrives** to write, write the **Verity vDrives**, print a report of **Verity vDrives** written, and then read **Verity vDrives** statistics.

The Keys tab allows the Election Official Key to be written. **Verity Keys** are made for, and utilized by, the entire system, including **Scan, Touch Writer, Central** and **Count**.



#### 4.2.1.4 Exporting Signed Elections

The final step of the **Verity Build** includes the exportation of a signed election that will be utilized within **Verity Central** and **Verity Count**.

#### 4.2.2 Verity Touch Writer

**Verity Touch Writer** is a standalone precinct level ballot marking device solution for paper ballots. It assists voters in marking their ballot and prints it out for them. Once the ballot is printed, **Verity Touch Writer** erases all memory components of that session. **Verity Touch Writer** is paired with a commercial off the shelf printer to allow the voter to mark then print their vote selections. **Verity Touch Writer** provides input via the **Verity Access (ATI)**, utilizing the wheel/button panel, paddles, or sip and puff accessories. **Verity Touch Writer** is used in conjunction with **Verity Scan** to provide the voter with a reviewable paper ballot. **Verity Touch Writer** is enabled for a given election via a **Verity Build** created **Verity vDrive** and **Verity Key**.

#### 4.2.3 Verity Scan

**Verity Scan** records Cast Vote Records (CVRs) and audit log data in redundant, secure storage locations. The storage locations include the **Verity vDrive**, CFAST and the ballot box for scanned paper ballots. Paper ballots can be scanned and transferred into digital CVRs. **Verity vDrive** storage allows for the CVRs and device logs to be transferred into the **Verity Central** ballot resolution system or the **Verity Count** tabulation system. **Verity Scan** is enabled for a given election via a **Verity Build** created **Verity vDrive** and **Verity Key**.

#### 4.2.4 Verity Central

**Verity Central** is a high volume scanning and ballot review system within the **Verity Voting 1.0** system. This application acts as a centralized compilation and processing site for ballot handling, reading and processing before tabulation.

**Verity Central** allows for ballots to be scanned in bulk for users to review during scanning and through resolution for voter intent. Each ballot has the front and back pages scanned simultaneously to capture all voter marks, supporting duplex ballots. Users with proper training can review the ballots for write-ins and ballots flagged as having voter intent issues (such as overvotes, undervotes, and write-in candidates). Once all votes have been reviewed as indicated by flagging, the ballots are then written as Cast Vote Records (CVRs) to vDrives. The final CVR records on **Verity vDrives** are then sent to a **Verity Count** workstation for official tabulation.

**Verity Central** is enabled for a given election via a **Verity Build** created exported signed election and **Verity Key**. The election is imported via the application's **Election Manager**.

Within the **Verity Central** application, the workflow follows the path of chevrons Election, Scan, Review, Write Ballots, and Reports.



#### 4.2.4.1 Elections Chevron

The Elections chevron has three tab options: Elections, Tasks and Preferences.

The Elections tab allows a user to open a loaded election. Elections are imported through the Election Management application.

The Tasks tab creates and manages tasks and the closing of polls for scanning ballots, resolving voter intent issues, and writing vDrives. Defer write-in resolution to **Verity Count** which when selected, any resolutions of voted write-ins will be handled through a **Verity Count** workstation, not through **Verity Central**. Default is to resolve in **Verity Central**.

The Preferences tab provides configuration settings for maintaining and interacting with election results within Central.

No other chevrons will become active and accessible until an election is opened from the Elections tab and at least one task is created and opened from the Tasks screen.

#### 4.2.4.2 Scan Chevron

The Scan chevron includes the tabs, Scan, Manage Batches, Search Ballots and Settings.

The Settings tab should be accessed prior to scanning. Scanner Setup opens a scanner driver setup window and sets the scanner to be used.

Test Scan is used to run a ballot through the selected scanner in order to verify proper operation.

Allow unique identifiers where, when scanning ballots, each ballot may have a unique serial number (per the election definition). This option also allows for the same serial number to be reused and not rejected during ballot scanning.

Allow incomplete multi-sheet ballots where when scanning ballots, any incomplete ballots are allowed to scan and not be rejected. Incomplete ballots do not include all pages.

The Scan tab enables users to scan large amounts of ballots, front and back at the same time, when sent through one of the supported COTS scanners. As the ballots are scanned, the ballot images are analyzed and accepted or rejected. If rejected, the system alerts the user to review the ballot for issues.

The Manage Batches tab displays all scanned and saved batches of ballots. Users can generate and view a report on a batch, delete the batch entirely, change the type, and edit the notes.

The Search Ballots tab provides a screen for searching out specific ballots within scanned batches of ballots. These ballots can be viewed or deleted from the batch. Search criteria can be a serial number, batch ID number or scan order.



#### 4.2.4.3 Review Chevron

The Review chevron has two tabs, Review Images, and Write-in Candidates.

The Review Images tab allows the user to filter and review ballots to resolve voter intent issues.

The Write-in Candidates tab allows the user to manage write-in candidate choices for contests. All possible candidate options are listed on the screen, separated by election contest.

#### 4.2.4.4 Write Ballots Chevron

The Write Ballots chevron provides an interface for writing ballots to **Verity vDrives**. All ballots must be written to **Verity vDrives** prior to closing polls for a task. If the **Verity vDrives** is damaged or is lost, the previously written batches can be rewritten to a new **Verity vDrives** as recovery media.

The Write ballots chevron contains 2 tabs, Write Ballots and Recovery vDrive tabs.

The Write Ballots tab allows the user to write ballots to **Verity vDrives**. The screen displays a list of batches available for writing to **Verity vDrives**. Every written **Verity vDrives** has a backup restoration copy saved. Once ballot batches are written to a **Verity vDrives**, the batches cannot be selected and written to other **Verity vDrives**.

The Recovery vDrive tab allows the user to create new **Verity vDrives** to replace damaged or lost **Verity vDrives**. If the **Verity vDrives** with written batches is determined to be damaged or is lost, the user can create another **Verity vDrives** of previously written data.

#### 4.2.4.5 Reports Chevron

Reports chevron is the final chevron used in **Verity Central**. The Reports chevron has 2 tabs, Reports and Exports.

The Reports tab provides detailed information on the database at the time of generation. User are allowed to generate, view, and print reports. A set of standard reports is provided to the user in order to generate and review against the loaded task and election.

The Exports tab provides export options against the database. This data is exported to CSV files.

### 4.2.5 Verity Count

**Verity Count** allows users to tabulate all voted ballots with updates of the election. Users can generate standard and custom reports for the entire election or specific precincts and polling places. Users insert and read ballots from **Verity vDrives**. As ballots are read, **Verity Count** can tabulate automatically or as manually selected, updating all reporting polling places and precincts, to give an at-a-glance view into the election.

