

Voting System Qualification Test Report
Dominion Voting Systems, Inc.
Sequoia WinEDS Release 4.0.175, Version 2

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Florida Department of State
Division of Elections
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Executive Summary

On June 4, 2015, Dominion Voting Systems, Inc. (DVSI) submitted an application requesting certification of Sequoia WinEDS Release 4.0.175, Version 2. This release is a modification of previously certified WinEDS Release 4.0.175, Version 1, approved on June 1, 2012. This modification includes:

- AVC EDGE direct recording equipment (DRE) touchscreen tabulator¹, firmware version 5.2.17

Version 2 makes a firmware change to the EDGE DRE to minimize machine set up issues on Election Day as reported in the last election cycle. Pollworkers were using an outdated procedure to set up the EDGE touchscreen tabulators on Election Day. This procedure resulted in the EDGE having to be completely reset and to replace the election media before the equipment could be used again. The firmware change allows the poll workers to continue to use their current procedure without having to undergo the reset and media replacement.

Additionally, based upon a special request by the Supervisor of Elections for Palm Beach County (which is one of only two counties still using the DVS' WinEDS system), the application was expanded to include software functionality that would facilitate the submission of election results in the uniform extensible markup language (XML) file format as required of all counties.

- WinEDS Florida State Export application, version 1.1.5

The Bureau of Voting Systems Certification (BVSC) conducted the qualification testing in five stages:

- First, replicate the readiness check with the current Version 1 EDGE firmware shutdown for the first voting session.
- Second, install the Version 2 upgrade for the new EDGE firmware and verify that it prevents the readiness check.
- Third, perform regression tests using Palm Beach County's 2014 General Election without any ancillary effects.
- Fourth, verify the Florida Export File satisfies the election night reporting and the precinct level election results using the extensible markup language (XML) file format.
- Fifth, verify compliance with standards for sound pressure level. Also included in this segment was a mass ballot count on the EDGE, which is required for any tabulator that undergoes a change in its firmware.

Testing for this iteration of the system, *DVSI - Sequoia WinEDS Release 4.0.175, Version 2*, occurred in the BVSC test laboratory in Tallahassee, Florida, in June 2015. This examination was a noticed event open to the public.

Qualification test results affirm that the *Sequoia WinEDS Release 4.0.175, Version 2*, meets the applicable requirements of the Florida Voting Systems Standards, Florida Statutes and Rules, and the Help America

¹ By 2020, ADA polling equipment must comply with Section 101.56075(3), Florida Statutes that in effect requires removal of direct recording electronic (DRE) tabulator.

Vote Act (HAVA) for usability and accessibility. BVSC therefore recommends the modified certification of the referenced voting system.

Introduction/System Overview

The “DVSI - Sequoia WinEDS Release 4.0.175, Version 2” is a modification to the EDGE firmware based on the existing certified “DVSI – Sequoia WinEDS Release 4.0.175, Version 1” voting system in the State of Florida. This system includes the existing version of the WinEDS election management system (EMS), the existing firmware for Optech Insight and Insight Plus, existing software for Optech 400-C, and the new firmware for the AVC EDGE DRE touchscreen tabulator. Since the EMS portion of this system is already certified and unaltered by the modification, this voting system did not require the full qualification test. Therefore, BVSC solely conducted a desktop review and test of the EDGE firmware that included regression testing, a mass ballot count, and a sound pressure level test conducted for informational purposes.

Background

On November 11, 2011, Sequoia WinEDS Release 4.0.175, Version 1 was submitted as an upgrade to WinEDS Release 3.1.077. Both releases are paper based voting systems that had only one element in compliance with the HAVA and ADA provisions for precinct voting: the AVC EDGE, a DRE². The 2011 voting system upgrade was necessary for Palm Beach County, which requires modeming with two or more precinct tabulators in a single precinct. That capability did not exist with WinEDS Release 3.1.077. DVSI provided this capability with the new Insight Listener software and the new election management software WinEDS 4.0.175, as well as the Optech Insight firmware. Thus, *DVSI - Sequoia WinEDS Release 4.0.175, Version 1* required a full qualification test, modem test, and mass ballot count tests, and was certified on June 1, 2012

The EDGE uses a results cartridge (i.e., PCMCIA memory card) that contains the election results, a yellow vote session activation button, a power on/off switch, and a poll open/close switch [Figure 1].



