Certification Test Plan – Modification

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Version 1.2

Prepared for:

Vendor Name	Hart InterCivic (Hart)
Vendor System	Verity Voting 2.2.2
EAC Application No.	HRT-Verity-2.2.2
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Accredited by the Election Assistance Commission (EAC) for Selected Voting System Test Methods or Services

Revision History

Date	Release	Author	Revision Summary
February 14th, 2018	v1.0	*M. Santos*	Initial Submittal
February 15th, 2018	v1.1	*M. Santos*	Added section 1.4.2 Project Timeline
March 6th, 2018	v1.2	*M. Santos*	Updated for EAC comments

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1 INTRODUCTION

This Modification Certification Test Plan outlines the test approach SLI Compliance will follow when performing Certification Testing on the **Hart Verity Voting 2.2.2 voting system** against the 2005 Voluntary Voting System Guidelines (VVSG). **Verity Voting 2.2.2** is a modification of **Verity Voting 2.2.1**, with limited changes. The system will be tested based on the "modified system" requirements, as set forth in section 4.6.2.3 of the "**EAC** Voting System Testing and Certification Program Manual, version 2.0".

When the testing is complete, SLI will submit a Certification Test Report that details all test results and findings from the Certification Test effort, as well as a recommendation to the **EAC**.

1.1 Description and Overview of the Certified System

This test plan contains a description of the previously certified system, the specific modifications to the current system version, and the impact of those modifications on the system and certification testing.

1.1.1 Definition of the Baseline Certified System

This modification project builds upon the foundation established in **Verity Voting 2.2 and 2.2.1**, which contained the applications **Verify Data**, **Verity Build, Verity Central** and **Verity Count**, as well as the polling place devices **Verity Scan** and **Verity Touch Writer**, and **Verity Print**.

1.1.2 Modifications

Verity Voting 2.2.2 is a modification of the EAC-certified **Verity Voting 2.2.1** system.

The modifications to **Verity 2.2.2** addresses adding support for 8.5" x 20" ballots, support for uncommitted choices in a contest, and enhancements to touch screen device calibration procedures.

1.1.2.1 8.5" x 20" Ballot Support
Support for 8.5" x 20" ballots is added throughout the Verity system.

1.1.2.2 Optimize Loading of an Election
Optimizations have been made to the process of setting up an election in a device, prior to Open Polls.

1.1.2.3   Tablet Touchscreen Calibration Enhancement

Touchscreen calibration is enhanced with the addition of an additional calibration confirmation point that must be pressed within 20 seconds to confirm the calibration. The addition of this screen prevents a bad or invalid calibration from being saved to the device.

1.1.2.4   Uncommitted Choices in a Contest

This voting variation is the ability to create a ballot choice that is excluded from ballot rotation in a contest where other choices do rotate. This functionality is used in Presidential Primary elections.

An "uncommitted" vote means:

> Each party ballot has a vote position for "uncommitted." When a voter selects "uncommitted," it indicates the voter is exercising a vote for that political party but is not committed to any of the candidates listed on the ballot. If enough voters cast "uncommitted" votes, the party may send delegates to the national nominating convention who are not committed to a specific candidate."

In the examples below, the election includes the office contest "Dogcatcher," which has three choices and a single write-in line. Write-in lines can be configured without the text label.
The choices are:
> "Jane Jones": set to include in rotation, sequence number = 1
> "John Smith": set to include in rotation, sequence number = 2
> "Uncommitted": set to exclude from rotation, sequence number = 3

The election is set to rotate by precinct.
The election includes the following precincts and rotation indices for this contest:
> "Precinct 1": rotation index =1
> "Precinct 2": rotation index=2
> "Precinct 3": rotation index=3

In Count, the Report Setting for choice order in a contest is "Rotated ballot order." The feature is enabled to allow reports to reflect the rotated order; this setting can also be disabled by the user, if desired.

The following chart shows the outcome of applying rotation in each precinct:

Item	Precinct 1	Precinct 2	Precinct 3
Paper ballots	**Dogcatcher** ☐ Jane Jones ☐ John Smith ☐ Uncommitted ☐ - - - - - - Write-in:	**Dogcatcher** ☐ John Smith ☐ Jane Jones ☐ Uncommitted ☐ - - - - - - Write-in:	**Dogcatcher** ☐ Jane Jones ☐ John Smith ☐ Uncommitted ☐ - - - - - - Write-in:
Electronic ballots	**Dogcatcher** ☐ Jane Jones ☐ John Smith ☐ Uncommitted ☐ To enter a write-in, touch	**Dogcatcher** ☐ John Smith ☐ Jane Jones ☐ Uncommitted ☐ To enter a write-in, touch her	**Dogcatcher** ☐ Jane Jones ☐ John Smith ☐ Uncommitted ☐ To enter a write-in, touch her
Precinct report	Dogcatcher Choice / Party / Absentee Vo Jane Jones — 0 John Smith — 0 Uncommitted — 0 Cast Votes: 0 Undervotes: 0 Overvotes: 0	Dogcatcher Choice / Party / Absentee Votin John Smith — 0 0.0 Jane Jones — 0 0.0 Uncommitted — 0 0.0 Cast Votes: 0 0.0 Undervotes: 0 0.0 Overvotes: 0 0.0	Dogcatcher Choice / Party / Absentee Votin Jane Jones — 0 0.0 John Smith — 0 0.0 Uncommitted — 0 0.0 Cast Votes: 0 0.0 Undervotes: 0 0.0 Overvotes: 0 0.0

No defects are addressed with the release of Verity 2.2.2.

