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Test Report for EAC 2005 VVSG Certification Testing
Unisyn Voting Solutions OpenElect® 2.0.A Voting System

EAC Project Number: UNS1704

Version: Initial

Date: 4/16/18

EAC Lab Code 1501

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SIGNATURES

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REVISIONS

Revision	Description	Date
NR	Initial Release	4/16/18

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1.0 INTRODUCTION

The purpose of this Test Report is to document the procedures that Pro V&V, Inc. followed to perform certification testing during a system modification campaign for the Unisyn Voting Solutions OpenElect Voting System (OVS) Version 2.0.A to the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Certification testing of the OVS Version 2.0.A Voting System submitted for evaluation was performed to ensure the applicable requirements of the EAC 2005 VVSG and the EAC Testing and Certification Program Manual, Version 2.0, were met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test were incorporated in the test campaign

Prior to submitting the voting system for testing, Unisyn submitted an application package to the EAC for certification of the OpenElect 2.0.A Voting System. The application was accepted by the EAC and the project was assigned the unique Project Number of UNS1704.

1.1 Description and Overview of EAC Certified System Being Modified

The EAC Certified System that is the baseline for the submitted modification is described in the following subsections. All information presented was derived from the previous Certification Test Report, the EAC Certificate of Conformance and/or the System Overview.

The OVS 2.0 is a paper ballot voting system using touch screen and scan technology to scan and validate ballots, provide voter assisted ballots to accommodate voters with special needs, and tabulate results. The OCS, FVT, OVO, OVI-VC, and OVCS components of the OVS 2.0.A have previously been tested as part of the OVS 2.0 test campaign.

The OVS 2.0 consists of the following major components:

- **OpenElect Central Suite (OCS)**
- **OpenElect Voting Optical (OVO)**
- **OpenElect Voting Interface – Vote Center (OVI-VC)**
- **FreedomVote Tablet (FVT)**
- **OpenElect Voting Central Scan (OVCS)**

The OVO, FVT, and OVI-VC are the OVS components designed to accept voter input. The FVT and OVI-VC are the OVS ballot marking devices (BMDs). The OVO can collect and tally precinct votes, generate reports, and store election data internally. The OVCS is the bulk scanner used for mail-in ballots, provisional ballots, and recounts.

Open Elect Central Suite (OCS)

The OCS System supports elections on the OVO, OVI-VC, FVT, and OVCS systems. The Election Management System (EMS) consists of the following components running as either a front-end/client application or as a back-end/server application:

Ballot Layout Manager (BLM) – uses a database to create and store precinct and district information and an interface to create, check, translate, and produce the ballot styles needed by a jurisdiction for an election. The BLM output is printer ready artwork of all ballots in all languages and the Unisyn election definition file.

Election Manager (EM) – converts the Unisyn election definition file to a Unisyn-specific XML format and prepares compressed, encrypted election files for output to CD or USB. The EM allows the jurisdiction to add voting device specific options for elections, i.e. whether to check the contests for undervotes, and whether to allow or disallow certain features such as sounds, party icons, reports, etc. The EM also creates and manages Supervisor and Maintenance technician logins and passwords.

Election Server (ES) – loads the correct system time on the voting devices and uses the Election Definition created by the EM to download new election data, via a closed and secure network, to OVS voting devices.

Tabulator Client (TC) – retrieves vote files and ballot images from a Transport Media (TM) device (USB), stores them on its disk, and transfers the files to the Tabulator and notifies the Tabulator that a new file is present.

Tabulator (Tab) – receives and validates uploaded voting data and provides a status of uploaded files as well as handling Rank Choice Voting (RCV) functionality. It also updates the database with adjudicated ballots from the Auditor application. The Tabulator maintains the Tabulator database, which stores the results from all precincts.

Auditor – accesses ballot images and data from the OVCS and TC PCs to allow jurisdiction personnel to evaluate ballots with questionable or erroneous marks and change votes in accordance to the voter's perceived intent. The Auditor can also be used to process write-in. votes. All changes uploaded to the Tabulator database and actions are password controlled.

Tabulator Reports (TR) – accesses data from the Tabulator database to generate the necessary reports

Additionally, the OCS includes the Software Server (SS) system for updating and validating the software on the OVO and the OVI-VC voting devices. The FVT's software is updated manually via a USB thumb drive.

OpenElect Voting Optical (OVO)

The OVO is a full-page dual-sided optical scan precinct scanner that scans and validates voter ballot pages and provides a summary of all ballot pages cast. The election is loaded from the OVS Election Server over a secure local network or from the TM.

On Election Day, an OVO at each poll location scans and validates voters' ballots, and provides precinct tabulation and reporting. The OVO runs Logic Tests and Training Elections in addition to General and Primary Elections. A Software Server utility is provided to update the OVO with the current level of certificated software. The OVO unit can also paired with OVI-VC and FVT units for early voting to scan and tabulate early voting ballots and election support at voting centers.

OVO units can be used at election headquarters to read absentee, provisional or recount ballots in smaller jurisdictions.

The OVO consists of the following components:

- **Personal Computer (PC) -** Computer component (with a touch panel display) has pre-installed server software (that manages data and communication) and client software that provides a user interface for voting and maintenance. A new election loaded via the Election Server or manually via a Transport Media (TM) sets passwords, parameters, and ballot styles for that election. (Valid ballots for a poll location are reinitialized or set on Election Day startup by scanning a ballot header card).
- **Transport Media (TM)** – 1 GB or larger USB thumb drive that provides the means of transporting audit, optional ballot page images and results files from the precinct on Election Night to Election Headquarters where the central count system resides.
- **Ballot Reader -** Dual-sided scanner connected to the PC to scan data from marked ballot pages. The Ballot Reader ejects accepted ballot pages into an attached ballot box or rejects unaccepted ballot pages back out to the voter.
- **Printer -** 58 mm thermal receipt printer connected to the PC to print voter receipts and reports at the OVO.
- **UPS** - Uninterruptible power supply is provided as part of the system.

