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Test Plan for EAC 2005 VVSG Certification Testing Unisyn Voting Solutions OpenElect 2.0 Voting System

EAC Project Number: UNS1701

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U.S. Election Assistance Commission

VSTL

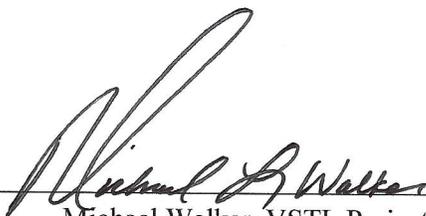
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1.0 INTRODUCTION

The purpose of this Test Plan is to document the procedures that Pro V&V, Inc. will follow to perform certification testing during a new system campaign for the Unisyn Voting Solutions OpenElect Voting System (OVS) Version 2.0 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. Prior to submitting the voting system for testing, Unisyn submitted an application package to the EAC for certification of the OpenElect 2.0 Voting System. The application was accepted by the EAC and the project was assigned the unique Project Number of UNS1701.

At test conclusion, the results of all testing performed as part of this test campaign will be submitted to the EAC in the form of a national certification test report.

1.1 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, 2006 Edition, “NVLAP Procedures and General Requirements (NIST Handbook 150)”, dated February 2006
- 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)
- Unisyn Voting Solutions Technical Data Package (*A listing of the OpenElect 2.0 documents submitted for this test campaign is listed in Section 4.6 of this Test Plan*)

1.2 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

“ES” – Election Server

“FCA” – Functional Configuration Audit

“FVT” – Freedom Vote Tablet

“LAT” – Logic and Accuracy Test

“NOC” – Notice of Clarification

“OCS” – OpenElect Central Suite

“OVCS” – OpenElect Voting Central Scan

“OVI-VC” – OpenElect Voting Interface

“OVO” – OpenElect Voting Optical

“OVS” – OpenElect Voting System

“PC” – Personal Computer

“PCA” – Physical Configuration Audit

“QA” – Quality Assurance

“RFI” – Request for Interpretation

“TC” – Tabulator Client

“TDP” – Technical Data Package

“TM” – Transport Media

“TR” – Tabulator Reports

“UPS” – Uninterruptible Power Supply

“VSTL” – Voting System Test Laboratory

“VVSG” – Voluntary Voting System Guidelines

1.3 Testing Responsibilities

All testing will be conducted under the guidance of personnel verified by Pro V&V, Inc. to be qualified to perform the testing.

1.3.1 Project Schedule

The Project Schedule for the test campaign is located in Appendix A. The dates on the schedule are not firm dates but planned estimates based on the anticipated project work flow.

1.3.1.1 Owner Assignments

This information is contained in the Project Schedule presented in Appendix A.

1.3.1.2 Test Case Development

Pro V&V will utilize baseline test cases for the Functional Configuration Audit (FCA), Usability, and System Integration Tests. These test cases will be augmented with specially designed test cases tailored to the specific design of the OVS 2.0. Additionally, specific election definitions will be designed for the Operational Status Check and the Logic & Accuracy Tests.

1.3.1.3 Test Procedure Development and Validation

Pro V&V will utilize VSTL Test Procedures during the duration of the test campaign. These procedures are developed to the EAC 2005 VVSG standards. The validation of the VSTL Test Procedures is accomplished by Technical Review and Approval. If necessary and where practical, a validation might include execution to attempt to achieve the expected results using the selected tool of the testing methodology. Test Plans, Test Suites, Test Specifications, and Test Cases will be validated prior to execution. This validation will include the following:

- Confirmation of adequate test coverage of all requirements.
- Confirmation that test case results are not ambiguous and have objective pass/fail criteria.
- Confirmation that any automated test suites will produce valid results.

1.3.1.4 Third Party Tests

Pro V&V will be utilizing third party testing during the performance of hardware testing. All testing will be witnessed by Pro V&V personnel at the third party test site with the exception of Temperature Power Variation in which Pro V&V qualified staff will execute all testing at the third party facility.

