COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF STATE

REPORT CONCERNING THE EXAMINATION RESULTS OF HART VERITY VOTING 2.3.4 WITH VERITY SCAN PRECINCT SCANNER, VERITY COUNT TABULATING AND REPORTING SOLUTION, VERITY CENTRAL - CENTRAL SCANNING SOLUTION, VERITY TOUCH WRITER AND TOUCH WRITER DUO BALLOT MARKING DEVICES, AND VERITY DATA ELECTION DATA ENTRY SOFTWARE AND VERITY BUILD ELECTION DEFNITION SOFTWARE

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Acting Secretary of the Commonwealth
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EXAMINATION RESULTS OF HART VERITY VOTING 2.3.4 VOTING SYSTEM WITH VERITY SCAN PRECINCT SCANNER, VERITY COUNT TABULATING AND REPORTING SOLUTION, VERITY CENTRAL - CENTRAL SCANNING SOLUTION, VERITY TOUCH WRITER AND TOUCH WRITER DUO BALLOT MARKING DEVICE, AND VERITY DATA ELECTION DATA ENTRY SOFTWARE AND VERITY BUILD ELECTION DEFNITION SOFTWARE

I. INTRODUCTION

Article XI-A of the Pennsylvania Election Code, 25 P.S. §§ 3031.1 *et seq.*, authorizes the use of electronic voting systems. Section 1105-A of the Pennsylvania Election Code, 25 P.S. § 3031.5, requires that the Secretary of the Commonwealth (Secretary) examine all electronic voting systems used in any election in Pennsylvania and that the Secretary make and file a report stating whether, in her opinion, the electronic voting system can be safely used by voters and meets all applicable requirements of the Election Code. Verity Voting 2.3.4 release was to include the Verity Touch Writer ballot marking device that was withdrawn from the Verity 2.3.3 EAC certification campaign. Based on a letter of intent for presenting the Verity Voting 2.3.4 system for Pennsylvania (PA) state certification from Hart Intercivic Inc. (Hart), the Department of State's Bureau of Election Security and Technology (Department) scheduled functional testing and examination for May 1, 2019 of Verity Voting 2.3.4 voting system.

The Secretary of the Commonwealth (Secretary) appointed SLI Global Solutions and Center for Civic Design (CCD) as professional consultants to conduct an examination of Verity Voting 2.3.4 voting system. The examination process included a functional examination (functional examination) and accessibility examination. SLI in consultation with the Department concluded that there is no additional security testing required for the Verity Voting 2.3.4 since the Verity 2.3.3 included the Touch Writer and the security testing done for software modifications done to the Touch Writer was covered during the EAC certification testing of the voting system.

The functional examination commenced on May 1, 2019 and was performed at SLI Global Solutions located in Wheat Ridge, Colorado. The examination lasted 2 days. Mike Santos, Senior Test Manager, and Kyle Johnson, Senior Test Engineer (Functional

Examiner) of SLI Global Solutions, conducted the functional examination of the Verity Voting 2.3.4 pursuant to Section 1105-A(a) of the Election Code, 25 P.S. § 303l.5(a). Sindhu Ramachandran, Voting Systems Analyst, represented the Secretary of the Commonwealth and observed the examination via web conference. Pamela Geppert, Director of Certification represented Hart. The examination was videotaped by SLI.

The Department in consultation with the Accessibility Examiner decided to have an Accessibility Examination that consists of only Expert Review of the Hart Verity Voting 2.3.4 system to review the addition of the pop-up message in the software. The Expert review was done on May 29, 2019 via web conference. Whitney Quesenbery and Denis Anson (Accessibility Examiner) representing CCD performed expert review of the Hart Verity 2.3.4 system, specifically the Touch Writer modification to display a pop-up message when the voter has used the straight party option and then attempts to make a deselection that would result in that contest having no remaining marks. Julian Montoya, Certification Project Manager, represented Hart and Sindhu Ramachandran, Voting Systems Analyst, observed the review representing the Secretary.

II. THE HART VERITY VOTING 2.3.4 VOTING SYSTEM

Verity Voting 2.3.4 is a paper-based voting system that provides end-to-end election support, from defining an election to generating final reports. The system presented for certification in Pennsylvania is comprised of the following components:

Software Applications

- Verity Data 2.3.1 – Data management software application
- Verity Build 2.3.1 – Election definition software application
- Verity Central 2.3.1 – Central scanning software application.
- Verity Count 2.3.1 – Tabulation and reporting software application
- Verity User Management 2.3.1 – User Management software application
- Verity Election Management 2.3.1 – election Management software application

Note: Verity User Management and Verity Election Management are components that perform specific functions and can be used with Verity Data, Verity Build, Verity Central and Verity Count.

Voting Devices[1]

- Verity Scan 2.3.1 – digital scanning voting device
- Verity Touch Writer 2.3.4 – Ballot Marking Device with external COTS printer
- Verity Touch Writer Duo 2.3.3 – Ballot marking device with internal COTS ballot summary printer and Audio Tactile Interface
- Verity Controller 2.3.2 – Polling place management device for use with Verity TouchWriter Duo
- Verity Print 2.3.1 – On demand ballot production device
- Verity AutoBallot – Optional barcode scanner kit for Verity Controller and Verity Print

The following is a description of the Verity 2.3.4 components summarized from the System Overview section of the Functional Examiners' report and Verity System administrators guide document and Polling Place field guide submitted by Hart as part of the voting system Technical Data Package (TDP).

Verity Data

In Verity Data, jurisdictions can enter, import and manage election data, jurisdiction data, and translations, and record and import audio. Verity Data allows election officials to choose ballot templates, view ballot previews, and lock the election data so that it may be opened in Verity Build.

Verity Build

[1] Verity Touch and Verity Touch with access the DRE components of the Verity 2.3.3 is not certified for use in Pennsylvania.

In Verity Build, election officials can open an election, proof data, configure device settings, print ballots, and write vDrives and Verity Keys.

Verity Central

Verity Central is an application designed to manage central ballot scanning operations. With Verity Central election officials can scan and review ballots, resolve write-in votes and voter intent issues, and write cast vote records to vDrives for tabulation in Verity Count.

Verity Count

Verity Count is Verity's comprehensive application for ballot tabulation and reporting. In Count, election officials will read vDrives, tabulate ballots, resolve write-in votes, print reports, and export election results.

Verity User Management

User Management application allows an authorized user to add and manage other users, define and edit user roles, manage user policies, and update user passwords.

Verity Election Management

In the Election Management application, administrators can add, copy, import, export, rename, delete, archive, and restore elections created in the Verity system.

Verity Print

Verity Print is a pre-voting ballot production device for use by election officials and/or poll workers. Verity Print produces unmarked paper ballots. Print is paired with a commercial off-the-shelf printer to allow the user to select and print the desired ballot style. The Verity Print device is activated so the election official can print one or more blank ballots from one selected precinct at a time. Ballots can be printed on-demand for immediate

use, or they can be printed in advance for additional inventory.

Verity Scan

Verity Scan is a polling place digital scanner for paper ballots. Scan is paired with a purpose-built ballot box. Once the polls are open, to vote, voters simply insert their ballots and then voters wait for Verity Scan to indicate that the ballot has been successfully cast. Verity Scan also provides warnings to voters on undervotes, overvotes, and blank ballots as specified in the election definition. After scanning, a Cast Vote Record is stored on vDrive portable flash media. Verity Scan provides a capability to print end of day report at close of polls. vDrives with cast vote records can also be tabulated by the Verity Count software application. Verity Scan includes a compact and durable integrated storage case for secure, easy transportation and storage.

Verity Touch Writer

Verity Touch Writer is a ballot marking device for paper ballots. Voters use the electronic interface to privately and independently make their selections on the ballot. Voters can also make selections with Verity Access, an Audio-Tactile interface (ATI) component with three tactile buttons, one audio port for headphones, and one port for external two-switch devices. When voters finish making their selections, they print the marked ballot. Verity Touch Writer is configured with a COTS printer (OKI B431D/ OKI B432D). The printed ballot with voter selections is scanned by the Verity Scan using the same algorithm used for tabulating hand marked paper ballots.

Verity Touch Writer Duo

Verity Touch Writer Duo is a ballot marking device for paper ballots. Voters use the electronic interface to privately and independently make their selections on the ballot. Voters can also make selections with Verity Access, an Audio-Tactile interface (ATI) component with three tactile buttons, one audio port for headphones, and one port for external two-switch devices. When voters finish making their selections, they print the marked ballot. Verity Touch Writer Duo has an integrated printer. The printed ballot with

voter selections is scanned by the Verity Scan using Optical Character Recognition (OCR) technology. Touch Writer Duo is configured for use in a daisy-chained network with Verity Controller.

Verity Controller

Verity Controller is a polling place management device that is used to generate random access codes for voters. Access Codes are used to activate a ballot session on Verity Touch Writer Duo. Up to twelve Touch Writer Duo devices can be connected to a single Verity Controller.

Verity Access

Verity Access is an audio tactile interface (ATI) controller that is connected to Verity Touch Writer Duo ballot marking devices as a complement to the touchscreen display, to provide additional options for accessible voting. Access has three tactile buttons, one audio port, one port for two-switch adaptive devices (such as “jelly switches" or sip-and-puff devices), and a custom USB cable. Jacks for headphones and adaptive devices are located on the top edge of the device, and the device has gripping surfaces on either side.

Verity AutoBallot

Verity AutoBallot is an optional barcode scanner kit for Verity Controller and Verity Print that allows air-gapped integration between an e-pollbook check-in process and the task of selecting the proper ballot style for the voting system. AutoBallot automates the ballot style selection process by allowing poll workers to scan a barcode output from an electronic poll book and activate the correct ballot style with the click of a button, thereby reducing human error. The optional AutoBallot kit includes a COTS barcode scanner with attached USB cable and a custom vDrive compartment door that allows connection of the barcode scanner to the Verity device.

Ballot Box

Verity Ballot Box includes separate, secure compartments for scanned and un-

scanned ballots, and it folds for easy transportation and storage.

Voting Booth

Voting Booth is designed for use with Verity Touch Writer Duo. The booth includes only three parts to assemble, and it also includes nylon privacy screens. ADA-compliant versions of the Verity voting booth are designed for keeping accessibility and controls within reach.

Verity vDrive

vDrives are flash memory media devices that carry the election definition from Verity Build to Verity devices, including Scan, Touch Writer Duo, Print, and Controller. vDrives also store Cast Vote Records (CVRs) and audit information. After polls are closed, vDrives can be removed from devices to transfer CVRs and/or audit logs to Verity Count. vDrives are also used to store CVRs associated with scanned ballots in Verity Central. vDrives from Scan and Central are read Into Count, which tabulates votes and reports results.

Verity Key

Verity Key is a two-factor authentication device used to secure access to critical functions throughout the election. Two-factor authentication means that users must have the physical key device, which is similar to a USB token, as well as knowing the passcode associated with the physical security device. This electronic device is required for access to secure functions in the Build, Central, and Count applications, including tasks such as accepting ballot styles, opening new election functions, and tabulating votes, and is required to configure devices for use in an election.

Manufacturer Software/Firmware

The Verity Voting 2.3.3 voting system consists of the following custom software and firmware components:

Application	Version
Verity Data	2.3.1
Verity Build	2.3.1
Verity Central	2.3.1
Verity Count	2.3.1
Verity Print	2.3.1
Verity Scan	2.3.1
Verity Touch Writer	2.3.4
Verity Touch Writer Duo	2.3.3
Verity Controller	2.3.2

COTS Software/Firmware

Additional COTS software and firmware included in the system has been defined as part of the EAC system certification scope added to this report as Attachment A.

Hardware

Below is a listing of the custom hardware components that comprise the Hart Verity Voting 2.3.3 voting system:

Component	Version
Verity Print – Ballot Printer	3005356 Rev D
Verity Scan – Paper Ballot Scanner	3005350 Rev H
Verity Touch Writer – Electronic BMD Device	3005352 Rev G
Verity Touch Writer Duo – Electronic BMD Device	3005700 Rev A
Verity Controller – Networked Centralized Management Device	3005351 Rev D
Verity Auto Ballot	3005174 Rev B

COTS Hardware

Additional COTS hardware included in the system has been defined as part of the EAC system certification scope added to this report as Attachment A.

Test Materials

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

III. EXAMINATION APPROACH, PROCEDURES AND RESULTS

A. Examination Approach

Functional Examination

To ascertain whether Verity Voting 2.3.4 can be safely used by voters at elections in the Commonwealth and meets all the requirements of the Pennsylvania Election Code, the Examiner developed test protocols for the examination. The test protocols separated the requirements of Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 - 3031.22, into six main areas of test execution: (1) Source Code Review; (2) Documentation Review; (3) System Level Testing; (4) Security/Penetration Testing; (5) Privacy Analysis; and (6) Usability Analysis. Source Code Review of the Verity Touch Writer code was performed prior to the functional examination to determine if there are any vulnerabilities found that would warrant additional security examination.

Documentation Review was performed to verify that the portions of the Pennsylvania Election Code, which reference documentation detail, are sufficiently met by the Hart Verity Voting 2.3.3 documentation. The Functional Examiner validated compliance of the system with the following sections of the Election Code during the documentation review.

- 1105-A(a), 25 P.S. § 3031.5(a), requiring that an electronic voting system has been examined and approved by a federally recognized ITA;
- 1107-A(11), 25 P.S. § 3031.7(11), requiring an electronic voting system to be suitably designed in terms of usability and durability, and capable of absolute accuracy;
- 1107-A(13), 25 P.S. § 3031.7(13), requiring an electronic voting system to correctly tabulate every vote;
- 1107-A(14), 25 P.S. § 3031.7(14), requiring an electronic voting system to be safely transportable; and

- 1107-A(15), 25 P.S. § 3031.7(15), requiring an electronic voting system to be designed so voters may readily understand how it is operated.

System Level Testing examined the Verity Voting 2.3.4 voting system in terms of conducting an election. The Functional Examiner prepared election definitions, including ballot layouts, translations and audio ballots using Verity Data and locked the election data after review. The definitions were then loaded onto Verity Build. Ballot data and Ballot layout was proofed, election settings were configured, and vDrives and Verity Keys were created to populate the elections to the required components (Verity Central, Verity Touch Writer Duo/Controller, Verity Touch Writer, Verity Scan and Verity Print) using the Verity Build software. The polling place was set up using Verity Scan, Verity Touch Writer, Verity Controller and Verity Touch Writer Duo. Votes were captured using Verity Touch Writer Duo and ballots were printed and tabulated via Verity Scan configured to scan Touch Writer Duo ballots. Ballots were also marked manually and using Verity Touch Writer and then tabulated through Verity Scan configured to scan optical scan ballots. The functional examiner printed some blank ballots using Verity Print. All ballots (hand-marked paper ballots and Touch Writer Duo ballots) created were then tabulated through the Verity Central, central scanning solution with COTS scanner (Canon DR-G1100/ DR-G1130), thus each ballot was tabulated three times. Tabulation results were then processed using the Verity Count tabulation and reporting solution, write-in votes were adjudicated, and reports were generated with results for the election. The results reports were then validated against the expected results of the voted ballots.

All components of the Verity Voting 2.3.4 system were exercised to verify that they meet all pertinent requirements of the Pennsylvania Election Code. The test cases were designed to ascertain compliance with the following sections of the Election Code:

- 1101-A, 25 P.S. § 3031.1, requiring an electronic voting system to provide for a permanent physical record of all votes cast;
- 1107-A(2), 25 P.S. § 3031.7(2), requiring an electronic voting system to permit voting on both candidates and ballot questions, according to the official ballot;
- 1107-A(3), 25 P.S. § 3031.7(3), requiring an electronic voting system to permit

straight party voting, including the "Pennsylvania method" of straight party voting;

- 1107-A(4), 25 P.S. § 3031.7(4), requiring an electronic voting system to permit a voter to vote for candidates of all different parties, and write-in candidates;

- 1107-A(5), 25 P.S. § 3031.7(5), requiring an electronic voting system to permit a voter to enter write-in votes;

- 1107-A(6), 25 P.S. § 3031.7(6), requiring an electronic voting system to permit a voter to cast votes for candidates and ballot questions he or she is entitled to vote for, and prevents a voter from casting votes the voter is not entitled to vote on;

- 1107-A(7), 25 P.S. § 3031.7(7), requiring an electronic voting system to prevent over-votes;

- 1107-A(8), 25 P.S. § 3031.7(8), requiring an electronic voting system to prevent a person from casting more than one vote for a candidate or question, except where this type of cumulative voting is permitted by law;

- 1107-A(9), 25 P.S. § 3031.7(9), requiring an electronic voting system to permit voters to vote in their own parties' primaries, and prevents them from voting in other parties' primaries, while also permitting voters to vote for any nonpartisan nomination or ballot question they are qualified to vote on; and

- 1107-A(10), 25 P.S. § 3031.7(10), requiring an electronic voting system that registers votes electronically to permit voters to change their votes up until taking the final step to register the vote, and for systems that use paper ballots or ballot cards, permits a voter to get a new ballot in the case of a spoiled ballot, and to mark and cancel the spoiled ballot;

- Parts of 1107-A(16), 25 P.S. § 3031.7(16), requiring an electronic voting system which provides for district-level tabulation to include (i) a public counter to register how many ballots are submitted to be counted; (iv) will not tabulate an over-vote, with an option to notify a voter of an over-vote if used during voting hours; and (v) generates a printed record that counters are set to zero before voting commences; and

- Parts of 1107-A(17), 25 P.S. § 3031.7(17), requiring an electronic voting system which provides for central-count tabulation to (ii) preclude tabulation of an over-vote; and (iii) indicate that counters are set to zero before processing ballots, either by district or with the capability to generate cumulative reports.

The Functional Examiner also used the System Level Testing to further evaluate the design and accuracy aspects of the system as required by Sections 1107-A(11) and (13), 25 P.S. §§ 3031.7(11) & (13), through his use at public demonstration and testing, even though

the requirements were already validated in the documentation review phase by reviewing EAC certification reports.