**Verity Count** is enabled for a given election via a **Verity Build** created exported signed election and **Verity Key**. The election is imported via the application's **Election Manager**.

**Verity Count** has the following chevrons: Elections, Read, Resolve, Results, and Import/Export.



#### 4.2.5.1 Elections Chevron

The Elections chevron has 3 tabs, Elections, Tasks and Preferences.

The Elections tab allows a user to open an election.

The Tasks tab manages tabulation tasks, used to tabulate election results. A task is required to begin working with election data and generating results and reports.

The Preferences tab provides configuration settings for maintaining and interacting with election results within **Verity Count**.

#### 4.2.5.2 Read Chevron

The Read chevron has 2 tabs: Dashboard and Media Reading.

The Dashboard tab provides an overview of the entire election, options for viewing further details, reading additional **Verity vDrives**, and an option for tabulating results.

The Media Reading tab provides extensive details for **Verity vDrives** read into the system, including the amount of successful and failure reads and the current status of the **Verity vDrives** reading. If ready to insert, a new **Verity vDrives** can be inserted for CVR loading.

#### 4.2.5.3 Resolve Chevron

The Resolve chevron has 1 tab: Write-in Votes.

The Write-In Votes tab allows review and resolution of ballots with write-in votes of candidates.

#### 4.2.5.4 Results Chevron

The Results chevron has the following tabs: Options, Reports, Precincts, Polling Places, Registered Voters, Vote Recording and Auditing Dashboard.

The Options tab provides preferences and configuration settings for all generated reports.

The Reports tab provides option for generating standard and custom reports.

The Precincts tab provides details reports and information for all precincts and precinct-splits.

The Polling Places tab details reports and information for polling places as they receive and report voting data.

The Registered Voters tab provides details information regarding all registered voters for a precinct/precinct split with options to configure and update totals.

The Vote Recording tab provides options for recording manual votes, changing voting totals through adding or subtracting ballots based on reviews.

The Auditing Dashboard tab provides an interface for generating filtered reports and exports of raw CVR data.



#### 4.2.5.5 Import/Export Chevron

The Import/Export chevron has 2 tabs, Import and Export.

The Import tab provides options for importing data from CSV files.

The Export tab provides options for exporting data into CSV files.

Each of the software based portions of the **Verity Voting 1.0** voting system (**Verity Build**, **Verity Central** and **Verity Count**) provide the ability to be utilized in either a single application implementation or a networked configuration, of like components, utilizing a centralized database implementation.

#### 4.2.6 Supported Languages

The **Hart Verity Voting 1.0** voting system supports the English and Spanish languages.

#### 4.2.7 Supported Functionality

##### 4.2.7.1 Voting Variations

**Verity Voting 1.0** supports the following voting variations:

- Closed primary elections
- Blanket primary elections
- Open primary elections
- General elections
- Partisan offices
- Non-partisan offices
- Write-in voting
- Primary presidential delegation nominations
- Ballot rotation
- Straight party voting
- Split precincts
- Vote for N of M

Note that **Verity Voting 1.0** does not include Ranked Choice Voting as a fully implemented voting variation. **Verity Build** will build a ballot to Ranked Choice voting, the voting devices **Verity Scan** and **Verity Touch Writer**, as well as **Verity Central** will allow RCV selections by the voter and record them. **Verity Count** does not perform ranked choice processing, instead it will treat the 1<sup>st</sup> candidate selected as the candidate chosen. While the full functionality is not in place, SLI tested the implemented functional portions in their respective areas as listed.





## 4.2.8 Ballot Standards

**Verity Build** employs and supports the ballot standards as follows:

- Supports the following paper sizes:
  - 8.5" x 11"
  - 8.5" x 11" w/ 3" stub (8.5" x 14")
  - 8.5" x 14"
  - 8.5" x 14" w/ 3" stub (8.5" x 17")
  - 8.5" x 17"
  - 8.5" x 17" w/ 2" stub (8.5" x 19")
  - 11" x 17"
- Supports ballot layouts in portrait orientation.
- Supports duplex ballot layouts.
- Supports the inclusion of ballot stubs on paper ballots.
- Supports layouts for a variety of ballot types, including Test mode, Official mode, and Sample ballots.
- Compatible with the production of ballots on standard, commercially available white paper stock.

## 5 Certification Test Results Summary

### 5.1 Source Code Review Summary

SLI has reviewed the software source code for each application in the **Hart InterCivic Verity 1.0** voting system to determine the code's compliance with The EAC VVSG 2005, Volume 1 Sections 5, 9 and Volume 2 Section 5.4 and for compliance with **Hart InterCivic's** internally developed coding standards. **Verity 1.0** is implemented with the C, C++ and C# languages. Results of the source code review are detailed in "Attachment C. – List of Source Code Reviewed and Results".

The review was conducted for:

- **Software Integrity:** The module contains no self-modifying code. Software remains unchanged and retains its integrity. The module has defined array dimensions, which are positive constant integers (Pointer variables, dynamic memory allocation and management are not applicable to Visual Basic.)
- **Modularity:** The modules have a specific testable function; performing a single function; is uniquely named; follows a standard format, has a single entry point; has a single exit point (or deviates in an acceptable manner); has error handling; and acceptable module size
- **Control Constructs:** Logic flow utilizes standard constructs of the development language used; constructs are used consistently throughout the code; logic structure is not overly complex, and acceptable use of error handlers.

- **Naming Conventions:** Variable and Function names that clearly define the purpose of the variable or function. Use of standard notation for variables by type. Use of names that are unique for both global and local variables. Use of names that are unique for functions (except where it deviates in an accepted manner).
- **Coding Conventions:** Use of a standard methodology for the construction of a code module. This includes uniform calling sequences, parameter validation, a single executable statement per line, and status or error messages.
- **Comments Conventions:** Comment Header blocks for the module / function follows a standard format in its layout and content. In code comments are clearly delineated and readable.

### Evaluation of Source Code

The source code was reviewed for compliance per the guidelines defined in EAC VVSG 2002 *Volume 2, Section 5.4*. The source code was written adequately in terms of the EAC VVSG 2005. The code is modular and contains sufficient error handling. Readability is sufficient and supports maintainability.

The reviewer's assessment is based on the following observations:

- Software Integrity
  - There were no unbounded arrays. This follows the 2005 EAC VVSG requirements for software integrity.
  - No instances of self-modifying or dynamically loaded code were observed.
- Modularity
  - The code is modular and self-contained.
  - Modules perform only the specified functionality.
  - The requirement of single entry and exit points are complied with.
  - Modules are small enough to facilitate ease of reading and understanding.
- Control Constructs
  - Control Constructs used are in accordance with those allowed by the VVSG.
  - Loop control constructs have been appropriately chosen for the logical tasks to be accomplished. (There are, however, instances of loop constructs written to include early termination logic other than by the normal loop exit condition specification. The interpretation of the currently written VVSG requirement is that this early loop termination logic is not disallowed by the VVSG but it is a variation of the construct other than that described by the standard and was accepted. As the code is currently written there will be no problems caused by those loop controls however, future changes to the code should be performed with some caution to ensure that the system state is stable.)
  - Modules have fewer than 6 levels of indented scope.

