**PROPOSED RESOLUTION 23–28 – August 2, 2023**
**CERTIFICATION OF THE CLEAR BALLOT**
**CLEARVOTE 2.4 VOTING SYSTEM**

**WHEREAS**, Title II of Article 7 of the Election Law *inter alia* provides for the examination of and process for approving voting systems and their components for use at elections in the State of New York; and

**WHEREAS,** Clear Ballot has submitted a voting system which contains new hardware and software components; and

**WHEREAS**, SLI Compliance (SLI) has conducted certification testing of said system, to ascertain compliance with the provisions of the U.S. Election Assistance Commission's 2005 Voluntary Voting System Guidelines, the State Board's Regulations, 9 N.Y.C.R.R. Part 6209, and the applicable sections of New York State Election Law; and

**WHEREAS**, the summary report of SLI Inc. was provided to the Board for consideration and has been duly considered; and

**WHEREAS**, the New York State Technology Enterprise Corporation (NYSTEC) has performed an independent review of the work conducted by SLI Compliance (SLI); and

**WHEREAS** the summary report of NYSTEC was provided to the Board, for consideration and has been duly considered; and

**WHEREAS**, having considered the Usability Test documentation provided by Clear Ballot, it is the opinion of the Operations Unit that the determinations as set forth in the State Board's Regulations, 9 N.Y.C.R.R. Part 6210.19 can be applied without alteration; and

**WHEREAS**, having considered the summary reports and the results of functional testing, the Operations Unit of the New York State Board of Elections recommends the certification of certain components of said system, to wit:

- Clear Ballot ClearVote 2.4 voting system hardware components:
    - ClearCast
    - ClearMark

- Clear Ballot ClearVote 2.4 voting system software components:
    - ClearDesign EMS Version 2.4
    - ClearCount Version 2.4
    - ClearCast Version 2.4
    - ClearMark Version 2.4

**WHEREAS,** having duly considered the aforesaid reports, functional testing, staff analysis and recommendations, and applicant submissions;

**NOW THEREFORE BE IT RESOLVED** that the Commissioners of the New York State Board of Elections do hereby certify the Clear Ballot ClearVote 2.4 voting system.

# New York State Board of Elections
# Voting System Verification Testing

## Clear Ballot ClearVote 2.4
## Master Test Report v4.0

Document Number: NYS-220030-MTR-04

Prepared for:

| | |
|---|---|
| **Client Name** | *New York State Board of Elections (NYSBOE)* |
| **Address** | *40 North Pearl St.*<br>*Albany, New York 12207* |

Prepared by:


4720 Independence St.
Wheat Ridge, CO 80033
303-422-1566
www.SLICompliance.com

## Revision History

| Date | Version | Author | Revision Summary |
|---|---|---|---|
| May 16th, 2023 | 1.0 | M. Santos | Initial Release |
| June 9th, 2023 | 2.0 | M. Santos | Updated for NYSTEC comments |
| June 16th, 2023 | 3.0 | M. Santos | Updated table 4 |
| June 26th, 2023 | 4.0 | M. Santos | Updated for discrepancy resolution |

### Disclaimer

The information reported herein must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

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# 1 INTRODUCTION

## 1.1 Project Overview

The New York State Board of Elections (NYSBOE) requires that before any voting system may be eligible to be purchased in New York State (NYS), it must be certified by the NYSBOE that such system(s) meet the requirements of the NYS Election Law, Section 6209 of Subtitle V of Title 9 of the Official Compilation of Codes, Rules and Regulations of the State of New York, and the federal 2005 Voluntary Voting System Guidelines (VVSG), Volumes 1 and 2.
SLI Compliance has been engaged by the NYSBOE to provide verification testing services to support the process of voting system certification by the NYSBOE.

## 1.2 Purpose

The purpose of this Final Master Test Report (defined as Deliverable 10: Final Master Test Report) is to create documentation of the testing that SLI Compliance, as NYSBOE's Independent Test Authority (ITA), performed throughout the course of voting system verification testing.

## 1.3 References

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

1. SLI VSTL Quality System Manual, v 3.0, February 13, 2019.
2. Voluntary Voting System Guidelines (2005 VVSG)
3. NYS 2022 Election Law
4. NYS 6209 Regulations

## 1.4 Terms and Abbreviations

The following terms and abbreviations were used throughout this document:

**Table 1 – Terms and Abbreviations**

| Term | Abbreviation | Definition |
|---|---|---|
| Ballot Marking Device | BMD | An accessible computer-based voting system that produces a marked ballot (usually paper) that is the result of voter interaction with visual or audio prompts. |
| Commercial Off the Shelf Software | COTS | Computer software that is ready-made and available for sale, lease, or license to the general public |

| Term | Abbreviation | Definition |
|---|---|---|
| Direct Recording Electronic | DRE | Voting systems that, using Touch Screen or other user interfaces, directly record the voter's selections in each race or contest on the ballot in electronic form. |
| Election Assistance Commission | EAC | An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program. |
| Election Management System | EMS | Typically, a database management system used to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to layout the ballots, download the election data to the voting devices, upload the results and produce the final results reports. |
| Functional Configuration Audit | FCA | The testing activities associated with the Functional testing of the system |
| Independent Test Authority | ITA | This is a test lab that is not connected with the vendor or manufacturer of the voting system. |
| Institute of Electrical and Electronics Engineers | IEEE | A non-profit organization, IEEE is the world's leading professional association for the advancement of technology. |
| National Institute of Standards and Technology | NIST | NIST is a non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life. |
| National Voluntary Laboratory Accreditation Program | NVLAP | A division of NIST that provides third-party accreditation to testing and calibration laboratories. |
| New York State | NYS | Acronym for the State of New York |
| New York State Board Of Elections | NYSBOE | The New York State Board of Elections is a bipartisan agency vested with the responsibility for administration and enforcement of all laws relating to elections in New York State. |
| New York State Technology Enterprise Corporation | NYSTEC | NYSTEC is a private, not-for-profit engineering company with offices in the state of New York. It acts as a trusted technology advisor to government agencies and private institutions. |