1.3.1.5 EAC and Manufacturer Dependencies

This information is contained in the Project Schedule presented in Appendix A.

1.4 Target of Evaluation Description

The following sections contain a product description and an overview of the design methodology of the OVS 2.0, as taken from the Unisyn technical documentation.

1.4.1 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 OVS 2.0 consists of the following major components:

- **OpenElect Central Suite (OCS)**
- **OpenElect Voting Optical (OVO)**
- **OpenElect Voting Interface (OVI)**
- **Freedom Vote Tablet (FVT)**
- **OpenElect Voting Central Scan (OVCS)**

The OVO, FVT, and OVI are the OVS components designed to accept voter input. The FVT and OVI 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, FVT, and OVCS systems. The 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. 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 Transport Media (TM) devices, stores them on its disk, and transfers the files to the Tabulator and notifies the Tabulator that a new file is present.

Tabulator Server – 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 and change questionable or erroneous marks on ballot in accordance to the voter's perceived intent. The Auditor can also be used to process write-ins on both full page and BMD Ballots. 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

In addition, the OCS includes the Software Server (SS) system for updating and validating the OVO and the OVI-VC (voting device) software.

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 be paired with OVI 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.

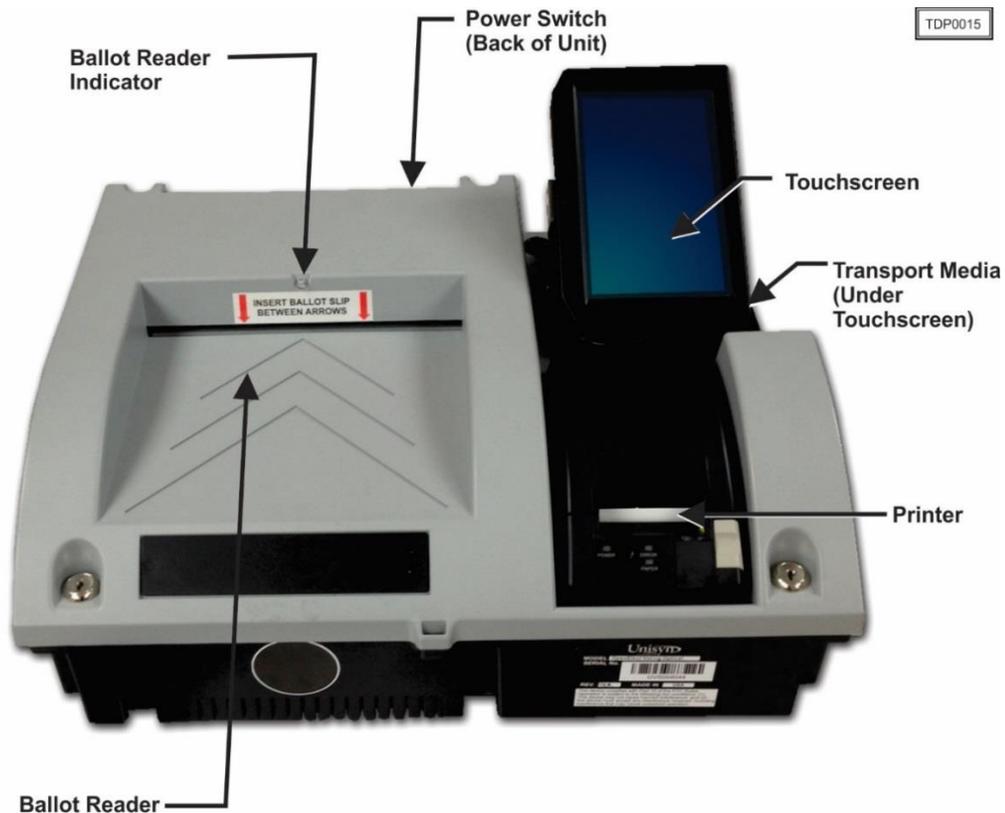


Figure 1-1. OVO

OpenElect Voting Interface (OVI)

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 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 then prints the ballot and the voter inserts it into the OVO to cast their vote. When authorized, the OVI provides for write-in candidates.