Figure 1 Backside of the AVC EDGE DRE with activation button, power switch, and poll switch

During 2012, Palm Beach County election staff encountered an operational issue with the EDGE that occurs with the first voting session. Staff applied the same procedure that had been used with prior

² By 2016, ADA polling equipment must comply with Section 101.56075(3), Florida Statutes that in effect requires removal of direct recording electronic (DRE) tabulator.

WinEDS Release 3.1.077. In that procedure when the first voting session is activated and when there is a need to cancel this first session, the poll worker turns off the EDGE unit while keeping the EDGE’s POLLS still open. Once the EDGE is turned on to clear the vote session, the EDGE produces a readiness check failed for file “v.bloc.PRE” and the EDGE becomes inoperative. Thus, there was a need for a reset and a replacement results cartridge. This situation can occur with the first voting session when a visual limited voter becomes lost in the voting session and needs to abandon the process, or the poll worker could cause an error with the first activation.

System Overview

The Sequoia voting system is a blended-based voting system that has a paper-based system with an element for compliance with HAVA provisions for accessibility voting using a DRE touchscreen. The voting system consists of an election management system (EMS) – the WinEDS; an optical scan precinct count tabulator—the Insight Plus (Insight); and an optical scan central count tabulator - the AVC 400C. The Insight tabulator is a scanner for use with marksense paper ballots. This tabulator can transmit the tabulated results from the precinct to the EMS server using an analog modem. The Optech 400-C tabulator is a high-speed scanner for use with marksense paper ballots. The EDGE is a precinct-count DRE touchscreen tabulator which, with the audio and visual-accessible voting functionality (AVC EDGE Audio Component) [Figure 3] enables a voter to cast an electronic “paperless” ballot using a computer screen for visual voting and/or audio voting with tactile interfaces using a keypad and connection to ear phones. The EDGE does not transmit the tabulated results from the precinct to the EMS server, since it does not have a modem capability.

The two EDGE units approved for use in Florida are the EDGE I and EDGE II. The location of the EDGE I results cartridge is at the rear base of the tabulator. The EDGE II results cartridge is located on the back of the touch screen display. Currently, the EDGE I DREs [Figure 2] are still used in only two Florida counties (Indian River and Palm Beach counties).



Figure 2 AVC EDGE I



Figure 3 AVC EDGE Audio Component

Components under Review

Because the EMS portion of the voting system under test is already certified (*Sequoia WinEDS Release 4.0.175, Version 1*), testing was focused on the modified EDGE firmware and associated functionality. This review included test activities to verify that the modification to the EDGE firmware functioned as indicated by the vendor, as well as regression testing to ensure that the change did not affect the voting system's previously verified compliance with applicable Florida Statutes, Administrative Rules, and Standards. In addition, the voting system was examined for election night reporting and the precinct-level election results using Florida's schema for XML file format.

The EDGE touchscreen tabulator required a firmware change to prevent a readiness check that requires a shut down and prevent further ballot activation on the first voting session. In Version 1, poll workers were using an older EDGE process that caused the readiness check to require the EDGE shut down whenever there is a need to cancel the first voting session. That procedure would allow the poll worker to turn off the EDGE without closing the polls and activate the new voting system once the EDGE is turned on and use the yellow activate button on the back of the EDGE. In this situation, the EDGE would need a reset along with a replacement election media (a.k.a., results cartridge). The Version 2 EDGE firmware change allows the poll worker to continue with their current method or use the activate button to cancel the voting session.

Conduct of Tests / Findings

As the vendor's application is for certification of a modification to an existing certified voting system, only the modified components and functionality required testing. The test objective included the examination of the EDGE firmware version 5.2.17. Qualification examination included regression testing and mass ballot count test for the EDGE. The components and functionality that have not changed from Version 1 did not need to undergo testing, except as it supports and informs the testing of the modified component. Furthermore, BVSC examined a new reporting module, Florida State Export application version 1.1.5, to support XML reporting functionality for election night reporting and precinct-level election results.