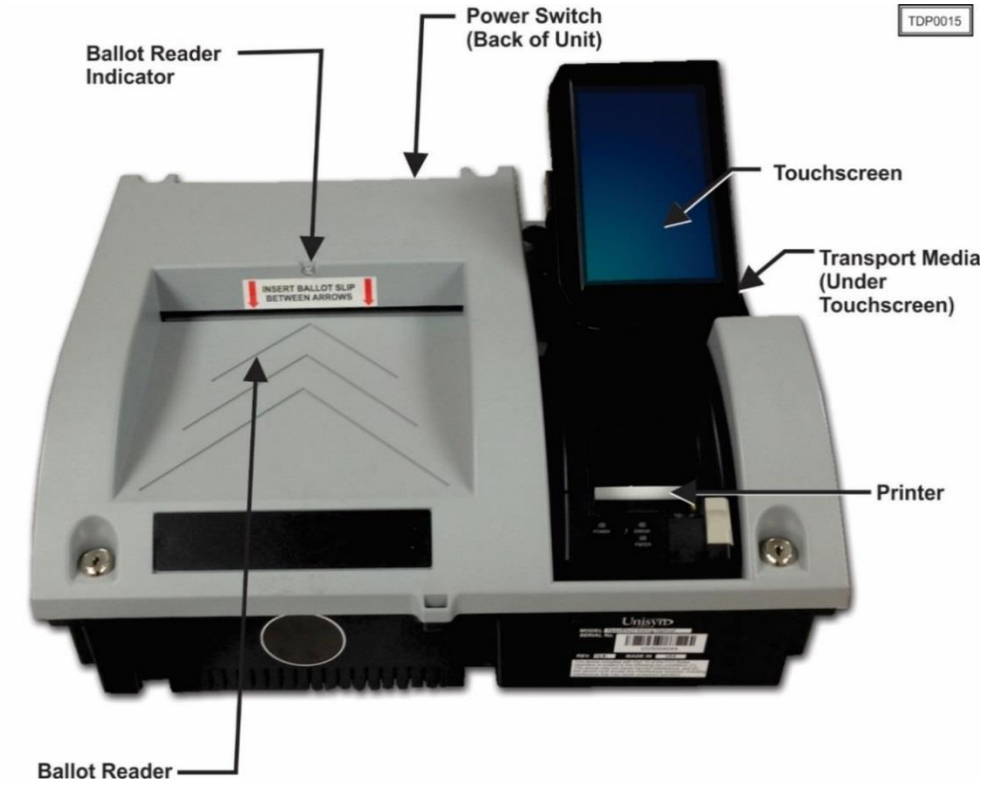

Figure 1-1. OVO

OpenElect Voting Interface – Vote Center (OVI-VC)

The OVI-VC is a ballot marking device (BMD) that supports both ADA and Regional Early Voting requirements. The OVI-VC has a 15-inch display and is equipped to assist voters, with varying abilities, to prepare their ballots independently and privately. It presents each contest on the correct ballot to the voter in visual and, if needed, audio formats. The OVI-VC gives voters the option to use an audio ballot, ADA keypad, sip and puff binary device, and touchscreen with varying font sizes to make their selections. Once the voter has made their selections, they are prompted to review their ballot selections. After the validation process is complete, the OVI-VC then prints the ballot and the voter inserts it into the OVO to cast their vote. When authorized, the OVI-VC provides for write-in candidates.

Each OVI-VC can support multiple languages for both visual and audio ballots, allowing the voter to choose their preferred language.

The OVI-VC consists of the following components:

- **Personal Computer (PC)** - Computer component (with a touch panel display) has pre-installed server software that manages data and communication and client software that provides user interfaces for voting and maintenance. A new election loaded via the Election Server or manually via a Transport Media (TM) sets passwords, parameters, audio, and ballot styles for that election.

- **Transport Media (TM)** - USB device with 1 GB or larger storage provides the means of transporting audit files to the OCS system.
- **Printer –** 82.5 mm thermal receipt printer is connected to the PC to print BMD Ballots and reports at the OVI-VC.
- **UPS** - Uninterruptible power supply is provided as part of the system.

Figure 1-2. OVI-VC

FreedomVote Tablet (FVT)

The FVT is a tablet ballot marking device that enables voters to make their vote selections and to print their voted ballot. It can be used on Election Day or during an early voting period. Like the OVI-VC, the FVT is ADA compliant. It assists voters, with varying levels of ability, through the voting process, ballot review, and printing functions. The FVT presents each contest on the ballot style to the voter in visual and/or audio formats. It facilitates special needs voters through a variety of methods including wheelchair access, sip and puff, zoom-in ballot function and audio assistance for the visually impaired. The voter with limited vision can navigate through the ballot using an audio ballot and the ADA keypad or touchscreen to input their selections. Once the ballot is printed, it is taken to the OVO to be cast. Each FVT can support multiple languages for both visual and audio ballots, allowing the voter to choose their preferred language.

The FVT consists of the following components:

- **Tablet** – The Android tablet has a 13.3 in. touchscreen and comes with pre-installed software that provides user interfaces for voting and maintenance. Election files generated by the EM are loaded manually via a USB. The election files will allow the jurisdiction to determine the FVT's mode such as early voting or training, sets passwords, parameters, audio, and ballot styles for that election.
- **Barcode Reader -** 2D USB Barcode reader will read the 2D barcodes produced by the EM such as the initialize barcode and administrative/maintenance barcodes. It will also read the 'populate' barcode produced by other qualified systems.
- **USB Hub –** A four port USB hub is installed in the FVT case to connect the printer, barcode scanner, and keypad to the tablet.
- **Printer –** 82.5 mm thermal receipt printer is connected to the Tablet to print BMD ballots and reports.
- **Optional ADA Devices** – 10-key keypad with Sip and Puff Interface, Headphones, Sip and Puff Device.