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

The OVI 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 OVI Ballots and reports at the OVI.
- **UPS** - Uninterruptible power supply is provided as part of the system.



Figure 1-2. OVI

Freedom Vote Tablet (FVT)

The FVT is a tablet based, ballot marking device that enables voters to print regional ballots on Election Day and during early voting. The FVT is ADA compliant, assisting voters with varying levels of ability to vote, review and either print or cast their ballot. Like the OVI it assists voters, with varying levels of ability, through the election process, ballot review and printing functions. The FVT presents each contest on the correct ballot to the voter in visual and 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, 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 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.
- **Internal Battery Pack (Optional)** – internal 12V DC battery pack that provides power to the barcode reader and printer in the event of a power outage.
- **Optional ADA Devices** – 10-key keypad with Sip and Puff Interface, Headphones, Sip and Puff Device.

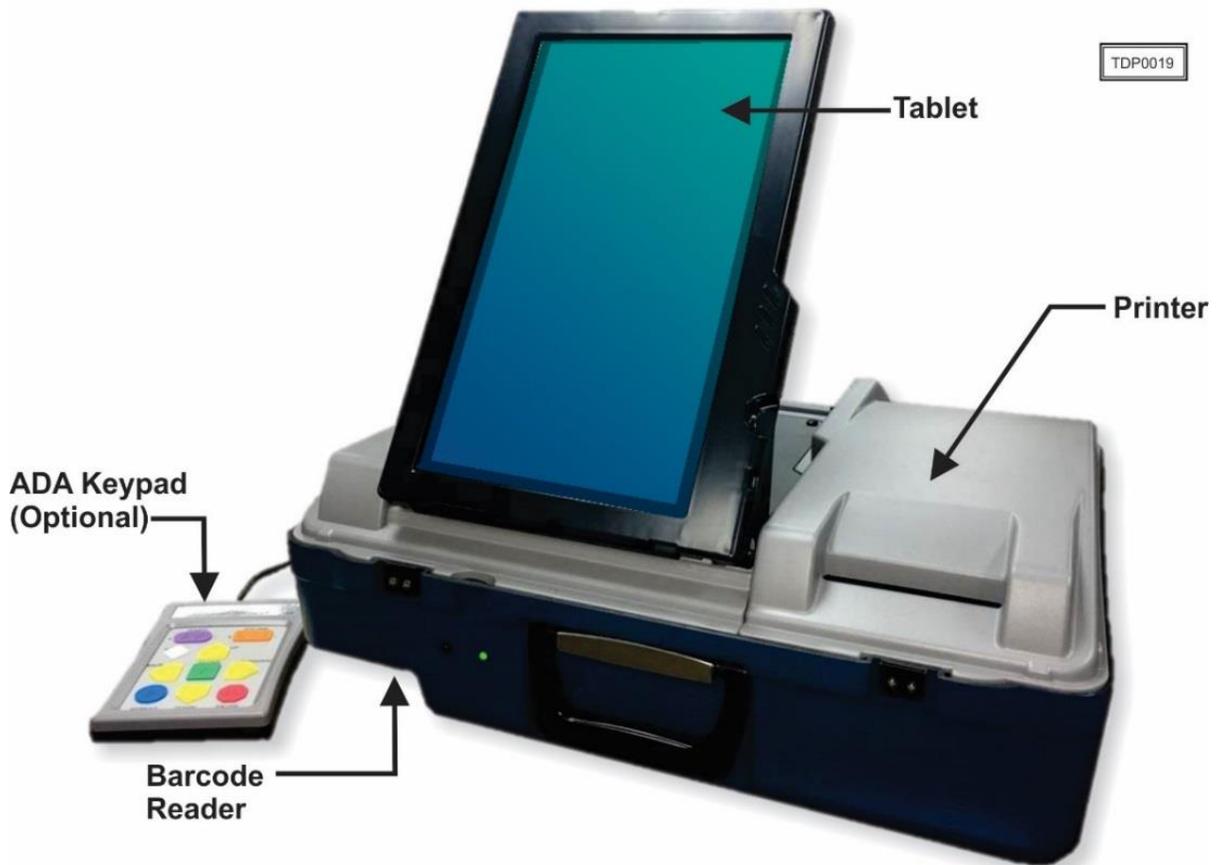


Figure 1-3 FVT

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 that is connected to the PC to scan data from marked ballots.