The Security/Penetration Analysis examined the voting system's compliance with the requirements of the Pennsylvania Election Code by analyzing physical security procedures and impoundment of ballots. Precinct tabulation devices were installed for delivery to the precinct, and the Functional Examiner analyzed the pertinent security procedures performed on each device to ascertain compliance with Section 1107-A(12), 25 P.S. § 3031.7(12), requiring an electronic voting system to provide acceptable ballot security procedures and impoundment of ballots to prevent tampering with or substitution of any ballots or ballot cards. The Functional Examiner also used the security analysis phase of testing to validate compliance with parts of Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), related to system security.

The Privacy Analysis examined the voting system's compliance with Section 1107-A(l) of the Election Code, 25 P.S. § 3031.7(1), requiring that an electronic voting system provide for absolute secrecy of the vote, by analyzing how the polling place devices (Verity Scan and Verity Touch Writer Duo) met the pertinent privacy requirements.

The Usability analysis evaluated the compliance of the voting system with Sections 1107-A(14) and (15), 25 P.S. §§ 3031.7(14) & (15). The results from the tests were used by the Functional Examiner to supplement his conclusions from the documentation review phase.

Accessibility Examination

The accessibility examination was designed to provide insight and information on each voting system's usability and accessibility, especially for voters with disabilities and for poll workers responsible for managing the system on Election Day. As mentioned in the introduction section, the Accessibility Examination for Verity Voting 2.3.4 included only Expert Review by the Accessibility Examiner because the system components to be examined remained same between Verity Voting 2.3.3 and Verity Voting 2.3.4, and the only

change was to the Touch Writer. The Accessibility Examiner performed the expert review of the updated straight party voting interactions and messages on Verity Touch Writer via web conference. Hart representative working thru the ballot following the instructions from the Accessibility Examiner. The findings and discussion in this report include the full Accessibility examination done on Verity Voting 2.3.3 and the expert review done on Verity voting 2.3.4.

B. Examination Process and Procedures

The examination process and procedures followed for Verity Voting 2.3.4 examinations are listed in the below sections. The final determination in this report is based on the combined analysis of the results and conclusions from all the tests including the Accessibility Examination and Security Testing done on Verity Voting 2.3.3 voting system.

Verity Voting 2.3.4 Examination

Functional Examination

Hart supplied all the hardware equipment required for the examination. All software and firmware necessary to perform the examination was received directly from the Voting System Test Laboratories (VSTL) that tested the voting system for EAC certification. The trusted build of the software and firmware for each device being evaluated were installed using the appropriate media for installation. The hash codes for all system components were captured using the process listed in the manufacturer's Technical Data Package (TDP) by the Functional Examiner with assistance from a Hart representative. The Functional Examiner further compared and confirmed that all the captured hash codes matched the hash codes for the EAC certified system executables before executing the test scripts.

The Functional Examiner created the election data definition using Verity Data and created the Verity Keys and vDrives for the election using Verity Build. Polling place devices Verity Scan, Verity Touch Writer and Verity Touch Writer Duo/Controller were prepared for election day voting. Verity Print also was set up for blank ballot printing. The election was also loaded to Verity Central and Verity Count and the devices and COTS

components were prepared for scanning and tabulation respectively. The polling place was set up and the functional examiner performed System Level Testing (closed primary and general election). Polls were closed and results were tabulated and reconciled with expected results. Ballots were also scanned on the central scanning solution, Verity Central (COTS Scanners Canon DR-G1100 and DR-G1130), and results were validated against expected results. The functional examiner also performed the security analysis, usability analysis and privacy analysis. The election runs were completed successfully, and the results reconciled.

Accessibility Examination

The results of the accessibility examination for the Verity Voting 2.3.4 voting system is based on the combined testing done on Verity Voting 2.3.3 and 2.3.4.

The polling place components of Verity Voting 2.3.4 voting system are Verity Touch Writer Duo and Verity Controller, Verity Touch Writer, and Verity Scan. The Verity Touch Writer Duo includes the printer within the machine itself and prints a ballot with only the voter's choices (the QR code on the ballot contains only ballot type information and is used to initialize the scanner). The ballots when scanned using Verity Scan, tabulates voter selections using Optical Character Recognition (OCR). The Verity Touch Writer includes a COTS printer to print ballots which are similar to optical scan ballots, which can be tabulated on Verity Scan using the same algorithm to tabulate hand marked paper ballots.

- For the Touch Writer, a poll worker initiates a voting session for all voters.
- For the Duo, a poll worker initiates the ballot marking device from a separate unit, prints an access code, and then gives the printed code to the voter along with a blank, specially formatted piece of ballot paper. Voters are able to enter the access code independently using all of the assistive features of the system. For blind voters, the code would have to be scanned with personal OCR or given verbally by the poll worker.

Voters make selections on both units using the same techniques to mark their ballot. To print the final ballot, The Touch Writer uses a separate printer, and the Duo prints the ballot

within the ballot marking device, without a separate printer.

Both systems require voters to insert their printed ballot into a scanner to cast their ballot.

Touch Writer Duo/Touch Writer accessibility features:

- 12.1" touch screen, in portrait orientation
- Audio assistance
- Tactile interface with a "MOVE" wheel that can rotate freely in either direction, a select button, and a help button.
- Audio and dual switch ports are included on the tactile interface. All buttons are labeled in text and Braille, and the ports are labeled with a raised icon.

Voter preference settings:

- Language choice
- Audio volume and voice speed changes (Slow, Normal, and Fast)
- Text Size (Small, Normal, and Large)
- Screen contrast options: color, white background with black text, and black background with white text
- Screen blank, while using the audio only

Verity Scan Polling Place Scanner

The scanner has three notable accessibility features. The scanner opening has raised guides that voters may feel with their hands to help orient the ballot. The scanner screen is the same size as the Touch Writer and Duo. Once the ballot is accepted by the scanner, then it plays a chime to indicate success.

Verity Controller

Paired only with the Duo device, the Verity controller itself does not provide any direct accessibility features. However, if voters need help beyond what is provided onscreen, they can discreetly summon a poll worker with the touch of a button.

The machine features listed above are not exhaustive. For more information about the Hart Verity systems, refer to the vendor provided technical specifications.

Verity 2.3.3 Accessibility Examination

The full accessibility examination done on Verity Voting 2.3.3 included expert review by the Accessibility Examiner, sessions with 4 poll workers representing Dauphin County, and sessions with 14 voters with disabilities using different assistive devices for voting. The voter sessions each took approximately an hour and the poll worker sessions took approximately 90 minutes each. Hart supplied the hardware and supplies for the Accessibility Examination. The equipment was prepared for the examination by loading the required election definition using transport media.

The examination team specially designed a test ballot for this evaluation. The test ballot provided a typical Pennsylvania ballot experience, with a mix of contests and variation in the number of candidates running in each contest. The facilitator instructed voters how to vote so that examiners could compare results between each session. The same ballot is used for all voting system examinations.

Both the ballot contents and the voting instructions were designed to exercise different types of interactions:

- Navigation within the ballot
- Navigation within each contest
- Undervotes

- Overvotes
- Using and making changes to straight party selections
- Navigation within the review/summary screen
- Making changes to a contest from the review/summary screen

The ballot included both very short contests, and those long enough to potentially fill more than one screen, even at the default text size.

The Accessibility Examiner prepared voting scenarios for each voting session to allow comparison of results between each session. The scenarios were constructed to provide a structured opportunity to explore how the system works in all interaction modes, using:

- Visual display mode with default settings and use of enhanced options for text size, brightness, and contrast
- Audio format with options for volume and tempo
- Touch input and navigation on the display screen
- Input and navigation using a tactile keypad
- Input and navigation using a sip-and-puff

Expert Review by Accessibility Examiner

The Accessibility Examiner used the same ballot and instructions to be used for voter and poll worker review, for their expert review, so they would be familiar with the interaction voters would experience.

Sessions with voters

Each voter session took about an hour. They included:

- An opening interview about their previous voting experience and the types of assistive technologies they use in daily life and in voting.

- A very basic orientation to the system with opportunities for voters to ask questions about any assistive technologies available.

- Machine set-up using the provided assistive features and/or devices based on the needs of the individual voter. Where a blind voter would typically use the provided or personal headset to listen to the audio instructions, the tests used an external speaker so that the testers could inquire about the voters understanding of the instructions.

- Voting a ballot following facilitator-guided voting instructions, and facilitator help only where necessary. Voters were encouraged to give feedback about their experiences, both positive and negative, as they went through the ballot.

- A closing interview including a questionnaire about their voting experience and reactions to the system.

Voters used Touch Writer or the Duo to mark their ballot, printed their ballot and all were able to cast their ballot using the scanner.

Sessions with poll worker groups

The sessions took 60-90 minutes each, depending on how many people were in each group. The session included:

- A brief orientation to the voting systems and the accessibility features, similar to a poll worker training.

- An opportunity for the poll workers to review vendor-provided instructions before trying the system. They marked ballots and experimented with the accessibility features.

Examiners provided an opportunity for the poll workers to interact with two to three different access-needs scenarios, depending on the size of the group and available time. Each scenario involves an examiner role-playing as a voter with an unspecified disability. In some scenarios, the voter doesn't immediately identify their disability. Since this was not intended to test the poll-worker's ability to determine appropriate accommodations, each simulated voter provided information about the accommodations they needed, in general language. Sometimes, this requires the poll worker to ask the voter what additional assistance she or he might need. Then the poll worker activates the necessary accessibility features for the voter. The Accessibility Examiner took notes about aspects of the system that worked well and problems they encountered during all three phases of the examination. The issues were then categorized based on their impact on a voter's ability to vote independently and privately.

- Positives – things that voters mentioned as meeting or exceeding their expectations
- Annoyances – things voters mentioned as problems, but which did not significantly slow their progress in marking their ballot
- Problem solving – instances where voters hesitated and had to figure out how to complete an action or task, but were able to do so on their own, by exploring the system or relying on past experience with technology
- Needs assistance - problems that could only be solved with help, such as instructions or assistance from a poll worker
- Likely to prevent independent voting for voters with some disabilities - problems that could prevent successful independent and private voting, even with good knowledge about how to use the system and accessibility features

The Accessibility Examiner then compiled the findings including categorizations from the examination into a report submitted to the Secretary.

Verity 2.3.4 Accessibility Examination

The Accessibility Examiner performed an expert review for the updates on the Verity Voting 2.3.4 system. This examination was specifically for the Hart Verity Touch Writer modifications done to satisfy VVSG. In the new version of the Touch Writer:

- If a straight party option is selected, it is not possible to leave a contest included in the straight party interaction with no selection. If a voter tries to deselect all candidates, a message is displayed – "You cannot remove all selections in this contest because you have already chosen a straight-party preference. If you do not want to vote for any candidate(s) in this contest, you must first return to the straight-party screen and remove your straight party preference."

- If a voter removes their selection of a straight party option, all candidate selections controlled only by the straight party logic are removed, leaving only candidates the voter has directly selected.

- When the ballot is printed, the straight party option (if any) is shown as selected on the bubble-style ballot.

Security Testing

The Security Testing performed on Verity Voting 2.3.3 comprised of a series of test suites which are utilized for verifying that a voting system will correspond to applicable security requirements within the Pennsylvania Election Code and the Pennsylvania Voting System Security standard. Security Testing covered the aspects of Confidentiality, Anonymity, Integrity, Availability, Auditability and Accountability. The tests included Documentation Review, Design, Software Security, Network, Audit Logging and Physical Security. The Security Examiner also performed a penetration testing of the Hart Verity Voting 2.3.3 voting system.

During the security testing of the election system, a cross section of the VVSG 2005 requirements were retested as a due diligence measure to ensure that nothing was missed during the EAC Certification effort of the Verity Voting solution.

The tests also included in depth verification and validation of reports, audit logs generated by the systems under test to verify and validate that all the requirements have been met. The security examiner also noted that the tests included in depth examination of election specific results and media, reports and audit logs, including attempts to decrypt, manipulate, and corrupt election data in an attempt to change or influence the final results of an election.

C. Examination Results

Verity Voting 2.3.4 Functional Examination

The Functional Examiner's report indicated successful completion of tests executed to ascertain compliance with Pennsylvania election code requirements mandated by the Pennsylvania Election Code. The Examiner report for Verity Voting 2.3.4 included details of the test cases, execution and successful completion. Source Code Review for the modified code in Verity Voting 2.3.4 was performed, with a focus on determining whether any vulnerabilities could be found. The Functional Examiner reported that the code review was completed with no identified malicious software, cryptographic software, process control or password management vulnerabilities. The Examiner concluded that no deficiencies were found during source code review.

System Level testing included a closed primary election and a general election. A closed primary election consisting of two parties (Republican, Democratic), and three precincts was conducted utilizing software components - Verity Data, Verity Build, Verity Central and Verity Count and Verity Devices – Verity Touch Writer Duo and Controller, Verity Touch Writer, Verity Scan, Verity Central with COTS Scanner (Canon DR-G1100 and DR-G1130). Overall there were 40 contests: 38 partisan (19 Republican and 19 Democratic) contests and 2 referendums. 23 "Vote for One," 2 "Vote for no more than Two," 4 "Vote for no more than Three," 9 "Vote for no more than Four," and 2 "Vote for no more than Fifteen. For each precinct, the test used different ballot styles each of which contained unique sets of contests and candidates, for which the Examiner voted for candidates and questions. Referendum contests were added to test the generation of non-partisan ballots.

The Functional Examiner validated compliance of the system to Sections 1101-A and 1107-A(2), (5)-(11), 25 P.S. §§ 3031.1, 3031.7(2), (5)-(11). No issues or anomalies were experienced during these tests, and the objective criteria established in the test protocols were met. A general election consisting of four parties (Republican, Democratic, Green and Libertarian), three precincts (one of which was a split precinct), and 21 contests including 2 retention questions, 13 "Vote for One," 1 "Vote for no more than Two," 6 "Vote for no more than Three," and 1 "Vote for no more than Fifteen" was run utilizing software components - Verity Data, Verity Build, Verity Central and Verity Count and Verity Devices – Verity Touch Writer Duo and Controller, Verity Touch Writer, Verity Scan, Verity Central with COTS Scanner (Canon DR-G1100 and DR-G1130). The Functional Examiner examined the compliance of the system to Sections 1101-A and 1107-A(2)-(8), (10)-(11) and (13), 25 P.S. §§ 3031.1, 3031.7(2)-(8), (10)-(11) & (13).

The Functional Examiner included test cases to validate Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17), which mandate that voting systems generate zero proof reports and correctly handle over-votes during the election runs. The remainder of the requirements of 25 P.S. §§ 3031.7(16) and (17) were validated by the Functional Examiner during the Security/Penetration Analysis.

The Functional Examiner used English and Spanish ballots for the test. Each specific hardware and software component were tested for compliance with the required sections of the Election Code.

Security/Penetration Analysis

The Functional Examiner adopted a strategy to review each pertinent requirement for this test individually and then created test cases to address it in either a documentation review, a functional test, or both. The Functional Examiner included test cases to examine compliance of the system to Section 1107-A(12), 25 P.S. § 3031.7(12) and parts of Sections 1107-A(16) and (17), 25 P.S. §§ 3031.7(16) & (17). As applicable, results were leveraged from the Verity Voting 2.3.3 Examination for system components of that version that were

unchanged.

Privacy Analysis

The Functional Examiner reviewed and inspected the privacy aspects of Verity Voting 2.3.3/2.3.4system to determine compliance with Section 1101-A(1) of the Election Code, 25 P.S. § 3031.7(1). The Functional Examiner determined that the components of the system used at the polling place comply with 25 P.S. § 3031.7(1) by review of system documentation and physical inspection. Central scanners were physically examined by the Functional Examiner for adequate visual secrecy. The Functional Examiner also verified that no voter data, including stored ballot images are tied back to any specific voter in a manner that would compromise voter secrecy.

Usability Analysis

The Functional Examiner performed this portion of the test on Verity Voting 2.3.3 and then conducted a follow-up examination on Verity Voting 2.3.4. The Functional Examiner determined that Verity Voting 2.3.4 demonstrated compliance with the usability requirements of Section 1107-A(14) and (15) of the Election Code, 25 P.S. §§ 3031.7(14) & (15), by reviewing appropriate EAC certification reports and his experience using the various functionalities of the system during the examination.

The following table is a summary of the results of the tests conducted by the Functional Examiner to validate compliance to PA Election Code requirements compiled from the examination proceedings and the Functional Examiners examination report.

Election Code	**Components**	**Test Phase**
25 P.S.§ 3031.5(a)	All components of the Verity Voting 2.3.4 voting system	Documentation review

Comments – Functional examiner reviewed the draft EAC certification report for Verity Voting 2.3.4. The system was further certified by EAC on May 29, 2019 demonstrating compliance to the requirement that a voting system must be examined and approved by a federally recognized independent testing authority (ITA), or VSTL as such authorities are now called, as meeting the applicable performance and test standards established by the federal government. The final EAC certification scope is added to this report as Attachment A.		
25 P.S. § 3031.7(11)	All components of the Verity Voting 2.3.4 voting system	Documentation review
Comments – The Functional Examiner concluded that the design requirements are met by the combination of EAC hardware Non-Operating Environmental Tests, which included bench handling, vibration, low temperature, high temperature, humidity and product safety tests. The system accuracy testing during EAC certification testing provided confirmation of system accuracy.		
25 P.S. § 3031.7(15)	All components of the Verity Voting 2.3.4 voting system	Documentation review
Comments – The system summative usability test reports were accepted by the EAC as part of the Federal Certification. This, along with the Functional Examiner's use of the system, demonstrates that the system can be readily learned and hence satisfied the usability requirements 25 P.S. § 3031.7(15).		
25 P.S. § 3031.7(16)(iv)	Verity Scan	System Level Testing (Primary and General Election
Verity Scan - Examiner attempted to scan overvoted ballots and verified that the device issued a warning to the voter. The system allowed the voter to choose to cast their ballot with overvotes if the voter so chose. The voter could also decide to spoil the ballot and mark a new		

ballot. The scanner also tabulated the votes appropriately and did not count any votes in an overvoted contest. The tests determined that the system is compliant with 25 P.S. § 3031.7(16)(iv). In addition, ballot marking devices Verity Touch Writer and Verity Touch Writer Duo did not allow the voter to overvote. Under voted contests were warned to the voter but were allowed. Verity Scan also tabulated votes appropriately with under voted contests counting a valid vote for the voter's choice.		
25 P.S. § 3031.7(16)(v)	Verity Scan	System Level Testing (Primary and General Election
Examiner generated the zero-proof report before opening polls and also generated reports after closing polls, to verify the total number of ballots that have been tabulated, total number of votes cast for each candidate on the ballot and the total number of votes cast for, or against any question appearing on the ballot. The Examiner thus concluded that the system demonstrates compliance with 25 P.S. § 3031.7(16)(v).		
25 P.S. § 3031.1	Verity Voting 2.3.4 voting system	System Level Testing (Primary and General Election
Comments - Verity Voting 2.3.4 is a paper based voting system and voters use hand-marked paper ballots or Verity Touch Writer /Touch Writer Duo marked ballots to cast their vote. The ballots are printed and tabulated on Verity Scan precinct scanner or Verity Central, central scanning solution. The system thus provides a permanent physical record of each vote cast on paper and thus complies to 25 P.S. § 3031.1.		
25 P.S. § 3031.7(1)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central	Privacy Analysis

Comments -

Verity Touch Writer, Verity Touch Writer Duo, Verity Scan

This examination consisted of

a) Review of documentation to confirm that voting system set up instructions are provided for voting in absolute secrecy.

b) Physical Inspection of polling place setup for adequacy of visual secrecy for Verity Touch Writer Duo, Verity Touch Writer, Verity Scan.

c) Set up Verity Touch Writer Duo, Verity Touch Writer and Verity Scan as prescribed in documentation. Vote a ballot and determine that the polling place devices provide absolute privacy.