| Term | Abbreviation | Definition |
|---|---|---|
| Physical Configuration Audit | PCA | The testing activities associated with the physical aspects of the system (hardware, documentation, builds, source code, etc.) |
| Request For Information (form) | RFI | A form used by testing laboratories to request, from the NYSBOE, interpretation of a technical issue related to testing of voting systems. |
| Requirements Matrix | N/A | This is the matrix created by and maintained by SLI Compliance that traces the requirements to the various test cases, test steps, and test methods. |
| Technical Data Package | TDP | This is the data package that is supplied by the vendor and includes: Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of each voting system. |
| Voluntary Voting Systems Guidelines Volumes 1 & 2 | VVSG | A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all of the basic functionality, accessibility and security capabilities required of these systems. |
| Voting System Test Lab | VSTL | This is a designation for a test lab that is accredited by the Election Assistance Commission. |
| Voting System Under Test | VSUT | The designation for a voting system that is currently being tested. |

## 1.5 Scope of Testing

SLI Compliance provided verification testing on the ClearVote 2.4 system identified by the NYSBOE based on the guidelines and test approach established for voting system verification testing as defined by the NYSBOE (please see section 1.6 – Approved Project Testing Approach).
This effort included the testing required to demonstrate testing of ClearVote 2.4 against all the applicable requirements of the 2005 VVSG and NYS laws and regulations, as specified in the project Requirements matrix (Attachment A – NYS Clear Ballot ClearVote 2.4 System Requirements Matrix w Test Cases).
For the voting system identified for verification, Voting System Specific Test Reports (defined as Deliverable 9: Voting System Specific Test Reports) were developed by SLI Compliance to address the areas of Source Code Review, Security Source Code Review, Functional Testing and Security Functional Testing.

## 1.6 Approved Project Testing Approach

Per the testing approach approved for the Clear Ballot ClearVote 2.4 project, by NYSBOE (see "Attachment B - SLI Testing Approach for Clear Ballot ClearVote 2.4 - Finalized 12132022"), the following details dictated the approach of the project:
"

*Based on review/approval by NYSBOE/NYSTEC*:

- All previous EAC source code review to VVSG requirements will be accepted as a first round of review.
- All previous EAC functional testing to SHALL VVSG requirements will be accepted and leveraged.
- All previous EAC security testing to SHALL VVSG requirements will be accepted and leveraged.
- All previous EAC hardware testing to SHALL VVSG requirements will be accepted and leveraged.

*A secondary source code review to VVSG requirements will be conducted by SLI Compliance*.

- A 10% sample review will be conducted against all VVSG SCR requirements and will include:
  - a manual review to higher risk VVSG requirements.
  - a run of automated tool against all applicable VVSG requirements.
- A diff will be conducted and all source code changes not included in EAC certification, will be reviewed at 100%.
- Source code changes will be compared to the Change Notes to attempt to detect unidentified changes.
- A full source code review will be done against NYSBOE requirements.

*A trusted build/s will be conducted by SLI Compliance, if needed*.

*Security testing will be conducted by SLI Compliance to include the following*:

- Error messaging and Auditing will be tested against the VVSG
- A full security test will be done against NYSBOE requirements

*Functional testing will be conducted by SLI Compliance to include the following*:

- An end-to-end test will be conducted to verify the build and to attempt to detect unidentified changes.
- All functional testing of applicable SHOULD VVSG requirements will be tested as SHALL, as needed.
- All functional changes not included in EAC certification, will be tested along with any testing deemed necessary to confirm that the changes didn't affect other areas or cause issues around the changes made.
- Conduct upgrade testing and identify issues found.

*Documentation review will be conducted by SLI Compliance to include the following*:

- A diff will be conducted and all documentation changes not included in the EAC certification, will be reviewed at 100%.
- Documentation changes will be compared to the Change Notes to attempt to detect unidentified changes.

"

## 1.7 Final Master Test Report Attachments

The following attachment(s) are an integral part of this Final Master Test Report:

- Attachment A – NYS Clear Ballot ClearVote 2.4 System Requirements Matrix w Test Cases
- Attachment B - SLI Testing Approach for Clear Ballot ClearVote 2.4 - Finalized 12132022
- Attachment C – NYS Clear Ballot ClearVote 2.4 Master JIRAs (Confidential)

## 1.8 Scope of ClearVote 2.4 System

This section provides a description of the scope of ClearVote 2.4 voting system components.

The **ClearVote 2.4** 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.

**ClearDesign EMS** 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.
- Producing the election definition and auditing reports.
- Providing administrative management functions for user, database, networking, and system management.
- 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 **ClearMark, ClearCast** and **ClearCount** scanners for marked paper ballots.
- Import of the Cast Vote Records from **ClearCast** scanners.
- 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.

- **ClearCast** devices are precinct ballot counters (tabulators) that are used in conjunction with an external ballot box. The units are designed to scan marked paper ballots, interpret and record voter marks on the marked paper ballot and deposit the ballots into the secure ballot box.
- The **ClearMark** device is a standalone precinct level Ballot Marking Device (BMD) which also includes an Audio Tactile Interface (ATI), which allows voters who cannot complete a paper ballot to generate a machine-readable and human readable paper ballot, based on vote selections made, using the ATI.
- **ClearCount** is a high-speed, central ballot scanning systems used for high-volume processing of ballots (such as vote by mail). The unit is based on COTS scanning hardware coupled with custom Clear Ballot-developed ballot processing application software which resides on an attached workstation.