- Array boundaries are checked.
- Naming Conventions
  - Function and variable names are in accordance with the requirements of the VVSG.
  - Names differ by more than a single character and have been chosen as to enhance the readability of the code.
  - There are no instances of language keywords being used as a name for procedures or variables.
- Coding Conventions
  - Coding conventions employed are in compliance with the requirements of the VVSG.
  - Code is well structured and was written appropriately to the standards.
- Comments
  - Module headers are in compliance with the requirements of the VVSG.
  - In-line comments are sufficient in number and placement to facilitate a reasonable understanding of the code.
  - Variables have appropriate comments at the point of declaration.
- On the Application level, no more than 50% of the modules can exceed 60 lines, no more than 5% can exceed 120 lines, and none can exceed 240 lines without justification.
  - Functions/modules were within the EAC VVSG tolerances;

## 5.2 Technical Data Package Review Summary

SLI reviewed the *Hart InterCivic Verity 1.0* TDP, as detailed in sections 3.1 and 3.4, for compliance with the EAC VVSG 2005 according to *Volume 2 Section 2*.

The review was conducted for the required content and format of:

- **System Overview:** System description and performance are adequately described.
- **System Functionality Description:** System functional processing capabilities, encompassing capabilities required by the Standards and any additional capabilities provided by the system, including a simple description of each capability.
- **System Hardware Specification:** System Hardware Characteristics, Design and Construction
- **Software Design and Specification:** Purpose and scope, applicable documents, software overview, software standards and conventions, software operating environment, software functional specification, programming specifications, system database, interfaces and appendices.



- **System Security Specification:** Access control policy and measures, equipment and data security, software installation, telecommunications and data transmission security, elements of an effective security program.
- **System Test and Verification Specifications:** Development and certification test specifications that Hart applied to their testing efforts
- **System Operations Procedures:** Operation environment, system installation and test specifications, operational features, operating procedures, operations support.
- **System maintenance Procedures:** Preventative and corrective maintenance procedures, maintenance equipment, facilities and support.
- **Personnel Deployment and Training Requirements:** Personnel resources and training required to operate and maintain the system
- **Configuration Management:** Configuration management policy, configuration identification, procedures for baseline, promotion, demotion and configuration control, release process, configuration audits and management resources,
- **Quality Assurance Program:** Quality assurance policy, parts and materials special testing and examination, quality conformance inspections
- **System Change Notes:** Changes to a previously certified system (N/A)

## Evaluation of TDP

Once initially identified discrepancies were resolved, the Technical Data Package for the Hart InterCivic Verity 1.0 voting system was found to sufficiently comply with the standards such that a jurisdiction would be able appropriately deploy the Hart InterCivic Verity 1.0 voting system. Results of the PCA documentation review are detailed in “Attachment E – PCA Summary”.

## 5.3 Hardware Testing

SLI and their third-party certified hardware test laboratories, EMC Integrity, and Cascade TEK, performed an analysis and review of the **Verity 1.0** voting system hardware components, namely **Verity Scan**, **Verity Touch Writer** and **Verity Central** (with the Kodak i5600, Canon DR-G1100 and Cannon DR-G1130 high speed ballot scanners)

During execution of testing performed at EMC Integrity and Cascade TEK, an SLI representative was present to oversee the testing.

The test methodologies for all tests are identified in the following hardware test plans and hardware test reports:

- Hart InterCivic Verity VVSG EMC EMI Test Plan v5 0 - SLI
- Hart InterCivic Verity VVSG Hardware ENV Test Plan v4 0 - SLI
- CTC C1303B - Cascade TEK
- ETRB41001 revA\_Verity\_Scan – EMC Integrity
- TRB41001 revA\_Verity\_Scan – EMC Integrity



- ETRB41002 revA\_Verity\_TW – EMC Integrity
- TRB41002 revA\_Verity\_TW – EMC Integrity

Additionally SLI conducted a review on Safety Report:

“ Verity\_Safety\_Report\_PTI-1411085-000\_TRF\_iec60950\_ALL from PTI.”

Conclusion:

- All critical components comply with IEC 60950-1: 2005, or relevant component standards.

Hardware testing conducted specifically for this test campaign involved the **Verity Scan** and **Verity Touch Writer**. That testing involved verification of the following requirements:

- VVSG 2005 Vol. 1, Section 4 Hardware Requirements
- VVSG 2005 Vol. 2, Section 4 Hardware Testing

Additionally hardware testing conducted specifically for this test campaign involved the **Verity Central** (COTS) systems. That testing involved verification of the following requirements:

- VVSG 2005 Vol. 2, 4.7.1 Temperature and Power Variation , 4.7.3 Reliability

### 5.3.1 Operating Mode

Prior to and during testing, proper operation of the equipment was confirmed using Hart InterCivic software. An operational status check was successfully performed prior to and after each test verifying the equipment is within acceptable performance limits. Equipment was inspected for damages after each test. No issues were found.

**Verity Scan** and **Verity Touch Writer** were in a test election mode and the following **Verity** applications were executed:

- Shoe Shine test application – provides a method of exercising the integrated scanner in Verity Scan. When application runs a ballot is inserted into the scanner and the scanner continuously scan the ballot through its ballot feeder.
- Audio Test application – is used to test the Audio playback in Verity Touch Writer.
- USB Stick Test – is an application to write data to either of the USB ports that are inside Verity Scan and Touch Writers secure device compartment.
- Printer Test - is an application to print to the thermal printer integrated into Verity Scan and Touch Writers.



## 5.4 Known Vulnerabilities Testing

**Hart Verity Voting 1.0** is an un-fielded system, with all new hardware and software components. This system does not contain a DRE precinct voting device, nor does it support public transmissions.

Within the declared system, the only public facing components are the **Verity Scan** precinct optical scanner, which processes ballots marked by voters in a public polling place and **Verity Touch Writer**, a precinct place ballot marking device.

**Verity Central** is a central count location device, which is implemented in a secure environment.

Given this, there are no known vulnerabilities to this particular system at this time.

Review of the “Known Vulnerabilities” database, maintained by SLI, provided 14 known vulnerabilities to previous Hart systems already accounted for in SLI’s Test Methods.

## 5.5 Functional Testing Summary

SLI performed tests on each of the system configurations identified in Sections 3 and 4.2. The testing incorporated end-to-end election scenarios testing the functionality supported by Hart.

### 5.5.1 How each Device was tested

Functionality was tested as identified below. The following functional areas exist for Hart InterCivic Verity 1.0 voting system.