1.1.3 Initial Assessment of Impact of the Modifications

Verity Voting 2.2.2's modification for 8.5" x 20" ballot affects **Verity Data**, **Verity Build, Verity Touch Writer, Verity Print, Verity Scan** and **Verity Central**.

Verity Voting 2.2.2's modification for "Uncommitted Choices" affects **Verity Data**, **Verity Build, Verity Touch Writer, Verity Scan, Verity Central**, **Verity Count** and cast vote records, when an uncommitted choice is marked.

Verity Voting 2.2.2's modification for "Touch Screen Calibration" affects **Verity Build, Verity Touch Writer, and Verity Print**.

Verity Voting 2.2.2's modification for "Device Election Loading Optimization" affects **Verity Scan, Verity Touch Writer, and Verity Print**.

Review of the modifications implemented and source code modified indicates the need for only a limited Functional Configuration Audit in order to verify that the system continues to meet 2005 VVSG 1.0 requirements. The limited FCA takes into account not only the implemented modification, but also functions that have not changed but may be impacted by a modification.

Software/firmware that either has modified source code or requires a new build will be subjected to a limited FCA review.

Verity Data, Verity Build, **Verity Print**, **Verity Touch Writer**, **Verity Scan, Verity Central** and **Verity Count** have modified source code and will require new builds.

1.1.4   Regression Testing

This section describes what system elements will be regression tested to establish assurance that the modifications have no adverse impact on the compliance, integrity or performance of the system.

All components of **Verity Voting 2.2.2** will be regression tested in order to verify continued compliance to (2005) VVSG 1.0.

The 8.5" x 20" modification will be explicitly tested and verified in **Verity Data, Verity Build, Verity Touch Writer, Verity Print, Verity Scan,** and **Verity Central**.

The "Uncommitted Choice in Rotation" modification will be explicitly tested and verified in **Verity Data**, **Verity Build, Verity Touch Writer, Verity Scan, Verity Central**, **Verity Count** and cast vote records, when an uncommitted choice is marked.

The "Touch Screen Calibration" modification will be explicitly tested and verified in **Verity Touch Writer and Verity Print**.

Audit and Error Messaging/Recovery will be reviewed with respect to the implementation of the "Uncommitted Choice in Rotation" and "Touch Screen Calibration" modifications.

Additionally, one system level general election, one system level open primary election and one system level closed primary election test will be performed to verify system robustness.

1.2 References

The following key documents were used in preparing this test plan.

1. Election Assistance Commission Voluntary Voting System Guidelines (EAC VVSG), 2005 Version 1.0 Volumes I and II.
2. NIST Handbook 150: 2016.
3. NIST Handbook 150-22: 2017.
4. EAC Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 2.0, May 2015
5. SLI VSTL Quality System Manual, Rev. 2.4, prepared by SLI, dated October 20th, 2017.

1.3 Terms and Abbreviations

The following terms and abbreviations will be used throughout this document:

Table 1 – Terms and Abbreviations

Term	Abbreviation	Description
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 mark sense-based ballot and vote counting 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.
Chevron	No Abbreviation	**Verity** components use workflow chevrons. Workflow chevrons, arranged along the top of the screen, identify the function the user is currently viewing.
Commercial Off the Shelf	COTS	Term used to designate computer software, hardware or accessories that are ready-made and available for sale, lease, or license to the general public.

Term	Abbreviation	Description
Direct Recording Electronic	DRE	Voting systems that, using Touch Screen or other user interfaces, directly record the voter's selections in each race or contest on the ballot in electronic form.
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.
Functional Configuration Audit	FCA	The testing activities associated with the functional testing of the system.
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.).
Precinct Count Scanner	PCS	A digital scanner is a mark sense-based ballot and vote counting device located at a polling place and is typically operated by scanning one ballot at a time.
Request For Information	RFI	A means used by testing laboratories and manufacturers to request that the EAC provide an interpretation of a technical issue related to testing of voting systems.
Requirements Matrix	N/A	A matrix that traces the VVSG requirements to the various test modules and test methods.

Term	Abbreviation	Description
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	The data package supplied by the vendor, which 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 a 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).
Verity vDrive	vDrive	Media used for transportation of voting system data
Voluntary Voting System Guidelines	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 for EAC certification.
Voter Verifiable Paper Audit Trail	VVPAT	An independent verification system for voting machines designed to allow voters to verify that their vote was cast correctly, to detect possible election fraud or malfunction, and to provide a means to audit the stored electronic results.
Voting System Test Lab	VSTL	An independent testing organization accredited by NVLAP and the EAC to conduct voting system testing for EAC certification.
Voting System Under Test	VSUT	The designation for a voting system that is currently being tested.

Term	Abbreviation	Description
Voting Test Specialist	VTS	An SLI employee within the Compliance division who has been qualified to perform EAC voting system certification testing.

1.4 Testing Responsibilities

The subsections below describe the project responsibilities.

1.4.1 Owner Assignments

- System analysis and review will be conducted by Source Code Review, Security and Voting Test Specialists, with oversight by the Test Manager
- Source code review will be conducted by Source Code Review Specialists, with oversight by the Test Manager
- Documentation review will be conducted by Voting Test Specialists, with oversight by the Test Manager
- Test module development and validation will be conducted by Security and Voting Test Specialists, with oversight by the Test Manager
- Test suite development and validation will be conducted by Security and Voting Test Specialists, utilizing SLI's formal Test Methods, with oversight by the Test Manager
- Formal test execution will be conducted by Security and Voting Test Specialists, with oversight by the Test Manager

1.4.2   Project Timeline

The following schedule outlines the expected timeline for this project.