The examination determined that this requirement was satisfactorily met provided the system is implemented following the instructions.

Verity Central

This examination consisted of a physical inspection of the central location setup for adequacy of secrecy, verifying that no voter data, including ballot images are tied back to any specific voter, in a manner that would compromise voter secrecy in any way. The Functional Examiner concluded that this requirement is satisfactorily met based on the tests.

25 P.S. § 3031.7(2)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central, Verity Count, Verity Data, Verity Build	System Level Testing (Primary and General Election

Comments -

The election definitions were created using Verity Data and Verity Build and loaded to polling place devices and central scanners, which provided assurance that the system can perform ballot creation activities. The Functional Examiner successfully added contests including straight party, parties, choices, precincts, districts, ballot styles, referendum questions and retention contests with appropriate candidates and choices.

The Verity Touch Writer, Verity Touch Writer Duo and Verity Scan components of the successfully permitted votes for "1 of 1," "N of M," and "Question" contests for a standard and ADA voting session. The Functional Examiner also exercised a straight party vote to confirm that all appropriate candidates were selected. The Functional Examiner thus concluded that the system is in compliance with 25 P.S. § 3031.7(2).

25 P.S. § 3031.7(3)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central	System Level Testing (General Election)

Comments -

The Functional Examiner marked ballots on Verity Touch Writer and Touch Writer Duo and confirmed that PA method is implemented accurately. Verity Scan and Verity Central also tabulated hand marked ballots when PA method voting variations were involved.

25 P.S. § 3031.7(4)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central	System Level Testing (General Election)

Comments -

All appropriate components of the Verity Voting 2.3.4 allowed the voter to cast votes for any candidate on the ballot and also allowed the voter to cast write-ins, and the Functional Examiner concluded that the system complies to the requirement.

25 P.S. § 3031.7(5)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central	System Level Testing (Primary and General Election
Comments - The Examiner included write-in votes on hand marked and machine marked ballots. The tabulation components appropriately identified the write -ins. The Functional Examiner concluded that the system is in compliance with 25 P.S. § 3031.7(5) since applicable components of the Verity Voting 2.3.4 allowed the voter to cast a write-in vote.		
25 P.S. § 3031.7(6)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity Central	System Level Testing (Primary and General Election)
Comments - Functional Examiner concluded that the system is in compliance with 25 P.S. § 3031.7(6) because the test used different ballot styles and the Examiner voted for candidates and questions. The Verity Touch Writer and Duo displayed only contests for which the voter was entitled to vote.		
25 P.S. § 3031.7(7)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan	System Level Testing (Primary and General Election)

Comments - Ballot marking devices Verity Touch Writer Duo and Touch Writer did not allow overvotes. Verity Scan has the capability to indicate overvotes for any office and the voter can either spoil the ballot or cast the ballot with overvotes if the voter decides to do so. The Functional Examiner also noted that the system allowed undervotes but warned the user about the undervote when configured to do so.		
25 P.S. § 3031.7(8)	Verity Scan, Verity Central	System Level Testing (Primary and General Election)
Comments - The successful validation of the election results shows that central scanning solution Verity Central, as well as precinct tabulator Verity Scan, include the capability to reject all choices recorded on the ballot for an office or question if the number of choices exceeds the number for which the voter is entitled to vote, adhering to 25 P.S. § 3031.7(8). The Functional Examiner also noted that Hart Verity Voting 2.3.4 voting system does not fully support Cumulative voting.		
25 P.S. § 3031.7(9)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity	System Level Testing (Primary Election)
Comments - The Functional Examiner validated that voters were able to vote for candidates seeking nomination from their party and referendum questions. non-partisan ballots contained only referendum questions.		

25 P.S. § 3031.7(10)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan	System Level Testing Primary and General Election)

Comments -

Verity Touch Writer and Duo allowed the voters to review their ballots before printing for tabulation on precinct scanner Verity Scan or central scanning solution Verity Central. The Functional Examiner attempted to change votes on Verity Touch Writer and Duo for candidates within the contest, as well as after leaving the contest and then returning to other contests and while reviewing the summary screen. The tests demonstrated that Verity Touch Writer Duo allowed changing the selections until the voter decides to print or cast the ballot. The Verity Scan precinct scanner provides the voter with a warning when the ballot contains potential errors, such as the presence of overvotes. The voter can either decide to affirm their intent by casting the ballot, or they can spoil the ballot and fill out another ballot.

25 P.S. § 3031.7(11)	Verity Voting 2.3.4 voting system	Documentation Review, System Level Testing

Comments -

Accuracy requirements of 25 P.S. § 3031.7(11) were ascertained by the successful tabulation and validation of the primary and general elections run by the Functional Examiner and the accuracy tests conducted during the EAC testing.

Examiner reviewed the draft EAC certification report and verified that the system was subjected to, and passed, bench handling, vibration, low temperature, high temperature, and humidity testing during its federal testing and concluded that the design requirements of 25 P.S. § 3031.7(11) are also met.

25 P.S. § 3031.7(12)	Verity Touch Writer, Verity Touch Writer Duo, Verity Scan, Verity	Security/Penetration Analysis
Comments - The precinct tabulation devices and ballot marking devices were configured for delivery to a polling place from a warehouse; this included all seals and locks recommended by the manufacturer. The central count was configured as set for operation in a county office. The devices were inspected for the ability to be tampered with. The inspection examined the ports, the outer case, and memory devices from the aspect of the device as delivered to the polling place and configured for voting. The Functional Examiner then performed an inspection of the devices and concluded that this requirement was satisfactorily met. The Functional Examiner also reviewed the system documentation to evaluate the adequacy of the vendor suggested ballot security procedures.		
25 P.S. § 3031.7(13)	All components of Verity Voting 2.3.4	Documentation Review, System Level Testing
Comments - The Functional Examiner concluded that the requirement is met since the system completed EAC accuracy testing and the results for the primary and general election run reconciled with expected results.		
25 P.S. § 3031.7(14)	All components of the Verity Voting 2.3.4	Documentation review
Comments – The Functional Examiner concluded that the design requirements are met by the combination of EAC hardware Non-Operating Environmental Tests, which included bench handling,		

vibration, low temperature, high temperature, humidity and product safety tests. The system accuracy testing during EAC certification testing provided confirmation of system accuracy.		
25 P.S. § 3031.7(15)	All components of the Verity Voting 2.3.4	Documentation review
Comments – The system summative usability test reports were accepted by the EAC as part of the Federal Certification. This, along with the Functional Examiner's use of the system, demonstrates that the system can be readily learned and hence satisfied the usability requirements 25 P.S. § 3031.7(15).		
25 P.S. § 3031.7(16)(i)	Verity Scan	Security/Penetration Analysis
Comments – This examination consisted of a review of manufacturer documentation for Verity Scan that details the presence has a public counter, and that it is visible. It was then validated that the device has a public counter as described in the documented and increments by one with each ballot cast. The Functional Examiner determined that this requirement was satisfactorily met.		
25 P.S. § 3031.7(16)(ii)	Verity Scan	Security/Penetration Analysis
Comments – This examination consisted of a physical inspection that that Verity Scan provides a lock by the use of which all operation of the tabulation element of the automatic tabulating equipment is absolutely prevented immediately after the polls are closed or where the tabulation of votes is completed. The inspection determined this requirement was satisfactorily met.		
25 P.S. § 3031.7(16)(iii)	Verity Scan	Security Penetration Analysis

Comments –

This examination consisted of a physical inspection that while polls are open, the Verity Scan does not allow any tampering of the tabulating element. The Functional Examiner verified that

- USB ports do not allow any data/information onto Verity Scan
- No Maintenance accessible screens allow tampering of tabulating element
- No Poll worker accessible screens allow tampering of tabulating element
- No Administrator accessible screens allow tampering of tabulating element

The Examiner concluded that the inspection determined that this requirement was satisfactorily met.

25 P.S. § 3031.7(16)(iv)	Verity Scan, Verity Touch Writer and Touch Writer Duo	System Level Testing

Comments –

Verity Scan - Examiner attempted to scan overvoted ballots and verified that the device issued a warning to the voter. The system allowed the voter to choose to cast their ballot with overvotes if the voter so chose. The voter could also decide to spoil the ballot and mark a new ballot. The scanner also tabulated the votes appropriately and did not count any votes in an overvoted contest. The tests determined that the system is in compliance with 25 P.S. § 3031.7(16)(iv).

In addition, ballot marking devices Verity Touch Writer and Verity Touch Writer Duo did not allow the voter to overvote. Under voted contests were warned to the voter but were allowed. Verity Scan also tabulated votes appropriately with under voted contests counting a valid vote for the voter's choice.

25 P.S. § 3031.7(16)(v)	Verity Scan	System Level Testing, Security/Penetration Analysis

Comments –

The Functional Examiner validated via test cases during the primary and general election that the tabulating devices Verity Scan generated zero proof reports before the ballots were cast and did not allow generating a zero-proof report once ballots were cast. The Examiner validated that polls cannot be opened without running the zero-proof report and the zero report shows that the counter for each candidate and question on the ballot showed zero. The public counter also showed zero since there were no ballots cast prior to the test runs.

25 P.S. § 3031.7(17)(i)	Verity Central	Security/Penetration Analysis

Comments –

This examination consisted of a physical inspection with each operator role within the Tabulator application to confirm that they do not have the capability to tamper, in any way, with the tabulating element during the course of its operation.

Unauthorized user of device (in any capacity)

- Voter
- Poll worker
- Maintenance provider
- Election Official

Authorized user of device (in all capacities)

- Voter
- Poll worker
- Maintenance provider
- Election Official

25 P.S. § 3031.7(17)(ii)	Verity Central	System Level Testing
Comments – Verity Central tabulated ballots correctly in an overvote situation, by not counting votes for any contestant in a contest if overvotes are present.		
25 P.S. § 3031.7(17)(iii)	Verity Central	System Level Testing
Comments – The Functional Examiner set up Verity Central environment as prescribed in Hart Verity Voting 2.3.4 documentation, powered up, poll opening was performed, producing a zero report to verify all memory registers were empty and no votes were yet cast.		
25 P.S. § 3031.7(17)(iv)	Verity Central	System Level Testing
Comments – Verity Central tabulated ballots correctly in an overvote situation, by not counting votes for any contestant in a contest if overvotes are present.		
25 P.S. § 3031.17	Verity Voting 2.3.4 voting system	NA
Comments – The Functional Examiner noted that the paper ballots will allow statistical recounts as required by Sections 1117-A, 25 P.S. § 3031.17.		

The Functional Examiner identified that the following within Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22. are

not applicable to the current examination, as each deal with non-functional testing aspects of acquisition, and use and maintenance aspects of a voting system:

- 25 P.S. § 3031.2;
- 25 P.S. § 3031.3;
- 25 P.S. § 3031.4;
- 25 P.S. § 3031.6;
- 25 P.S. § 3031.8;
- 25 P.S. § 3031.9;
- 25 P.S. § 3031.10;
- 25 P.S. § 3031.11;
- 25 P.S. § 3031.12;
- 25 P.S. § 3031.13;
- 25 P.S. § 3031.14;
- 25 P.S. § 3031.15;
- 25 P.S. § 3031.16;
- 25 P.S. § 3031.18;
- 25 P.S. § 3031.19;
- 25 P.S. § 3031.20;
- 25 P.S. § 3031.21; and
- 25 P.S. § 3031.22.

Verity Voting 2.3.4 Accessibility Examination

Verity Voting 2.3.4 Examiner Review

The Accessibility Examiner performed an expert review of the Touch Writer modifications with Hart representative navigating through the ballot. The Accessibility Examiner noted that implementing the scenarios for straight party voting are complex and suggested that the review looked for any actions taken by the system without confirmation by the voter and clarity of messages. The Accessibility Examiner noted that:

- The message that appears if a voter tries to deselect all candidates clearly states the reason why the system will not allow the deselection and offers information about the option to remove the straight-party selection.

- If a voter returns to the straight party option and changes or removes their selection, there is no message about the impact of this change and any contests with selections controlled by the straight party logic are changed without a detailed notification. However, the voter has the opportunity to review their selections either navigating contest by contest or on the review screen and can make changes and selections before printing and casting their ballot.

The Examiner recommended comprehensive voter education, hands-on practice in advance of the election, and good training for poll workers so they can effectively help voters. The Accessibility Examiner noted that the decision to use the straight-party voting option is a personal one, but voters who plan to use this option will be better supported in the transition to a new voting system with the ability to learn how it works before Election Day. Hands-on practice opportunities are the best way for voters to be sure they understand how the system works in a setting where they can ask questions and try different interactions.

The Accessibility Examiner also suggested future system updates to the manufacturer that will make the interactions clearer in situations where a voter decides to remove a straight party selection after they have begum marking the rest of the ballot. The Accessibility Examiner noted that ballots looking similar to hand marked paper ballot with bubbles cannot be effectively verified by voters who cannot read paper directly because personal print reading tools cannot interpret the selection marks. For this reason, it is important that the marking and review interfaces support voters in confirming that the ballot selections to be printed reflect their intent.

Verity Voting 2.3.3 Accessibility Examination

The tests included examiner review, sessions with voters and poll workers. A summary of the test details and findings is discussed in this section.

Examiner Review

The Accessibility Examiner conducted a review of the voting system under examination prior to sessions with voters and poll workers. The Accessibility Examination

team included both accessibility and usability expertise to ensure background and knowledge of the issues for accessible voting. The Accessibility Examiner has experience working with people with a wide variety of disabilities and understanding the impact of their disabilities on their daily life. In addition, the Accessibility Examiner possesses knowledge of the range and use of assistive technologies that voters with disabilities might rely on for access. The Accessibility Examiner also has experience conducting usability evaluations with voters and possesses a strong knowledge of best practices and design principles for digital technology and voting systems. The expert review by the Accessibility Examiner provided a chance to make sure the voters and poll workers understand how the system and accessibility features work and to note anything that could inform preparation for other testing.

Voter Sessions

The following voter population was represented in the test sessions:

- 4 blind from birth
- 1 blind, slow audio processing, and limited daily assistive technology use
- 1 with late onset blindness
- 1 with late onset very low vision
- 1 with dexterity limitations
- 1 with moderate cognitive disability with low literacy
- 3 in wheelchairs and limited arm and hand movement
- 1 in a wheelchair and limited reach
- 1 age related sensory degradation

Age Ranges: 22 thru 73.

Counties: Allegheny, Dauphin, Lebanon, Philadelphia, York

The voters had a range of voting habits. Two voters had never voted before but were encouraged by the new systems. One blind voter has been a poll worker in his precinct for a number of years. He helps reset the Danaher ELECTronic 1242 for each new voter.

The Accessibility examiner noted that they did not perceive any limitations in this diverse group of voters. While there was no representation from the deaf community, the systems do not require sound to operate.

Poll worker Sessions

Poll workers were invited to come in teams. We had a total of four participants across two sessions and represented Dauphin county. The poll worker groups:

- Had between five and twenty-six years of experience.
- Had at least one election judge
- Were experienced with the Danaher ELECTronic 1242 system.
- Had mostly limited experience serving voters with disabilities.
- Unique facts about the poll worker groups.
- Two poll workers had blind family members
- One poll worker was blind
- Two poll workers had recently moved to a different precinct, so their Election Day roles may change.

The accessibility examiner noted that poll workers with a wider range of voting system experience and different sized communities would be more beneficial for the testing effort.

The accessibility examiner compiled the findings from the examiner review, voter sessions and poll worker sessions into positives, annoyances, problem solving, needs assistance and likely to prevent independent voting for voters with some disabilities. The Accessibility Examiner included recommendations for improving the accessible voting experience with each of the top five accessibility issues identified. The report also included recommendations on how election officials can support voters and poll workers when the new system is fielded. This section reflects the summarized findings of the top positives and most significant issues identified, and the Accessibility Examiner's analysis and recommendations. Attachment B of this document lists these issues in fuller detail and also

describes all the observations from the Accessibility Examination.

The top accessibility issues identified by the Accessibility Examiner and voters are summarized in the following section. The Department further evaluated each of the findings and recommendations from the Accessibility Examiner and included the appropriate fielding recommendations as conditions for certification of the system[1]. The Department also discussed the findings from the Accessibility testing, specifically the ones that were marked as "Likely to prevent independent voting for voters with some disabilities" to ensure that appropriate fielding recommendations would alleviate the concerns for most voters.