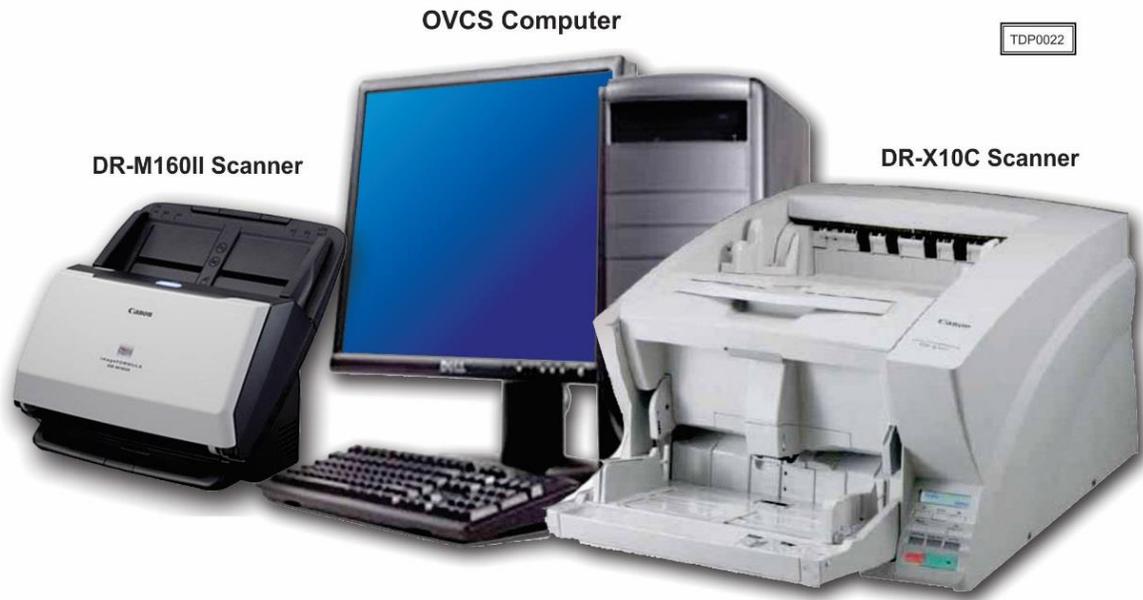


Figure 1-4. OVCS

1.4.2 Block Diagram

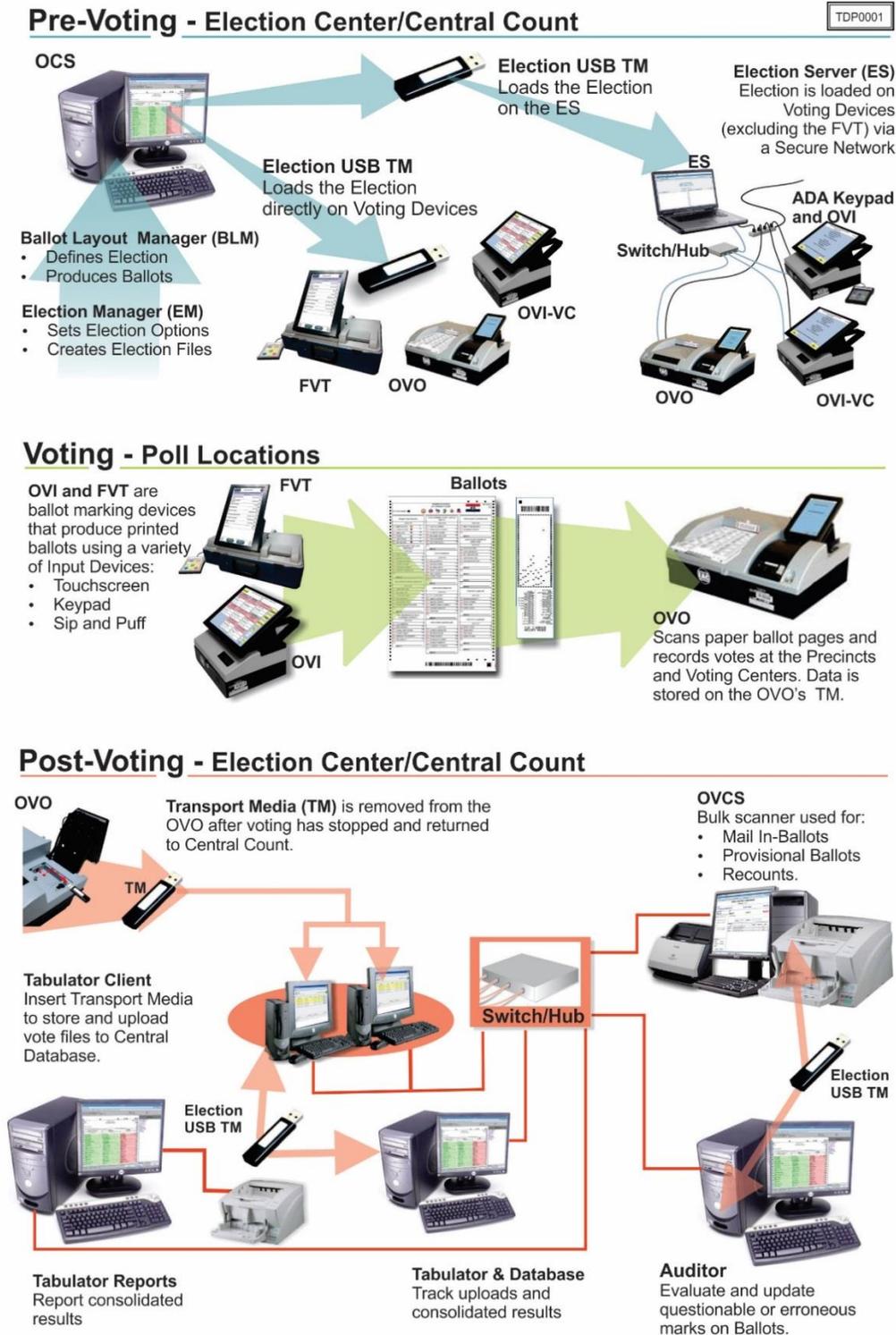


Figure 1-5. OVS 2.0 System Components Overview

1.4.3 System Limits

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

- 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 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.

1.4.4 Supported Languages

The submitted voting system supports:

- Armenian
- Chinese
- English
- Japanese
- Korean
- Russian
- Spanish
- Vietnamese

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

1.4.5 Supported Functionality

The OVS 2.0 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)
- Retraction Handling

1.4.5.1 Standard VVSG Functionality

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

1.4.5.2 Manufacturer Extensions

There are no manufacturer extensions on testing for this test campaign.