Task Name	Start	Finish
Hart Verity 2.2.2 Federal Certification Project Plan	**Fri 12/8/17**	**Thu 4/12/18**
Phase 1, Initiation, TDP Review	**Fri 12/8/17**	**Thu 3/22/18**
Submission - Source Code Check-in	**Fri 12/8/17**	**Fri 12/8/17**
Source Code Review	**Fri 12/8/17**	**Tue 12/19/17**
EAC Application	**Thu 1/11/18**	**Fri 1/19/18**
Source Code Review Round 2	**Mon 1/22/18**	**Thu 1/25/18**
Project Initiation	**Fri 1/26/18**	**Fri 1/26/18**
TDP Deliver/Receive Vendor Package	**Fri 1/26/18**	**Mon 1/29/18**
Hardware and Accessories	**Fri 1/26/18**	**Mon 1/29/18**
Start-up and Other Deliverables	**Fri 1/26/18**	**Fri 1/26/18**
TDP Deliveries - Documents	**Fri 1/26/18**	**Mon 1/29/18**
TDP Review	**Fri 1/26/18**	**Thu 2/1/18**
PCA Document Review	**Fri 1/26/18**	**Thu 2/1/18**
FCA Assessment	**Mon 1/29/18**	**Tue 1/30/18**
FCA Review of Vendor Testing	Mon 1/29/18	Mon 1/29/18
FCA Review complete	Mon 1/29/18	Tue 1/30/18
Hardware	**Fri 1/26/18**	**Fri 1/26/18**
HW / SW Configuration Audit	**Fri 1/26/18**	**Fri 1/26/18**
Test Plan Development	**Tue 1/30/18**	**Thu 3/22/18**
Phase 2, Test Creation	**Fri 1/26/18**	**Mon 2/12/18**
Vendor Specific Module and Suite Preparation	**Fri 1/26/18**	**Mon 2/12/18**
Phase 3	**Mon 2/12/18**	**Wed 2/14/18**
Trusted Build	**Mon 2/12/18**	**Wed 2/14/18**
Phase 4, Formal Testing	**Wed 2/14/18**	**Thu 3/8/18**
Official Test Execution of Test Suites	**Wed 2/14/18**	**Thu 3/8/18**
Prep Test Environment	**Wed 2/14/18**	**Wed 2/14/18**
Execute Test Suites	**Fri 2/16/18**	**Wed 3/7/18**
Final Documentation Updates	**Wed 3/7/18**	**Thu 3/8/18**
Phase 5 Certification Test Report, Delivery to EAC/Hart and PM	**Fri 1/26/18**	**Wed 4/11/18**
Certification Test Report and Final Test Plan	**Thu 3/22/18**	**Fri 4/6/18**
Delivery of Artifacts to EAC Repository	**Tue 4/10/18**	**Wed 4/11/18**
Project Management	**Fri 1/26/18**	**Fri 3/9/18**
Phase 6 - Project Closeout	**Wed 4/11/18**	**Thu 4/12/18**
Return Equipment to Hart	**Wed 4/11/18**	**Thu 4/12/18**
Archive Test Materials	**Wed 4/11/18**	**Wed 4/11/18**

1.4.3   Test Module Development and Validation

Test Modules will be developed to provide repeatable detailed test steps. The Modules are defined at a basic level in SLI's formal Test Methods and are designed for use in any suite that employs their functionality. This reusability reduces the development time associated with creating Modules. The Modules will be validated prior to Formal Test Execution to ensure accurate testing of the voting system. Additionally, the Test Modules will provide traceability to SLI's formal Test Methods, as well as the 2005 VVSG 1.0 requirements. This is done by listing the Test Method name, and each requirement addressed, in the name of the module.

1.4.4   Trusted Build

Prior to Formal Test Execution, a Trusted Build will be performed for **Verity Data, Verity Build**, **Verity Print**, **Verity Touch Writer**, **Verity Scan, Verity Central** and **Verity Count** in order to include modifications made to those applications.

1.4.5   Formal Test Execution

Formal execution of the validated Test Suites and modules will be conducted to verify the system's compliance with the 2005 VVSG 1.0 requirements.

1.4.6   Third Party Hardware Testing

No hardware testing is scheduled for this certification project.

1.4.7   EAC & Manufacturer Dependencies

The Test Plan will require **EAC** approval prior to finalization.

Hart will be required to provide all source code, documentation, equipment and supporting materials identified as part of the voting system.
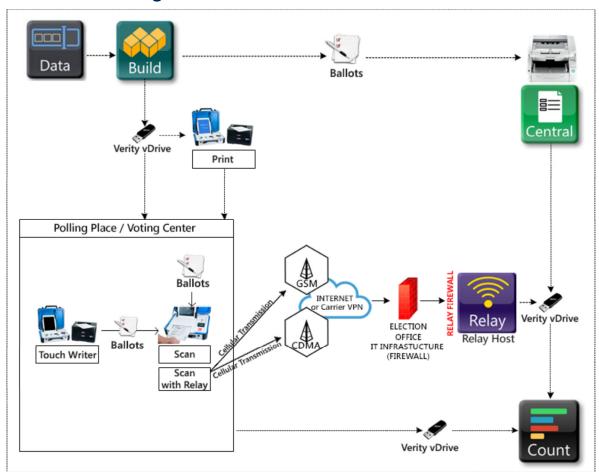
The source code must have all discrepancies resolved, be able to be built successfully, installed, as well as successfully complete operational status checks prior to formal test execution.