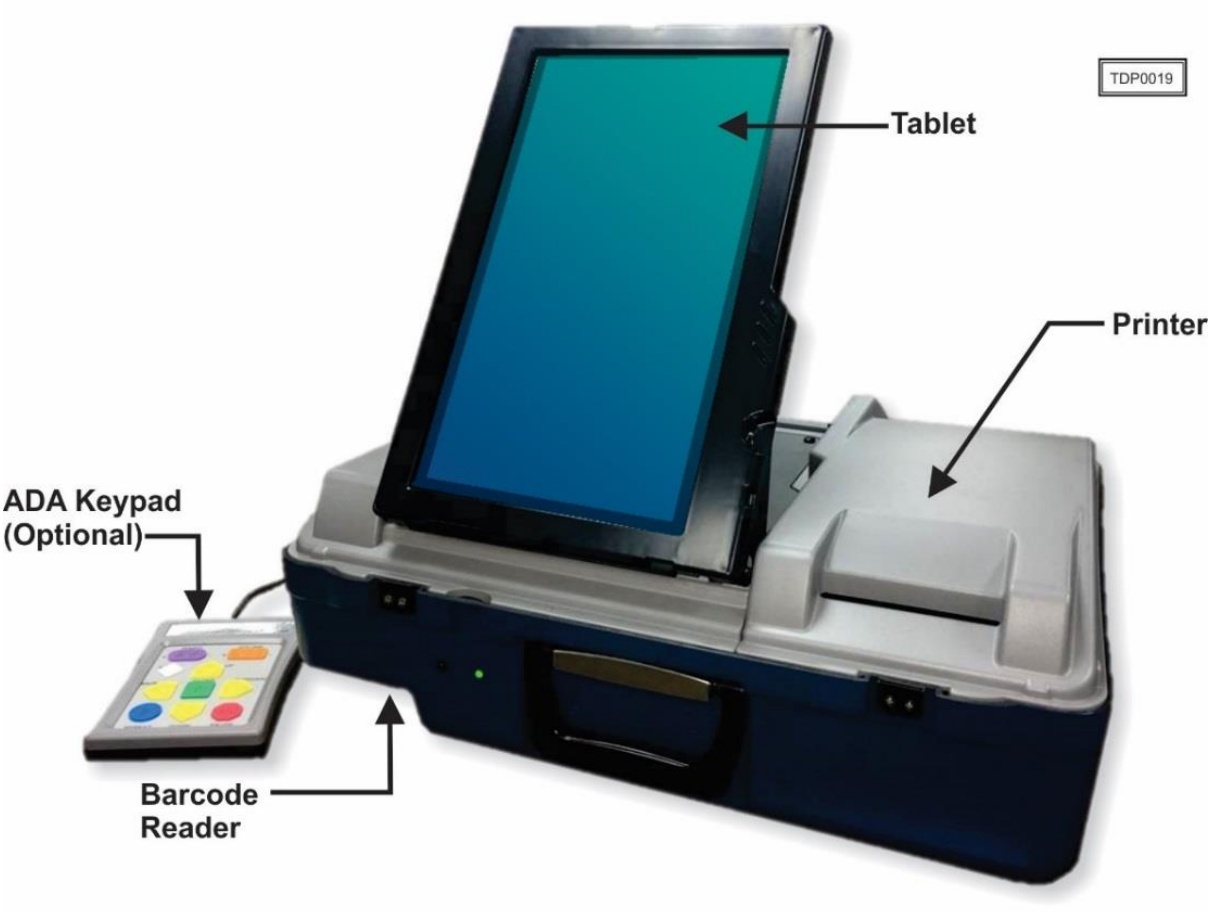

Figure 1-3. FVT

OpenElect Voting Central Scan (OVCS)

The OVCS units reside at election headquarters designated to read absentee, provisional or recount ballots in large jurisdictions or read the entire election's ballots at a central count location in smaller jurisdictions. The OVCS also captures Write-In data images and produces a Write-In image report for manual processing upon request. The OVCS system consists of the following components:

- **PC Desktop** – A desktop PC configuration with the following minimum characteristics:
  - PC: 1.8 GHz Processor, 2 GB RAM, 250GB (or larger) Hard Drive, USB Ports, Network Interface Port (Ethernet), CDRW/DVD, Video Port
  - 16:9 LCD
  - Keyboard and Mouse
- **Bulk Scanner** – A dual-sided scanner (either Canon model DR-M160II or model DR-X10C) that is connected to the PC to scan data from marked ballots.

Figure 1-4. OVCS

1.1.1 Details of System Tested

This subsection lists the proprietary and COTS software to be provided by the manufacturer as part of the test campaign.

The system tested for this test campaign was the Unisyn OVS 2.0.A Voting System. The following tables provide details of the 2.0.A system and its components.

Table 1-1. OVS 2.0.A COTS Software Components

FVT, OVO and OVI-VC Device Software	Version
CentOS Linux (OVO and OVI-VC)	6.3
Java JRE + Unlimited Cryptographic Extension	1.6.0_02
Android OS (FVT)	4.4.4

Table 1-2. OCS and OVCS COTS Software Components

OCS and OVCS Device Software	Version
CentOS Linux	6.5 and 6.8
Java JRE + Unlimited Cryptographic Extension	1.6.0_02
Apache-Tomcat Application Server	6.0.13
MySQL Database (BLM, EM, A, and Tab only)	5.0.45-7
JasperReports	2.0.5

Table 1-3. Voting System COTS Hardware

Hardware	Make	Model
OVO		
Duplex Ballot Scanner		
Duplex Ballot Scanner	PDI Scan	Pagescan III
Scanner Power Adapter	eUrasia Power	uA36-1024
58 mm Thermal Printer		
58 mm Thermal Printer	Citizen Printer	CT-5281
Printer Power Adapter	Citizen Printer	28AD4
Computer		
Chassis	Morex	Morex 2699
Power Adapter	DC/DC converter	MX-0608F
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	3120-21282
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120