2.0 PRE-CERTIFICATION TESTING AND ISSUES

2.1 Evaluation of Prior VSTL Testing

The OVS 2.0 is a new voting system that has not previously been tested to applicable federal standards in the EAC Program. The Unisyn OVS 1.3 system, previously certified by the EAC (Reference NTS Report No. TPR030407-01 Rev. B, which is available for viewing on the EAC's website at www.eac.gov) contains various components of the system currently under test; however, in some instances these components have been modified to meet the performance characteristics of the OVS 2.0 System. For components that were not modified, the TDP review that was previously performed will be utilized to meet the requirements of the required TDP review. All updated portions of the TDP will be subjected to a full TDP review as part of this test program. Additionally, the previously certified versions of the OVS system (1.1, 1.2, and 1.3) that contain the OVO, OVI, and OVCS components will be subjected to functional regression testing with the 2.0 version firmware (Reference Wyle Test Reports T58650.01-01 Rev. A and T70987.01-01 Rev. B, and NTS Test Report No. PR030407-01 Rev. B, respectively, which are available for viewing on the EAC's website, for further details).

Full functional and hardware testing will be performed on the OVS 2.0 configuration that includes the previously tested components as well as the FVT.

2.2 Evaluation of Prior Non-VSTL Testing

The OVS 2.0 is a new voting system that has not previously been tested to applicable federal standards in the EAC Program.

2.3 Known Field Issues

The OVS 2.0 Voting System is a new system that has not been fielded.

3.0 MATERIALS REQUIRED FOR TESTING

The following sections list all materials needed to enable the test engagement to occur.

The materials required for testing of the OVS 2.0 include all materials to enable the test campaign to occur. This includes the applicable hardware and software as well as the TDP, test support materials, and deliverable materials, as described in the following subsections.

3.1 Software

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

Table 3-1. OVS 2.0 COTS Software Components

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

Table 3-2. 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, Aud, and Tab only)	5.0.45-7
JasperReports	2.0.5

3.2 Equipment

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

For COTS equipment, every effort will be made to verify that the COTS equipment has not been modified for use. This will be accomplished by performing research using the COTS equipment manufacturer's websites based on the serial numbers and service tag numbers for each piece of

equipment. Assigned test personnel will evaluate COTS hardware, system software and communications components for proven performance in commercial applications other than voting. For PCs, laptops, and servers, the service tag information will be compared to the system information found on each machine. Physical external and internal examination will also be performed when the equipment is easily accessible without the possibility of damage. Hard drives, RAM memory, and other components will be examined to verify that the components match the information found on the COTS equipment manufacturer's websites.

Table 3-3. Voting System COTS Hardware

Hardware	Make	Model
OVO		
<i>Duplex Ballot Scanner</i>		
Duplex Ballot Scanner	PDI Scan	Pagescan III
Scanner Power Adapter	eUrasia Power	uA36-1024
<i>58 mm Thermal Printer</i>		
58 mm Thermal Printer	Citizen Printer	CT-5281
Printer Power Adapter	---	28AD4
<i>Computer</i>		
Chassis	Morex	---
Power Adapter	DC/DC converter	---
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	3120-21282
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120
<i>1 Gb USB TM</i>		
Innodisk	1 Gb USB	---
Delkin	1 Gb USB	SLC-MLC
<i>7" LCD Touchscreen Display</i>		
7" LCD Touchscreen Display	Xenarc Technologies	700TSV
<i>AC Power In Module</i>		
AC Power In Module	Delta	Emi 10BEEG3G
OVI		
<i>Sip and Puff (Optional)</i>		
Sip and Puff (Optional)	Origin Instruments	AirVoter
<i>Headphone (Optional)</i>		
Headphone (Optional)	Koss On-Ear Headphones	KPH5
<i>15 in LCD Touchscreen Display</i>		
15 in LCD Touchscreen Display	GVision	P15BX 2450-30120
<i>82.5 mm Thermal Printer</i>		
82.5 mm Thermal Printer	Star	TSP743IID-24, serial interface
Printer Adapter	Star	PS60A-24B 1
<i>Computer</i>		
Power Adapter Kit	DC-DC Converter	4000-00169
Motherboard	Jetway	JNF9D-2550
Memory	SuperTalent - Onboard RAM	3120-21282