#### 5.5.1.1 Verity Touch Writer

- **Verity Touch Writer** is a standalone precinct level ballot marking device. It assists voters in marking their ballot and prints it out for them. Once the ballot is printed, **Verity Touch Writer** erases all memory components of that session.
- **Verity Touch Writer** was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Verity Build** produced media and data. All documented features were tested, and all functional features were verified to be documented.
- **Verity Touch Writer** was then tested as an integrated piece of the voting system, in several different test suites, where it accepted user input instructions, prior to producing marked ballots that mirror user intent, utilizing all HAVA related options.
- As an individual component each function contained within the **Verity Touch Writer** device was examined to determine that it functioned as expected. Each screen was inspected and exercised in order to provide full coverage. All supported ballot sizes were exercised on the device as well. **Verity Touch Writer** testing also included all applicable HAVA aspects.



- **Verity Touch Writer** was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

#### 5.5.1.2 Verity Scan

- **Verity Scan** is a standalone precinct level scanning device. It accepts and records votes from voter hand marked ballots, as well as from **Verity Touch Writer** marked ballots. Data from the votes cast is stored in a **Verity vDrive** and transported to central count locations for accumulation and tallying in **Verity Count**.
- **Verity Scan** was tested first as an individual component in order to verify that all declared functionality is present and working as documented, with **Verity Build** produced media and data. All documented features were tested, and all functional features were verified to be documented.
- As an individual component, each function contained within the **Verity Scan** device was examined to determine that it functioned as expected. Each screen was inspected and exercised in order to provide full coverage. All supported ballot sizes were exercised on the device as well.
- **Verity Scan** was also tested as an integrated piece of the voting system in several different test suites, where it inputs **Verity Build** produced media and data, then accepts user filled out ballots as well as **Verity Touch Writer** produced ballots within the polling place, prior to producing all defined output media.
- **Verity Scan** was also tested within the Accuracy test, Volume test, Stress test, and multiple system level tests that simulated election day activities.

#### 5.5.1.3 Verity vDrive

- **Verity vDrive** is Verity memory device. It carries information from **Verity Build** to each of the components within the **Verity** system during the pre-voting phase of an election. On election day, data from the votes cast in **Verity Scan** and **Verity Central** is stored in a **Verity vDrive** and transported to central count locations for accumulation and tallying.
- **Verity vDrive** was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Verity Build** produced media and data. All documented features were tested, and all functional features were verified to be documented.
- **Verity vDrive** was also tested as an integrated piece of the voting system where it inputs **Verity Build** produced media and data, then accept and transporting cast vote record data and ballot images from the polling place to **Verity Count**.



#### 5.5.1.4 Verity Key

- **Verity Key** is Verity security device. It carries security information from **Verity Build** to each of the components within the **Verity** system.
- **Verity Key** was tested first as an individual component in order to verify that all declared functionality is present and working as documented, utilizing **Verity Build** produced data. All documented features were tested, and all functional features were verified to be documented.
- **Verity Key** was also tested as an integrated piece of the voting system where it is utilized for authorizing loading election information onto **Verity Touch Writer**, **Scan** and **Central**, as well as accumulating vote data into **Verity Count**.

### 5.5.2 How each Application was tested

#### 5.5.2.1 Verity Build

- **Verity Build** accepts imported election information and produces ballots, election information, **Verity vDrives** and **Verity Keys**.
- **Verity Build** was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All documented features were tested, and all functional features were verified to be documented.
- **Verity Build** was also tested as an integrated piece of the voting system where it output **Verity Build** produced media and data (via Verity Key and vDrive), which feed into **Verity Touch Writer**, **Verity Scan**, **Verity Central** and **Verity Count**.

#### 5.5.2.2 Verity Central

- **Verity Central** is a central count location system that utilizes high speed scanners to scan large volumes of voted ballots, which are recorded onto a **Verity vDrive** for transportation to **Verity Count** for accumulation and tallying.
- **Verity Central** was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All documented features were tested, and all functional features were verified to be documented.
- **Verity Central** was also tested as an integrated piece of the voting system where it inputs **Verity Build** produced media and data, then accepts user filled out ballots as well as **Verity Touch Writer** produced ballots, prior to producing all defined output medias.





### 5.5.2.3 Verity Count

- **Verity Count** is the **Verity** application used for accumulation and tallying of voted ballots, transported via **Verity vDrive**, from **Verity Scan** and **Verity Central**.
- **Verity Count** was tested first as an individual component in order to verify that all declared functionality is present and working as documented. All documented features were tested, and all functional features were verified to be documented.
- **Verity Count** was also tested as an integrated piece of the voting system where it inputs **Verity Build** produced media and data, then accepts **Verity vDrive** data from **Verity Scan** and **Verity Central**, prior to tabulating results and producing all defined output reports.

### 5.5.2.4 Verity Election Manager

- **Verity Election Manager** is the **Verity** application used for importing, exporting, archiving and restoring elections into and from **Verity Build, Central and Count**.
- **Verity Election Manager** was tested first as an individual component in order to verify that all declared functionality is present and working as documented,
- **Verity Election Manager** was also tested as an integrated piece of the larger voting applications where it resides (**Verity Build, Central and Count**), verifying that it performed the appropriate functions for the parent application.

### 5.5.2.5 Verity User Manager

- **Verity User Manager** is the **Verity** application used for creating and managing all user roles and accounts within each of the parent applications, **Verity Build, Central and Count**.
- **Verity User Manager** was tested first as an individual component in order to verify that all declared functionality is present and working as documented,
- **Verity User Manager** was also tested as an integrated piece of the larger voting applications where it resides (**Verity Build, Central and Count**), verifying that it performed the appropriate functions and managed the pertinent roles for the parent application.

### 5.5.2.6 Verity Desktop

- **Verity Desktop** is the **Verity** application used for setting workstation date/time, accessing the desktop and gathering hash codes for **Verity Build, Central and Count**.
- **Verity Desktop** was tested first as an individual component in order to verify that all declared functionality is present and working as documented,
- **Verity Desktop** was tested as an integrated piece of the larger voting applications where it resides (**Verity Build, Central and Count**), verifying that it performed the appropriate functions for the parent application.



### 5.5.3 How different System Level Configurations were tested

**Verity Build**, **Verity Central** and **Verity Count** are each capable of being run as standalone instantiations or networked with a central database. Also, **Verity Build** and **Verity Count** are able to be run on the same physical device, as **Verity Build/Count** in both a stand-alone implementation as well as in a networked configuration. Given these possible configurations, the following configurations were exercised:

- **Verity Build** was tested in standalone mode with accompanying database
- **Verity Count** was tested in standalone mode with accompanying database
- **Verity Build/Count** was tested in standalone mode with accompanying database
- **Verity Central** was tested in standalone mode with accompanying database
- **Verity Build** server was tested in a networked mode with accompanying database and 3 client workstations (total of 4 workstations).
- **Verity Count** server was tested in a networked mode with accompanying database and 3 client workstations (total of 4 workstations).
- **Verity Build/Count** server was tested in a networked mode with accompanying database and 3 client workstations (total of 4 workstations).
- **Verity Central** server was tested in a networked mode with accompanying database and 3 client workstations (total of 4 workstations).