**Table 3 – Clear Ballot ClearVote 2.4 Custom Software Components**

| System Component | Application(s) | Version |
|---|---|---|
| ClearDesign EMS | Election Management Software and Central Count Location Tabulation and ReportSoftware | 2.4 |
| ClearCount | Central count application software | 2.4 |
| ClearCast | Scanner Firmware | 2.4 |
| ClearMark | BMD Firmware | 2.4 |

**Table 4 – Clear Ballot ClearVote 2.4 Custom Hardware Components**

| System Component | Description |
|---|---|
| ClearCast | Poll Place Scanner and Tabulator that scans voter selections from both sides of the ballot simultaneously |
| ClearMark | Standalone precinct level Ballot Marking Device |

# 2 TEST ITEMS AND PASS/FAIL CRITERIA

## 2.1 Requirements to be Tested

The SLI requirements management tool stores the following:

- Requirements Matrix containing:
  - 2005 VVSG, Volume 1
  - 2005 VVSG, Volume 2
  - NYS 2022 Election Law
  - NYS 6209 Regulations
- Traceability from Requirements to test cases

## 2.2 Test Item Pass/Fail Criteria

Testing was conducted as an independent verification and validation across the ClearVote 2.4 system. System performance to pass/fail criteria was measured against expected results for each test case and related set of test procedures as defined by the Requirements Matrix. Each feature passed or failed depending upon the results of the testing performed. If the actual output from an action was equal to the expected output specified by a test case, then the action passed; if not, it failed.

# 3 TEST TASKS

NYSBOE Verification Testing included detailed testing required to ensure compliance to the approved Requirements Matrix are provided in this section. It should be noted that the results and discrepancy reports for each of the review/assessment and test activities are documented and maintained throughout each activity until the activity has been completed. Upon completion of the verification test engagement, all results are provided in the Clear Ballot ClearVote 2.4 Specific Test Reports and archived with all testing artifacts.

## 3.1 Physical Configuration Audit

### 3.1.1 Documentation Review

Clear Ballot ClearVote 2.4 documentation was reviewed as applicable to the approved Test Approach (please see section 1.6 – Approved Project Test Approach) in the delivery of the ClearVote 2.4's New York TDP, as well as all NYSBOE Election Law requirements).

#### General Documentation Review

As applicable to the approved Test Approach (please see section 1.6 – Approved Project Test Approach), the SLI Compliance test process included conducting a TDP review of the TDP (Technical Data Package).

Clear Ballot ClearVote 2.4 documentation that was included in EAC certifications and State certifications was accepted as meeting all relevant 2005 VVSG requirements, including those requirements in Volume 1, Section 8.7, and 2005 VVSG Volume 2, Section 2 and Section 5.

### Security Documentation Review

Clear Ballot ClearVote 2.4 documentation that was included in EAC certifications and State certifications was accepted as meeting all relevant 2005 VVSG Security requirements.

The documentation review process consisted of an automated search through all documents followed by manual review.
A string search utility was leveraged in a custom script written to scan all documents and report a list of findings based on a preconfigured wordlist.
A copy of the script source code, all wordlists used, and the resulting artifacts generated are included in the associated testing artifacts.
Following the generation of a comma-separated value (CSV) document during the automated script's execution, a manual review was conducted to evaluate the results and verify all documentation-related requirements are sufficiently met.
For additional information, please review the Security Test Report and artifacts.
No documentation discrepancies were noted.

### 3.1.2 Source Code Review

ClearVote 2.4 source code was accepted for all applicable 2005 VVSG requirements, as per the “Attachment B - Testing Approach for Clear Ballot ClearVote 2.4” document.
A review to NYS 2022 Election Law and 6209 Regulations was performed. See “NYSBOE Clear Ballot ClearVote 2.4 Source Code Review Test Report” and “NYSBOE Clear Ballot ClearVote 2.4 Security Source Code Review Test Report” for additional details.
Discrepancies found during testing may be found in ““NYSBOE Clear Ballot ClearVote 2.4 Source Code Review Test Report”” “Attachment D - Source Code Review Discrepancy Review Forms (Confidential)”:

### 3.1.3 Trusted Build

One Trusted Build was performed during this certification examination.

### 3.1.4 Software and Hardware Configuration Audit

The Software and Hardware Audit compared the voting system components (hardware and software) to the TDP submitted by Clear Ballot voting systems.
The provided configurations conformed to Clear Ballot voting systems specifications of the system under test, including TDP documentation, and was consistent with configurations listed within the ClearVote 2.4 EAC certification.

## 3.2 Functional Configuration Audit

### 3.2.1 Review of Prior ITA Test Cases and Results

No prior verification testing completed by previous NYSBOE ITAs was submitted for review.

### 3.2.2 Review of EAC Certifications

SLI Compliance accepted and leveraged all prior verification testing completed by previous EAC certifications, as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.

### 3.2.3 Review of Other State Verification Testing or Risk Analysis Results

No State certification reports for the ClearVote 2.4 voting system test were submitted for review and accepted.

### 3.2.4 Review of Prior Hardware Environmental Testing

Hardware environmental testing completed by NVLAP or A2LA accredited test labs, within an EAC certification, for overall system capabilities, voting, and post-voting functions as well as adherence to hardware environmental and EMC standards was accepted as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.

### 3.2.5 Hardware Environmental Testing

All hardware environmental testing completed against the EAC 2005 VVSG hardware environmental and EMC test requirements, within EAC certifications, was accepted, as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.

### 3.2.6 Module Testing

SLI Compliance designed module test cases to provide coverage of the applicable requirements, as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.

### 3.2.7 System Testing

System Testing involved exercising the specific functions of ClearVote 2.4 to the requirements, as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.
Formal Test Execution was performed, within the provided environment of the ClearVote 2.4 system, to verify all modifications and pertinent requirements, as defined in "Attachment A – NYS Clear Ballot ClearVote 2.4 System Requirements Matrix w Test Cases.
This includes validation of the voting system in a true end-user environment, following all pre-election day, election day, and post-election day voting rules and processes. The intent is to provide verification that a system can be used to perform its job following the

exact set of processes and steps that would be used by the target customer or end-user.