Top Issues

Silent/Hidden selection and deselection

The Pennsylvania Straight Party method rules add confusion to the process of marking the ballot when a voter opts to make manual selections after selecting a party:

- When changing a straight party vote in a contest, selecting any other option cleared all pre-marked, straight party choices. These candidates could be deselected off screen and out of the voter's view, without any system alert, or any alert when using the audio assistance.
- Voters trying to deselect a candidate were confused when they had to select a candidate twice to deselect them – first to switch into manual selection (selecting that candidate) and then to deselect the candidates.

Audio quality and instructions

- Voters reported the audio instructions and information as long, wordy, and, in places, repetitive.
- Some repeated information is unhelpful – for example the number of contests on the ballot - and voters suggested that it could be replaced – for example with the number of candidates in the current contest.

[1] Refer to conditions in this report with identification numbers O, P, Q, AA, BB, and EE which relate to the accessibility issues found during the examination findings.

- The recording quality and pauses between phrases slowed down voters and created some confusion.
- The top speed for the audio was too slow for some voters. The jerky quality of the audio at the top speed made it hard to understand, even for people used to very fast audio.
- The opening tutorial was too long for most voters who tried it, with no obvious way to jump from the middle of the tutorial to voting.

Touchscreen display issues

- The blue border that highlights the currently focused control buttons at the top and bottom of the screen while using the assistive devices does not provide sufficient contrast when applied to a dark background and voters found it difficult to tell which button was active.
- When voters use the large text size, information about how many candidates to vote for and all voting instructions disappears.
- The angle of the touchscreen cannot be changed, which can result in glare from overhead lighting.

Top Positives

The top positives identified by Accessibility Examiner and voters are summarized below. A full list of the findings for Accessibility Examination is added as Attachment B to this document.

Independent and private voting - All voters were able to learn the system quickly and complete their ballots independently, once the facilitator provided them with the appropriate accessibility features. No one found the system so difficult or frustrating that they were unable to vote, and most stated that the system would help other voters with disabilities as well. The system had good privacy measures and voters also agreed that their experience in a typical voting session would be relatively private on this machine.

Access features easily learned and helpful - As voters explored the access features, they seemed to learn them relatively easily. Most of the voters use similar assistive devices daily or when they currently vote. All voters found the default text size to be sufficient. Our participant voters all had either normal vision or no usable vision. The single voter with low vision chose not to try to read the screen with large print and used the audio feedback instead. For voters with low vision, the range from normal to large text was great enough that those with usable, but limited vision should be able to use the screen without difficulty. The MOVE wheel is unique to the Hart systems, and it was generally well received.

Helpful alerts and candidate selections language - The system alerts and messages are generally good, and voters did not react negatively to any of them. Accessibility examiner noted that there were opportunities for improvement in Hart's straight party implementation, text size changes, and cursor visibility when using assistive devices.

Consistent behaviors and easy navigation - The system navigation and screen behaviors were good and consistent during the entire voting experience. Voters did not report any confusion when switching selecting or deselecting buttons or when navigating through the ballot. For tactile keypad users, the order in which the system selected navigational and system settings buttons required learning but was consistent throughout.

The Accessibility Examiner included a special discussion about the following items in the report to the Secretary. For a detailed explanation and analysis of each of the items refer to Attachment B.

Paper ballot handling and the ballot scanner

- Voters who are blind, low vision, or have dexterity issues will require assistance scanning their ballot. Poll workers should have ballot privacy sleeves and good training to maintain voter privacy.

- Verifying a paper ballot can also be a barrier for blind and low vision voters. Blind voters had issues reading the ballot from Touch Writer Duo using their personal assistive devices since the ballot text is small and not laid out well for visual review. The layout also makes it difficult to read with a personal OCR tool. Although each word could be scanned, the office names were not clearly associated with the candidate names.

MOVE wheel on the tactile device

- The Accessibility examiner noted that some voters had difficulty holding the tactile device because there was not a place to lay it on the machine or voting booth, and it was not possible to rest it in their laps.
- Because the MOVE wheel is so easy to turn, some voters with low dexterity accidentally move it while trying to press the select button. The MOVE wheel's easy movement and the delayed audio makes it possible for voters to overshoot their selection.

Voter session preferences and tutorial

- The system gives the voters accessible device options and then guides them through a brief tutorial about how to use the MOVE wheel to make selections.
- The Accessibility Examiner's reactions to the system's preferences and tutorial options are mixed because voter's reactions were mixed.
    - One blind voter liked the tutorial and thought it would be beneficial to others.
    - Other voters using the audio, screen, and wheel didn't have much of a reaction until the tutorial, where they seemed confused on what the system was asking them to do.
    - The assistive tech savvy voters, especially blind voters, all wanted to skip it and move on.

The Accessibility Examiner concluded that the idea of the voter's preferences and tutorial is good, and it could be very beneficial to first-time assistive technology users if

redesigned slightly and suggested design recommendations. Refer to Attachment B for detailed analysis and the design suggestions to the vendor and election officials.

The Accessibility Examiner noted that both voters and poll workers stressed the need for a strong education program to introduce new systems, including opportunities for hands-on training or practice both as a new system is rolled out and at the polling location.

Verity Voting 2.3.3/Verity Voting 2.3.4 Security Examination

The Security testing was completed on Verity Voting 2.3.3 voting system. Security tests were designed and executed to address election confidentiality, integrity, and availability. When applicable, some reviews were reinforced by equivalent test results that were achieved as part of an EAC certification test campaign.

Tests were also done to PA Test Specifications and included requirements for the following security categories:

- Documentation Review
- Design
- Software Security - Access Control
- Network
- Audit Logging
- Physical Security
- Penetration Testing

The Security Examiner's report included evidence of conformity and notes from the SLI personnel who performed the tests. The security examiner also provided the risk assessment and deficiencies identified during the testing categorized into documentation, hardware and functional discrepancies. The security examiner further provided mitigation steps for each of the deficiencies and the Department included those as conditions for the certification.

D. Results

After all the testing activities, the Examiners and Department concluded that the Verity Voting 2.3.4 demonstrates compliance with all requirements as delineated in Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22.

E. Observations

During the examination, and in the review of documentation, the Examiner and/or Department staff noted the following observations:

1. Verity Voting 2.3.4 does not fully support cumulative voting.

2. The configuration of the system complying with the Pennsylvania Election Code requirements, including the PA method, will require the use of appropriate selections of configurable parameters.

3. Observations/Findings identified during the Accessibility Examination identified in Attachment B.

4. The ADA compliant ballot marking devices Verity Touch Writer Duo and Touch Writer presented as part of the Verity Voting 2.3.4 system, could be effectively used by all voters. This allows jurisdictions to expand the use of these devices for a larger universe of voters and not restrict their use to voters using assistive devices.

5. Verity Scan precinct scanner can only be configured to accept either Touch Writer Duo or hand marked/ Touch Writer paper ballots. Hence the same device cannot be used at the polling place to accept both optical scan and Duo ballots. Jurisdictions implementing a polling place where voters can choose between hand marked paper ballots and Verity Touch Writer Duo ballot marking device will need multiple precinct scanners if all ballots need to be scanned at the polling place.

6. Verity Voting 2.3.4 allows ballots to be configured to include unique ballot identifiers and ballot numbers. The system allows a human readable and bar code version of the identified to be printed on the ballot.

IV. Conditions for Certification

Given the results of the examination that occurred in January and February 2019 and the findings of the Examiners as set forth in their reports, **the Secretary of the Commonwealth certifies the Verity Voting 2.3.4 subject to the following conditions:**

A. Pennsylvania counties using the Verity Voting 2.3.4 must comply with the Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011, and any future revisions or directives. In particular, Pennsylvania counties must adhere to item four (4) of the directive when setting up and positioning the Verity Touch Writer Duo in the polling place to assure compliance with the constitutional and statutory requirements that secrecy in voting be preserved *(see* Pa. Const Art. VII § 4; and Section 1107-A(l) of the Election Code, 25 P.S. § 3031.7(1)).

B. No components of the Verity Voting 2.3.4 voting system shall be connected to any modem or network interface, including the Internet, at any time, except when a standalone local area wired network configuration in which all connected devices are certified voting system components. Transmission of unofficial results can be accomplished by writing results to media and moving the media to a different computer that may be connected to a network. Any wireless access points in the distinct components of Verity Voting 2.3.4, including wireless LAN cards, network adapters, etc. must be uninstalled or disabled prior to delivery or upon delivery of the voting equipment to a county board of elections.

C. Because Verity Voting 2.3.4 is a paper-based system, counties using the Verity Voting 2.3.4 must comply at a minimum with Section 1117-A of the Election Code, 25 P.S. § 3031.17, that requires a "statistical recount of a random sample of ballots after each election using manual, mechanical or electronic devices of a type different than those used for the specific election." This audit must be conducted via a manual count of the voter marked paper ballots exclusively. Counties must include in the sample ballots such samples as may be marked by ADA compliant components. Counties are advised to consult the

Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011 and any future revisions or directives that may apply to audits of electronic voting systems.

D. All jurisdictions implementing the Verity Voting 2.3.4 need to carry out a full Logic and Accuracy test on each device without fail and maintain evidence of Logic and Accuracy (L&A) testing in accordance with the statutory requirements for pre-election and post-election testing. The Department does not recommend automated L&A testing and discourages the use of preprinted ballots provided by vendors. All components being used on election day, including accessible devices and any Electronic Poll Books being used, must be part of the L&A testing. Counties must ensure that the L&A test includes all ballot styles and the test cases include all applicable scenarios of PA straight party method identified in Attachment C to the Directive for electronic voting systems published by BCEL on September 11, 2017. Jurisdictions must also include test cases to invoke the configured warnings during election definition during L&A testing.

E. Verity Voting 2.3.4 is a paper-based system, and hence, implementation of the system for precinct or central count scanning is scalable. Jurisdictions should calculate the number of voting booths and ballot marking devices necessary to accommodate the number of registered voters in a precinct to avoid long lines. Jurisdictions must include the Verity Touch Writer or the Verity Touch Writer Duo as an ADA compliant device in configuring a precinct polling place. Jurisdictions must also take into consideration the ballot box capacities on polling place components when deciding on the number of voting booths. Information on machine through put is available in VI. Conclusion.

F. All jurisdictions implementing the Verity Voting 2.3.4 must implement administrative safeguards and proper chain of custody to facilitate the safety and security of electronic systems pursuant to the Guidance on electronic Voting System Preparation and Security, September 2016.

G. Jurisdictions implementing the Verity Voting 2.3.4 with the Central Count

Tabulator as the primary system where votes are counted only at the central counting location using central scanners, must comply with Section 301(a) of Help America Vote Act of 2002. The mandate requires counties using central count paper-based systems to develop voting system specific voter education programs that inform voters of the effect of over voting and instruct voters on how to correct a ballot before it is cast, including instructions on obtaining a replacement ballot. Additionally, the mandate requires that the central count voting system must be designed to preserve voter confidentiality.

H. All jurisdictions implementing the Verity Voting 2.3.4 must ensure that no default passwords are used on any devices including COTS components and that all passwords are complex and secured. Counties must implement an audit process to review and ensure that no default passwords are used upon equipment install/reinstall and routinely change passwords (at least once prior to preparing for each primary and election) to avoid any password compromise. The passwords and permissions management must at a minimum comply to the password requirements outlined in NIST 800-63. This publication can be accessed at https://pages.nist.gov/800-63-3/sp800-63-3.html

I. All jurisdictions implementing Verity Voting 2.3.4 must configure the polling place components of the voting system to notify voters when they attempt to cast overvotes. This is to ensure that the system implementation adheres to the requirement of notifying the voter of overvotes as mandated by 25 P.S. § 3031.7(16).

J. All jurisdictions implementing Verity Voting 2.3.4 must work with Hart to ensure that only the certified system configuration is installed upon purchase and acceptance or any time a system component is replaced or upgraded. Jurisdictions must as part of their user acceptance test verify the implementation to ensure that the components, software and firmware belong to the certified system. Jurisdictions must also perform a trusted build validation as part of the election preparation activities and post-election canvass activities utilizing the vendor supplied methods of validation and verification of voting system integrity. A sample format that can be used for the attestation is added Attachment C to this document.

K. The direct recording components of Verity Voting 2.3.4 voting system, Verity

Touch and Verity Touch with access identified as system components per the EAC certification scope, is not certified for use in Pennsylvania with Verity Voting 2.3.4. This software was not presented to the Secretary for certification by Hart.

L. Jurisdictions implementing Verity Voting 2.3.4 must work with Hart to ensure that the implemented configuration is capable of operating for a period of at least two hours on backup power as required by the VVSG. If the system components don't include internal battery packs for reliable power, the Uninterruptible Power Supply (UPS) specified in the EAC certified configuration must be purchased and used at the polling places.

M. Jurisdictions using the services of Hart or a third-party vendor for election preparation activities must work with Hart or the vendor to ensure that systems used for ballot definition activities are considered part of the voting system and use certified voting system components. The systems used for ballot definition must be configured securely following conditions outlined in this report and following any Directives and Guidance issued by the Secretary. Any data transfer between the vendor and county must be done using encrypted physical media or secure file transfer process. The file transfer and download must be tracked and audited to make sure that data has not been accessed by unauthorized personnel.

N. Jurisdictions implementing Verity Voting 2.3.4 must implement the use of privacy sleeves to be used by voters carrying marked ballots between the ballot marking device and Verity Scan precinct scanner.

O. Jurisdictions must work with Hart to thoroughly test and review the audio ballot instructions to ensure that the voters using an audio ballot can cast the ballot without requesting assistance.

P. Jurisdictions implementing Harty Verity Voting 2.3.4 must

- Work with vendor to make sure that the audio ballot uses at the most two different voices, one for instructions and one for ballot information. If the vendor can support one voice for instructions and ballot information that

would be ideal.

- Ensure that ballot instructions are as concise as possible and include only as much information as necessary, since voters will be hearing it each time a contest is selected.

- Trim recorded files as tightly as possible so that there is no lead-in or trailing silence at the beginning of each recording.

Q. Jurisdictions implementing Harty Verity Voting 2.3.4 must ensure that the audio cue made by the Verity Scan is at an audible range for voters. The volume of the cue was noted by the accessibility examiner to be not loud enough causing some voters to miss it.

R. Jurisdictions must make voters aware that voting straight party is optional via clear instructions on paper, on screen and on audio ballots. This is to ensure that the voter doesn't assume that he/she must make a selection for the straight party contest. The ballot instructions must be approved by the Department and follow any directives and/or guidance issued by the Department.

S. The electronic voting system must be physically secured while in transit, storage, or while in use at their respective locations. Unmonitored physical access to devices can lead to compromise, tampering, and/or planned attacks.

T. Jurisdictions must implement processes and procedures involving management, monitoring and verification of seals, locks/keys, before, during and after the election.

U. Jurisdictions must seal any unused ports on the voting system components using tamper evident seals even if the port is inside a locked compartment. Jurisdictions must work with Hart and use physical port blocking plugs to close unused ports whenever possible before placing the tamper evident seal. The Department also recommends using port blocking plugs for exposed ports for all components of the voting system housed in

county office that can be removed by authorized personnel when the port is needed.

V. Jurisdictions must protect installations of the EMS server on portable devices must protect the laptops to prevent lost or stolen device.

W. Jurisdictions must implement processes to gather and safekeep system logs for each component of the voting system after each election. Consistent auditing of system logs and reports is vital to maintain system transparency and to ensure that any compromise or malfunction is observed and reported in a timely manner.

X. Jurisdictions implementing Verity Voting 2.3.4 must ensure that the USB devices and any other removable media used for election activities are maintained with a strict chain of custody. There must be a process to manage the removable media inventory to avoid misplaced and lost media. The devices must be reformatted before use in each election. Appropriate steps must be taken to ensure that the format is a full reformat of the USB devices.

Y. Jurisdictions implementing Verity Voting 2.3.4 must ensure that poll worker training emphasizes the need for maintaining the strict chain of custody on USB devices (verity keys and vDrives) used at the polling place. County election officials must include processes to ensure that all supplied media is returned at the end of the election day.

Z. Jurisdictions implementing Verity Voting 2.3.4 must work with Hart to ensure appropriate levels of training for election officials are planned on implementation. Counties must ensure that the trainings adhere to the “Minimum Training Requirements” specified in Attachment D of this document.

AA. Jurisdictions implementing Verity Voting 2.3.4 must include voter and poll worker training as part of the implementation plan. The training must include hands on practice for both voters and poll workers. Specific consideration must be given to voters using assistive devices and poll worker education to assist voters with disabilities. The poll workers must be trained about system behaviors, especially the PA straight party method implementation on the voting system. Voters must be informed about the straight party

behavior through public information campaigns, systems demonstration and election day signage. Refer to Attachment B, listing detailed recommendations for training during deployment noted by the Accessibility Examiner.

BB. Jurisdictions implementing Hart Verity Voting 2.3.4 must train poll workers to assist voters in ways that do not compromise the voter's privacy. This might include having standard instructions for poll workers to use to guide a voter in casting their own ballot or narrating the poll worker's actions so that the voter understands what the poll worker is doing. Refer to Attachment B, listing detailed recommendations for training during deployment noted by the Accessibility Examiner.

CC. Jurisdictions implementing Verity Voting 2.3.4 must work with Hart during ballot definition activities to ensure that the ballots do not contain any unique identifiers in the bar code or human readable form that would enable someone to link a voted ballot to a specific voter.

DD. The full implementation of Hart Verity Voting 2.3.4 system includes use of COTS components. Jurisdictions must ensure that the COTS components are also considered as voting system components and must not use them for any other purpose while being stored between elections. Any changes to the COTS components including but not limited to firmware upgrades patching etc. must be completed by the voting system manufacturer or per instructions by the voting system manufacturer. Jurisdictions must also work with Hart in the event they need to replace a COTS component that is part of the voting system. Jurisdictions must be aware that the system certification includes specific versions of all the hardware and software components and any changes will violate the integrity of the voting system.