### 5.5.4 Test Suites Utilized

The following test suites were executed:

#### 5.5.4.1 Readiness test suite

Ensuring readiness of a voting system is crucial for testing and assisting each jurisdiction in preparing for use of a voting system. Readiness Testing is different from testing very specific pieces of functionality within a system; it is broader than acceptance and functionality testing. It focuses on creating a validated baseline for testing and verifying system readiness.

The Readiness suite consisted of a full system setup. The setup included the election importation module (**Verity Election Manager**), user management module (**Verity User Manager**), workstation management module (**Verity Desktop**), election creation module (**Verity Build**), precinct location count devices (**Verity Touch Writer** and **Verity Scan**), Central Count devices (**Verity Central** with associated COTS scanner as well as an accumulation and reporting system (**Verity Count**). A basic election was created and executed, including offices with candidates, parties, referenda and multiple ballot styles.

The Readiness test is considered the gateway test which is performed prior to any other formal testing and is always performed prior to any other testing.



#### 5.5.4.2 Verity Election Manager test suite

All functionality present in **Verity Election Manager** was verified to work as documented, providing the appropriate functionality for each main application/workstation type, and that all functionality is appropriately documented.

This test covered **Verity Build, Verity Central** and **Verity Count**.

#### 5.5.4.3 Verity User Manager test suite

All functionality present in **Verity User Manager** was verified to work as documented, providing the appropriate functionality for each main application/workstation type, and that all functionality is appropriately documented.

This test covered **Verity Build, Verity Central** and **Verity Count**.

#### 5.5.4.4 Verity Desktop test suite

All functionality present in **Verity Desktop** was verified to work as documented, providing the appropriate functionality for each main application/workstation type, and that all functionality is appropriately documented.

This test covered **Verity Build, Verity Central** and **Verity Count**.

#### 5.5.4.5 Verity Build – Single workstation test suite

All functionality present in **Verity Build** was verified to work as documented, and that all functionality is appropriately documented.

This test covered **Verity Build** in a stand-alone configuration and focused on all functionality within the application.

#### 5.5.4.6 Verity Build – Client/Server configuration, Networked test suite

Testing of the client/server configuration, for **Verity Build**, was the focus of this testing, such that reliability of data consistency was verified in a networked setting. **Verity Build** networked supports a Server/Client workstation and up to 3 additional Client workstations, and was tested in its maximum configuration of 4 total workstations.

#### 5.5.4.7 Verity Central– Single workstation test suite

All functionality present in **Verity Central** was verified to work as documented, and that all functionality is appropriately documented.

This test covered **Verity Central** in a stand-alone configuration and focused on all functionality within the application.

#### 5.5.4.8 Verity Central – Client/Server configuration, Networked test suite

Testing of the client/server configuration, for **Verity Central**, was the focus of this testing, such that reliability of data consistency was verified in a networked setting. **Verity Central** networked supports a Server/Client workstation and up to 3 additional Client workstations, and was tested in its maximum configuration of 4 total workstations.



#### 5.5.4.9 Verity Count– Single workstation test suite

All functionality present in **Verity Count** was verified to work as documented, and that all functionality is appropriately documented.

This test covered **Verity Count** in a stand-alone configuration and focused on all functionality within the application.

#### 5.5.4.10 Verity Count – Client/Server configuration, Networked test suite

Testing of the client/server configuration, for **Verity Count**, was the focus of this testing, such that reliability of data consistency was verified in a networked setting. **Verity Count** networked supports a Server/Client workstation and up to 3 additional Client workstations, and was tested in its maximum configuration of 4 total workstations.

#### 5.5.4.11 Verity Build/Count– Single workstation test suite

This test covered **Verity Build/Count** in a stand-alone configuration and focused on all functionality within the two applications and verified that the applications did not interfere with each other, nor produce unexpected behavior.

#### 5.5.4.12 Verity Build/Count – Client/Server configuration, Networked test suite

Testing of the client/server configuration, for **Verity Build/Count**, was the focus of this testing, such that reliability of data consistency was verified in a networked setting. **Verity Build/Count** networked supports a Server/Client workstation and up to 3 additional Client workstations, and was tested in its maximum configuration of 4 total workstations.

#### 5.5.4.13 Verity Scan test suite

All functionality, including administrative, maintenance as well as election day poll worker functionality, present in **Verity Scan** was verified to work as documented, and that all functionality is appropriately documented.

#### 5.5.4.14 Verity Touch Writer test suite

All functionality, including administrative, maintenance as well as election day poll worker functionality, present in **Verity Touch Writer** was verified to work as documented, and that all functionality is appropriately documented.

#### 5.5.4.15 GenVariation1 test suite

The focus of this suite was validating N of M voting, Partisan offices, Non-Partisan Offices, Ranked Order Voting, Straight Party Voting, Ballot Rotations, Ballot Formatting, precincts and split precincts, as well as Tally and Reporting functionality.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan** into **Verity Build**.

This suite utilized 8.5x11 and 8.5x14 ballots, both stubbed and unstubbed. Languages implemented in the suite included English, Spanish and (English/Spanish).



#### 5.5.4.16 GenVariation2 test suite

This suite built off the GenVariation1 Test. Additional definition was added, with a focus on validating N of M voting, Partisan offices, Non-Partisan Offices, Write-Ins, ADA/HAVA, as well as Tally and Reporting functionality.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build** networked, **Verity Touch Writer, Verity Scan, Verity Central** networked as well as **Verity Count** networked. Vote counts were accumulated from both **Verity Central** and **Verity Scan** into **Verity Build**.

This suite utilized 8.5x14, 8.5x17, 11x17 ballots, both stubbed and unstubbed. Languages implemented in the suite included English, Spanish and (English/Spanish). ADA devices utilized included Headphones, paddles, sip and puff.

#### 5.5.4.17 PriOpen test suite

The focus of this suite was an election designed to conform to an Open Primary election with focus on validating primary presidential delegation nominations, N of M voting, Partisan offices, Non-Partisan Offices, Straight Party Voting, Ballot Rotations, Ballot Formatting, ADA/HAVA, precincts and split precincts, as well as Tally and Reporting functionality. Please see “Table 3 – Terms and Abbreviations” for additional detail of an Open Primary.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**.

This suite utilized 8.5x11, 8.5x14, 8.5x17, 11x17 ballots, both stubbed and unstubbed. Languages implemented in the suite included English, Spanish and (English/Spanish).