The following types of system testing were not employed for ClearVote 2.4, as they were covered by EAC certification testing:

- Nominal Conditions
- Failure Injection
- Data Driven
- Usability
- Data Referential Integrity
- Regression
- Volume Test
- Stress Tests
- Accessibility Test
- Performance Tests
- Recovery

### Regression Testing

No Regression testing was performed, as no new Trusted Builds were performed during the ClearVote 2.4 examination, after the initial Trusted Build.

### Formal Functional Test Execution

SLI Compliance performed the Formal Functional Test Execution testing which included functional, NY Law verification applicable to the scope of the campaign, as per the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document and "Attachment A – NYS Clear Ballot D-Suite 5.16 Requirements Matrix w Test Cases". This is the formal functional test of the system to ensure that all Clear Ballot voting systems modifications work, and existing features work as expected.
See "NYSBOE Clear Ballot ClearVote 2.4 Functional Test Report" for details of functional testing performed.

### End to End

End to End testing was performed, utilizing General and Primary elections during the NYS ClearVote 2.4 examination, which encompassed system utilization from creating an election definition, preparing election media and artifacts, opening of polls, processing ballots, as well as the accumulation, adjudication, tallying and reporting of results.

### 3.2.8 Security Testing

SLI Compliance performed the Security testing applicable to the scope of the campaign, as per "Attachment A – NYS Clear Ballot D-Suite 5.16 Requirements Matrix w Test Cases" and the NYSBOE "Attachment B - Testing Approach for Clear Ballot ClearVote 2.4" document.
See "NYSBOE Clear Ballot ClearVote 2.4 Security Functional Test Report" for details of Security functional testing performed.

The following types of Security testing for ClearVote 2.4, utilized a combination of leveraging EAC certification testing in conjunction with SLI examination as per the approved testing approach (see section 1.6). Portions covered by SLI are listed below:

- Role
  - (Was examined as a part of the "Access" section of the penetration test, which included investigation Role-based access controls (RBAC))

- Access
  - (Was examined as a part of the “Access” section of the penetration test, which included a review of physical security)
- System Security
  - (Was examined to verify executable resilience against tampering as a part of the “Privilege Escalation” section of the penetration test)
- System Log
  - (Was examined as a part of the “Defense Evasion” section of the penetration test to verify file integrity)
- Audit Records
  - (Was examined as a part of the “Defense Evasion” section of the penetration test, which included tampering with logging processes)
- Software Security
  - (Was examined to verify that software files could not be modified and that unauthorized software was prevented from being installed on devices as a part of the “Execution” section of the penetration test)
- Threat Protection
  - (Was examined as a part of the “Execution” section of the penetration test, evaluating the susceptibility to malware)
- Audit Log
  - (Was examined as a part of the “Defense Evasion” section of the penetration test to modify or delete log files and data)
- Vote Count Integrity
  - (Was examined within the “Execution”, “Exfiltration”, and “Cryptography” sections of the penetration test)
- Data Protection
  - (Was examined within the “Execution”, “Exfiltration”, and “Cryptography” sections of the penetration test)
- External Access
  - (Was examined within the “Execution”, “Exfiltration”, and “Cryptography” sections of the penetration test)

### 3.2.9 Review for Known Vulnerabilities

Any known vulnerabilities provided by Clear Ballot Voting Systems are included in the Security testing process. All vulnerabilities are listed within the Security test report and associated attachments, including detailed vulnerability information and review of the potential for exploitation. For additional information, please review the ”NYSBOE Clear Ballot ClearVote 2.4 Security Functional Test Report”.

# 4 Conclusion

This section summarizes the conclusions for each of the areas of examination within this project.

This section details issues that were encountered during the project, listing the issues as “JIRA”s, where JIRA is the discrepancy tracking application utilized by SLI Compliance.

By the conclusion of this project, all issues, except for one, were resolved after delivery of updates or by consultation with the NYSBOE.

All specific details for each area can be found in the that areas specific test report and accompanying documentation.

## 4.1 TDP Review

SLI Compliance reviewed the ClearVote 2.4 TDP against the New York State Requirements and 6209 Election Law. During the course of review, SLI Compliance found 11 documentation issues during this documentation review. These requirement issues were documented in JIRA; CV24-1, CV24-2, CV24-3, CV24-4, CV24-5, CV24-6, CV24-7, CV24-8, CV24-9, CV24-10, CV24-48, CV24-64.

All issues were resolved with the submission of modified documentation.

All issues discovered during testing have been addressed and all Jira’s marked as resolved.
No open issues remain for this area of review.

Additional TDP Review details can be found in the “TDP Review for Clear Ballot ClearVote 2.4” and accompanying documentation.

## 4.2 Clear Ballot Voting Systems Functional Testing

SLI has completed functional testing of the **Clear Ballot ClearVote 2.4** system against the referenced 2005 VVSG and NY 2022 Election Law requirements. There were thirteen findings, JIRAs: CV24-16, CV24-19, CV24-20, CV24-21, CV24-23, CV24-25, CV24-33. CV24-34, CV24-37, CV24-44, CV24-49, CV24-50, CV24-51, CV24-52, CV24-57, CV24-59, CV24-60, CV24-61, CV24-62, CV24-63.

All Functional Jira issues have been resolved.

Additional Functional Testing details can be found in the “NYSBOE Clear Ballot ClearVote 2.4 Functional Test Report”, Attachment C – NYS Clear Ballot ClearVote 2.4 Functional JIRAs (Confidential) and accompanying documentation.

## 4.3 Hardware Testing

SLI has completed Hardware testing of the **Clear Ballot ClearVote 2.4 system** against the referenced 2005 VVSG and NY 2022 Election Law requirements, as per "SLI Testing Approach for Clear Ballot ClearVote 2.4".
All components of the ClearVote 2.4 system had all hardware requirements accepted from EAC certifications.
There are no open issues for this area of review.