Table 1-3. Voting System COTS Hardware *(continued)*

Hardware	Make	Model
1 Gb USB TM		
Innodisk	1 Gb USB	DEUA1-01G172AC1SB-B088
Delkin	1 Gb USB	SLC-MLC
7" LCD Touchscreen Display		
7" LCD Touchscreen Display	Xenarc Technologies	700TSV
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
OVI-VC		
Sip and Puff (Optional)		
Sip and Puff (Optional)	Origin Instruments	AirVoter
Headphone (Optional)		
Headphone (Optional)	Koss On-Ear Headphones	KPH5
15 in LCD Touchscreen Display		
15 in LCD Touchscreen Display	GVision	P15BX 2450-30120
82.5 mm Thermal Printer		
82.5 mm Thermal Printer	Star	TSP743IID-24, serial interface
Printer Adapter	Star	PS60A-24B 1
Computer		
Power Adapter Kit	DC-DC Converter	MX-0608F
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	3120-21282
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120
1 Gb USB TM		
Innodisck	1 Gb USB	DEUA1-01G172AC1SB-B088
Delkin	1 Gb USB	SLC-MLC
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
OVCS		
Large Volume Scanner		
Large Volume Scanner	Cannon	DR-X10C
Desktop Scanner		
Desktop Scanner	Cannon	DR-M160II
FVT		
13.3 in Touchscreen Tablet		
13.3 in Touchscreen Tablet	Android Tablet	GVision - T13
Tablets Battery Charger	Sager Power System	GC30B-4P1J
82.5 mm Thermal Printer		
82.5 mm Thermal Printer	Star	TSP743IIU-24
Printer Adapter	Lind 60W 24VDC	ST2425-626

Table 1-3. Voting System COTS Hardware *(continued)*

Hardware	Make	Model
Barcode Reader 1D,2D series		
Barcode Reader 1D,2D series	Newland	FM420
USB Hub		
USB Hub	Tripp Lite	USB Hub
Hub Adapter	Meanwell	PSD-15A-05
1 Gb USB TM		
Innodisck	1 Gb USB	DEUA1-01G172AC1SB-B088
Delkin	1 Gb USB	SLC-MLC
Micro SD		
Micro SD	Innodisk Industrial	Micro SD 2.0
Battery		
Battery Pack 12 V 6.0 AH	Powers Sonic	PSH-1255-FR
Adapter	Mean Well	GC30B-4PIL
AC Power In Module		
AC Power In Module	Delta	Emi 10BEEG3G
Sip and Puff (Optional)		
Sip and Puff	Origin Instruments	AirVoter
Headphone (Optional)		
Headphone	Cyber Acoustics	ACM-70
USB to Ethernet RJ45 Adapter (Optional)		
USB to Ethernet RJ45 Adapter	D-Link	DUB-E100
UPS		
Minuteman Power Technologies	Para Systems, Inc.	Entrust

Table 1-4. OVCS System COTS Software Components

OVS Hardware	Version
Desktop for non-redundant solutions	Dell OptiPlex
Desktop for redundant solutions	Dell Precision
Canon Scanner (OVCS)	Canon DR-X10C or DR-M160II
Laptop	Dell Latitude

1.2 References

- Election Assistance Commission 2005 Voluntary Voting System Guidelines (VVSG) Version 1.0, Volume I, "Voting System Performance Guidelines", and Volume II, "National Certification Testing Guidelines"
- Election Assistance Commission Testing and Certification Program Manual, Version 2.0
- Election Assistance Commission Voting System Test Laboratory Program Manual, Version 2.0

- National Voluntary Laboratory Accreditation Program NIST Handbook 150, 2016 Edition, "NVLAP Procedures and General Requirements (NIST HB 150-2016)", dated July 2016
- National Voluntary Laboratory Accreditation Program NIST Handbook 150-22, 2008 Edition, "Voting System Testing (NIST Handbook 150-22)", dated May 2008
- United States 107th Congress Help America Vote Act (HAVA) of 2002 (Public Law 107-252), dated October 2002
- Pro V&V, Inc. Quality Assurance Manual, Revision 7.0
- Election Assistance Commission "Approval of Voting System Testing Application Package" letter dated January 25, 2017
- EAC Requests for Interpretation (RFI) (listed on www.eac.gov)
- EAC Notices of Clarification (NOC) (listed on www.eac.gov)
- Pro V&V Test Report No. TR-01-01-UNI-002-01.01 Rev. B, "Test Report for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.0 Voting System"
- Unisyn Voting Solutions Technical Data Package *(A listing of the OpenElect 2.0.A documents submitted for this test campaign is listed in Section 4.6 of this Test Plan)*

1.3 Terms and Abbreviations

This subsection lists terms and abbreviations relevant to the hardware, the software, or this Test Plan.

"ADA" – Americans with Disabilities Act 1990

"BLM" – Ballot Layout Manager

"BMD" – Ballot Marking Device

"CM" – Configuration Management

"COTS" – Commercial Off-The-Shelf

"DRE" – Direct Record Electronic

"EAC" – United States Election Assistance Commission

"EM" – Election Manager

"EMS" – Election Management System

"EOS" - Election Operating System

"ES" – Election Server

"FCA" – Functional Configuration Audit

"FVT" – FreedomVote Tablet

"LAT" – Logic and Accuracy Test

"NOC" – Notice of Clarification

"OCS" – OpenElect Central Suite

"OVCS" – OpenElect Voting Central Scan

"OVI-VC" – OpenElect Voting Interface – Vote Center

"OVO" – OpenElect Voting Optical

"OVS" – OpenElect Voting System

"PC" – Personal Computer

"PCA" – Physical Configuration Audit

"QA" – Quality Assurance

"RFI" – Request for Interpretation

"RCV" – Rank Choice Voting

"SS" – Software Server

"TC" – Tabulator Client

"TDP" – Technical Data Package

"TM" – Transport Media (USB Thumb Drive)

"TR" – Tabulator Reports

"UPS" – Uninterruptible Power Supply

"VSTL" – Voting System Test Laboratory

"VVSG" – Voluntary Voting System Guidelines

2.0 CERTIFICATION TEST BACKGROUND

2.1 Revision History

The OVS 2.0.A Voting System is a modified voting system configuration that introduces OpenVPN to the certified OVS 2.0 system configuration. OpenVPN was included to provide FIPS 140-2 compliant cryptographic protection to OCS telecommunications. OVS 2.0.A also includes additional modifications/enhancements.

2.2 Scope of Testing

Testing from the previous test campaign was used to establish the baseline. The focus of this test campaign was on the introduction of OpenVPN as the validated cryptographic module to secure OCS telecommunications FIPS 140-2 validated modules and the modifications/enhancements implemented since the previous test campaign. The following tasks were required to verify compliance of the modifications:

- Source Code Review, Compliance Build, Trusted Build, and Build Document Review
- System Integration Testing
- Limited Technical Documentation Package (TDP) Review
- Limited Functional Configuration Audit (FCA)
- Regression Testing
- Usability and Maintainability Testing (Acoustic)
- Security Testing

2.2.1 Modification Overview

The system modifications included the introduction of OpenVPN as the validated cryptographic module to secure OCS telecommunications FIPS 140-2 validated modules and the modifications/enhancements implemented to the certified OVS 2.0 system configuration.