#### 5.5.4.18 PriClosed Test Suite

The focus of this suite was an election designed to conform to a Closed Primary election with N of M voting, Partisan offices, Non-Partisan Offices, Ballot Formatting, ADA/HAVA, precincts and split precincts, as well as Tally and Reporting functionality. Please see “Table 3 – Terms and Abbreviations” for additional detail of a Closed Primary.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**.

This suite utilized 8.5x14, 8.5x17, ballots, both stubbed and unstubbed. Languages implemented in the suite included English, Spanish and (English/Spanish). ADA devices utilized included Headphones, paddles, sip and puff.



#### 5.5.4.19 PriBlanket Test Suite

The focus of this suite was an election designed to conform to a Blanket Primary election with N of M voting, Partisan offices, Non-Partisan Offices Ballot, Ballot Formatting, ADA/HAVA, precincts and split precincts, as well as Tally and Reporting functionality. Please see “Table 3 – Terms and Abbreviations” for additional detail of a Blanket Primary.

This test covers **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts will be accumulated from both **Verity Central** and **Verity Scan**.

This suite utilized 8.5x11, 8.5x17, 11x17 ballots, both stubbed and unstubbed. Languages implemented in the suite included English, Spanish and (English/Spanish).

#### 5.5.4.20 Error Messaging and Recovery Test Suite

Testing in this suite focused on Error Messaging and Recovery in key areas of the system identified from researching previous testing and voting system documentation to help identify potential failure points. Voting systems can be subject to various conditions and when the system exceeds limitations errors are typically found. SLI leveraged its election experience and voting system knowledge to test the Error Messaging and Recovery of the **Verity 1.0** voting. Testing of Error messaging focused on the appropriate error messages being generated in response to specific errors, and content of the message. The testing of the voting system Error Recovery capability was also incorporated into Stress testing in order to leverage the necessary range of performance impacts needed to generate system errors and force recovery.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.

#### 5.5.4.21 Audit Content Validations Test Suite

Audit records are used to track what system functions have been executed, what data has been modified, as well as by who and when. Additionally, audit record data content can be a key factor in identifying system anomalies and provide assistance in troubleshooting system errors. In tandem with the System Audit Validation, analysis of the **Verity 1.0** voting system was performed to determine strategic points of the system that require auditing, along with the content needed to accurately depict the machinations of the system for the given situation. The **Verity 1.0** applications utilize both an audit log and a system log to track workstation occurrences at two different levels. Tests were incorporated into Election Validation suites as well as specific Audit Validation suites, such that all related requirements were explicitly validated.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.



#### 5.5.4.22 System Audit Test suite

Election audit trails provide the supporting documentation for verifying the accuracy of reported election results. They present a concrete, indestructible archival record of all system activity related to the vote tally, and are essential for public confidence in the accuracy of the tally, for recounts, and for evidence in the event of criminal or civil litigation. This testing focused on validating the system's ability to provide audit capability throughout the entire voting system, including availability, generation, integrity, and accuracy of the system's audit capability to ensure it meets the necessary requirements. The **Verity 1.0** applications utilize both an audit log and a system log to track workstation occurrences at two different levels. Negative testing was utilized to force the system into conditions that triggered errors and verified that the voting system captures those conditions.

This test covered **Verity User Manager, Verity Election Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.

#### 5.5.4.23 Accuracy Test Suite

Testing the ability of the system to capture, record, store, consolidate and report the specific selections and absence of selections, made by the voter for each ballot position without error.

Required accuracy is defined in terms of an error rate that for testing purposes represents the maximum number of errors allowed while processing a specified volume of data. For the Accuracy test, the defined volume is no errors in 1.55 million ballot marking positions, or no more than 1 error in 3.1 million ballot marking positions.

Accuracy testing was conducted at both the device level and the system level.

Each device was subjected to scrutiny that verified that the requirements for accuracy are met. Additionally, the system was reviewed and exercised to validate that the accumulation, tallying and reporting mechanisms at the system level are able to accurately perform their functions.

This test covered, **Verity Scan, Verity Touch Writer, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**. Note that **Verity Central** was tested with all supported scanners.

**Verity Scan** supports 3 base ballot sizes

- 8.5" x 11"
- 8.5" x 14"
- 8.5" x 17"

Each ballot size was exercised in the **Verity Scan**. Each size contained 2600 ballots with 600 ballot marking positions. This totaled 7800 ballots and 4.8 million marking positions read by **Verity Scan**.



**Verity Touch Writer** supports 3 base ballot sizes

- 8.5" x 11"
- 8.5" x 14"
- 8.5" x 17"

Each ballot size was exercised in the **Verity Touch Writer**. Each size contained 50 ballots with 600 ballot marking positions. This totaled 150 ballots and 90,000 marking positions, which were then read by **Verity Scan**.

**Verity Central** supports 3 scanner types and 4 base ballot sizes

- 8.5" x 11"
- 8.5" x 14"
- 8.5" x 17"
- 11" x 17"

Each ballot size was exercised in **Verity Central** through each scanner type. Each size contained 2600 ballots with 600 ballot marking positions. This totaled 7800 ballots and 4.8 million marking positions through each scanner type, for a total of 23,400 ballots and 14.4 million ballot marking positions.

All ballot sizes and ballots exercised as described above, were inputted into **Verity Count**. This accumulated to 31,350 ballots and 20.1 million ballot marking positions.

All Accuracy tests were completed without issue, and each device and application was considered to pass.

#### 5.5.4.24 Mark Sensitivity Test suite

The purpose of Ballot Mark Sensitivity testing was to determine that the system under test is able to accurately determine when a mark has been made within a ballot marking position. For this test, various marks were made within the ballot marking positions, using Verity supported colors of ink.

Marks include fully filled boxes, left and right oriented slashes, "X" markings, check marks, horizontal single line marks, and circles of various sizes. Marks also included vertical lines within the marking position that fill approximately five percent of the designated space. Small dots down to approximately two percent of the ballot marking position are also included.

Inks implemented included blue and black.

This test covered **Verity Scan**, **Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan** into **Verity Count**.





#### 5.5.4.25 Volume and Stress test suite

Volume Testing consists of a system's response when subjected to large quantities of data, "more than the expected", as called out in the standards. Volume testing is typically considered a type of non-functional testing. However, as a voting system's primary function is to accumulate, tally, and pass a volume of data (votes) the VSTL approaches volume testing as a functional test. Experience has shown that large amounts of data can slow a system, or even cause failures and loss of data due to architectural limitations. Utilizing the VSTL's experience with voting systems the testing focused on not only passing large amounts of data but how the system operates and handles the data in key areas of functionality within the voting system.

This test covered **Verity Touch Writer**, **Verity Scan**, **Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**.