Physical Audit

BVSC conducted a physical audit to verify that the voting system under test matched the specifications described in the application and the Technical Data Package (TDP) documentation.

Findings:

BVSC found no discrepancies with the setup of the Sequoia voting system configuration, or with the firmware update on the EDGE DRE touchscreen tabulator.

Functional System Audit

BVSC conducted a functional system audit to verify that all components of the voting system operate as described in the technical data package (TDP).

Voting Equipment Menus – Administrative and Diagnostic Reports

BVSC performed a functional audit by testing available menu options and administrative reports as well as systems functions in the course of testing.

Findings:

The system performed as indicated in the vendor’s TDP and in accordance with the Florida Voting Systems Standards (FVSS), Florida Statutes, and Administrative Rules.

Mock Elections

BVSC conducted a mock election incorporating the modified EDGE firmware. BVSC used Palm Beach County’s 2014 General Election. The tests included those cast via the accessible voting session on the EDGE. BVSC simulated an election using the EDGE, from initial preparations and Logic & Accuracy (pre-election activities) through voting (election activities). Also, BVSC used Palm Beach County’s 2014 Primary and General Elections incorporating the Florida State Export application version 1.1.5 to produce election night and precinct level reporting using Florida’s XML schema.

Pre-Election Activities

Pre-election activities included using Palm Beach County’s 2014 General Election, preparing the election media, preparing and validating the expected results, and preparing the voting equipment.

Election Activities

Election activities included opening polls, casting ballots using test decks and closing polls.

Post-Election and Reporting Activities

BVSC used Palm Beach County 2014 Primary and General Elections for election night reporting and precinct-level results. Testing included election results by election group: Early Voting, Election Day, Absentee, and provisional voting utilizing the Florida State Export application.

Findings:

The voting system performed as indicated in the vendor’s TDP and in accordance with FVSS, Florida Statutes, and Administrative Rules. The Florida State Export application satisfies Florida’s XML schema.

Mass Ballot Count – AVC EDGE DRE Tabulator

As the firmware for the EDGE was upgraded from the previous certified version, BVSC conducted a mass ballot count on the EDGE tabulator, using the Palm Beach County 2014 General Election database. The minimum requirement was a ballot count of 9,900 ballots on a single scanner. Staff used an automated test script that produce 12,663 ballots.

Findings:

The EDGE met the acceptance criteria for the precinct scanner mass ballot count as shown in table below:

Table 1. Acceptance criteria for EDGE

ICE Mass Ballot Count – Acceptance Criteria	Expected	Accepted
Did the memory registers overflow?	No	✓
Did the public counters increment appropriately?	Yes	✓
Did the tabulated results agree with predetermined vote totals?	Yes	✓
Number of errors (must not exceed 1 in 1,000,000 vote targets). An error is defined as a target scan that produces a result other than the expected result.	≤ 1/1M vote targets	✓
Number of multiple feeds (must not exceed 1 in 5,000 ballots). A multiple feed occurs when the machine pulls multiple ballots and does not “catch” the error.	≤ 1/5K ballots	✓
Number of incorrect rejections of ballots (must not exceed 3%)	≤ 3% total ballots	✓

Accessibility – Sound Pressure Level

BVSC conducted an information-only test for the sound pressure level on the EDGE to show that it continues to satisfies section 101.56062(1)(g-i), F.S.

BVSC used an ITU-T P.50³ test signal, which it incorporated into an election definition. The test signal replaced the initial sound file normally heard by a voter at the beginning of an accessible voting session. The election definition played the test signal as a loop. BVSC took all sound pressure level measurements after the elapse of a complete loop to capture instrument readings across the entire loop.

³ ITU-T P.50 - “ITU-T” is the telecommunication standardization sector of the “ITU,” which is the International Telecommunication Union. ITU is a United Nations specialized agency for information and communication technologies. The “P.50” represents one of their “P Series” objective transmission standards/measures used for testing the transmission quality of artificial voices.

The test equipment included a Type I IEC 318⁴ Brüel & Kjaer Artificial Ear, a Brüel & Kjaer Pressure-field ½-inch microphone (Type 4192), and Brüel & Kjaer model 2250-A analyzer⁵. BVSC conducted the test using the commercial off-the-shelf (COTS) headphones provided by the vendor.