## 4.4 Source Code Review

SLI has completed the source code review of the **Clear Ballot ClearVote 2.4 system** against the referenced 2005 VVSG, Clear Ballot Voting Systems declared standards and NY 2022 Election Law requirements, as per "SLI Testing Approach for Clear Ballot ClearVote 2.4".
No modified source code was found that could not be attributed to a listed modification.
No discrepancies were noted.

Additional Source Code Review details can be found in the "NYSBOE Clear Ballot ClearVote 2.4 Source Code Review Test Report" and accompanying documentation.

## 4.5 Security Source Code Review

SLI has completed the security source code review of the **Clear Ballot ClearVote 2.4** system against the referenced NY Election law, security concerns, and potential vulnerabilities. All findings resulting from the security source code review are included in this report and accompanying documentation.

Review of the findings resulted in determinations of potential vulnerabilities found. Manual review of those potential vulnerabilities determined these potential vulnerabilities would be exploitable only by a vendor insider attack.

No open issues remain for this area of review.

Additional Security Source Code Review details can be found in the "NYSBOE Clear Ballot ClearVote 2.4 Security Source Code Review Test Report" and accompanying documentation.

## 4.6 Security Functional Testing

SLI has completed Security functional testing of the **Clear Ballot ClearVote 2.4** system against the referenced 2005 VVSG and NY 2022 Election Law requirements. All findings are included in this report and accompanying documentation.
Fourteen documentation discrepancies were noted, CV24-18, CV24-22, CV24-27, CV24-28, CV24-29, CV24-30, CV24-35, CV24-41, CV24-42, CV24-43, CV24-53, CV24-54, CV24-56, CV24-58.
All Security documentation issues were resolved with updated documentation.

Ten Functional Discrepancies were noted, CV24-13, CV24-17, CV24-24, CV24-31, CV24-32, CV24-38, CV24-39, CV24-40, CV24-46, CV24-47.
All Security issues have been addressed.

All issues discovered during testing have been addressed and all Jira's marked as resolved.

No open issues remain for this area of review.

Additional detail is included in the "NYSBOE Clear Ballot ClearVote 2.4 Security Functional Test Report", Attachment C - NYS Clear Ballot ClearVote 2.4 Security Jira Issues (CONFIDENTIAL) and accompanying documentation.

End of Master Test Report

***Report:***

# Testing Oversight of Clear Ballot ClearVote 2.4

## Public Report v1

***Prepared for:***

NEW YORK STATE | Board of Elections

Amy Hild, Director of Election Operations
Thomas Connolly, Deputy Executive Director
Brendan Lovullo, Deputy Executive Director
New York State Board of Elections
40 North Pearl St.
Albany, NY 12207

6/26/2023

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NYSTEC
YOUR INDEPENDENT TECHNOLOGY ADVISOR

| ACRONYMS AND TERMS | |
|---|---|
| **ATI** | Audio Tactile Interface |
| **BMD** | Ballot Marking Device |
| **CMVP** | Cryptographic Module Validation Program |
| **COTS** | Commercial Off-the-Shelf |
| **EAC** | Election Assistance Commission |
| **EMS** | Election Management Software |
| **FIPS** | Federal Information Processing Standards |
| **GPO** | Group Policy Objects |
| **IoT** | Internet of Things |
| **LTSC** | Long-Term Servicing Channel |
| **NYSBOE** | New York State Board of Elections |
| **PDF** | Portable Document Format |
| **QA** | Quality Assurance |
| **SCA** | Software Composition Analysis |
| **SLI** | SLI Compliance, a Division of Gaming Laboratories International, LLC |
| **TDP** | Technical Data Package |
| **VVSG** | Voluntary Voting System Guidelines |

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# List of Tables

# 1 Introduction

The New York State Board of Elections (NYSBOE) asked NYSTEC, as a security expert, to perform an independent review of work conducted by SLI Compliance (SLI) for their testing of the ClearVote 2.4 electronic voting system. ClearVote 2.4 was developed by Clear Ballot for certification and use in New York State elections. NYSTEC was tasked with reviewing all deliverables produced by SLI, including functional, source code, and security test plans based on the federal 2005 Voluntary Voting System Guidelines (VVSG) and 2021 New York State voting laws and regulations. NYSTEC enlisted the services of Cyber Castellum, a security consulting firm, to review the system source code testing.

ClearVote 2.3 is U.S. Election Assistance Commission (EAC) certified. All modifications included in the ClearVote 2.4 system were fully tested against all VVSG and New York State requirements. Because the entire voting system would be used in New York State if certified, the testing scope included all devices and components of the system.

This report includes:

- A list of SLI deliverables reviewed.
- A breakdown of the work performed.

# 2 Executive Summary

SLI tested the functionality, security, and system documentation of the ClearVote 2.4 system, based on VVSG version 1.0 (2005) and New York State voting laws and regulations (2021). NYSTEC reviewed SLI's requirements mapping, test plans, discrepancies (referred to as JIRAs by SLI), and reports, as well as the code review report from Cyber Castellum. Based on those reviews, NYSTEC believes that SLI adequately tested the functionality and security of the system.

The scope of testing performed by SLI to evaluate the ClearVote 2.4 system included:

- All applicable 2021 New York State election laws.
- Section 6209 of Subtitle V of Title 9 of the Official Compilation of Codes, Rules, and Regulations of the State of New York.
- The EAC 2005 VVSG 1.0 (2005), Volume 1 and 2 requirements, per the NYSBOE-approved testing approach for the ClearVote 2.4 certification event.

All 2005 VVSG requirements that indicated "shall" (rather than "should") were previously tested for EAC certification and, therefore, were accepted and not repeated. NYSTEC did not review any testing conducted during EAC certification. As part of this testing, all 2005 VVSG requirements that indicated "should" were tested as if the "should" read as "shall."