**Verity Scan** is a standalone device that processes ballots one at a time. Anticipated expected usage in an election environment is 1,000 ballots per device. The test was conducted in a 12 hour time period and processed 4,300 ballots.

**Verity Central** is designed to run either in standalone or in networked configurations of up to 4 workstations (1 Server/Client and 3 Clients). The Server/Client workstation maintains the database for all 4 workstations. This configuration was exercised in order to create a significant volume on **Verity Central**. The Kodak i5600 ballot scanner has an expected usage of 20,000 ballots in an 8 hour period. The Cannon DR-G1100 ballot scanner has an expected usage of 14,000 ballots in an 8 hour period. The Cannon DR-G1130 ballot scanner has an expected usage of 14,500 ballots in an 8 hour period. 1 Kodak i5600, 2 Cannon DR-G1100's and 1 CannonDR-G1130 were utilized in this volume/stress configuration. The expected usage was 62,500 ballots in an 8 hour period. The test was conducted in a 12 hour period and processed 94,000 ballots.

Stress testing consists of a "system's response to transient overload conditions." Experience has shown that when passing a dataset through a system that eclipses the system architectural limitations, failures can occur and result in the loss of critical data. Utilizing the VSTL's experience with voting systems, the testing focused on the system's ability to operate after the limitations have been exceeded and if failures occur, how the data is maintained or recovered in key areas of functionality within the voting system.

As this test is the "next step" from the Volume test, it was performed at the conclusion of the Volume test, utilizing the implementation setup as described for the Volume test.

**Verity Scan**. The test was conducted in an additional 8 hour time period and processed an additional 3700 ballots on the same device. The number of ballots for the device totaled 8,000.

**Verity Central**. The test was conducted in an additional 6 hour time period and processed an additional 51000 ballots on the same configuration. The number of ballots for the device totaled 145,000.

This test covered **Verity Build**, **Verity Touch Writer**, **Verity Scan**, **Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**.



#### 5.5.4.26 Language testing

Testing was conducted to ensure the voting system is capable of implementing and presenting the ballot, ballot selections, review screens and instructions in the required languages, English and Spanish. This testing is incorporated in the General and Primary test suites detailed within this section.

This testing covers **Verity Election Manager, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**. Vote counts were accumulated from both **Verity Central** and **Verity Scan**.

#### 5.5.4.27 Data Retention/HW Integrity testing

Testing integrity requirements ensure the physical stability and function of the vote recording and counting processes, such that the system is not prone to a single point of failure that would prevent voting at a polling place. The requirements related to this testing were incorporated into other test suites for validation. Testing verified prevention of failure of data input or storage, in terms of data retention, as well as confirming that appropriate audit records are maintained without modification.

This test covered **Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.

#### 5.5.4.28 Import Election Data test suite

This testing was concerned with the import capabilities of the voting system as the primary means of populating the system with election data. This test verified the appropriate documentation exists for a 3<sup>rd</sup> party to create the necessary XML data file to create an election within the Verity Voting 1.0 voting system. Testing also verified that Verity Build successfully checked for appropriate data and gracefully handles negative data entries beyond the scope of the voting system's expected inputs

This test configuration covers **Verity Election Manager** and **Verity Build**.

#### 5.5.4.29 Security Access Control test suite

Access control testing verifies procedures and system capabilities that detect or limit access to system components in order to guard against loss of system integrity, availability, confidentiality, and accountability. This testing verified that system resources such as data files, application programs and computer-related facilities and equipment are protected against unauthorized operation, modification, disclosure, loss or impairment. Unauthorized operations include modification of compiled or interpreted code, run-time alteration of flow control logic or of data, and abstraction of raw or processed voting data in any form other than a standard output report by an authorized operator.

This test covered **Verity User Manager, Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.



#### 5.5.4.30 Security Software test suite

Software security testing was conducted to verify the installation procedures and ongoing foreign software detection mitigation abilities of the voting system in order to protect against the modification of the software and/or the insertion of malicious software during the installation and during ongoing operations.

This test covered **Verity Desktop, Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.

#### 5.5.4.31 Physical Security Measures test suite

Physical security testing verified monitoring and control of the environment of the work place and computing facilities. It also verified monitor and control access to and from such facilities. Separating the network and work place into functional areas are also physical controls. Some portions of physical security are functional while other portions are procedural. Functional portions were tested as appropriate while procedural portions were verified to be documented as prescribed by the VVSG.

This test covered **Verity Build, Verity Touch Writer, Verity Scan, Verity Central** as well as **Verity Count**.

#### 5.5.4.32 Audio test suite

Audio testing was performed in order to verify that the polling place ballot marking device, **Verity Touch Writer**, fell within the acceptable parameters of hearing as defined in the 2005 VVSG.

This test covered **Verity Touch Writer**.

#### 5.5.4.33 Maintainability and Accessibility test suite

Testing accessibility requirements for a voting system generally consist of both objective and observable requirements. In combination the two types of requirements verify that the voting system components are accessible to all eligible voters, including those that may have a type of challenge that creates a need for assistance of some type. The voting systems should be self contained such that the individual voter is able to cast their vote without assistance from another party. Accessibility calls for the voting system to take into account vision, varying degrees of vision, dexterity, mobility, aural issues, and speech and language proficiency.

Usability is defined 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. Testing is conducted to ensure



voters are able to negotiate the process effectively, efficiently and comfortably according to the requirements dictated, including HAVA requirements.

This tests focus was as described above, as well as a review of the report of mandated usability study performed by Hart, as per 2005 VVSG requirements.

This test covered **Verity Touch Writer** and **Verity Scan**

#### 5.5.4.34 Maintainability and Accessibility test suite

Maintainability encompasses a range of maintenance actions that examine all scheduled and unscheduled events in place for preventing failures on all hardware devices. Testing verifies the ease with which maintenance actions can be performed based on the design characteristics of the equipment and software. Non-technical election workers are to be able to be made aware of the problem through the equipment and software's ability to correctly self-diagnose problems.

This test included review of Hart documentation for maintenance actions as well as performance of those maintenance actions for ease of use and understandability.

This test covered **Verity Touch Writer** and **Verity Scan**

#### 5.5.4.35 Data Retention and Hardware Integrity testing

Integrity requirements ensure the physical stability and function of the vote recording and counting processes, such that the system is not prone to a single point of failure that would prevent voting at a polling place. Testing will also verify prevention of failure of data input or storage, in terms of data retention, as well as confirming that appropriate audit records are maintained without modification.

The requirements related to this testing were incorporated into other test suites for validation. A review of all this testing performed and notation of any pertinent issues encountered would also factor into the requirements validation consideration.

This testing covers **Verity Build**, **Verity Touch Writer**, **Verity Scan**, **Verity Central** as well as **Verity Count**.



## 5.6 Evaluation of Testing

The above tests were successfully conducted using the executables delivered in the final Trusted Build, in association with the appropriate hardware versions as declared in this Test Report for the **Hart InterCivic Verity 1.0** voting system.