In addition, **Hart** is required to provide training on the voting system and support throughout the life of the project.

1.5 Scope of Testing

1.5.1 Block Diagram

Overview of the diagram:

- The components are displayed as touch points of data access, transfers, and verification.

- Dotted lines show the flow of data and air gaps using **vDrives**.

- **Verity Print** is a ballot production device that provides unmarked printed ballots.

- **Verity Touch Writer** and **Verity Scan** (Verity Voting devices) may be installed in Polling Places.

- **Verity Key** (not shown) is a USB device that is required for user access into components to load election elections, use features, and generate reports. Feature access depends on the roles applied to user accounts.

- **Verity Relay** is a transmission option within the Verity Voting system.

1.5.2 EAC Request For Interpretation – RFI

No EAC RFI's are relevant to this modification project.

1.5.3 EAC Notices of Clarification - NOC

This Certification Test Plan and the execution of tests for the voting system identified in this plan account for the following NOC's:

- NOC 13-02: Detailed Description of Changes for Modifications
- NOC 09-005: Development and Submission of Test Plans for Modifications to EAC Certified Systems.
- NOC 09-002: Clarification of EAC Laboratory Independence Requirement
- NOC 09-001: Clarification of the Requirements for Voting System Test Laboratories (VSTLs) Development and Submission of Test Plans
- NOC 08-003: Clarification of EAC Conformance Testing Requirements for Voting System Test Laboratories (VSTLs)

2 PRE-CERTIFICATION TESTING AND ISSUES

2.1 Evaluation of prior VSTL testing

Prior VSTL testing has been performed on previous versions of the **Hart Verity Voting 2.2.2** voting system. A full test campaign was done by SLI during the **Verity Voting 2.0** EAC certification project. A modification campaign was done by SLI for the **2.2** and **2.2.1 Verify Voting** system. The **Verity Voting 2.2** release constitutes the main code base used for the **Verity Voting 2.2.2** release.

2.2 Evaluation of prior non-VSTL testing

No prior state or non-VSTL lab testing has been performed on the **Hart Verity Voting 2.2.2** voting system. Review of Hart's internal testing is performed during the FCA review.

2.3 Known Field Issues

Hart Verity Voting 2.2.2 is a modification of **Verity Voting 2.0** and **Verity 2.2**.

For the **Verity Voting 2.2.2** system, the only voting devices are the **Verity Scan** precinct digital scanner, which processes ballots marked by voters, **Verity Touch Writer**, a ballot marking device and **Verity Print**, a pre-voting ballot production device that is used to print blank ballots.

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

There are no known field issues or vulnerabilities to this particular system at this time.

Review of the "Known Vulnerabilities" database, maintained by SLI, has provided 14 known vulnerabilities to previous Hart systems (Hart eSlate System Version 6.21) which are accounted for in SLI's Test Methods.

3 MATERIALS REQUIRED FOR TESTING

Any materials that are used in an election cycle must be provided to SLI to facilitate testing of the voting system. This section outlines these required materials.

3.1 Software/Firmware

All software and 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 following software/firmware is required. This includes all supporting software such as operating systems, compilers, assemblers, application software and firmware, any applications used for burning of media, transmission of data or creation/management of databases.

3.1.1   Hart Verity Voting 2.2.2 Software/Firmware

Hart Verity Voting 2.2.2 voting system consists of the following software and firmware components:

- **Verity Data** EMS software
- **Verity Build** EMS software
- **Verity Central** high speed optical scanner software
- **Verity Count** central count location tabulation and reporting software
- **Verity Scan** optical scanner firmware
- **Verity Touch Writer** BMD firmware
- **Verity Print** printer firmware
- **Verity** Device Microcontroller firmware for **Verity Touch Writer**
- **Verity Relay** Transmission software.

Note: Versions for each will be available after execution of the Trusted Build, and will be listed in the Test Report.

3.1.2   COTS Software/Firmware

This section details the Commercial Off The Shelf software and firmware utilized within the **Verity Voting 2.2.2** system.

Table 2 – COTS Software/Firmware

Manufacturer	Application	Version	Verity Voting 2.2.2 Component
Microsoft	Microsoft Windows Embedded Standard 7 with Service Pack 1 – 64bit	6.1.7601	Data/Build, Data/Build + Count, Central, Count, Print, Scan, Touch Writer, Relay host
Microsoft	Microsoft SQL Server 2012 for Embedded Systems	11.00.2100	Data/Build, Data/Build + Count, Central, Count, Relay host
Microsoft	Microsoft SQL Server 2012 Express	11.00.2100	Print, Scan, Touch Writer
McAfee	McAfee Application Control for Devices	6.1.1.369	Data/Build, Data/Build + Count, Central, Count, Print, Scan, Touch Writer, Relay host
Microsoft	Windows Communication Foundation (WCF)	4.5	Relay host, Scan with Relay

3.1.3   Additional Supporting Test Software

This section outlines all test specific software that will be used in the certification campaign.

Table 3 – Additional Supporting Test Software

Manufacturer	Application
LocMetrics	LocMetrics Line Counter, a commercial application used to determine the counts of executable and comment lines
SLI	Module Finder, a SLI proprietary application used to parse module names from C/C++, Java and VB code and populate the identified module names into the review documents
PrestoSoft	ExamDiff Pro: a commercial application used to compare revised code to previously reviewed code

3.2 Equipment

The following equipment is required for the execution of the hardware, software and security tests. This includes system hardware, general purpose data processing and communications equipment, and any test instrumentation required.