2.2.1.1 Detailed List of Changes

The list below includes changes between the OVS 2.0.A Voting System and the baseline OVS 2.0 Voting System:

Ballot Layout Manager (BLM)

- Add Sequential Page Numbers to All Multipage Reports
- Support for MP3 sound files on FVT
- Tennessee: uniquely identifiable stub on FVT print. (On cancel or timeout, print cancel stub)
- Add export/import function for Translations text

Election Manager (EM)

- Add Sequential Page Numbers to All Multipage Reports
- PA rule toggle only valid for "override" straight ticket rule
- Support for MP3 sound files on FVT

Tabulator

- Add Sequential Page Numbers to All Multipage Reports

Tabulator Reports (TR)

- Add Sequential Page Numbers to All Multipage Reports

Validator

- Allow OVO and OVI-VC application software to be loaded from the USB
- Add System Verifier function from Validator (output validation signatures to file if signed profile exists on USB)

OpenElect Central Suite (OCS)

- Add OpenVPN (FIPS Cert) to secure all OCS network traffic

FreedomVote Tablet (FVT)

- Support for MP3 sound files on FVT
- Stub: A uniquely identifiable stub can be printed for each voting session. (On cancel or timeout, print cancel stub)
- Add log export, machine info report to the Customer Acceptance menu
- Show on Barcode Reader Test scanned data in easy to read format
- Allow reprint of the Open Report
- Add FVT application version to Diagnostics > Auto Test printout
- Display low battery warning message
- Add voter confirm screen after the last ballot page

Linux

- VPN files are installed as part of the OCSInstaller
- Remove Election Server (ES) and Software Server (SS) files from the system and icons from the desktop as part of the VPN install using the OCSInstaller

2.2.2 Block Diagram

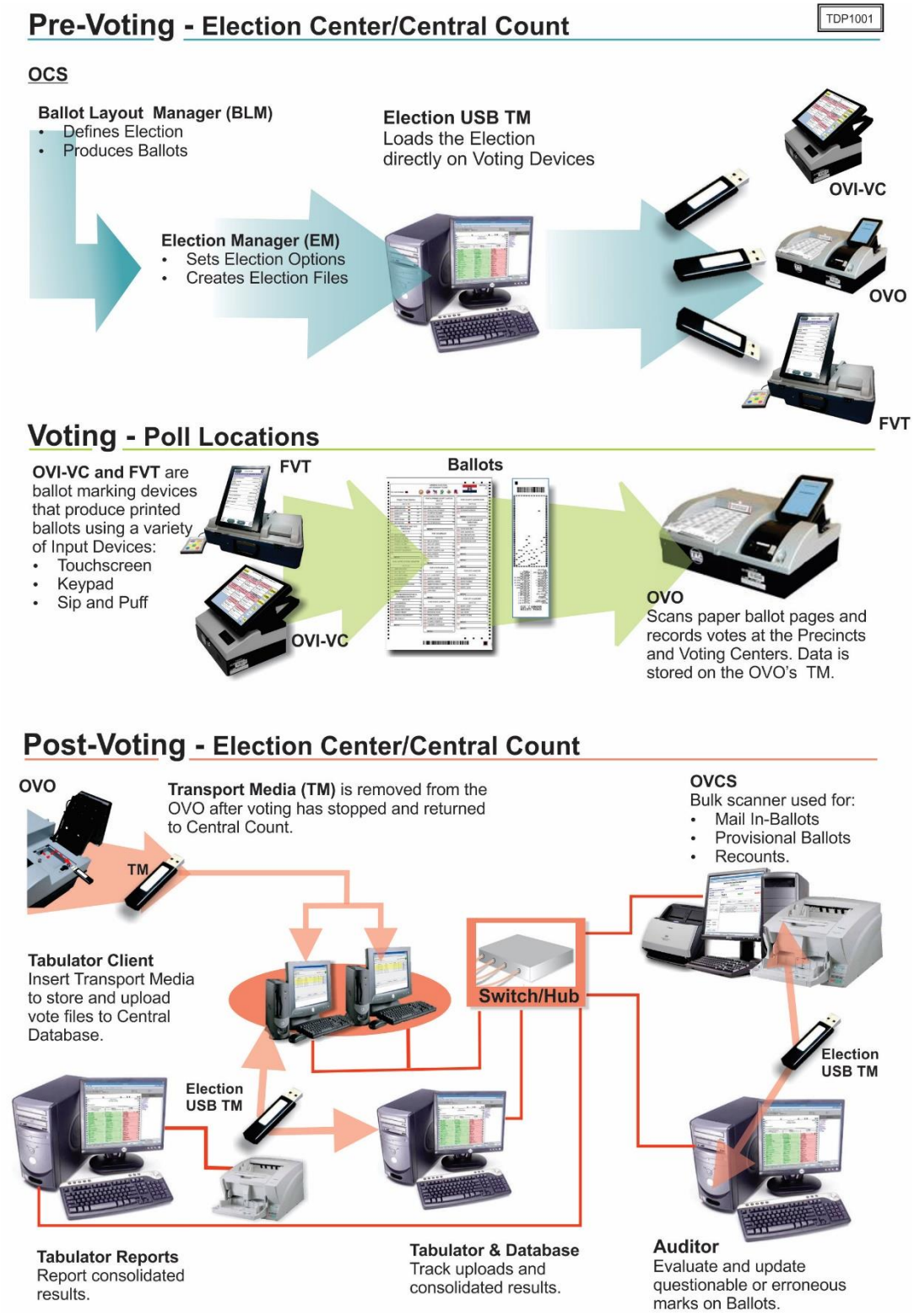

Figure 1-5. OVS 2.0.A System Components Overview

2.2.3 System Limits

Unisyn defined the following system performance characteristic limits for the OVS 2.0.A:

- The OCS and OVCS Software are intended for use by a single jurisdiction with one set of districts, voting centers, and precincts at any given time.
- The OCS and OVCS designed for handling up to 20 consecutive elections.
- Ten elections may be stored in the OCS database simultaneously.
- The system allows 400 ballot styles for an election.
- One OVO can be initialized for use with ballots from 1-50 precincts, or all precincts.
- An OVI-VC and FVT can present all precincts to the voter.
- The system allows voting by precinct and split precinct.
- The OVO provides several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
  - **Election Day** voting at the polls and voting centers
  - **Training Election** voting for training or sales purposes
  - **Logic Test** voting to test data and tabulation
  - **Absentee** session
  - **Recount** session
  - **Provisional** session
  - **Regional Early Voting** session
- The OVO provides the following System Performance:
  - Expected speed (per ballot page) 5 seconds to ballot page confirm
  - Throughput capacity (per ballot page) 6 ballot pages per minute
  - Maximum Volume 5,000 ballot pages
  - Ballot Pages
    - 11” ballot page:
      - Maximum number of voting positions per ballot page (11 inch ballot pages, without Rank Choice Voting): 228
      - Maximum number of voting positions per ballot page (11 inch ballot pages, with Rank Choice Voting): 456
    - 14” ballot page:
      - Maximum number of voting positions per ballot page (14 inch ballot pages, without Rank Choice Voting): 300

        - Maximum number of voting positions per ballot page (14 inch ballot pages, with Rank Choice Voting): 600
    - 17" ballot page:
        - Maximum number of voting positions per ballot page (17 inch ballot pages, without Rank Choice Voting): 372
        - Maximum number of voting positions per ballot page (17 inch ballot pages, with Rank Choice Voting): 744
    - 19" ballot page:
        - Maximum number of voting positions per ballot page (19 inch ballot pages, without Rank Choice Voting): 420
        - Maximum number of voting positions per ballot page (19 inch ballot pages, with Rank Choice Voting): 840
- Maximum number of ballot styles: 50 ballot styles per OVO session if individually entered with a maximum of 400 ballot style choices. For All Precinct sessions, all ballot styles are accepted by the OVO.
- The OVCS provides several voting sessions to accommodate different ballot counting purposes. Only one session can be used at a time:
    - Normal - Election Day Tabulation
        - Election Day Tabulation
        - Recount
        - Training
    - LAT - Logic and Accuracy Test (LAT) voting to test data and tabulation
    - Absentee session
    - Provisional session
    - Write-In only session
- The OVCS provides the following System Performance:
    - Max Ballot pages per batch 500
    - Max Ballot pages per session 5,000
    - Expected speed (ballot pages per hour) 500 ballot pages per hour
    - Maximum number of ballot styles: 400 ballot style choices

In the end-to-end OVS, a single election is limited to:

- Up to 12 political parties (including non-partisan) voting their own ballot in a Primary Election. Up to 12 political parties (including non-partisan) voting in a General Straight Ticket Election. Twenty-four parties may appear on the ballot for candidates.
- Up to 2,000 precincts.

- Up to 120 candidates per contest, with a limit of 3,000 combined count of candidates and contests.
- Up to 8 language translations (applies to ballot pages).
- Up to 3 ballot pages per ballot.
- Up to 5,000 ballot pages processed (cast votes) at an OVO during a single voting session.

2.2.4 Supported Languages

The OVS 2.0.A Voting System supports the following languages types:

- Hindi
- Chinese
- English
- Japanese
- Korean
- Navajo
- Spanish
- Thai

Support for all stated languages was verified; however, only English and Spanish language ballots were cast during the performance of functional testing. Additionally, one character based language (Chinese) was tested during System Integration Testing.

2.2.5 Supported Functionality

The OVS 2.0.A is designed to support the following voting variations:

- General Election
- Closed Primary
- Open Primary
- Early Voting
- Partisan/Non-Partisan Offices
- Write-In Voting
- Primary Presidential Delegation Nominations
- Straight Ticket Voting (*including Pennsylvania and Indiana Rules*)
- Presidential-only Voting
- Split Precincts

- Multiple Selection Contests: Vote for N of M
- Ballot Rotation
- Cross Party Endorsement
- Multi-Page Ballots
- Multi-Party Candidate Endorsements
- Provisional or Challenged Ballots
- Absentee Ballots
- Recount Tabulation
- Ranked Choice Voting (RCV)

2.2.6 VVSG

The OVS 2.0.A was evaluated against the relevant requirements contained in the EAC 2005 VVSG, Volumes I and II.

2.2.7 RFIs

There are no RFIs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

2.2.8 NOCs

There are no NOCs released by the EAC as of the date of this Test Report that pertain to this test campaign that were not in effect at the time of the baseline system certification.

3.0 TEST FINDINGS AND RECOMMENDATIONS

To evaluate the OVS 2.0.A test requirements, the submitted modifications were evaluated against each section of the EAC 2005 VVSG to determine the applicable tests to be performed. Based on this assessment, it was determined the following evaluations were required to verify compliance of the modifications:

Limited Technical Documentation Package (TDP) Review

A limited TDP Review was performed to ensure that all submitted modifications are accurately documented and that the documents meet the requirements of the EAC 2005 VVSG.

Source Code Review, Compliance Build, Trusted Build, and Build Document Review

The source code review was based on the source code changes made since the previous system was certified. In addition, the source code submitted was reviewed for implementations of the FIPS certified cryptographic module.

Physical Configuration Audit (PCA)

A PCA was performed to compare the voting system submitted for certification testing to the manufacturer's technical documentation. The purpose of the PCA was to verify that the submitted hardware was unmodified from the previously certified voting system

Limited Functional Configuration Audit (FCA)

The FCA for this test campaign included an assessment of the submitted modifications and included inputs of both normal and abnormal data during test performance. This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data.

System Level Testing

System Level Testing included the evaluations of the following test areas: PCA, TDP Review, Security Review, Source Code Review, FCA, Accuracy Testing, System Integration Testing, Usability & Accessibility, and QA & CM System Review. The Security Review focused on the introduction of OpenVPN as the validated cryptographic module to secure OCS telecommunications FIPS 140-2 validated modules.