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

Hardware	Make	Model
Hard Drive	Western Digital	WD5000AZLX
Adapter	EDAC	EA 10951c-120
<i>1 Gb USB TM</i>		
Innodisk	1 Gb USB	---
Delkin	1 Gb USB	SLC-MLC
<i>AC Power In Module</i>		
---	Delta	Emi 10BEEG3G
OVCS		
<i>Large Volume Scanner</i>		
Large Volume Scanner	Cannon	DR-X10C
<i>Desktop Scanner</i>		
Desktop Scanner	Cannon	DR-M160II
FVT		
<i>13.3 in Touchscreen Tablet</i>		
13.3 in Touchscreen Tablet	Android Tablet	GVision - T13
Tablets Battery Charger	Sager Power System	GC30B-4P1J
<i>82.5 mm Thermal Printer</i>		
82.5 mm Thermal Printer	Star	TSP743IIU-24
Printer Adapter	Lind 60W 24VDC	ST2425-626
<i>Barcode Reader 1D,2D series</i>		
Barcode Reader 1D,2D series	Newland	FM420
<i>USB Hub</i>		
USB Hub	Tripp Lite	USB Hub
Hub Adapter	Meanwell	PSD-15A-05
<i>1 Gb USB TM</i>		
Innodisk	1 Gb USB	---
Delkin	1 Gb USB	SLC-MLC
<i>Micro SD</i>		
Micro SD	Innodisk Industrial	Micro SD 2.0
<i>Battery</i>		
Battery Pack 12 V 6.0 AH	Powers Sonic	PSH-1255-FR
Adapter	Mean Well	GC30B-4PIL
<i>AC Power In Module</i>		
AC Power In Module	Delta	Emi 10BEEG3G
<i>Sip and Puff (Optional)</i>		
Sip and Puff	Origin Instruments	AirVoter
<i>Headphone (Optional)</i>		
Headphone	Koss On-Ear Headphones	KPH5
Headphone	Sony	MDR-210LP
<i>USB to Ethernet RJ45 Adapter (Optional)</i>		
USB to Ethernet RJ45 Adapter	D-Link	---
UPS		
Minuteman Power Technologies	Para Systems, Inc.	Entrust

Table 3-4. 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

3.3 Test Materials

This subsection lists the test materials required to execute the required tests throughout the test campaign.

The materials required for certification testing of the OVS 2.0 include software, hardware, test materials, and deliverable materials.

3.4 Deliverable Materials

This subsection lists the materials identified by the manufacturer as materials deliverable to the end user for the system being tested.

Table 3-5. Voting System Deliverables

Material	Version	Description
OCS	2.0	EMS Software Suite
OVO	2.0	Precinct Ballot Scanner
OVI	2.0	Accessible Voting Station
OVCS	2.0	Central Count Scanner
FVT	2.0	Ballot Marking Device
Ballot Box	---	OVO Ballot Receptacle
Transport Media	1 GB	USB Flash Drive
Minuteman UPS	Entrust	UPS
Headphones (optional)	Koss, Sony	Stereo headphones
Sip and Puff (optional)	Origin AirVoter	Binary Input Device
OVS 2.0 TDP*	2.0	OVS Technical Data Package

* Listed in Section 4.6

4.0 TEST SPECIFICATIONS

Certification testing of the OVS 2.0 submitted for evaluation will be performed to ensure the applicable requirements of the EAC 2005 VVSG and the EAC Testing and Certification Program Manual, Version 2.0 are met. Additionally, all EAC Request for Interpretations (RFI) and Notices of Clarification (NOC) relevant to the system under test will be incorporated in the test campaign. A complete listing of the EAC RFIs and NOCs is available on the EAC website.