3.2.1 Hart Verity Voting 2.2.2 Equipment

The following **Hart Verity Voting 2.2.2** equipment will be used in testing:

Table 4 – Hart Verity Voting 2.2.2 Equipment

Hardware	Model
Verity Scan (digital scanner)	Revision C
Verity Scan optional cellular modem kit	Revision A
Verity Touch Writer (BMD)	Revision C
Verity Print	Revision B

3.2.2 COTS Equipment

The following Commercial Off-the-Shelf equipment will be used in testing:

- Desktops/Laptops
- Printers

Table 5 – COTS Equipment

Manufacturer	Hardware	Model
OKIDATA (for **Verity Data, Verity Build**, **Verity Print, Verity Central, Verity Touch Writer** and **Verity Count**)	Ballot and Report Printer	B432dn
OKIDATA (for **Verity Print, Verity Build**)	Ballot Printer	C831dn
Various (for **Verity Data, Verity Build, Verity Central** and **Verity Count**)	Intel-Windows Workstation **(Minimum Requirements)** Processor – Intel Celeron D 420 3.06GHz Dual Core Memory – 2GB Hard Drive – 120 GB Removable Storage – 8xDVD+/-RW Slim line USB Ports – 4 ports Video Card - Integrated Graphics	

Manufacturer	Hardware	Model
	Keyboard - USB Keyboard Mouse - USB Mouse	
Various (for **Verity Data, Verity Build**, **Verity Central, Verity Count, Verity Relay**)	**Monitor (Minimum Requirements)** Panel Size - 50.8 cm Aspect Ratio - Widescreen (16:9) Optimal Resolution - 1600 x 900 at 60Hz Contrast Ratio - 1000: 1 Brightness - 250 cd/m2 (typical)	
Canon (for **Verity Central**)	Ballot Scanner	DR-G1100
Canon (for **Verity Central**)	Ballot Scanner	DR-G1130
QuickCarrier® USB-D by MultiTech Systems cellular modem	Aeris cellular modem	MTD-EV3-N16
QuickCarrier® USB-D by MultiTech Systems cellular modem	Sprint cellular modem	MTD-EV3-N2
QuickCarrier® USB-D by MultiTech Systems cellular modem	Verizon cellular modem	MTD-EV3-N3
QuickCarrier® USB-D by MultiTech Systems cellular modem	Global (AT&T, T-Mobile, etc…) cellular modem	MTD-H5-2.0

3.3 Test Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, test ballot cards and control cards, standard and optional output data report formats, and any other materials used in testing.

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

3.4 Deliverable Materials

The following are documents and materials to be delivered as a part of the *Hart Verity Voting 2.2.2* system.

- Change Notes Verity Voting, Version 2.2.1 to 2.2.2
- Technical Reference Supplement – Reading vDrives
- Technical Reference Supplement – Clearing vDrives and Re-Opening Polls
- Verity Relay – Technical Reference Manual

- Relay – Theory of Operations
- Specifications and Manuals
- Verity System Description
- Verity Voting System Limits
- Verity Airgap Interface Technical Reference Manual
- Verity Software Architecture Design
- System Description Technical Document
- Verity Central Technical Requirements Document
- Verity Count Technical Requirements Document
- Election Management Technical Requirements Document
- Electronic Voting Devices Technical Requirements Document
- Verity Key Design Technical Document
- Verity Logging Technical Requirements Document
- Verity Precinct Scanner Technical Requirements Document
- Verity Security Requirements Document
- Verity Datastore Schema
- System Description Technical Document
- Verity Security Requirements
- Verity Risk and Threat Assessment
- Verity Key Design
- Verity Service and Maintenance Guide
- Verity Software Architecture Design
- Verity Voting Maintenance Information Operations Guide
- Election Definition and Device Settings Technical Reference Manual
- Central Ballot Scanning and Review Software Technical Reference Manual
- Count Vote Tabulation Software Technical Reference Manual
- Verity Voting Maintenance Information
- Operations Guide
- Quality Manual
- Voting System Implementation and Maintenance
- Supplier Qualification and Management
- Verity Operational Guide
- Verity Performance Characteristics
- Verity Bill of Materials and Approved Vendor List for each Verity Component
- Verity Scan Assembly
- Verity Touch Writer Assembly
- Verity Access Assembly
- Verity Ballot Box Assembly
- Verity Standard Booth Assembly
- Verity Accessible Booth Assembly
- Verity Electronics Specification
- Verity Base Station Microcontroller Specification

- SQA Requirements Management Process
- Management and Best Practices Training Agenda
- Verity Data Training Agenda
- Verity Build Training Agenda
- Verity Central Training Agenda
- Verity Count Training Agenda
- Verity Service and Maintenance Training Agenda
- Verity Polling Place Operations Training Agenda
- Assisting Persons With Disabilities Training Agenda
- Train the Trainer Training Agenda
- Verity Operations PRD – Ops/Services/Supply Chain Planning Document
- Configuration Management Process
- Verity Operational Guide
- Software Versioning Procedure
- Voting System Implementation and Maintenance

4 TEST SPECIFICATIONS

The following are the specifications for testing to be conducted on the **Hart Verity Voting 2.2.2** system. The specifications contain details on the focus of testing, configuration(s), and the functions to be tested.