The system integration tests were performed to ensure the OVS 2.0.A functioned as a complete system. The system integration testing addressed the integration of the hardware and software. This testing focused on the compatibility of the voting system software components and subsystems with one another and with other components of the voting system. During test performance, the system was configured as would be for normal field use. As part of the System Integration Test, one primary election and one general election were executed to verify that the system functions as described in the system documentation.

The Accuracy Test was performed to ensure the OVS 2.0.A correctly captured, stored, consolidated, and reported the specific ballot selections, and absence of selections, for each ballot position.

3.1 Summary Findings and Recommendations

Summary findings for the System Level Testing (System Integration Testing, Accuracy Test, and Limited FCA), Security Testing, and Source Code Review are detailed in the relevant sections of this report. In addition to these areas of testing, a PCA and a Limited TDP Review were performed, as described below.

Physical Configuration Audit (PCA)

A PCA was performed to compare the voting system components submitted for testing to the manufacturer's technical documentation and the baselined OVS 2.0 System.

Limited Technical Documentation Package (TDP) Review

A limited TDP Review was performed to ensure that all submitted modifications were accurately documented and that the documents met the requirements of the EAC 2005 VVSG.

This review focused on TDP documents that had been modified since the certification of the baseline system. Any revised documents during the TDP review process were compared with the previous document revision to determine changes made, and the document was re-reviewed to determine whether subject requirements had been met.

A listing of all documents contained in the OVS 2.0.A TDP is provided in Table 3-1.

Table 3-1. TDP Documents

Document Number	Description	Version	Release
04-00512	Technical Data Package-Document List and Version Control	1.1	2.0.A
04-00446	OVS System Overview	1.0	2.0.A
04-00444	System Functionality Description	1.1	2.0.A
04-00458	System Hardware Specification	1.0	2.0.A
04-00464	Software Design and Specification	1.0	2.0.A
04-00447	System Security Specification	1.1	2.0.A
04-00453	System Test and Verification Plan	1.0	2.0.A
04-00460	Systems Operations Procedure: Warehouse Technician's Guide	1.1	2.0.A
04-00459	System Maintenance Procedures	1.1	2.0.A
04-00445	Personnel Training and Deployment Requirements	1.0	2.0.A
04-00448	Configuration Management Plan	1.0	2.0.A
04-00454	Quality Assurance Plan	1.0	2.0.A
04-00427	Election Manager User Guide	1.1	2.0.A
04-00428	Ballot Layout Manager User Guide	1.2	2.0.A
04-00431	Tabulator Client User Guide	1.0	2.0.A
04-00432	Tabulator User Guide	1.0	2.0.A
04-00433	Tabulator Reports User Guide	1.1	2.0.A
04-00495	OVCS User Guide	1.0	2.0.A
04-00530	Auditor Users Guide	1.0	2.0.A
04-00549	EOS Linux and OCS Installation Guide	1.2	2.0.A
04-00449	System Coding Standards	1.0	2.0.A
04-00462	Election Day Troubleshooter’s Guide	1.0	2.0.A
04-00463	Election Day Poll Worker’s Guide	1.3	2.0.A
04-00494	OVS Acronyms	1.0	2.0.A
04-00503	OVS Paper Specification	1.0	2.0.A
04-00469	Final Quality Assurance Report	1.0	2.0.A

Additionally, the requirements for the QA and CM system review were evaluated throughout the test campaign, as described below:

QA and CM System Review

This testing utilized the TDP Review in conjunction with the PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the Unisyn technical documentation. The review of the Quality Assurance and Configuration Management documentation focused on Unisyn’s adherence to its stated QA and CM processes. No discrepancies were noted during the reviews.

3.1.1 Source Code Review, Compliance Build, Trusted Build, and Build Document Review

Pro V&V reviewed the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V verified that the submitted documentation was sufficient to enable: (1) a review of the modified source code and (2) Pro V&V to design and conduct tests at every level of the software structure to verify that design specifications and performance guidelines are met.

Summary Findings

Automated Source Code Review: The Automated Source Code Review was performed during the OCS applications, OVO, OVI-VC, FVT, and OVCS Compliance and Trusted Builds. No source code issues were found during the Automated Source Code review.

Manual Source Code Review: The Manual Source Code review was performed prior to the Compliance and Trusted Builds. The Manual Source Code was a comparison between the previously certified source code and the source code submitted for this test campaign.

Compliance Build: The compliance build was performed following the compliance review. Once the compliance review was performed and the source was deemed stable enough to proceed with testing, the source code and all additional packages were compiled into a Compliance Build.

Trusted Build: The trusted build consisted of inspecting customer submitted source code, COTS, and Third Party software products and combining them to create the executable code. This inspection followed the documented process from the "United States Election Assistance Commission Voting System Test Laboratory Program Manual" Section 5.5 – 5.7. *Performance of the trusted build includes the build documentation review*

3.1.2 System Level Testing

System Level Testing included the Limited Functional Configuration Audit (FCA), Regression Testing, Accuracy Testing, and the System Integration Tests. System Level testing was implemented to evaluate the complete system. The system was configured exactly as it would for normal field use. This testing included all proprietary components and COTS components (software, hardware, and peripherals) in both the EMS Standard and EMS Express system configurations. For software system tests, the tests were designed according to the stated design objective without consideration of its functional specification. The system level hardware and software test cases were prepared independently to assess the response of the hardware and software to a range of conditions.

System Integration testing evaluated the integrated operation of both hardware and software. Compatibility of the voting system software components or subsystems with one another, and with other components of the voting system environment, was determined through functional tests integrating the voting system software with the remainder of the system.

The FCA for this test campaign included an assessment of the submitted modifications and tests conducted to verify that the system hardware and software performed as described in the manufacturer's documentation.

This evaluation utilized baseline test cases as well as specifically designed test cases and included predefined election definitions for the input data. The System Integration Tests were performed to verify the OVS 2.0.A functioned as a complete system.