## 2.1 Retests of ClearCount 2.2 Issues

Two issues found during the certification of ClearCount 2.2, a component of ClearVote 2.4 that was certified in a previous testing event and being tracked, were shown in this testing event to be resolved by Clear Ballot. Additionally, the software validation process in ClearCount 2.2 has been resolved.

## 2.2 NYSTEC Recommendations

NYSTEC has the following recommendations:

- Several issues were found by SLI during its review of the source code. The risk associated with these issues is being mitigated through controls present on the devices where the code is installed. As a best practice in software development, code should not rely on external environmental controls for security; therefore, NYSTEC recommends that Clear Ballot review these issues in their code and remediate, if necessary, in a future build. NYSBOE should keep track of these issues to ensure that they are resolved in any future versions brought to them for certification.
- The three open functional discrepancies (JIRAs) should be tracked and shown to be fixed in a future version.

## 2.3 Components in the ClearVote 2.4 System

According to the SLI report, "*The ClearVote 2.4 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.*"

System components include:

**ClearDesign Election Management Software (EMS)** – A set of applications that are responsible for all pre-voting and post-voting groups of activities in the process of defining and managing elections.

**ClearMark** – A standalone precinct level ballot marking device (BMD) that includes an audio tactile interface (ATI).

**ClearCast** – A scan precinct ballot counter (tabulator) that is used in conjunction with an external ballot box.

**ClearCount** – A high-speed, central ballot scanning system used for the high-volume processing of ballots.

# 3 SLI Testing

This section reviews the testing SLI performed on the ClearVote 2.4 system.

## 3.1 Documentation Review

### 3.1.1 Review of Prior Work

Prior work documentation lists the last certification date for each component of the system, to demonstrate which versions would need to be reviewed during the current testing event. This aided SLI in determining the scope of testing. NYSBOE's policy is to leverage all EAC testing for New York State such that any VVSG 1.0 (2005) requirement that indicated "shall" was accepted without evaluating test cases. NYSTEC reviewed SLI's assessment of prior work for the ClearVote 2.4 system and resolved with SLI all our questions. NYSTEC's final review, including all comments, is included in this report as Attachment A.

### 3.1.2 Technical Data Package (TDP) Review

The TDP review assesses the technical documentation submitted to NYS for this certification testing event. SLI worked with the vendor throughout the testing process to ensure that any updates needed — due to changes required to remediate issues found during testing — were included in the technical documentation. NYSTEC reviewed the final TDP submission and found no issues. NYSTEC's final review, including all comments, is included in this report as Attachment B.

### 3.1.3 Requirements Matrix

The requirements matrix is the foundation for this certification testing event, as it evaluates all VVSG 1.0 (2005) and New York State requirements against any modifications or prior work. This high-level assessment is then directly mapped to the master test plan, individual test plans, and — at the lowest

level — test cases. NYSTEC's final reviews, including all comments, are included in this report as Attachment C.

## 3.2 Test Plans and Reports

### 3.2.1 Master Test Plan and Report

The master test plan created by SLI used the determinations for planned testing from the requirements matrix (See Section 3.1.3, Requirements Matrix) to organize the requirements by type (functional, security, or source code). NYSTEC reviewed the master test plan with SLI over several rounds of discussion, and all issues and questions were resolved. NYSTEC's final review, including all comments, is included in this report as Attachment D.

Results from the testing prescribed by the master test plan were reviewed and identified no outstanding issues. NYSTEC's final review, including all comments, is included in this report as Attachment E.

### 3.2.2 Functional Testing

Functional testing aims to validate the system against requirements. Functional testing for this project was divided into two test plans, the functional test plan and the security functional test plan. SLI evaluated the ClearVote 2.4 system against all applicable New York State 2021 election law, §6209 Voting System Standards, and VVSG 1.0 (2005) requirements, per the testing approach approved by NYSBOE.

NYSTEC reviewed the functional test plan and agreed with all SLI assessments for that testing. All questions were resolved. NYSTEC's final review of the functional test plan, including all comments, is included in this report as Attachment F.

NYSTEC reviewed the functional test report and agreed with all SLI assessments for that testing. Questions were raised, and all were resolved. NYSTEC's final review of the functional test report is included as Attachment G.

NYSTEC reviewed the security functional test plan and agreed with all SLI assessments for that testing. Any testing plans that were too high-level were verified in the test cases for clarification. All questions were resolved. NYSTEC's final review, including all comments, is included in this report as Attachment H.

NYSTEC reviewed the security functional test report and agreed with all SLI assessments for that testing. Questions were raised regarding test cases, and all were resolved. NYSTEC's final review of the security functional test report, including all comments, is included in this report as Attachment I.

NYSTEC reviewed the security functional test cases. All questions were resolved. NYSTEC's final review, including all comments, is included in this report as Attachment J.

## 3.3 Source Code Reviews

### 3.3.1 Source Code Review Test Plans

Cyber Castellum completed a quality assurance (QA) review of SLI's source code review and security source code review test plans that evaluate the code base against New York State requirements.

### 3.3.2 Source Code Review Reports

Cyber Castellum completed a QA review of SLI's source code review report and security source code review report, and the resulting Cyber Castellum report is included in this report as Attachment M. SLI used an automated code scanning software, Checkmarx, which can quickly review large software packages with a customized configuration to check for coding standards and known security vulnerabilities. SLI properly selected all pertinent scans for the ClearVote 2.4 code base.

Checkmarx identified 617 potential vulnerabilities, but approximately 82% of findings were marked as "Not Exploitable." The remaining findings were added to a list of 109 potential vulnerabilities. SLI classified the exploit potential of those 109 potential vulnerabilities to require "extensive knowledge of the system or a vendor insider."