EE. Jurisdictions implementing Verity Voting 2.3.4must consider the following during voting booth set up for serving voters requiring assistive devices

- Voters with disabilities may have assistive technology that they use in their daily life which may need to be brought to the polling place. These

technology/devices must be allowed at the polling place. The voting booth set up must account for the requirements to keep the assistive technology or personal notes that they need to place within reach. They may also need room to place the printed ballot on a flat surface to use personal technology such as magnifiers or text readers to verify it.

- The path to the Verity Scan precinct scanner should be as easy as possible, ideally a straight line with no obstructions. The path should include ample room to turn a wheelchair if the machine is positioned with the screen facing the wall. The ADA standards suggest a minimum of 60x60 inches for this.

- The cord used to connect the tactile keypad must not interfere with the voter's ability to find and take their printed ballot.

- The voting booth must be set up so the voter's back is to a wall, so no one can walk behind them and with sufficient space to the left and right. The set up must ensure that there is a good path for a manual or motorized wheelchair to get to the voting booth easily and the system is not too far back and that it is within reaching distance for those in a manual or power wheelchair.

Refer to Attachment B, listing detailed recommendations for deployment noted by the Accessibility Examiner.

FF. Jurisdictions can make use of the adjudication functionality to adjudicate write-ins and evaluate questionable ballots, contests or selections to determine voter intent. Any decisions made during review of the ballot must be agreed upon by a team of at least two reviewers authorized by the election official. The election official can also consult the paper ballot to assist with determinations made during adjudication. In the event of a recount, the voter verified paper ballots must be used for the count.

GG. Hart must ensure that the COTS printer used for Touch Writer (OKI B431D/B432DN) must be configured to ensure that the printer settings cannot be changed by the voter at the polling place. The configuration must ensure that the printer settings can

only be modified by authorized personnel.

HH. Hart must work with the jurisdictions implementing Verity voting 2.3.4 to ensure that the system has been hardened for a secure implementation. Jurisdictions must implement processes to ensure that all components of the voting system have been hardened per the instructions in the TDP. Jurisdictions must ensure that all county office components of the voting system are appropriately labelled and sealed to enable prevention and detection of unauthorized access.

II. Hart must submit the following system education materials to the Department of State and must consent to the publication and use of the video on any websites hosted by any Pennsylvania counties and the Pennsylvania Secretary of the Commonwealth or publicly available social media platform. The videos must be closed captioned for the visually impaired.

- A video (in an electronic format) for voters that demonstrates how to cast a vote and ballot using the Voting System.
- A video (in an electronic format) for precinct election officials that demonstrates how to setup, operate, and shutdown the Voting System components on an Election Day. The video must demonstrate how to set up and operate the voting system accessible devices for use by voters.
- A "quick reference guide" for precinct election officials to consult on Election Day. The guide must be specific to the purchasing county's setup and use of the Voting System including accessible options.
- A "quick reference guide" with images that demonstrates to voters how to cast a vote. Must be provided in additional languages for any jurisdictions required to meet thresholds in the Voting Rights Act.

JJ. Hart must adhere to the following reporting requirements and submit the following to the Secretary:

- Equipment Reporting. Reported field issues or anomalies that occur in Pennsylvania or elsewhere with any piece of equipment deployed in the Commonwealth of Pennsylvania within 3 days of the occurrence;

- Advisory Notices. System advisory notices issued for any piece of equipment deployed in the Commonwealth of Pennsylvania regardless of whether the incident behind the notice occurred in Pennsylvania;

- Ownership, Financing, Employees, Hosting Location. Any changes to information on the Supplier's employees and affiliates, locations, company size and ability to provide technical support simultaneously to several counties in the Commonwealth of Pennsylvania and other jurisdictions that use its Voting System. Additionally, Hart must provide information on foreign ownership/financing, data hosting, and production for any equipment or ancillary products, including any potential conflict of interest that may have developed for employees and affiliates;

- Security Measures and any updated security testing or risk/vulnerability assessments conducted by the Supplier or a third-party;

- SOC 2 Reporting – Hart shall provide the Secretary with its annual American Institute of Certified Public Accountants (AICPA) Attestation Standard (AT) Sec. 101 Service Organization Control ("SOC") 2, Type 2 certification (AT Sec. 101 SOC 2, Type 2), or an equivalent certification approved by the Commonwealth. Equivalent certifications include, but are not limited to: International Organization of Standards (ISO) 2700x certification; certification under the Federal Information Security Management Act (FISMA); and AT Sec. 101 SOC 3 (SysTrust/WebTrust) certification.

KK. Hart must adhere to the "Source Code and Escrow Items Obligations" specified in Attachment E of this document.

LL. Hart must work with jurisdictions to ensure that the system is configured to

comply with all applicable requirements of the Pennsylvania Election Code delineated in Section Article XI-A of the Pennsylvania Election Code, Sections 1101-A to 1122-A, 25 P.S. §§ 3031.1 – 3031.22.

MM. Jurisdictions implementing the Verity Voting 2.3.4 and Hart must work together to implement the system under this certification and must comply with the conditions found in this report, and any directives issued by the Secretary of the Commonwealth regarding the use of this System, in accordance with Section 1105-A(a)-(b) of the Election Code, 25 P.S. § 303l.5(a)-(b). Hart must ensure that future releases of the voting system with enhanced security and accessibility features are presented for approval to the Secretary.

NN. In addition, pursuant to the Directive on Electronic Voting Systems issued by the Secretary of the Commonwealth on August 8, 2006, the Directive Concerning the Use, Implementation and Operation of Electronic Voting Systems by the County Boards of Elections issued on June 9, 2011 and Section 1105-A(d) of the Pennsylvania Election Code, 25 P.S. § 3031.5(d), this certification and approval is valid only for Verity Voting 2.3.4. If the vendor or a County Board of Elections makes any changes to the Verity Voting 2.3.4 voting system subsequent to the date of its examination, it must immediately notify both the Pennsylvania Department of State and the relevant federal testing authority or laboratory, or their successors. Failure to do so may result in the decertification of the Verity Voting 2.3.4 voting system in the Commonwealth of Pennsylvania.

V. Recommendations

A. All jurisdictions implementing Verity Voting 2.3.4 voting System should ensure that the system is correctly set up pursuant to all the recommendations of the Directive Concerning the Use, Implementation and Operations of Electronic Voting Systems by the County Boards of Elections issued by the Secretary of the Commonwealth on June 9, 2011 and Guidance on Electronic Voting System Preparation and Security, September 2016.

B. All jurisdictions implementing the Verity Voting 2.3.4 should ensure that precinct election officials and poll workers receive appropriate training and are comfortable using the system.

C. All jurisdictions considering purchase of the Verity Voting 2.3.4should review the System Limits as mentioned in the EAC certification scope added as Attachment A to this report.

D. The Secretary recommends that Hart and counties work with the Department on any changes to their voting equipment including, but not limited to, purchase and upgrades.

E. Secretary recommends in-house ballot definition activities at a county location whenever possible. If an external vendor location is used, the county should implement oversight measures to ensure that election data including ballot definition files and audit logs stored on devices outside of the county are protected from unauthorized access.

VI. Conclusion

As a result of the examination, and after consultation with the Department's staff, counsel and the examiners, the Secretary of the Commonwealth concludes that the Verity Voting 2.3.4 can be safely used by voters at elections as provided in the Pennsylvania Election Code and meets all of the requirements set forth in the Election Code, **provided the voting system is implemented under the conditions listed in Section IV of this report.** Accordingly, the Secretary certifies Verity Voting 2.3.4 for use in this Commonwealth.

The Verity Touch Writer Duo ballot marking device can accommodate 15-20 voters with disabilities an hour or 30-60 voters an hour when used as the primary voting system depending on size of the ballot. Hart recommends one Touch Writer Duo device for every 250 voters when used as the primary voting device. Verity Scan precinct scanner is capable of scanning approximately 6-10 ballots a minute assuming continuous uninterrupted scanning depending on ballot length. The Verity Scan precinct scanner can serve 80-120 voters per hour based on ballot length. One Verity Scan can hold 9,999 cast voter records.

Attachment A – EAC Certification Scope

Cert. of
Conformance and S

United States Election Assistance Commission

Certificate of Conformance

Hart Verity Voting 2.3.4

The voting system identified on this certificate has been evaluated at an accredited voting system testing laboratory for conformance to the 2005 *Voluntary Voting System Guidelines (2005 VVSG)* . Components evaluated for this certification are detailed in the attached Scope of Certification document. This certificate applies only to the specific version and release of the product in its evaluated configuration. The evaluation has been verified by the EAC in accordance with the provisions of the EAC *Voting System Testing and Certification Program Manual* and the conclusions of the testing laboratory in the test report are consistent with the evidence adduced. This certificate is not an endorsement of the product by any agency of the U.S. Government and no warranty of the product is either expressed or implied.

Product Name: Verity Voting

Model or Version: 2.3.4

Name of VSTL: SLI Compliance

EAC Certification Number: HRT-VERITY-2.3.4

Date Issued: May 29, 2019

Executive Director
U.S. Election Assistance Commission

Scope of Certification Attached

Scope of Certification

This document describes the scope of the validation and certification of the system defined above. Any use, configuration changes, revision changes, additions or subtractions from the described system are not included in this evaluation.

Significance of EAC Certification

An EAC certification is an official recognition that a voting system (in a specific configuration or configurations) has been tested to and has met an identified set of Federal voting system standards. An EAC certification is **not**:

- An endorsement of a Manufacturer, voting system, or any of the system's components.
- A Federal warranty of the voting system or any of its components.
- A determination that a voting system, when fielded, will be operated in a manner that meets all HAVA requirements.
- A substitute for State or local certification and testing.
- A determination that the system is ready for use in an election.
- A determination that any particular component of a certified system is itself certified for use outside the certified configuration.

Representation of EAC Certification

Manufacturers may not represent or imply that a voting system is certified unless it has received a Certificate of Conformance for that system. Statements regarding EAC certification in brochures, on Web sites, on displays, and in advertising/sales literature must be made solely in reference to specific systems. Any action by a Manufacturer to suggest EAC endorsement of its product or organization is strictly prohibited and may result in a Manufacturer's suspension or other action pursuant to Federal civil and criminal law.

System Overview:

The **Hart Verity Voting 2.3.4** 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 2.3.4** functions include:

- Defining the political divisions 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 ballots for polling place and absentee voting or by mail voting.
- Preparing media for precinct voting devices and central count devices.

- Configuring and programming the **Verity Scan** digital scanners for marked paper ballots and print vote records.
- Configuring and programming the **Verity Controller** with **Verity Touch** and **Touch Writer Duo** devices.
- Configuring and programming the **Verity Print** on-demand ballot production device.
- Producing the election definition and auditing reports.
- Providing administrative management functions for user, database, networking and system management.
- Import 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.

Verity Scan is a digital scan precinct ballot counter (tabulator) that is used in conjunction with an external ballot box. The unit is designed to scan marked paper ballots or Verity Touch Writer Duo printed vote records, interpret and record voter marks on the marked paper ballot or record voter selections on the printed vote records, and deposit into the secure ballot box.

Verity Touch Writer is a standalone Ballot Marking Device (BMD) which also includes an Audio Tactile Interface (ATI). Touch Writer allows voters who cannot hand-mark a paper ballot to generate a machine-readable and human readable paper ballot, based on vote selections made through the accessible electronic interface.

The **Verity Touch Writer Duo** is a daisy chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch Writer Duo** BMD devices, which allows voters to utilize the touchscreen or optional Audio Tactile Interface to generate a machine-readable and human readable printed vote record, based on vote selections made.

The **Verity Touch** is a Direct Recording Electronic (DRE) device chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch** devices, which allow voters to cast their vote electronically via a touchscreen.

The **Verity Touch with Access** is a DRE device chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch** or **Touch with Access** devices, which allow voters to cast their vote electronically via a touchscreen or Audio Tactile Interface (ATI).

Verity Print is an on-demand ballot production device for unmarked paper ballots.

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 Desktop enables users, 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 Data provides the user with controls for entering and proofing data and audio. **Verity Data** also performs validation on the exported information to ensure that it will successfully import into **Verity Build**.

Verity Build opens the election to proof data, view reports, and print ballots, and allows for configuring and programming the **Verity Scan** digital scanners, and **Controller/Touch Writer Duo** BMD devices, **Verity Print**, **Verity Controller/Touch** series 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 custom **Hart-**developed ballot processing application software which resides on an attached work-station.

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.

Certified System before Modification (If applicable):

Verity Voting 2.3

Anomalies and/or Additions addressed in Verity Voting 2.3.4:

The modifications to Verity 2.3.4 address updates for **Verity Touch Writer** and **Verity Touch Writer Duo**, as requested by the State of Pennsylvania:

- Straight party deselection behavior on the electronic interface of Touch Writer and Touch Writer Duo
- Modifications to Touch Writer to inform the voter that they cannot create a situation where a straight-party preference is selected and a down-ballot contest on the paper ballot is left completely unmarked, that they would need to deselect their straight party preference.

Mark definition:

System supports marks that cover a minimum of 4% of the rectangular marking area.

Tested Marking Devices:

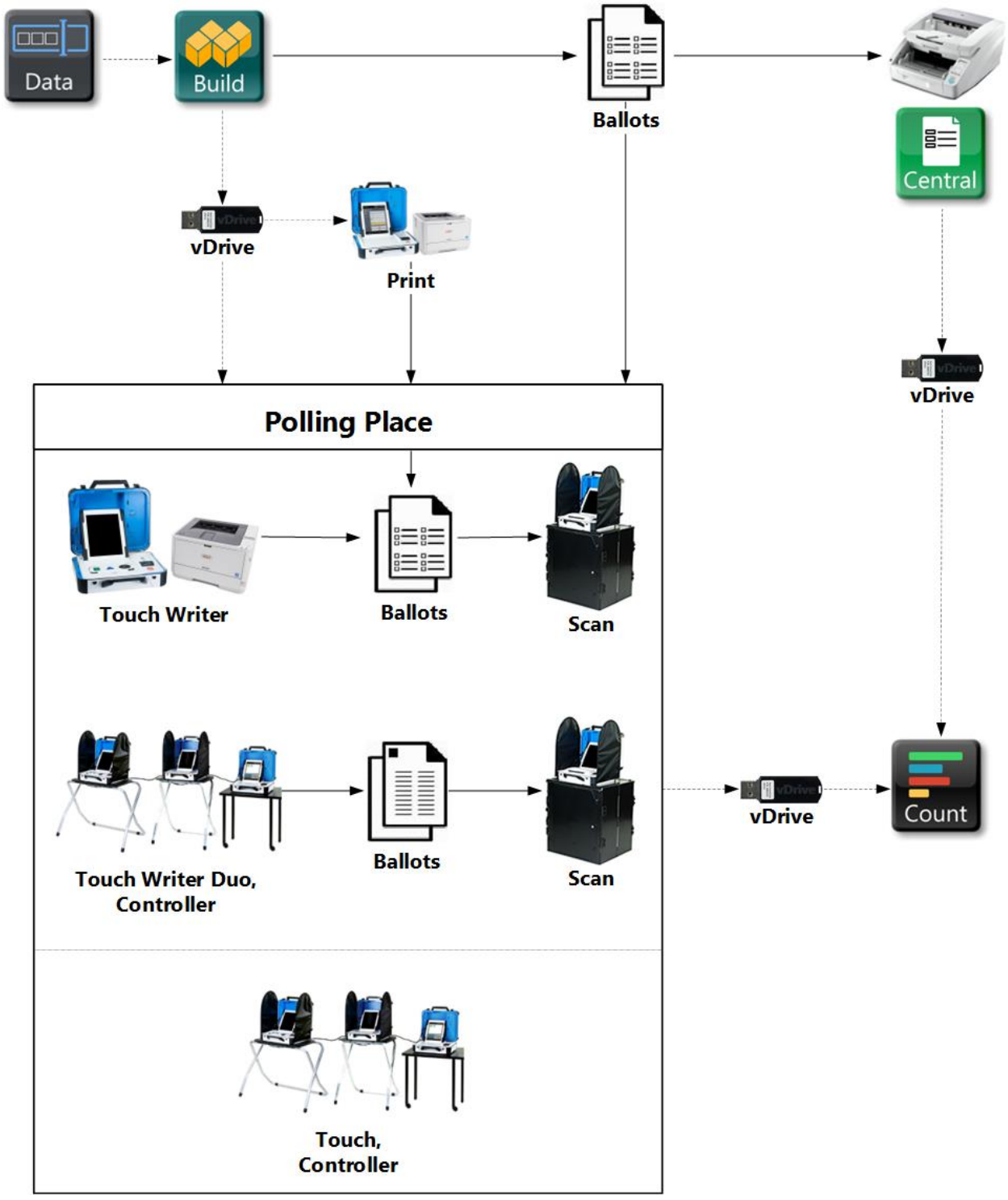
System supports Black and Blue ballpoint pens; testing was performed with black, blue, dark blue, pink, light green, green, orange, and red pens, as well as #2 pencil lead.

Language capability:

System supports English, Spanish, Chinese, Japanese, Korean, Khmer, Thai, Vietnamese, Tagalog, Ilocano, and Hindi.

Components Included:

This section provides information describing the components and revision level of the primary components included in this Certification.