4.1 Requirements

4.1.1 VVSG Requirements

The **Verity Voting 2.2.2** modification will be tested to the 2005 VVSG 1.0 requirements listed below:

Verity Voting 2.2.2's modification for 8.5" x 20" ballot affect the following pertinent VVSG requirements:
- 2.1.6.c,d,e
- 2.2.1.2.b

Verity Voting 2.2.2's modification for "Uncommitted Choices" affects affect the following pertinent VVSG requirements:
- 2.1.2.c
- 2.1.7.1.c
- 2.1.7.2.g
- 2.3.3.1.c
- 2.3.3.2.a,b

Verity Voting 2.2.2's modification for "Touch Screen Calibration" affects **Verity Build, Verity Touch Writer, Verity Print** and **Verity Touch**.

- 4.3.4.b

Verity Voting 2.2.2's modification for "Device Election Loading Optimization" affects **Verity Scan, Verity Touch Writer, Verity Print** and **Verity Touch**.

- 2.2.3.b

4.1.2   Hardware Requirements

As the only modifications are software logic updates, no hardware is affected, and as such, no hardware requirements are applicable to this effort.

4.1.3   Hart State Specific Modification Requirements

The requirements in this section are provided in order to clearly specify the modifications implemented to satisfy state jurisdiction requests for additional functionality.

The following requirements represent Hart internally developed specifications designed to satisfy these jurisdictional requests.

Pertinent Hart requirements, with Hart internal numbering, are:

8.5"x20" ballot support

Data

- 4.1.1.1 Data shall support selecting this paper size on the Select Templates screen

- 4.1.1.2 Data shall support displaying this paper size on the ballot preview screen

- 4.1.1.3 Data shall support this paper size in ballot layout validation

- 4.1.1.4 If stubs are included when this paper size is selected:

  - o   4.1.1.4.1 If Number of Stubs is 2, each stub's height shall be 1"

  - o   4.1.1.4.2 If Number of Stubs is 1, the stub height shall be 2"

Build

- 4.1.2.1 Build shall support displaying this paper size on the ballot preview screen

- 4.1.2.2 Build shall support printing this paper size from the Print Ballots screen

- 4.1.2.3 Build shall support this paper size in ballot layout validation

Central

- Central shall support scanning 8.5"x20" ballots

- Central shall support displaying 8.5"x20" ballots for review

- Central shall support printing images from 8.5"x20" ballots

- Central shall support exporting images from 8.5"x20" ballots

Devices

- 4.1.4.1 Scan shall support scanning 8.5"x20" ballots
- 4.1.4.2 Touch Writer and Print shall support printing 8.5"x20" ballots

Uncommitted Choices

General

- 4.2.1.1 The system shall allow an uncommitted choice to be added to a contest if:

- 4.2.1.1.1 The contest type is "Office"

- 4.2.1.1.2 The election type is "Closed Primary" or "Open Primary"

Verity Data

- 4.2.2.1 Contest entries on the Contests screen shall include a checkbox indicating whether an uncommitted choice should be added to this contest

  - o 4.2.2.1.1 This checkbox shall only appear if the contest is allowed to have an uncommitted choice
  - o 4.2.2.1.2 By default, this option shall be unchecked

- 4.2.2.2 The All Contests report shall include an uncommitted choice in contests that have an uncommitted choice.

- 4.2.2.3 The Contests Import shall include a field for indicating if an uncommitted choice is included

  - o 4.2.2.3.1 The import functionality shall validate that the contest is allowed to have an uncommitted choice

- 4.2.2.4 The Contests Export shall include a field for indicating if an uncommitted choice is included

- 4.2.2.5 Uncommitted choices shall be included on the Rotation Report

- 4.2.2.6 The Data Validation that ensures there are not more valid choices than ballot choices shall be modified to account for uncommitted choices.

- 4.2.2.6.1 This Data Validation shall return an error if the number of choices + the uncommitted choice + the number of write-ins is less than the Number of Valid Choices.

Election Definition

- 4.2.3.1 The election definition shall include data indicating whether a contest includes an uncommitted choice

Election Management

- 4.2.4.1 The unsigned export shall include data indicating whether a contest includes an uncommitted choice

- 4.2.4.2 The signed export shall include data indicating whether a contest includes an uncommitted choice

- 4.2.4.3 The archive format shall include data indicating whether a contest includes an uncommitted choice

Ballot Layout (Paper, Electronic, and Electronic Preview)

- 4.2.5.1 If a contest includes an uncommitted choice:
  - o 4.2.5.1.1 Ballots shall include an uncommitted choice in this contest
    - 4.2.5.1.1.1 The Choice Name for all uncommitted choices shall be "Uncommitted"
    - 4.2.5.1.1.1.1 This choice name shall have audio and translations for all languages
  - o 4.2.5.1.2 The uncommitted choice shall always appear after the ballot choices and before any write-in lines, regardless of whether rotation is applied.
    - 4.2.5.1.2.1 This Choice shall NOT have a party affiliation
    - 4.2.5.1.2.2 This Choice shall NOT have any additional text

Cast Vote Records

- 4.2.6.1 Cast Vote Records shall include uncommitted choices when they are marked.

Verity Device Reports

- 4.2.7.1 For any contest that includes an uncommitted choice subtotals for the uncommitted choice shall appear after the ballot choices and before any write-in data, regardless of whether rotation is applied to the report.

Verity Central

- 4.2.8.1 Verity Central shall treat the uncommitted choice the same way it treats any other choice.

Verity Count

- 4.2.9.1 For any contest that includes an uncommitted choice subtotals for the uncommitted choice shall appear after the ballot choices and before any write-in data, regardless of whether rotation is applied to the report.

- 4.2.9.2 The Detailed Vote Totals Export shall include rows for uncommitted choice subtotals in all contests where an uncommitted choice exists.