No JIRAs were created for those potential vulnerabilities, as many were judged to be false positives. The others — when examined within the context of the physical environment, implemented security controls, and knowledge required to exploit the issue — were assessed by SLI to not pose a significant threat to the ClearVote 2.4 system.

Cyber Castellum noted the shortcomings related to the following items as identified in the code review plans and reports delivered by SLI:

- Items marked by SLI as "Not Exploitable."
- Dependency checks.
- Quality of source code.

These shortcomings noted by Cyber Castellum were due to the distributed nature of the SLI testing process and the fact that Cyber Castellum did not see other parts of the overall testing performed by SLI. For an explanation of each shortcoming, see Sections 3.3.2.1, 3.3.2.2, and 3.3.2.3.

SLI did not use the Checkmarx software to scan installed commercial off-the-shelf (COTS) software code or libraries for known vulnerabilities, as that was out of scope. NYSTEC verified that SLI manually investigated for any known vulnerabilities for installed COTS software.

#### *3.3.2.1 Items Marked by SLI as "Not Exploitable"*

In its report, Cyber Castellum remarks about the number of findings that SLI labeled as "Not Exploitable."

> *"SLI has conducted triage of all vulnerabilities identified by Checkmarx. According to the triage conducted, over 82% are false positive, Not Exploitable. Thus, as a result, none of the vulnerabilities triaged were confirmed to be an issue. This is highly unlikely, as out of the 617 vulnerabilities triaged, not even a single vulnerability is confirmed."*

Cyber Castellum is interpreting the Checkmarx label "Not Exploitable" as being a true false positive. However, SLI defines "Not Exploitable" as:

> ***"Not Exploitable** – confirmed to be a false positive. Either compensating controls exist which the scanner missed or misinterpreted the context."*

Thus, the 508 (617 findings minus 109 potential vulnerabilities) findings are not necessarily false positives. SLI believes there are countermeasures in place to keep the vulnerabilities from being exploited by an attacker. NYSTEC agrees with Cyber Castellum's conclusion that, even though SLI believes the potential vulnerabilities are mitigated via external controls, Clear Ballot should review the findings and update the code as warranted.

#### *3.3.2.2 Dependency Checks*

In its report, Cyber Castellum discusses that tools to find publicly disclosed vulnerabilities of code were not used:

> *"There is no methodology or process documented in the SLI plans and/or reports for the identification of vulnerabilities in software dependencies. It was confirmed during a call with SLI that they do not have the rights to Checkmarx SCA and no other tool is utilized for the identification of vulnerabilities in software dependencies. The SLI reports do not include any vulnerabilities associated with dependency checks. However, a list of vulnerabilities associated with platform and libraries have been provided. Due to the lack of understanding of the methodology and process Cyber Castellum cannot validate the completeness of the list."*

SLI did not perform a known vulnerability review during source code testing but did during functional security testing. SLI's Security Functional Test Report v2.0 states:

> *"The known vulnerability database identifies all documented software libraries present within the TDP and provides results regarding known relevant vulnerabilities related to each software library. Some libraries may have dependencies upon others; however, each piece of software was individually investigated."*

Cyber Castellum was only given the source code review and security source code review reports and did not have access to the information on the known vulnerability testing by SLI. NYSTEC believes the known vulnerability approach taken by SLI is adequate. In addition, NYSTEC verified that SLI manually investigated for any known vulnerabilities for installed COTS software.

#### *3.3.2.3 Quality of Source Code*

In its report, Cyber Castellum outlined the quality of the source code:

> *"*The report that focused on the quality of the source code only identified four informational discrepancies, all due to code indentation the same as the function. No other code quality issues have been identified.*"*

Most of the source code quality issues relate to 2005 VVSG requirements, which were tested in the ClearVote 2.3 EAC Certification. As such, SLI performed a manual review of only higher risk VVSG requirements, which explains the low number of code quality findings.

# 4 Discrepancies

## 4.1 SLI Findings

In a code review, a discrepancy occurs when the source code does not meet defined requirements or specifications, does not function as intended, or allows a security breach. In all other testing, a discrepancy occurs when an element of the voting system does not meet defined functional or security requirements. The final count of open discrepancies reflects issues that were not addressed during the certification process and that remain in violation of requirements.

TABLE 1, COUNT OF ALL DISCREPANCIES REPORTED BY SLI

| | REPORTED TEST ISSUES (JIRAS) | SOURCE CODE | SECURITY SOURCE CODE (POTENTIAL VULNERABILITIES) | TOTAL |
|---|---|---|---|---|
| **Discrepancies found during testing** | 66 | 4 | 109 | 179 |
| **Open discrepancies** | 3 | 4 | 109 | 116 |

## 4.2 Open Discrepancies

As of the conclusion of this testing effort, there are three open functional discrepancies.

# 5 NYSTEC Activities

NYSTEC performed the following oversight activities for the testing conducted by SLI:

- Reviewed all deliverables supplied by SLI for this certification testing event. After review and consultation with the NYSBOE Operations Unit, NYSTEC sent comments and questions to SLI. SLI responded, and there were several iterations and discussions until all issues were resolved. NYSTEC reviewed the following SLI deliverables:
  - Requirements matrix.
  - Review of prior work.
  - TDP.
  - Master test plan.
  - Functional test plan.
  - Security functional test plan.
- NYSTEC brought in a subcontractor, Cyber Castellum, to perform a security QA review of the code review performed by SLI. Cyber Castellum reviewed the following SLI deliverables:
  - Source code review test plan.
  - Security source code review test plan.
  - Security source code review test cases.
  - Source code review test report.
  - Security source code review test report.

- NYSTEC reviewed the security functional test cases, and it appears that SLI sufficiently tested the system. Any issues found were discussed with SLI and resolved. SLI updated all corresponding deliverables.
- NYSTEC reviewed discrepancy reports from SLI as they were received and then worked with the NYSBOE Operations Unit, SLI, and Clear Ballot to resolve any discrepancies.
- NYSTEC reviewed all final reports from SLI:
  - Master test report.
  - Functional test report.
  - Security functional test report.