System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comments
Verity Data	2.3.1			Data management software
Verity Build	2.3.1			Election definition software
Verity Central	2.3.1			High speed digital scanning software
Verity Count	2.3.1			Tabulation and reporting software
Verity Print	2.3.1			On-demand ballot printing device firmware
Verity Scan	2.3.1			Digital scanning device firmware
Verity Touch Writer	2.3.4			Ballot marking device
Verity Touch Writer Duo	2.3.3			Ballot marking device, with internal COTS ballot summary printer and optional audio tactile interface
Verity Controller	2.3.2			Polling place management device
Verity Touch	2.3.1			Direct Recording Electronic (DRE) voting device
Verity Touch with Access	2.3.1			Accessible DRE voting device, with audio tactile interface
Verity Device Microcontroller	V17			Firmware for Verity devices
Verity Touch Writer Duo Microcontroller	V1			Firmware for Verity Touch Writer Duo
Application control – Data/Build, Central, Count, Print, Scan, Touch Writer, Touch Writer Duo, Controller, Touch, Touch w/ Access	6.1.1.369		COTS: McAfee Application Control for Devices	Configured for Verity workstations and devices
Database- Data/Build, Central, Count	11.00.2100		COTS: Microsoft SQL Server 2012 for Embedded Systems	
Database - Print, Scan, Touch Writer, Touch Writer Duo, Controller, Touch, Touch w/ Access	11.00.2100		COTS: Microsoft SQL Server 2012 Express	
Verity Operating System – Data/Build, Central, Count, Print, Scan, Touch Writer, Touch Writer Duo,	6.1.7601		Microsoft Operating System	Microsoft Windows Embedded Standard 7 w/ service pack 1 – 64 bit

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comments
Controller, Touch, Touch w/ Access				
Verity Scan		Revision H		
Verity Scan – Update for scanner mechanism and tablet electronics obsolescence		Revision A		
Verity Print		Revision D		
Verity Touch Writer Duo		Revision A		
Verity Controller		Revision D		
Verity Controller – Update for tablet electronics obsolescence		Revision A		
Verity Touch		Revision D		
Verity Touch w/ Access		Revision E		
OKI Data	N22202A		B431d Printer Driver	Data/Build, Central, Count, Print, Touch Writer
OKI Data	N22500A		B432dn Printer Driver	Data/Build, Central, Count, Print, Touch Writer
OKI Data	N35100A		C831dn Printer Driver	Print
TWAIN Working Group	2.0.1		Twacker 32 Scanner Driver	Central
Canon	M111181		DR-G1100 Scanner Driver	Data/Build, Central
Canon	M111171		DR-G1130 Scanner Driver	Data/Build, Central
	1405-8GV3		8-port Ethernet Switch	Data/Build, Central, Count
Vinpower Digital USB Duplicator 7-targets	USBShark-7T-BK			Data/Build
Vinpower Digital USB Duplicator 23-targets	USBShark-23T-BK			Data/Build
Verity Ballot Box	Revision B			Scan
Accessible Voting Booth	Revision D			Touch Writer Duo, Touch Writer
Standard Voting Booth	Revision D			Touch Writer Duo, Touch
Thermal Printer	PJ723		Brother PJ700	Touch Writer Duo
Verity Key		N/A	COTS: Maxim iButton	Security key used with voting system
Verity vDrive		N/A	COTS: Apacer	4GB USB flash drive, portable electronic media used for transportation of voting system data
Ballot/Report Printer		B432dn	COTS: OKI Data	

System Component	Software or Firmware Version	Hardware Version	Operating System or COTS	Comments
– Data, Build, Central, Count, Print, Touch Writer, Touch Writer Duo				
Ballot Printer – Build, Print		C831dn	COTS: OKI Data	
Scanner – Central		DR-G1100	COTS: Canon	
Scanner – Central		DR-G1130	COTS: Canon	
Workstation – Data, Build, Central, Count			COTS: HP Z240 Workstation; HP Z230 Workstation	Min. 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 Keyboard - USB Keyboard Mouse - USB Mouse
Monitor – Data, Build, Central, Count			COTS: Monitor	Min. 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)

System Limitations

This table depicts the limits the system has been tested and certified to meet.

Element	Testing Limit/Requirement Z240 64GB Systems (does not include Data/Build/Count combined system)	Testing Limit/Requirement Z230 32GB Systems (includes Z240 64GB Data/Build/Count combined system)
Precincts	3,000	2,000
Splits per Precinct	20	20
Total Precincts + Splits in an election	3,000	2,000
Districts for voting devices and applications	400	75
Parties in a General Election	24	24
Parties in a Primary Election	10	10
Contests in an election	2,000	200
Choices in a single contest	300	75
Total contest choices (voting positions) in an election	5,000	600

Element	Testing Limit/Requirement Z240 64GB Systems (does not include Data/Build/Count combined system)	Testing Limit/Requirement Z230 32GB Systems (includes Z240 64GB Data/Build/Count combined system)
Max length of choice name	100 characters	100 characters
Max write-in length	25 characters	25 characters
Voting Types	5	5
Max polling places per election	3,050	1,200
Max devices per election	N/A	N/A
vDrive capacity – Scan voting device	9,999 sheets per vDrive	9,999 sheets per vDrive
vDrive capacity – Verity Central	80,000 sheets per vDrive	80,000 sheets per vDrive
Number of voters definable per election	2,500,000	1,000,000
Number of total ballots cast per election	1,750,000	1,000,000
Max number of sheets per ballot	4 sheets	4 sheets
Max number of sheets – Verity Scan	9,999	9,999
Max number of CVRs – Verity County	7,000,000	7,000,000
Ballot Sizes	8.5”x11”, 8.5”x14”, 8.5”x17”, 8.5”x20”, 11”x17” (Central only)	8.5”x11”, 8.5”x14”, 8.5”x17”, 8.5”x20”, 11”x17” (Central only)
Number of languages in a single election (including English)	11	11

Functionality

2005 VVSG Supported Functionality Declaration

Feature/Characteristic	Yes/No	Comment
Voter Verified Paper Audit Trails		
VVPAT	No	
Accessibility		
Forward Approach	Yes	
Parallel (Side) Approach	Yes	
Closed Primary		
Primary: Closed	Yes	Supports standard closed primary and modified closed primary
Open Primary		
Primary: Open Standard (provide definition of how supported)	Yes	Open Primary
Primary: Open Blanket (provide definition of how supported)	Yes	General “top two”
Partisan & Non-Partisan:		
Partisan & Non-Partisan: Vote for 1 of N race	Yes	
Partisan & Non-Partisan: Multi-member (“vote for N of M”) board races	Yes	
Partisan & Non-Partisan: “vote for 1” race with a single candidate and write-in voting	Yes	
Partisan & Non-Partisan “vote for 1” race with no declared candidates and write-in voting	Yes	
Write-In Voting:		

Feature/Characteristic	Yes/No	Comment
Write-in Voting: System default is a voting position identified for write-ins.	No	By default, the number of write-ins available in a contest is zero, users may increment as necessary
Write-in Voting: Without selecting a write in position.	No	
Write-in: With No Declared Candidates	Yes	
Write-in: Identification of write-ins for resolution at central count	Yes	
Primary Presidential Delegation Nominations & Slates:		
Primary Presidential Delegation Nominations: Displayed delegate slates for each presidential party	Yes	
Slate & Group Voting: one selection votes the slate.	Yes	
Ballot Rotation:		
Rotation of Names within an Office; define all supported rotation methods for location on the ballot and vote tabulation/reporting	Yes	Rotation by precinct and precinct split
Straight Party Voting:		
Straight Party: A single selection for partisan races in a general election	Yes	
Straight Party: Vote for each candidate individually	Yes	
Straight Party: Modify straight party selections with crossover votes	Yes	
Straight Party: A race without a candidate for one party	Yes	
Straight Party: "N of M race (where "N">1)	Yes	
Straight Party: Excludes a partisan contest from the straight party selection	Yes	
Cross-Party Endorsement:		
Cross party endorsements, multiple parties endorse one candidate.	No	
Split Precincts:		
Split Precincts: Multiple ballot styles	Yes	
Split Precincts: P & M system support splits with correct contests and ballot identification of each split	Yes	
Split Precincts: DRE matches voter to all applicable races.	Yes	
Split Precincts: Reporting of voter counts (# of voters) to the precinct split level; Reporting of vote totals is to the precinct level	Yes	
Vote N of M:		
Vote for N of M: Counts each selected candidate, if the maximum is not exceeded.	Yes	
Vote for N of M: Invalidates all candidates in an overvote (paper)	Yes	
Recall Issues, with options:		
Recall Issues with Options: Simple Yes/No with separate race/election. (Vote Yes or No Question)	Yes	
Recall Issues with Options: Retain is the first option, Replacement candidate for the second or more options (Vote 1 of M)	Yes	
Recall Issues with Options: Two contests with access to a second contest conditional upon a specific vote in contest one. (Must vote Yes to vote in 2nd contest.)	Yes	

Feature/Characteristic	Yes/No	Comment
Recall Issues with Options: Two contests with access to a second contest conditional upon any vote in contest one. (Must vote Yes to vote in 2nd contest.)	Yes	
Cumulative Voting		
Cumulative Voting: Voters are permitted to cast, as many votes as there are seats to be filled for one or more candidates. Voters are not limited to giving only one vote to a candidate. Instead, they can put multiple votes on one or more candidate.	Yes	
Ranked Order Voting		
Ranked Order Voting: Voters can write in a ranked vote.	Yes	
Ranked Order Voting: A ballot stops being counting when all ranked choices have been eliminated	N/A	Tabulation rules are unique per jurisdiction
Ranked Order Voting: A ballot with a skipped rank counts the vote for the next rank.	N/A	Tabulation rules are unique per jurisdiction
Ranked Order Voting: Voters rank candidates in a contest in order of choice. A candidate receiving a majority of the first choice votes wins. If no candidate receives a majority of first choice votes, the last place candidate is deleted, each ballot cast for the deleted candidate counts for the second choice candidate listed on the ballot. The process of eliminating the last place candidate and recounting the ballots continues until one candidate receives a majority of the vote	N/A	Tabulation rules are unique per jurisdiction
Ranked Order Voting: A ballot with two choices ranked the same, stops being counted at the point of two similarly ranked choices.	Yes	
Ranked Order Voting: The total number of votes for two or more candidates with the least votes is less than the votes of the candidate with the next highest number of votes, the candidates with the least votes are eliminated simultaneously and their votes transferred to the next-ranked continuing candidate.	N/A	Tabulation rules are unique per jurisdiction
Provisional or Challenged Ballots		
Provisional/Challenged Ballots: A voted provisional ballots is identified but not included in the tabulation, but can be added in the central count.	Yes	
Provisional/Challenged Ballots: A voted provisional ballots is included in the tabulation, but is identified and can be subtracted in the central count	Yes	
Provisional/Challenged Ballots: Provisional ballots maintain the secrecy of the ballot.	Yes	
Overvotes (must support for specific type of voting system)		
Overvotes: P & M: Overvote invalidates the vote. Define how overvotes are counted.	Yes	If the system detects more than the valid number of marks in a contest, it is counted as an overvote
Overvotes: DRE: Prevented from or requires correction of overvoting.	Yes	

Feature/Characteristic	Yes/No	Comment
Overvotes: If a system does not prevent overvotes, it must count them. Define how overvotes are counted.	Yes	If the system detects more than the valid number of marks in a contest, it is counted as an overvote
Overvotes: DRE systems that provide a method to data enter absentee votes must account for overvotes.	Yes	
Undervotes		
Undervotes: System counts undervotes cast for accounting purposes	Yes	
Blank Ballots		
Totally Blank Ballots: Any blank ballot alert is tested.	Yes	
Totally Blank Ballots: If blank ballots are not immediately processed, there must be a provision to recognize and accept them	Yes	
Totally Blank Ballots: If operators can access a blank ballot, there must be a provision for resolution.	Yes	
Networking		
Wide Area Network – Use of Modems	No	
Wide Area Network – Use of Wireless	No	
Local Area Network – Use of TCP/IP	Yes	
Local Area Network – Use of Infrared	No	
Local Area Network – Use of Wireless	No	
FIPS 140-2 validated cryptographic module	Yes	
Used as (if applicable):		
Precinct counting device	Yes	
Central counting device	Yes	

Attachment B – Accessibility Examination Findings and Recommendations

(The attachment contains observations from the complete accessibility examination and included Touch Writer Ballot Marking Device even though not certified as part of this campaign.)

A) Top positives

Hart Verity Voting
2.3 Top positives.pd

B) Top problems

Hart Verity Voting
2.3 Top problems.pc

C) Special Discussion

Hart Verity Voting
2.3 Special Discussic

D) Recommendations

E) All observations from Accessibility Examination

Hart Verity Voting
2.3 All observations.

F) Accessibility Testing Report for the Hart InterCivic Verity Touch Writer and Verity Duo Systems (Verity 2.3.4)

Top positives

The expert examination, voter experiences, and poll worker sessions recognized several positives of these voting systems. Because the voting experience is virtually identical for both the Touch Writer and the Duo, unless otherwise noted, no distinctions will be made between them.

Independent and private voting

All voters were able to learn the system quickly and complete their ballots independently, once the facilitator provided them with the appropriate accessibility features. No one found the system so difficult or frustrating that they were unable to vote, and most stated that the system would help other voters with disabilities as well.

The system had good privacy measures and voters also agreed that their experience in a typical voting session would be relatively private on this machine.

- The vendor provided voting booths each included privacy shields on either side of the ballot marking device, controller (if applicable), and scanner.
- The touchscreen is at the back of the machine, near the hinge of the clamshell case. Because it was deeper within the voting booth, it was well masked by the privacy shields. This presented a problem for voters in wheelchairs, though. Most were unable to reach far enough over the front of the unit to use the touchscreen and had to use the tactile keypad. More can be found about this issue in the next section.
- The touchscreen itself could only be viewed clearly from directly in front of it. As voters moved off to the side, the screen was shielded by a limited viewing angle.
- The vendor included a third-party privacy sleeve that all three examiners agreed was the best implementation of a privacy sleeve we had experienced. It was a folded piece of cardstock, like many others; however, it had a roughly 4 x 0.5-inch cut out a third of the way down the spine and another roughly 15 x 1.5-inch jut out along the right-hand side. This allowed voters with disabilities to place their ballot in the sleeve. Some were then able to feed the ballot in accurately because the sleeve helped manage the angle. Others still needed assistance, but a poll worker could feed the ballot into the scanner using the left-hand cut out without seeing the ballot at all.

This privacy sleeve can be found at https://printingsystems.us/product/168. The link above is only provided for informational purposes and is not an endorsement or promotion by these examiners, Misericordia University, or the Center for Civic Design.

Access features easily learned and helpful

As voters explored the access features, they seemed to learn them relatively easily. Most of the voters use similar assistive devices daily or when they currently vote.

All voters found the default text size to be sufficient. Our participant voters all had either normal vision or no usable vision. The single voter with low-vision chose not to try to read the screen with large print, and used the audio feedback instead.

For voters with low vision, the range from normal to large text was great enough that those with usable, but limited vision should be able to use the screen without difficulty.

The MOVE wheel is unique to the Hart systems, and it was generally well received. It has one half-sphere-shaped divot near the edge, where the voter can use a finger to turn it. Alternatively, there are raised spokes radiating from the hub that can be used to turn it as well.

- All three users with very limited use of their hands were able to vote with the tactile keypad, when they normally would require a dual switch device. One voter found the interaction similar to gaming interfaces and was able to complete the voting session very quickly.
- One blind voter who struggled to use the wheel tried the dual-switch buttons instead. This accessibility option worked well for her and she was able to complete her ballot successfully.

The blind voter's difficulty using the MOVE wheel was a good lesson that poll workers should give disabled voters privacy, but keep an eye on them to ensure their voting experience is smooth. They should be well-briefed in all accessibility devices, how they work, and that voters may struggle with one type of device but be successful with another.

Other limitations of the MOVE wheel can be found in the Special Discussion section.

The Duo requires the voter to enter a poll worker-issued code that initiates the proper ballot. The tactile device is active for this screen, which was a pleasant surprise to examiners and voters. However, the code is printed on paper, and is not accessible for blind voters, who would have to be told the code and memorize it (this would not be a barrier for most successful blind individuals). They could also use personal assistive technology (AT) to read the code in the voting booth.

Both poll worker groups reported that the access features would help voters who already visit their location on Election Day. They also agreed that these features would likely assist other voters with disabilities that do not currently come to the polls on Election Day.

Helpful alerts and candidate selections language

The system alerts and messages are generally good and voters did not react negatively to any of them. Hart's straight party implementation, text size changes, and cursor visibility when using assistive devices did fall short in some areas. See the next section for more information.

- **Overvote protection.** When voters attempted to select too many choices in a contest, the system displayed a full-screen alert. This alert informed the voter that the first selected choice would be removed and replaced with the choice they touched last. While the examiners found this alert style unusual and unique, it seemed to be effective, as most voters understood the message and knew how to proceed.

  Some voters, however, felt that the voting machine was making choices for them, and that the machine might make other choices without informing them. Most concerned voters felt that they could go back to the contest and make alternative choices, though some commented that with only an "OK" button to choose from, they would prefer to have the ability to reject the action.

- **Choices remaining within a contest.** On entering each contest, the system announces, "this is ballot item #. The total number of items on the ballot is #." The second part of this statement was redundant, since it never changed.

Voters felt that the same information could have been expressed as, "this is ballot item # of #."

They also suggested that the number of candidates be added to the information, such as, "there are # candidates in this contest."

For each contest, the screen displays and the audio reads the "Vote for N" message, then announces that, "the remaining number of choices you can mark is #." Some, but not all, voters found and understood this message, while others were not able to link the meaning to number of candidates selected, either by the straight party selection or manually selected out of view.

When a straight-party is selected, the system announces that, "the number of choices you can mark is zero." This is accurate, but not informative to voters who did not understand that the selections were made through their straight party selection.

- **Review screen.** On the review screen, the system adequately alerts voters within each contest when they have not selected as many choices as allowed or when they leave a contest blank.

- **Printing the ballot.** The system and the printer communicate well together. After voters selected the "PRINT" button, the system continually displays and announces, for audio users, "Your ballot is printing." This continues until the ballot has fully printed, when the message changes to "Your ballot has printed." This is very helpful for two reasons:

  The printer takes some time to warm up and begin printing. We were not able to determine whether this would be true during a normal election, but would certainly be true if the machine was used only for voters with disabilities. The repeated message was helpful because voters might think there is a problem when the printer does not visually or audibly react immediately.

  Voters who cannot see the printer may not know when their ballot has printed successfully. The timely change in messaging lets them know they can retrieve their ballot. This was particularly important for double-sided ballots on the Verity Touch.

Consistent behaviors and easy navigation

The system navigation and screen behaviors were good and consistent during the entire voting experience. Voters did not report any confusion when switching selecting or deselecting buttons or when navigating through the ballot.

For tactile keypad users, the order in which the system selected navigational and system settings buttons required learning, but was consistent throughout.