Findings:

BVSC determined the default volume and number of increments from the minimum to the maximum audio level have a total 14 incremental steps. There are two small black buttons below the ‘Volume’ and two small buttons below the ‘Speed’. [Figure 4] The default volume is 7 steps above the minimum level and there are 7 steps from the default volume to the maximum. Note that the lowest test signal level was at the quiet room (i.e., background noise) that is not perceived by the voter. Further, BVSC believes that the majority of the 7 low volume steps produce a noise that cannot be perceived by the voter. Thus, BVSC used the default volume as the minimum level for this SPL test.



Figure 4 AVC EDGE keyboard

BVSC found that the EDGE complies with the applicable statute. The results of the sound pressure level tests for the EDGE are in the table below:

Table 2. Sound pressure level test results – ICE

Sound Pressure Level Test Results – EDGE				
	Average Maximum Volume (dBA) ⁶	Average Minimum Volume (dBA)	Gain (dB) ⁷	Intermediate Level (dBA) ⁸
Right Headphone	97.40	63.46	33.94	78.30
Left Headphone	101.32	67.46	33.86	82.20

⁴ IEC - International Electrotechnical Commission. IEC 318 is a measure used for ear simulators as defined in ITU-T P-Series standards.

⁵ Brüel & Kjaer 2250 Analyzer - A hand-held analyzer and sound level meter that performs high-precision measurement tasks in environmental, occupational, and industrial application areas. The manufacturer calibrated all equipment used in this test within the recommended calibration timeframes.

⁶ Must be greater than 97 dB (decibels weighted).

⁷ Maximum volume minus minimum volume. Must be greater than 20 dB.

⁸ Must be between (Minimum volume + 12 dB) and 97 dB.

Source Code Review

A review of the source code for the EDGE touchscreen tabulator occurred during BVSC's witnessed build that occurred in Denver, CO from May 11 to 13, 2015. This review showed that the change in the code satisfies the remedy to prevent the shutdown.

BVSC performed a manual review of the changes in the source code and found the changes are acceptable.

Findings:

BVSC determined that the source code posed no significant safety, security, or operational risks.

Continuous Improvement / Recommendations

During testing, staff encountered no issues that prevent recommendation for certification of the *Sequoia WinEDS Release 4.0.175, Version 2* voting system.

Conclusion

Qualification test results affirm that *Sequoia WinEDS Release 4.0.175, Version 2*, met applicable requirements of the Florida Voting Systems Standards, Florida Statutes and Rules, and the Help America Vote Act (HAVA) for usability and accessibility. The Florida Division of Elections, Bureau of Voting Systems Certification, therefore, recommends certification of the referenced voting system.

Appendices

Acronyms

ADA	Americans with Disabilities Act
AVC	Automatic Voting Computer
AVC EDGE I and II	DRE touchscreen tabulator
BVSC	Bureau of Voting Systems Certification (Florida Dept. of State, Division of Elections)
COTS	Commercial off-the-shelf
DOE	Division of Elections (Florida Dept. of State)
Dominion	Dominion Voting Systems, Inc.
DOS	Florida Department of State
DRE	Direct Recording Electronic voting machine
DVSI	Dominion Voting Systems, Inc.
EDGE	AVC EDGE I and II DRE
EMS	Election Management System
FVSS	Florida Voting Systems Standards
HAVA	Help America Vote Act
Insight	Optech Insight and Optech Insight Plus optical scan tabulator
Keypad	EDGE Audio Voting Accessory 5.2
Optech	Product line of ballot scanners originally from Business Records Corporation
Optech 400-C	Paper-based high speed central count tabulator
Optech Insight Plus	Paper-based precinct count tabulator
SPL	Sound Pressure Level
TDP	Technical Data Package
Version 1	Sequoia WinEDS Release 4.0.175 Version 1, already certified
Version 2	Sequoia WinEDS Release 4.0.175 Version 2, system under test for EDGE upgrade
WinEDS	Sequoia EMS
Witness Build	An audited compilation environment that a trusted person who witness the chain of evidence from the TDP and source code for creating the actual computer programs that will be evaluated for certification.
XML	Extensible Markup Language

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