- 4.2.9.3 Uncommitted choices shall always appear after the ballot choices and before any write-in entries in the Vote Recording wizard

4.2 Hardware Configuration and Design

The **Hart Verity Voting 2.2.2** system, as declared in the application for certification submitted to the EAC, consists of:
- A **Verity Data/Build** workstation to create all election information and election media.
- **Verity Print** is a pre-voting ballot production device that is paired with COTS printer, to produce unmarked paper ballots.
- At the precinct level, **Verity Scan** optical scanners and **Verity Touch Writer** BMD configurations are employed.
- The central count location employs a high speed COTS scanner, in combination with a workstation that utilizes the **Verity Central** software, for tabulation of paper ballots.
- The consolidation, tally and reporting location employs a workstation with **Verity Count** software as well as a printer.
- The **Verity Relay** remote transmission option employs a host workstation and the **Relay** accessory for **Verity Scan**.

Note that these are the basic components of the system. **Verity Data/Build**, **Verity Central** and **Verity Count** can be run in standalone or networked configurations with additional client workstations.

4.3 Test Suite Design

4.3.1 Software Functional Test Design and Data

SLI has prepared functional test modules using the operator/user procedures specified in the TDP. Functionality provided by the **Verity Voting 2.2.2** voting system is exercised in order to verify that each functional component performs as

expected. Accept/reject criteria are based on requirements of the VVSG and the system specification documents provided within the TDP. As many of the individual functional components rely on preceding functionality within the system, SLI incorporates system level suites that employ modules that exercise the individual functional components of the system.

After analysis of the changes incorporated into the **Verity Voting 2.2.2** voting system, the following tests are implemented.

Verity Data/Build test suite – The modification to the **Verity Data/Build** component will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the firmware, does not adversely affect operations.

Verity Touch Writer test suite – The modification to the **Verity Touch Writer** component will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the firmware, does not adversely affect operations.

Verity Print test suite – The modification to the **Verity Print** component will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the firmware, does not adversely affect operations.

Verity Scan test suite – The modification to the **Verity Scan** component will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the firmware, does not adversely affect operations.

Verity Central test suite – The modification to the **Verity Central** application will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the software, does not adversely affect operations.

Verity Count test suite – The modification to the **Verity Count** application will be given focused testing in order to verify that the modification implemented, and the subsequent Trusted Build of the software, does not adversely affect operations.

General Election test – The full **Verity Voting 2.2.2** voting system will be reviewed in order to verify continued integration of the voting system and that all components continue to work as expected.

Closed Primary Election test – The full **Verity Voting 2.2.2** voting system will be reviewed in order to verify continued integration of the voting system and that all components continue to work as expected.

Open Primary Election test – The full **Verity Voting 2.2.2** voting system will be reviewed in order to verify continued integration of the voting system and that all components continue to work as expected.

4.4 TDP Evaluation

SLI is completing an assessment of the deliveries of the Technical Data Package for **Verity Voting 2.2.2** against the **Verity Voting 2.2** TDP. Any modification to previously reviewed documentation is being reviewed.

4.4.1 Document Review

SLI conducts a PCA review of all vendor documents submitted for review in the delivery of the **Hart Verity Voting 2.2.2** TDP. These include:

- System configuration overview
- System functionality description
- System hardware specifications
- Software design and specifications
- System test and verification specifications
- System security specifications
- User/system operations procedures
- System maintenance procedures
- Personnel deployment and training requirements
- Configuration management plan
- Quality assurance program
- System change notes

Documents are verified for compliance to the 2005 VVSG, Volume 2, Sections 2.2 through 2.13 and Volume 2, Section 6.6. Unless noted otherwise, all requirements are successfully met within the pertinent areas of the TDP.

4.5 Source Code Review

4.5.1.1 Source Code Review

The certification campaign for the **Hart Verity Voting 2.2.2** voting system includes proprietary software and firmware that have been created/modified. SLI has conducted a source code review of all modified proprietary source code submitted in the delivery of the voting system for compliance to the VVSG version 2005, Volume 2, Section 6.6. No COTS products were modified for this voting system version.

The coding languages involved in the vendor's applications include:

- C
- C++
- C#

Source Code Review Tools utilized by SLI include:

- Practiline Line Counter: a commercial application used to determine the counts of executable and comment lines;
- Module Finder: an SLI proprietary application used to parse module names from C/C++ and VB code and populate the identified module names into the review documents;
- ExamDiff Pro: a commercial application used to compare revised code to previously reviewed code; and

Any subsequent re-reviews of source code will be the result of fixes to discrepancies identified in the Functional Configuration Audit activities.

COTS Operating systems and software used in the voting system have been verified as authentic and unmodified in the **Verity Voting 2.2.2** test campaign.

4.6 QA & CM Process Review

The review processes employed are designed to verify that the manufacturer not only has documented processes and procedures in both the Quality Assurance and Configuration Management arenas, but that those processes and procedures are actually implemented within the software development life cycle that is used to produce the **Hart Verity Voting 2.2.2** version that is submitted for certification.

The QA portion of the review focuses on the testing performed by the system's manufacturer, **Hart InterCivic**. The scope of the testing performed is reviewed in order to verify that the manufacturer has verified all VVSG requirements are met. SLI reviews the test case design documents and data as provided by **Hart InterCivic**. In evaluating selected modules with respect to flow control parameters and data on both entry and exit, SLI assesses for discrepancies between the Software Specifications and the test case design. Additionally, interviews of key Quality Assurance staff may be conducted to verify that the QA processes and procedures are known, understood and implemented by the appropriate personnel within the organization.