The only exception was the review screen. When voters made changes on the review screen, the system would take them to that specific contest, which is good. However, it did not return them automatically to the review screen when the voter selected "NEXT" at the bottom of the screen. It merely moved them to the next contest of the initial voting experience, which was confusing to a few voters—especially those who could not see the screen for contextual reference. Only one voter found the "REVIEW YOUR CHOICES" button without being prompted. All voters were able to get back to the review screen by selecting "NEXT" enough times.

On return to the review screen, whether by the "REVIEW YOUR CHOICES" button or multiple Next selections, the voter is placed at the top of the ballot, rather than the contest from which they left. They are then required to move down the ballot manually to continue the review.

Also, when a contest is left blank, the navigational button at the bottom-right of the screen changes from a blue "NEXT" button to a grey "SKIP" button. The language used on both systems is understandable and non-coercive. Voters understood these messages and only one voter was confused by it. None reported that they felt compelled to make additional selections.

Additional positive observations can be found in the "All Observations" section of this report.

Top problems

The two Hart Verity systems were well received by voters, and examiners did not find any glaring issues that would prevent a voter from successfully casting a ballot privately and independently. The first two problems below are the most significant. The other issues are treated as repeated annoyances that were observed during the expert examination and voter or poll worker sessions.

Again, unless otherwise noted, this Top Problems section will treat both systems as one.

1. Silent/Hidden selection and deselection

There were three elements of silent and/or hidden selection and de-selection on the Hart system that voters found confusing. In most cases, voters were able to mark their ballot as instructed through trial and error, but when switching from straight party to manual selections under the Pennsylvania Method, they did not notice changes made by the system and might vote in a way that does not match their intent.

- **Destructive candidate deselection when changing a straight party contest**
  After making a straight party choice, if voters wanted to vote for candidates other than the straight party selections, the system automatically deselects all of the other pre-marked candidates, leaving the chosen candidate as the only one selected. In a contest with a short list of candidates, this behavior, dictated by the PA Method, caused confusion, but with persistence voters were able to select the candidates specified in the test instructions.

  For example, when the voters were asked to vote for just one of the three automatically selected candidates, some attempted to deselect an unwanted candidate by selecting that candidate. Because of the interpretation of the PA Method, this resulted in confirming the vote for that candidate instead of deselecting that candidate, as the voters stated they had expected. Where changes were evident, the voters were able to correct the error and vote as instructed. (Please see more about candidate selection in the next section.)
- **When the contest was long, candidates were often de-selected on a different screen, with no notification from the system**. For example, in a

contest of 20 candidates, if a voter chose the Republican straight party option, but wanted to vote for the Green party candidates, the voter would need to scroll to the bottom of the list, forcing the pre-marked votes out of view. Once, the voter selected the desired candidate, the pre-marked votes are deselected out of view, and no alert is provided to notify the voter. For voters relying solely on the audio, no deselection is voiced at any time no matter the contest length.

Voters may be able to indirectly determine that choices have been deselected by referring to the number of choices that remain instructions. This is constantly visible on the screen, but the audio only voices it after a selection is made.

- **Voters must select a pre-marked option twice to deselect it.** For sighted voters, this was less of an issue. However, for audio users, it took some trial and error to understand why the initial selection did not turn off a pre-marked candidate.

Why is this a problem?

The system relies on voters perceiving the change in selections and understanding why those changes have happened. This is a problem because:

- Voters should have control of all selections.
- Off-screen actions force all voters to problem solve. This is worse for voters using the audio format or a dual switch because navigation is more difficult.
- Voters with cognitive disabilities may be unable to understand what has happened when the interface is unpredictable and/or inconsistent.
- If a voter has to ask for assistance in the middle of the ballot, their privacy and independence are compromised.
- In several cases when test voters were asked about the state of their ballot after such deselection, they thought that candidates were still marked who were not. When prompted to go back and check, they were able to correct the deselection, but without the prompt, it is likely that they would have cast ballots not marked as they intended.

Recommendations

There are two defenses against the silent deselection issue for some voters. Voters have the opportunity to review their choices before printing their ballot.

And, most voters can review their printed ballot before casting it. Not all voters will be protected by these two options.

While the machines must comply with the Pennsylvania Method of straight party voting, there are ways to fully inform the voter of selection and deselection changes. For example:

- Create meaningful visual and audio feedback messages and confirmation processes to tell voters what is happening—including the number and names of the candidates being deselected. No selection or deselection should ever take place without explicit action or confirmation from the voter. Language should be included like: "If you do X, these voters will be deselected" or "Are you sure you want to…."
- Be consistent and toggle all selections on and off when touched or selected with the tactile keypad, including selections made when the straight party option is active. This is consistent with how selection and deselection works in general and is not destructive.
- Counties can make sure poll workers are aware of these system behaviors so they can answer questions from voters. This especially applies to voters with disabilities. Also, counties can inform voters about the straight party behavior through public information campaigns, system demonstrations, and Election Day signage.

2. Audio quality and instructions

What happened?

Voters reported a number of problems with the audio quality and instructions.

- **Long, wordy, and repetitive**. Audio voters universally reacted negatively to the length of the instructions on each screen. At the start of each contest or whenever the voter reenters a contest, the system replays the same very detailed voting instructions. Then, it announces the current contest number and how many contests there are in total. Several of our voters began mimicking this announcement as it was made.
- **Unhelpful information**. As mentioned above, the same instructions were repeated over and over, along with the contest progression information. Voters reported that after they learned the system, they no longer needed the details, and they wished the contest count was a number of candidates in each contest.

- **Recording quality**. Overall, voters liked the tone of the voices used for the instructions. The system used recordings of actual human speech for the instructions and ballot information. Many voting systems use a synthesized voice. It seems that most instructions are pre-recorded and in the same voice. The rest of the ballot information seems to be cobbled together from different recordings by different people. For example, if the system were reading the date, different voices would read the months, days, and year, for a total of three voices. It is unclear to the examiners if this was intentional or if this is just how the test ballot was created. In places, recorded announcements were preceded by vocal scraps and clicks, indicating poor editing practices. While the final volume was approximately the same for each of the voices used in the audio track, the background noise level and distortion differed markedly, affecting the intelligibility of the voice, and distracted the voters.
- **Playback speeds**. Voters could choose the speed of the recordings: Slow, Normal, or Fast. The higher speed seemed to be reached by simply slicing out segments of the recording (e.g. every third .05 seconds). The slicing interval was fairly long and not keyed to vocal content, which made it sound very choppy. The normal speed was easily understandable, but also very slow for an instructional voice. This was helpful to those voters that use little to no audio assistive devices, but frustrating to voters (typically blind voters) used to faster audio. None of the voters chose slow, all but one voter chose normal, and most voters disliked the fast speed.
- **Playback content.** Experienced users of screen reading technology often read quite fast. Our test voters felt that even the "Fast" voice was painfully slow and choppy. When the voice is does not pronounce names clearly, there can be confusion about names that sound similar. Several easily-confused names are included in the test ballot, and participants who are more expert with screen readers mentioned that it would be ideal to have an option to spell-out a name.
- **Pauses.** In addition to the recording speed, the system seemed to insert a number of pauses before and after each section of audio. For example, in reading a candidate's name, the system would have a long pause between the candidate name and party. There was also a significant delay from when the cursor landed on the item to when the system actually voiced it.

  These delays meant that sometimes voters thought the recording was finished and started to move on without hearing the full message. In one test

instruction, voters are told to select a candidate endorsed by both parties. The gap between the two-party names was long enough that some did not hear the second party.

The voter who chose the fast speed discovered that the pauses do not seem to shorten at all, which makes the pauses feel even longer.

Why is this a problem?

Most voters only need the minimum number of instructions, with few repetitions, to successfully navigate the ballot. When instructions include too much detail, are too long, or repeat the same information over and over, it is difficult to retain all that has been said. Voters have either stopped listening or are fatigued from trying to remember it all. Some voters listen to all of the instructions just to be sure nothing has changed. Two blind voters that are very assistive technology savvy and usually move through the ballot quickly were slowed down significantly by the pace of the voice, the pauses, and waiting to hear new information each time.

Also, since most audio assistance users are accustomed to a fast voice, slow instructional and informational voices slow them down much like a sighted person would read slower if the text on a page were very faint.

Cognitive overhead. Whether it was trying to understand and remember all of the instructions or having to listen to different voices, significant effort was required to think through the process of voting. When voters have to concentrate on what the voice is saying, they are not as able to determine who or what they would like to vote for.

Recommendations

To the extent that it is possible, counties should:

- Work with the vendor to make sure either all voices are the same or are limited to two different voices: one for instructions and one for ballot information.
- Rewrite the ballot instructions to be as concise as possible and include only as much information as necessary, since voters will be hearing it each time a contest is selected.

- When possible, use a modern text-to-speech (TTS) system in place of digitized voice. (Some languages do not have written versions, so the option for digitized voice must be retained.)

  Typical speaking rate for people is in the range of 100 to 125 words per minute, but average reading speeds are in the range of 400 to 500 words per minute. The standard for synthesized voices for screen readers is that they remain understandable at speeds in excess of 600 words per minute, and many blind people can read in excess of 1000 words per minute, with appropriate voices. TTS systems designed for screen reading offer high speed reading, and the ability to spell words a letter at a time when spelling is not clear.
- Trim recorded files as tightly as possible so that there is no lead-in or trailing silence at the beginning and end of each recording.
- Preload all the text snippets progressively, so there is not such a long delay in the load time.

3. Touchscreen display issues

What happened?

Examiners and voters discovered three issues with the touchscreen and display.

- **Cursor difficult to see.** As voters using the tactile keypad or dual switch moved around the screen, the selected item had a blue box around it. When this highlight was over light areas of the screen, it was easy to see, and very effective. But when it was highlighting system controls, which had a black background, it faded into the background, and was very difficult to discern. Many times, voters lost the cursor and had to move the wheel or press a button to figure out where it was. For voters using the audio feedback with the MOVE wheel, this was not an issue, nor was it an issue for voters using the touch screen. But test voters using the Move wheel while reading the screen visually often lost track of the focus.
- **Large text size eliminates onscreen instructions.** Only one poll worker/voter used the large text. When they did they discovered the instructions panel on the left-hand side of the screen had disappeared. The number of choices remaining text moved to the top of the screen, which was helpful, but the "Vote for N" instruction is lost, leaving only the countdown

for number of selections remaining. Audio voters do not lose the instructions, as they are voiced with each contest.

- **Fixed screen angle.** The touchscreen display is fixed in the voting machine and the angle cannot be changed to reduce glare.

Why is this a problem?

For voters using the wheel because of arm/hand limitations rather than vision, a lost cursor can be found easily by moving the wheel one direction and then returning it to the previous position. Dual switch users do not have this luxury. If they lose the cursor, and press the advance button to find it, it could easily move past the desired selection. This means they have to go through all of the options on the screen again to arrive back at the desired selection. For long contests or the write-in screen, this can take a long time and become very frustrating.

For this test, the instructions were the same on each screen, so when they disappeared while using the large text, it was not really an issue. However, the text in this box can be customized by the counties for each contest, and not all contests have the same instructions. The "Vote for N" information is very important so voters know how many choices they can make.

Polling location lighting varies greatly. For those with typical bright overhead lighting, glare may develop on the screen making it difficult for all voters, but especially those with sensitive eyes or low vision to see the screen.

Recommendations

Change the color and the width of the cursor highlight so it can be clearly seen, especially when against a dark background. Additionally, counties should alert poll workers that some voters may need help finding the cursor.

Minimally, put the "Vote for N" information in the same bar with number of choices remaining text. If possible, move the instructions bar to the top of the screen above or below the number of choices remaining box.

Additional observations can be found in the "All Observations" section of this report.

Special discussion

Paper ballot handling

One of the accessibility goals is to allow all voters to vote independently and privately, including verifying their ballot. All paper ballots introduce barriers for voters with low-vision, no-vision, and with limited dexterity.

Most voters appreciated the printed ballot, which allowed a second chance to review the vote before casting. The implementation of the printing and paper-handling of these paper ballots had some issues for voters and poll workers.

Reading the paper ballot

The Touch Writer and Duo ballot marking systems use two different printing options. The Touch Writer uses a separate, off-the-shelf printer that sits next to the voting machine. The on-demand, printed ballot looks identical to a pre-printed ballot used for absentee or provisional voters.

The Duo uses a thermal printer included inside the ballot marking device, so no separate printer is used. Voters are given a blank, specially formatted piece of cardstock when they check in. Only the voter's selections and associated scanning codes are printed in text on the paper.

Having the ballot marking device print on demand means that voters do not have to handle a blank, pre-printed ballot before making choices. While the Duo uses a blank, specially formatted piece of cardstock, it is still a blank piece of paper that does not resemble a conventional paper ballot in any way.

Using a traditional printed ballot is a problem for two reasons.

- **Touch Writer verification is not independently verifiable for some voters.** Blind and low vision voters often use personal assistive devices that read documents to them. Assistive technology (AT) examiners tried could not read the multi-column format back accurately, and it did not know which candidate or option the voter selected. All voters who tried to use this technology were unable to verify their ballot.

  Neither the Touch Writer nor the Duo provides a built-in feature to allow

a voter to "read back" the ballot by reinserting the printed, completed ballot into the voting system. Therefore, the voter would require assistance from a sighted person to read back their choices to verify the printed ballot.

- **Duo Print too small and not formatted for easy verification.** Sighted voters did not seem to have an opinion on the Duo's voter selections-only printed ballot, but they all agreed that the text is too small and the contest lines are too close together for easy visual scanning.

  AT had two problems reading the Duo ballot: the distance between the contest name and candidate meant that it often read this data as two separate lists. In addition, the ballot includes a sequence number and abbreviates the party name so the readback sounded jumbled.

Recommendations

- Always print ballots using "Voter Selection Only" (VSO). This allows personal AT to simply read the names on the print-out, rather than attempt to identify the filled ovals on the ballot. This format allows voters with personal assistive technology to read back their choices.

- Text on the printed ballot should meet VVSG requirements and be at least 3.0mm. Even with this small text, the layout can help voters read the ballot and verify their ballot more effectively.

  - Keep columns close together so that eyes tracking across the page do not have to travel far. If possible, connect spaces between columns with dots or dashes so voters can easily follow lines across the page.

  - Add space between rows of text.

- Include only what is absolutely necessary for the scanner to accurately read and cast the ballot. Codes and other technical information are confusing and should be clearly separated from selection/no selection information.

- If a QR code is used for functions such as identifying the ballot type, this information should be placed next to it in readable text so that voters know what is on their ballot.

Interacting with the Verity Scan ballot scanner

The Verity Scan digital scanner had both positives and negatives. In general, the ballot scanner does not produce any major accessible voting barriers.

Some features stood out and could be considered a positive for voters with disabilities.

- The scanner tray opening is just wide enough for the ballot and has tall guides along the sides to minimize the chance that the ballot will be improperly inserted.
- Voters may insert the ballot in any orientation. This may lessen the interaction a poll worker will have to have with a voter with disabilities to cast their ballot.
- The scanner has a large touchscreen that indicates when a ballot as been accepted and cast successfully.
- There is a faint but audible chime to indicate a successfully cast ballot.

Examiners identified two negatives with the scanner.

- Since the Touch Writer ballot is printed on both sides, privacy is decreased while standing in line before scanning or being helped by a poll worker, even with the privacy sleeve.
- Blind, low vision, or low dexterity voters will not be able to scan their own ballot independently unless special AT is provided at the polling place.

Recommendations

- Make the cues more obvious that the ballot is cast. Use large print words or simple images on the screen to indicate the scanning steps and show that the ballot scanned successfully. Currently, the scanner shows a United States flag on the confirmation screen. A few voters questioned if that meant that the ballot was cast successfully. A clearer message would be helpful.
- There is a simple audio cue, but it was very quiet and should be louder. Many polling locations are loud and even in our test scenarios, simple conversation overpowered the chime, and voters missed it.
- Counties should purchase privacy sleeves to cover the ballot after the voter has reviewed it and until it is scanned. This will minimize invasions of privacy and will allow poll workers to assist more confidently.
- Counties should set aside a private area in each polling location and invest in devices that help voters using AT to read back their ballot to them.

- Train poll worker to assist voters in ways that do not compromise the voter's privacy. This might include having standard instructions for poll workers to use to guide a voter in casting their own ballot, or narrating the poll worker's actions so that the voter understands what the poll worker is doing.

MOVE wheel on the tactile device

Although the MOVE wheel requires some motor control, nearly all of our voters who were not using the touchscreen were able to use the wheel successfully. This included three voters who were quadriplegic, and had no finger control. These voters were able to use their knuckles to move the wheel while stabilizing the controller with their other hand.

That said, some participants had problems using it because of its size and how freely the wheel moves. These included:

- **Voting booth setup.** Because of the voting booth size, there was no place to stabilize the tactile interface. Voters had to either balance the device in their lap or hold it in their hands. Providing a deeper table with a lip would correct this, but move the touch screen farther away, providing additional issues. This problem was even more challenging on the Duo, because the ballot paper extended beyond the edge of the device. Placing the unit on a larger table with space in front of the machine is a potential solution to this issue.
- **Accidental movements.** The wheel can move freely in each direction, and it is relatively easy to move, which can be good and bad. Some voters with limited dexterity had to use the wheel with the edge of their palm or their knuckles. As they dialed in their desired selection, and then took their hand off the wheel to press the select button, the wheel would often move again because they accidentally bumped it. They were able to move back to the wheel to correct such moves, but it slowed the voting process.
- **Easy to overshoot.** Because the wheel is easy to move and recordings do not begin to play immediately when the cursor lands on a selection, it can cause voters to overshoot their desired selection.

Voter session preferences and tutorial

When voters used the tactile keypad at the beginning of the session, the system recognized this and gave the voter three accessibility options.

- Audio only (with a blanked screen), with the MOVE wheel
- Audio and touchscreen, with the MOVE wheel
- Only touchscreen, with the MOVE wheel.

If the screen is active, the voter could use either the wheel or the screen. If the voter uses the audio and the screen, the audio does not voice the screen-touched selections. The audio only reads selections if they are highlighted by the wheel.