The accuracy test ensured that each component of the voting system could each process 1,549,703 consecutive ballot positions correctly within the allowable target error rate. The Accuracy test was designed to test the ability of the system to "capture, record, store, consolidate and report" specific selections and absences of a selection. The required accuracy was defined as an error rate. This rate is the maximum number of errors allowed while processing a specified volume of data. For paper-based voting systems the ballot positions on a paper ballot must be scanned to detect selections for individual candidates and contests and the conversion of those selections detected on the paper ballot converted into digital data.

Summary Findings

Accuracy Testing: During Accuracy Testing, the OVO and OVCS were tested by utilizing a combination of hand marked (70%) and pre-marked (30%) ballots to achieve accuracy rate greater than 1,549,703 correct ballot positions. The OVI-VC and FVT were utilized to create ballots that were implemented as part of the pre-marked test deck.

The OVS 2.0.A System successfully passed the Accuracy Test. During execution of the test procedure, it was verified that the OVS 2.0.A System successfully completed the test with all actual results obtained during test execution matching the expected results.

System Integration Testing: To evaluate the integration of the system components and to perform the necessary regression testing, a General Election and a Primary Election were successfully exercised on the voting system, as described below:

- General Election GEN-02: A basic election held in three precincts. This election contains fifteen contests compiled into three ballot styles. Ten of the contests are in all three ballot styles with the other five split across the three precincts.

- Primary Election PRIM-02: Open Primary Election held in two precincts. This election contained thirteen contests compiled into three ballot styles. One contest is in all three ballot styles; all other contests are independent.

The OVS 2.0.A System successfully passed the System Integration Test. During execution of the test procedure, it was verified that the OVS 2.0.A System successfully completed the system level integration tests with all actual results obtained during test execution matching the expected results.

Functional Configuration Audit (FCA): A limited Functional Configuration Audit was performed on the OpenElect 2.0.A system to test the functional changes made to the system. Specially designed test cases were executed to assess that the changes perform as described in the system documentation. During the execution of these test cases a deficiency was noted and submitted to Unisyn for Resolution. See deficiency BLM-1 listed in Table 3-3 below.

Regression Testing: Using a new software build of the OCS applications, the Ballot Layout Manager application Version 2.0.A_R4 was used to verify that the deficiency, BLM-1, was addressed.

3.1.3 Security Testing

The system security functions for the modification remained unchanged from the previously certified system with the exception of the inclusion of OpenVPN to secure OCS telecommunications. A review was performed on the implementation of OpenVPN to verify its compliance to EAC RFI 2012-05 and in order to:

- Confirm the module implemented is present on the NIST CMVP validated products list.
- Confirm the module is configured and used per the published security policy.

The Unisyn OpenElect 2.0 used as a baseline for this project, failed to comply with EAC RFI 2012-05 requiring that all telecommunications be compliant with FIPS 140-2 by utilizing NIST CMVP validated modules. Unisyn proposed a solution for OpenElect 2.0A that was approved by the EAC, documented in and communicated via "FIPS Integration in Open Elect 2.0.a.doc". Unisyn implemented two options in satisfying the requirement, remove telecommunication functionality and implement certified cryptographic modules.

Summary Findings

Tests confirmed that Software Server and Election Server components were removed from the suite. Therefore telecommunication security requirements were removed from the segments from the OCS to the OVO/OVI-VC. Software and election metadata is transferred via removable media only.

Where telecommunications remained, Unisyn's solution was to add an additional layer of security, via OpenVPN, that would utilize validated cryptographic modules to any components transmitting data over their closed network. OpenVPN is reliant on the OpenSSL library for performing cryptographic functions. OpenSSL when compiled with the FIPS object module fulfills the requirement. Analysis was performed to verify that these libraries were implemented correctly. Within the system, OpenVPN provides CMVP validated cryptographic functions to telecommunication segments via the OpenSSL FIPS Object Module (version 2.0.10 cert # 1747). All other cryptographic functions implemented by the system utilize the Bouncy Castle library. Specific tests were developed to confirm the correct implementation and to observe the behavior of the OVS system when in client / server configuration utilizing OpenVPN to provide telecommunications security. It was confirmed that client components will not communicate with the server if the OpenVPN tunnel is not established.

3.1.4 Usability and Accessibility Testing (Acoustic Test)

Usability & Accessibility testing was performed to evaluate the OVS 2.0 System to the applicable requirements. The usability testing focused on the usability of the OVS 2.0 system.

Usability was defined generally as a measure of the effectiveness, efficiency, and satisfaction achieved by a specified set of users with a given product in the performance of specified tasks. The Accessibility portion of testing evaluated the requirements for accessibility. These requirements are intended to address HAVA 301 (a) (3) (B).

Summary Findings

The OVS 2.0.A System successfully met the requirements of the Usability & Accessibility (Acoustic Test) evaluation.

3.2 Anomalies and Resolutions

When a result is encountered during test performance that deviates from what is standard or expected, a root cause analysis is performed. Pro V&V considers it an anomaly if no root cause can be determined. In instances in which a root cause is established, the results are then considered deficiencies. No anomalies occurred during the testing of the OVS 2.0.A System.

3.3 Deficiencies and Resolutions

Any violation of the specified requirement or a result is encountered during test performance that deviates from what is standard or expected in which a root cause is established is considered to be a deficiency. Upon occurrence, deficiencies are logged throughout the test campaign for disposition and resolution. All deficiencies encountered during the Unisyn OVS 2.0.A test campaign were successfully resolved. In each instance, the resolutions were verified to be resolved through all required means of testing (regression testing, source code review, and TDP update) as needed.

The noted deficiencies are listed in Table 3-2.

Table 3-2. Noted Deficiencies

Deficiency #	Description of Deficiency	Resolution
BLM-1	Export/Import function for Translation Text Returns no translation for values in a Primary Contest	Addressed in the Ballot Layout Manager application Version 2.0.A_R4

4.0 RECOMMENDATION FOR CERTIFICATION

The OVS 2.0.A Voting System, as presented for testing, successfully met the requirements set forth for voting systems in the U.S. Election Assistance Commission (EAC) 2005 Voluntary Voting System Guidelines (VVSG), Version 1.0. Additionally, Pro V&V, Inc. has determined that the OVS 2.0.A functioned as a complete system during System Integration Testing. Based on the test findings, Pro V&V recommends the EAC grant the OVS 2.0.A certification to the EAC 2005 VVSG.