The CM portion of the review focuses on the organization's understanding and implementation of the declared configuration management processes, procedures and policies. Initial deliverables will be reviewed against all pertinent CM processes employed by **Hart**. All subsequent deliveries will also be reviewed to determine that

appropriate processes are employed. Additionally, interviews of pertinent staff, with regard to configuration management, may be conducted if determined to be necessary to verify that processes, procedures and policies are known, understood and implemented within the organization.

4.7 Trusted Build

The Trusted Build will be conducted prior to SLI's official testing and will be completed on site at SLI's facility. SLI will use its approved standard lab procedure that details the processes for controlling, managing, and conducting the Trusted Build. This process includes the following:

• Preparations for the Trusted Build – Obtaining and reviewing Hart's procedure for constructing the build platform, verifying the target build platform, and acquiring and verifying the necessary materials, if rebuild of the existing environment is needed.

• Execution of the Trusted Build – SLI will perform the Trusted Build by using the step-by-step build procedure, as provided by **Hart** to create a pristine build environment. SLI ascertains and records the following items throughout the build process:

  o Build environment images at various key points
  o Build environment and file hashes at various key points
  o Build environment hardware characteristics
  o Build results from code compilation and file hashes
  o Final software install files and file hashes
  o Build virtual machine files

• Deliverables to Testing – Upon completion of the Trusted Build, certain items are sent to the SLI test group. The final result will be a media containing the following:

  o Final software install files
  o Hash values to validate install files

• Final Record Keeping and Archiving Procedures – At the conclusion of the Trusted Build process, SLI completes all final record keeping and archiving procedures at SLI's facility. This record keeping includes any unique identifiers, results of the build with version numbers and dates, and descriptions of all hashes and images in the repository.

4.8 Standard VSTL Test Methods and Uncertainty of Test Data Measurement

This test campaign utilizes Standard VSTL test methods and election specific type test data only.

5 TEST DATA

Test data for the **Hart Verity Voting 2.2.2** voting system has been compiled such that all functionality declared will be tested to determine conformance to the standards.

5.1 Data Recording

SLI has evaluated the system functionality, as described by **Hart** technical documentation, as well as requirements as listed in the EAC 2005 VVSG 1.0, and made determinations as to expected results of all data inputs into the **Hart Verity Voting 2.2.2** voting system. This includes:

- Election type
- Precincts of all types
- Districts
- Offices
- Contests
- Candidates
- Parties
- Devices used
- Voting variations employed
- Issues/Referendums
- Votes cast for each candidate/issue/referendum
- Vote consolidation data from one device/level to the next

The data is contained in one master data record, including each input and each expected output. This data is incorporated into the appropriate test suite.

Testing information is recorded in the test suites, as well as in test notebooks, which are utilized according to SLI's standard lab procedure *SLP-VC-30 - Test Notebooks*.

5.2 Test Data Criteria

SLI has evaluated the system functionality as described by Hart technical documentation, as well as requirements as listed in the EAC 2005 VVSG 1.0, and made determinations as to expected output of all data inputs into the **Hart Verity Voting 2.2.2** voting system. A data matrix has been recorded, for each test suite, that couples data inputs to their expected output, as determined above. The system's execution shall be measured against the expected results.

6 TEST PROCEDURE AND CONDITIONS

This section describes the test conditions and procedures for execution of test suites. Additionally, this section is used to describe procedures for setting up equipment that will be utilized in the execution of the test suites.

6.1 Facility Requirements

Testing will be performed on site at SLI in Denver, Colorado.

Four secure labs are available with appropriate power supply and space to accommodate the various configurations defined within this test plan. Temperature/humidity gauges will be employed in order to determine the appropriate conditions exist during testing.

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

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

All TDP and test documentation is stored on site at SLI's facility in a secure project directory on SLI's secure Voting server.

6.2 Test Setup

Configurations of **Verity Voting 2.2.2** will be deployed that conform to each specific test suite's needs. In all instances **Verity Voting 2.2.2** documentation will be followed in the setup of the configurations.

6.3 Test Sequence

While there is no required sequence for performing voting system certification testing and audits, there are prerequisite tasks for some testing. Any needed prerequisites are contained within the suite for that test.

6.4 Test Operations Procedures

An inventory has been performed to verify the voting equipment received contains hardware and software elements as defined in the TDP prior to commencement of testing.

Throughout the testing effort, test suites and modules will be marked as follows:

- **Accept –** Test is accepted as successful.
- **Reject –** Test is rejected as unsuccessful.
- **NT –** Not Testable is used for test modules that cannot be completed. For example, if failure of one test modules failure precludes attempting subsequent test modules, the latter will be marked as NT.

Test results **Reject** and **NT** will include comments by the VTS explaining the reason for the result.

Issues encountered during review and testing will be documented on the Discrepancy Report and on the EAC's VRT. Test findings showing that an aspect of the voting system does not conform to the requirements of the identified test standard will be marked as Documentation Discrepancies, Source Code Review Discrepancies, Hardware Discrepancies, or Functional Discrepancies.

Issues that are encountered during testing or documentation review but are not addressed by the applicable standard will be added to the Discrepancy report and noted as Informational. The vendor has the option whether to address Informational issues. All responses provided by the vendor are noted in the Discrepancy Report attachment to the Certification Test Report.

7 Approval Signatures

SLI:

Traci Mapps
Director of Operations, SLI Compliance
March 7th, 2018

End of Certification Test Plan