In many places the audio instructs the voter to turn the wheel clockwise for the next selection. We had one blind voter who did not know the meaning of "clockwise."

After the accessible choice, the system asks the voter to set up the associated preferences for volume, playback speed, and text size and contrast, if using the screen. The system voices each option, but once a selection has been made, it does not voice a confirmation of that choice. Some voters did not know if their playback speed choice was set successfully, for example.

Once the voter's preferences have been selected, the system guided them through a brief tutorial about how to use the MOVE wheel to make selections and deselections. Unfortunately, this section was very visually based—even though blind voters were using it too. It had call-outs pointing to different options and elements of the screen, and to get the system to read aloud these sections, the voters had to highlight them with the MOVE wheel. Our blind voters stumbled through this section trying to understand what the system was trying to teach them because they did not have the benefit of seeing a top-down, visual layout.

Analysis

Examiner's reactions to the system's preferences and tutorial options are mixed because voter's reactions were mixed.

- One blind voter liked the tutorial and thought it would be beneficial to others.
- Other voters using the audio, screen, and wheel didn't have much of a reaction until the tutorial, where they seemed confused on what the system was asking them to do.

- For any of the assistive tech savvy voters, especially blind voters, they all wanted to skip it and move on.

It is important to point out that our blind voters had to go through both the audio and the screen setup options before getting to the tutorial because examiners needed to be able to see the screen. In a typical voting situation, this would not have been a requirement, and their reaction to the tutorial section may have been less harsh.

Examiners concluded that the idea of the voter's preferences and tutorial is good, and it could be very beneficial to first-time assistive technology users if redesigned slightly.

- Remove visually-based layout and design elements. Or at the very least, instruct the user to move the wheel to the right to hear the next element.

- Think carefully about instructions and commands. If using sight-related descriptive commands, such as "clockwise," also give a more concrete direction, such as "to the right." Some blind users may not have learned this term because they've never looked at a clock.

- Provide a way at the front to set up preferences, but allow experienced voters to skip the tutorial.

- If a voter has selected audio and touchscreen, voice all selections when touching the screen as well. This helps low-vision, low-literacy, and cognitively impaired voters understand the layout.

Recommendations

The participants – and examiners – saw the systems being tested for the first time during the examination. Many voters will also try using a new system for the first time in the voting booth, so our test was realistic for Pennsylvania voters.

The problems we encountered also suggest ideas for how election officials can support voters and poll workers as they introduce the new system and design their processes and procedures.

The recommendations here are based on observations of how both poll workers and voters used the system and direct suggestions they made.

Advanced training and hands-on practice

The need for an introduction and a chance to try out the system before Election Day was the strongest recommendation from every poll worker participant.

Poll workers felt strongly that any new system – particularly those with digital interfaces – would be intimidating to voters and fellow poll workers who were not used to computers. They recommended:

- Longer training sessions for poll workers to give them more time to familiarize themselves with a new system.
- Opportunities for hands-on experience, including scenarios for different situations they might have to handle.
- An aggressive voter education program to give voters a chance to try out the new system.
- Outreach to voters with disabilities, including those who regularly vote with assistance to let them know about the capabilities of a new system that might help them.
- Have voting machine hands-on demonstrations at disability events so that voters can get to know the machines, practice voting, and be prepared for what they may need on Election Day.
- Instructions or a practice system in the polling place, especially in districts with many older people.

Training for poll workers to support voters with disabilities

Poll workers may not be familiar with how to help people with disabilities. Most of the poll worker participants said that they had no blind or disabled voters in their polling places, although one pointed out that the features on these systems might enable their "assisted voters" to try voting independently.

In addition to a good training module on ways to help voters with disabilities, the training should focus on how to give instructions before and during a voting session to avoid compromising their privacy. For example:

- A "what if" troubleshooting guide could include specific questions to ask and prompts that poll workers can use to help a voter with problem solving without looking at the screen.
- Give poll workers guidance on where to stand while supporting voters. For example, standing behind the touchscreen and facing the voter would make it clear that they are not looking at the screen.
- Using the procedures for initiating a voting session, including the screens to select a language or acknowledge that assistive technology has been activated, to make sure that the voter has found the basic navigation keys on the keypad. On the Hart InterCivic systems, the setting and preferences buttons are at the top of the screen at all times. The poll worker can review these with the voter (reading the instructions to be sure they are consistent and accurate).

Poll worker procedures

Poll worker procedures can also help bridge any information gaps for voters, with instructions embedded in the voting process.

- Remind voters to check both the pre-printing review screen and their paper ballot before inserting it into the scanner.
- Tell voters that if they make a mistake, they can get a new ballot, if they have already printed it.
- Tell voters how to insert their ballot into the scanner: identify that the ballot must be placed in the center of the scan bed, and tell them the ballot is inserted directly into the machine, not just slid forward.

- Instruct voters that their ballot can be inserted into the scanner in any orientation. Using the privacy sleeve is the most secure. However, inserting the ballot upside down, with the print toward the floor, is sufficient.

Support for voters using the tactile keypad or dual switch and audio ballot might include:

- A keypad they can try out before entering the voting booth.
- Instructions for how to use the keypad in Braille, audio, and large print.
- Test all assistive aids with local voters.

As a voter approaches the voting station, poll workers can help voters adjust the voting system or attach personal assistive technology:

- Help voters get positioned at the voting system so they can reach all controls.
- Provide help plugging in personal headsets with verbal instructions or by doing it for the voter. The audio and dual switch jacks on this machine are located on the tactile keypad.
- Make sure voters are oriented and know where all parts of the voting system are, including the privacy shields or covers. This machine includes options to blank the screen during the audio ballot, but then there is a button on the screen to allow poll workers to bring back the visual mode if the voter has a question.
- Remind voters how to scan and cast their ballot and how to know when they are finished.

Polling place setup

Ensure all polling locations have at least one accessible voting booth with a chair that is easily removed if a voter uses a mobility device.

Voters with disabilities may have assistive technology or personal notes that they need to place within reach. They may also need room to place the printed ballot on a flat surface when using simple personal technology, such as magnifiers or text readers to verify it.

For all voting machines, the path to the touch screen and the scanner should be as easy as possible, ideally a straight line with no obstructions. The path should include ample room to turn a wheelchair if the machine is positioned with the

screen facing the wall. The ADA standards suggest a minimum of 60x60 inches for this.

Use assistive technology to support blind and low-vision voters in verifying their ballot, for example, a magnification unit or a simple OCR scanner.

Voting booth setup for this system

Two issues were identified specifically for this system during the examination and usability testing related to how the system and attached devices are placed. The system fits very tightly in the accessible voting booth supplied by the vendor for the exam.

- **Cable management for assistive devices.** The tactile keypad is normally stored in front of the screen, connected on a semi-permanent cord. The headphone is plugged in on the tactile keypad. The printer could be set up to the right or left.
  Recommendation: The cords need to be placed so that they don't interfere with the printed ballot or the voter's ability to find and take their printed ballot.
- **Privacy.** The footprint for this system is small, and the screen is already at the back of the system. For some wheelchair or scooter users, this may be too far back from the edge of the table.
  Recommendation: Position the booth so the voter's back is to a wall, so no one can walk behind them, and with sufficient space to the left and right. However, be sure that there is a good path for a manual or motorized wheelchair to get to the voting booth easily (see above), and be sure the system screen isn't too far back that it is within comfortable reaching distance for those in a wheelchair or scooter.

All observations

Voter comments and reviewer observations about each machine are described below. For each are, the observations are organized by the machine function and then by the severity.

Positives

Function	Observation	System	Severity
General	Overall, voters felt that both machines were easy to use. Much easier than what they are currently using in the elections, and for those who had tested multiple machines, easier than the others.	Both	Positive
	Voters commented that it was easy to navigate, and easy to go back and make changes.	Both	Positive
Display and Navigation	The accessible devices setup and tutorial at the beginning could be helpful to new voters.	Both	Positive
	Overall, voters liked the wheel as a control. One blind voter said "I like the way you drive it." The wheel was usable by individuals with quadriplegia, as well as most blind voters. One blind voter, who may also have cognitive issues, was not able to control the wheel, and had to use the dual-switch input. For this voter, the availability of a "back-up" button would have been an advantage.	Both	Positive
	Voter with quadriplegia used her knuckles to control the buttons and the wheel, and was much faster than she would have been with the dual-switch input.	Both	Positive
	When a voter is looking for a specific name, they listened to the beginning of the name, then moved on. This supports efficient navigation.	Both	Positive
Display and Navigation	The move wheel allows moving through the alphabet fairly quickly for write-in. You learn how far	Both	Positive

Function	Observation	System	Severity
	it is to a section of the alphabet, then fine-tune clicks from there.		
	On long ballots, where several screens of candidates are displayed, touching the scroll button twice in succession does not scroll a screen past. This is good.	Both	Positive
	While the screen is blanked, if someone touches the screen to reactivate it, the audio announces that the screen is active again.	Both	Positive
	When a contest is left blank, the "Next" button becomes "Skip."	Both	Positive
Assistive Technology (AT)	Sound volume range is very large.	Both	Positive
	Instructions for voting using accessible features are in plain language, easily understood, and alerts and messages are not coercive.	Both	Positive
	When moving through contest, feedback says "currently selected" before the name. This is a good model.	Both	Positive
	When reviewing candidate names, the system says "Currently Selected" before the name, which alerts the voter and avoids skipping over selections.	Both	Positive
Write-In Screen	Generally, voters successfully figured out the write-in process with few problems.	Both	Positive
Printed Ballot & Scanner	The system and the printer communicate well. While the printer is warming up, the system says the ballot is still being printed. As soon as the ballot is finished, the system immediately changes to a message saying the ballot printing is finished.	Both	Positive

Function	Observation	System	Severity
	The text size on the Touch Writer printed ballot is sufficient for most sighted voters.	Touch Writer	Positive
	The Duo printed ballot can be read by some personal assistive technology.	Duo	Positive
	Scanner provides both audio and visual feedback that the ballot has been accepted.	Scanner	Positive

Summary and Recommendations Verity 2.3.4

This is a report of recommendations for the Hart InterCivic TouchWriter certification following a review of the updated straight party voting interactions and messages.

Background

The rules for straight-party voting in Pennsylvania (the Pennsylvania Method) are based on paper or mechanical ballots, so can be challenging to implement in an electronic voting interface. Two aspects of the interaction are particularly challenging:

- A contest included in the straight party logic cannot be left blank. If a voter does not make a selection, attempting to leave the contest blank, the system must automatically select the straight party option(s).
- If a voter removes their selection of a straight party option all selections made *only* through the straight party logic must be automatically deselected.

Although both of these scenarios are likely to be rare, it is important that voters are effectively informed of the system's actions so they can accurately verify their ballot before casting it.

In the new interaction for the TouchWriter:

- If a straight party option is selected, it is not possible to leave a contest included in the straight party interaction with no selection. If a voter tries to deselect all candidates, a message is displayed:

> You cannot remove all selections in this contest because you have already chosen a straight-party preference. If you do not want to vote for any candidate(s) in this contest, you must first return to the straight-party screen and remove your straight party preference.
>
> OK

- If a voter removes their selection of a straight party option, all candidate selections controlled *only* by the straight party logic are removed, leaving only candidates the voter has directly selected.
- When the ballot is printed, the straight party option (if any) is shown as selected on the bubble-style ballot.

Discussion

One of our guiding principles in these examinations has been that all voting actions – including selection and de-selection of voting options – should be under the control of the voter.

This is particularly important for accessibility for voters with disabilities because:

- Voters using an audio ballot cannot see visual actions and rely on a linear narrative from the audio.
- Voters using large text may see a smaller part of the ballot than those using the default text size.
- Voters with cognitive disabilities may need help understanding the rules and actions governing straight party voting in Pennsylvania.

Acknowledging that the scenarios for straight-party voting are complex, we looked for any actions taken by the system without confirmation by the voter and clear messages explaining what will happen when the voter actions conflict with the Pennsylvania Method straight-party voting rules.

Working through the interactions during the remote exam session, we found that:

- The message that appears if a voter tries to deselect all candidates (shown above) clearly states the reason why the system will not allow the deselection and offers information about the option to remove the straight-party selection.
- If a voter returns to the straight party option and changes or removes their selection, there is no message about the impact of this change. Selections may change without notification at the time of the change. However, the voter still has the opportunity to review their selections either navigating contest by contest or on the review screen, and can make changes before printing and casting their ballot.

- The TouchWriter creates a ballot similar to a hand-marked paper ballot with bubbles that are filled in to indicate selections. These ballots cannot be verified by voters who cannot read the paper directly because personal print reading tools cannot interpret the selection marks. For this reason, it is important that the marking and review interfaces support voters in confirming that the ballot selections to be printed reflect their intent.

Recommendations

Voter and poll worker education

Straight-party voting scenarios like the ones discussed here are a reminder of the need for comprehensive voter education, hands-on practice in advance of the election, and good training for poll workers so they can effectively help voters who are confused.

We recommend that the Department of State work with counties to create voter education that can be used consistently across the state in all counties using each system.

The decision to use the straight-party voting option is a personal one, but voters who plan to use this option will be better supported in the transition to a new voting system with the ability to learn how it works before Election Day. Hands-on practice opportunities are the best way for voters to be sure they understand how the system works in a setting where they can ask questions and try different interactions.

Possible future system updates

Better messages and notifications would also make the interaction clearer in situations where a voter decides to remove a straight party selection after they have begun marking the rest of the ballot.

This might be as simple as adding a warning to the message above:

> …remove your straight party preference. This may change selections on your ballot.

There might also be a message from the straight-party contest screen.

- A message any time the straight party option is changed could issue a generic warning.
- A more specific message might be displayed only when the system knows that at least 1 change will be made.
- Or a message might identify the number of contests where selections will be changed.

Attachment C – Implementation Attestation

Implementation Attestaton Hart.pdf

Voting System Implementation Attestation

System Name: _____

County: _____

Date Installed/Upgraded: _____

The below hardware/software was installed and verified on the system implemented:

System Component	Software or Firmware Version	Hardware Version	Model	Comments
Verity Data				(Please specify the implementation, single device (desktop/laptop), Client/server
Verity Build				(Please specify the implementation, single device (desktop/laptop), Client/server
Verity Central				(Please specify the implementation, single device (desktop/laptop), Client/server
Verity Count				(Please specify the implementation, single device (desktop/laptop), Client/server
Verity Print				

Verity Scan				
Verity Touch Writer Duo				
Verity Controller				
Verity Touch Writer				

Note: The table above represents an outline of the expected details in the implementation attestation. Add additional components/software installed.

Further to the key hardware/software components listed above, any of the COTS software installed on the voting system adheres to the EAC certificate of conformance for the Verity Voting 2.3.3 system. Any ancillary components like switches, ballot boxes, charging carts sold on this contract are EAC certified components of the Verity Voting 2.3.3 electronic voting system. (Attach a list of items sold on this contract.)

Hart also has validated that the systems have been installed and hardened following the EAC certified system hardening instructions and no software other than the voting system software has been installed on any of the components.

Vendor Representative Signature: _____
Vendor Representative Name:_____
Title:_____
Telephone:_____
Email:_____

County Representative Signature: _____

County Representative Name:_____

Title:_____

Attachment D – Minimum Training Requirements

Hart must provide training and training materials as set forth below prior to the first use of the voting system in a primary or general election.

a) A demonstration of and training on the setup and operation of the Voting System to the purchasing county's board of elections' members and staff and the county's precinct election officials.

b) A training session on the Voting System's election management system and/or EPBs for the purchasing county's board of elections' members and no less than two and no more than six staff members chosen by the board of elections. The training sessions must afford the board members and its staff the opportunity to learn how to setup and program an election, and if applicable design and layout ballots independently of the Supplier's assistance and support.

c) A training session on the following subjects for the purchasing county's board of elections' members and no less than two and no more than six staff members chosen by the board of elections:

i. programming of all voting units and ancillary devices;

ii. tabulating results during the unofficial and official canvass;

iii. ensuring accuracy and integrity of results;

iv. preparing polling places and setting up the system for election day operation;

v. Training on accessibility options of the voting system

vi. Election day operating procedures;

vii. auditing procedures;

viii. conducting a recount;

ix. preserving records;

x. printing, designing, and formatting election reports;

xi. troubleshooting common issues;

xii. safeguarding and preventing tampering and unauthorized access to all parts of the Voting System; and

xiii. Post-election care, maintenance and storage.

d) Any and all system manuals necessary to allow a purchasing county to operate the Voting System independently of the Supplier's assistance and support.

e) Training materials for a purchasing county board of elections to use when training its precinct election officials on how to setup, operate, and close down the Voting System on Election Day.

Attachment E – Source Code Escrow Obligations for Hart

The Supplier must maintain an escrow agreement covering all source codes of the Voting System and/or EPB for a period of ten years from the date of delivery to and acceptance by a purchasing county board of elections. The Pennsylvania Secretary of the Commonwealth shall have the right to access the source codes in escrow subject to the conditions specified below in Item d). The Supplier must pay all costs associated with 1) placing the codes in escrow and 2) verifying that the Supplier has placed the codes in escrow (note: the escrow agent conducts this verification and charges a separate fee for this service).

a. Source code. Simultaneously with delivery of the Voting System and/or EPB software to purchasing Members, the Supplier shall deliver a true, accurate and complete copy of all source codes relating to the software to an escrow agent.
b. Escrow. To the extent that Voting System and/or EPB software and/or any perpetually-licensed software include application software or other materials generally licensed by the Supplier, Supplier agrees to place in escrow with an escrow agent copies of the most current version of the source code for the applicable software that is included as a part of the Services, including all updates, improvements, and enhancements thereof from time to time developed by Supplier.
c. Escrow agreement. An escrow agreement must be executed by the parties, with terms acceptable to the Commonwealth prior to deposit of any source code into escrow.
d. Obtaining source code. Supplier agrees that upon the occurrence of any event or circumstance which demonstrates with reasonable certainty the inability or unwillingness of Supplier to fulfill its obligations to Commonwealth under this Contract, Commonwealth shall be able to obtain the source code of the then-current source codes related to Voting Systems software, EPB software, and/or any Supplier Property placed in escrow from the escrow agent.