Issues were found during functional testing as described in section “5.8 – Discrepancies Found During Testing”. This resulted in a total of 4 Trusted Builds. The issues reduced in number in each Trusted Build, with the final issues being resolved in Trusted Build #4.

Significant regression testing and system level testing was performed on each Trusted Build, such that all functionality was reviewed.

## 5.7 Environmental Hardware Test Summary

Based upon an examination of the equipment listed in “Hart Verity 1.0 Voting Equipment

Hardware	Use	Model
Verity Scan	Precinct polling place digital scanner	Revision B
Verity Touch Writer	Precinct polling place Ballot Marking Device	Revision B
Verity Key	Security key used within the voting system	N/A
Verity vDrive	Media used for transportation of voting system data	N/A

Table 8 – COTS Equipment”, and **Hart’s** Hardware Specification, SLI concluded that the hardware listed is COTS (Commercial off the Shelf). As such, it is not subject to Environmental Hardware Testing.

SLI and their third-party certified hardware test laboratories, EMC Integrity, and Cascade TEK, executed Environmental Hardware testing on the non-COTS hardware listed in “Table 7 – Hart Verity 1.0 Voting Equipment”, and “**Error! Reference source not found.** – Hart Verity 1.0 Software and Firmware”.

The testing consisted of:

- Electromagnetic Emissions / Immunity Tests:
  - Radiated Emissions – FCC, Part 15 Class B ANSI C63.4.
  - Conducted Emissions – FCC, Part 15 Class B ANSI C63.4.
  - ESD – IEC 61000-4-2 (2008) Ed. 2.0.
  - Electromagnetic Susceptibility – IEC 61000-4-3 (1996).
  - Electrical Fast Transient – IEC 61000-4-4 (2004-07) Ed. 2.0.
  - Lightning Surge – IEC 61000-4-5 (1995-02).
  - Conducted RF Immunity – IEC 61000-4-6 (1996-04).
  - Magnetic Fields Immunity – IEC 61000-4-8 (1993-06).
  - Electrical Power Disturbance – IEC 61000-4-11 (1996-06).



- Non-Operating Environmental Tests:
  - Bench Handling - MIL-STD-810D, Method 516.3, Procedure VI
  - Vibration - MIL-STD-810D, Method 514.3, Category 1- Basic Transportation, Common Carrier.
  - Low Temperature - MIL-STD-810D, Methods 502.2, Procedure I- Storage.
  - High Temperature - MIL-STD-810D, Methods 501.2, Procedure I- Storage.
  - Humidity (85%) Soak - MIL-STD-810D, Method 507.2, Procedure I- Natural Hot-Humid.
  
- Operating Environmental Tests:
  - Temperature/Power Variation - similar to the low temperature and high temperature tests of MIL-STD-810-D, Method 502.2 and Method 501.2.
  - Reliability – Vol. 1, Section 4 for the acceptable Mean Time Between Failure (MTBF).

### 5.7.1 Evaluation of Environmental Hardware Testing

Any critical issues found were reported, resolved and re-tested. Attachments G contain the hardware environmental reports from SLI's EAC approved Hardware Environmental Test Subcontractor(s), EMC Integrity, and Cascade TEK. These reports detail specific information on the environmental hardware testing. As of the writing of this report, all devices subjected to hardware testing, as listed above, have successfully passed all tests.

## 5.8 Discrepancies Found During Testing

Discrepancies found fall into 4 major categories, Hardware, Documentation, Source Code, and Functional. Hardware discrepancies are issues that occur specifically in the hardware arena, and are usually found during the hardware testing phase. Documentation discrepancies are issues that occur during the PCA documentation review phase and are issues that are resolved by updates to the documentation. Source Code discrepancies are issues that occur during source code review and are issues that must be fixed in the source code prior to the Trusted Build. Functional discrepancies are issues that occur during functional testing and can be related to any software or firmware within the system. Functional discrepancies often lead to source code modifications, additional source code review and an additional Trusted Build.

### 5.8.1 Hardware Discrepancies

Ten hardware discrepancies were written during this campaign, with 7 of the issues occurring during the hardware testing. The primary issues were around electrical testing, such electrostatic discharge, electrical fast transient, lightning surge and radiated emissions. **Hart** developed appropriate remedies for each issue and eventually passed all hardware tests.



Two issues were concerned with firmware issues and were resolved during functional testing.

One issue was concerned with invalid calibration sheets and was resolved during functional testing.

### **5.8.2 Documentation Discrepancies**

Seventy Eight documentation issues were written during the PCA documentation review phase. The issues centered around 2 main issues, incorrect information or missing information. In all instances the issues were addressed and resolved prior to the writing of this report.

### **5.8.3 Source Code Discrepancies**

Source code review generated 5609 discrepancies during the review process.

Basic formatting and naming convention issues accounted for 4935 of the issues.

Basic construct issues were addressed in 664 of the discrepancies.

Issues of a logic nature accounted for 10 of the discrepancies.

All issues were addressed by the Trusted Build

### **5.8.4 Functional Discrepancies**

Functional testing generated 30 discrepancies.

XML import issues, concerned with importing election data, accounted for 7 discrepancies.

User interface issues accounted for 4 discrepancies.

System functionality issues accounted for 11 discrepancies.

Concurrency issues in networked configurations accounted for 5 discrepancies.

Memory issues accounted for 2 discrepancies.

Data retention issues accounted for 1 discrepancy.

All issues were resolved prior to the final Trusted Build, and writing of this report.

## **5.9 Deficiencies**

SLI has determined that there are no remaining unresolved deficiencies against the VVSG requirements.



## 6 Recommendations

SLI has successfully completed the testing of the Hart InterCivic Verity 1.0 voting system. It has been determined that the Verity 1.0 voting system meets the required acceptance criteria of the Election Assistance Commission Voluntary Voting System Guidelines 2005.

This recommendation reflects the opinion of SLI Global Solutions based on testing scope and results. It is SLI's recommendation based on this testing effort that the EAC grant certification of Hart InterCivic Verity 1.0 voting system.

**SLI:**

A handwritten signature in blue ink, appearing to read 'Traci Mapps'.

Traci Mapps  
VSTL Director/Sr. Director of Operations  
February 20<sup>th</sup> 2015





## **7 EAC Certification & Voting System Configuration**

This report has been submitted to the Election Assistance Commission on February 20<sup>th</sup> 2015. Upon acceptance of this report by the EAC technical committee, a certification number will be issued.

This certification is for the Hart InterCivic Verity 1.0 voting system, configured as detailed in section 3 of this document.

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## Appendix A – Test Plan

Please refer to the latest Test Plan for Verity 1.0 on the Election Assistance Commission website, located at: [www.eac.gov](http://www.eac.gov)

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End of Certification Test Report

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