# 6 Documents Referenced

**TABLE 2, DOCUMENTS REFERENCED**

| SLI TEST PLANS, TEST CASES, AND REQUIREMENTS MAPPING |
|---|
| Evaluation of Prior Work for Clear Ballot ClearVote 2.4 v2.0.pdf. |
| TDP Review for Clear Ballot ClearVote 2.4.pdf:<br>• Attachment A – NYS Clear Ballot ClearVote 2.4 TDP List.pdf.<br>• Attachment B – NYS Clear Ballot ClearVote 2.4 TDP JIRAs (Confidential).pdf. |
| NYS ClearVote 2.4 Requirements Matrix v2.0.xlsx. |
| NYSBOE Clear Ballot ClearVote 24 Master Test Plan v1.0.pdf. |
| NYSBOE Clear Ballot ClearVote 2.4 Functional Test Plan v2.0.pdf. |
| NYSBOE Clear Ballot ClearVote 2.4 Security Functional Test Plan v2.0.pdf. |
| NY Clear Ballot ClearVote 2.4 Security Test Cases.xlsx. |
| NYSBOE Clear Ballot ClearVote 2.4 Source Code Review Test Plan v1.0.pdf.<br>NYSBOE Clear Ballot ClearVote 2.4 Security Source Code Review Test Plan v1.0.pdf. |
| **SLI TEST REPORTS** |
| NYSBOE Clear Ballot ClearVote 2.4 Functional Test Report v3.0.pdf:<br>• Attachment A – NYS Clear Ballot ClearVote 2.4 Requirements w Test Cases.xlsx.<br>• Attachment B – NYS Clear Ballot ClearVote 2.4 As Run Test Cases (Confidential). |

| |
|---|
| • Attachment C – NYS Clear Ballot ClearVote 2.4 Functional JIRAs (Confidential).pdf. |
| NYSBOE Clear Ballot ClearVote 2.4 Functional Security Test Report v3.0.pdf:<br>• Attachment A – NYS Clear Ballot ClearVote 2.4 Requirements w Test Cases.xlsx.<br>• Attachment B - NYS Clear Ballot ClearVote 2.4 Security Test Cases (Confidential).<br>• Attachment C - NYS Clear Ballot ClearVote 2.4 Security Jira Issues (Confidential).pdf.<br>• Attachment D - NYS Clear Ballot ClearVote 2.4 Security Test Artifacts (Confidential).<br>• Attachment E - NYS Clear Ballot ClearVote 2.4 Security Test Notebook (Confidential).pdf. |
| NY Clear Ballot ClearVote 2.4 Master Test Report v2.0.pdf:<br>• Attachment A – Clear Ballot ClearVote 2.4 NYS Voting Systems Requirements.xlsx.<br>• Attachment B - SLI Testing Approach for Clear Ballot ClearVote 2.4 - Finalized 12132022.pdf.<br>• Attachment C – NYS Clear Ballot ClearVote 2.4 Master JIRAs (Confidential).pdf. |
| NYSBOE Clear Ballot ClearVote 2.4 Source Code Review Test Report v2.0.pdf:<br>• Attachment A – Clear Ballot ClearVote 2.4 NYS Voting Systems Requirements.xlsx.<br>• Attachment B - ClearVote 2.4 List of Source code Reviewed (Confidential).<br>• Attachment C - Source Code Review Form Spreadsheets (Confidential).<br>• Attachment D - Source code Review Discrepancy Report Forms (Confidential).<br>• Attachment E - Source Code Review Test Cases.pdf.<br>• Attachment F - Clear Ballot Declared Standards.<br>NYSBOE Clear Ballot ClearVote 2.4 Security Source Code Review Test Report v2.0.pdf:<br>• Attachment A – Clear Ballot ClearVote 2.4 NYS Voting Systems Requirements.xlsx.<br>• Attachment B - ClearVote 2.4 List of Source code Reviewed (Confidential).<br>• Attachment C - Checkmarx Final Results (Confidential).<br>• Attachment D - Checkmarx Software Audit - Clear Ballot Responses (Confidential).<br>• Attachment E - Checkmarx Queries List.<br>• Attachment F - Checkmarx Informational Results (Confidential). |
| **REPORTS FROM NYSTEC SUBCONTRACTOR CYBER CASTELLUM** |
| ClearVote 2.4 Code Review Test Plan Comments - Final Draft v1.0.pdf. |
| Evaluation of SLI Clear Ballot Code Review Report.pdf. |

# 7 Attachments

A. Clear Ballot – Prior Work – NYSTEC Comments.pdf.

B. Clear Ballot – TDP Review – NYSTEC Comments.pdf.

C. Clear Ballot – NYS Requirements Matrix – NYSTEC Comments.pdf.

D. Clear Ballot – Master Test Plan – NYSTEC Comments.pdf.

E. Clear Ballot – Master Test Report – NYSTEC Comments.pdf.

F. Clear Ballot – Functional Test Plan – NYSTEC Comments.pdf.

G. Clear Ballot – Functional Test Report – NYSTEC Comments.pdf.

H. Clear Ballot – Security Functional Test Plan – NYSTEC Comments.pdf.

I. Clear Ballot – Security Functional Test Report – NYSTEC Comments.pdf.

J. Clear Ballot – Security Functional Test CASES – NYSTEC Comments.pdf.


Phone: (888) 969-7832
Email: nystec@nystec.com
Website: www.nystec.com

ROME
99 Otis Street, 2nd Floor
Rome, NY 13441

ALBANY
540 Broadway, 3rd Floor
Albany, NY 12207

NEW YORK CITY
27 West 24th St., Suite 901
New York, NY 10010