4.1 Requirements (Strategy of Evaluation)

To evaluate the OVS 2.0 test requirements, each section of the EAC 2005 VVSG will be analyzed to determine the applicable tests. The EAC 2005 VVSG Volume I Sections, along with the strategy of evaluation, are described below:

Section 2: Functional Requirements

The requirements in this section shall be tested during the FCA and System Integration Test. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data.

Section 3: Usability and Accessibility Requirements

The requirements in this section shall be tested during the Usability and Accessibility Testing. This evaluation will utilize baseline test cases as well as specifically designed test cases and will include predefined election definitions for the input data. Pro V&V will review the results of Summative Usability Testing performed by Mile7 on the OVS 2.0, to verify that the submitted test results are in Common Industry Format.

Section 4: Hardware Requirements

The requirements in this section shall be tested and/or evaluated by personnel verified by Pro V&V to be qualified to perform the testing.

Section 5: Software Requirements

The requirements in this section shall be tested utilizing a combination of review and functional testing during the Source Code Review, TDP Review, and FCA.

Section 6: Telecommunications Requirements

The requirements in this section shall be tested utilizing baseline test cases as well as specifically designed test cases.

Section 7: Security Requirements

The requirements in this section shall be tested during the Source Code Review, Security Tests, and FCA.

Section 8: Quality Assurance Requirements

The requirements in this section shall be tested throughout the test campaign. This testing will utilize a TDP Review in conjunction with the Source Code Review and 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 documentation will focus on Unisyn's adherence to its stated QA processes.

Section 9: Configuration Management Requirements

The requirements in this section shall be tested throughout the test campaign. This testing will utilize a TDP Review in conjunction with the Source Code Review and PCA to determine compliance to the EAC 2005 VVSG requirements and the requirements stated in the Unisyn technical documentation. The review of the Configuration Management documentation will focus on Unisyn's adherence to its stated CM processes.

Throughout the test campaign, Pro V&V personnel shall maintain a test log identifying the system and equipment under test and any records of deviations to the test plan along with the rationale for performing the deviations. Pro V&V shall also utilize an internal bug tracking system to record and track all issues and/or discrepancies noted during the test campaign.

4.1.1 Mapping of Requirements to Equipment Type and Features

This information shall be included in the EAC provided matrix.

4.1.2 Rationale for 'Not Applicable' Requirements

The OVS 2.0 is a paper-based system that supports a closed network. Therefore, all EAC 2005 VVSG requirements, with the exceptions listed below, will be evaluated as part of this test campaign.

- Volume I, Section 6 (Telecommunications Requirements)
- Volume I, Section 7.52-7.54 (Telecommunications and Data Transmission)
- Volume I, Section 7.6 (Use of Public Networks)
- Volume I, Section 7.7 (Wireless Communications)
- Volume I, Section 7.9 (Voter Verifiable Paper Audit Trail Requirements)

The rationale for not evaluating the OVS 2.0 to the indicated sections is described in following table. Specific requirements that are excluded from this test campaign are identified in the EAC online matrix tool.

Table 4-1. Not Applicable Requirements

EAC 2005 VVSG Version 1 Volume I, Section	Rationale for 'Not Applicable'
6, 7.5.2-7.5.4	These requirements are written for use on public networks. The Unisyn OVS 2.0 does not use public networks.
7.6	This section pertains to systems that transmit data over public telecommunications. The Unisyn OVS 2.0, as submitted for certification, does not permit transmission over public networks.
7.7	No wireless technology is present in the Unisyn OVS 2.0.
7.9	The Unisyn OVS 2.0 is a paper-based system

4.2 Hardware Configuration and Design

The Unisyn OVS 2.0 is a paper-based optical scan voting system. The OVS 2.0 consists of the following major components: the OCS, OVO precinct scanner, OVI precinct voting interface, OVCS central count scanner, and FVT precinct voting tablet. All components of the OVO, excluding the case, are COTS. All components of the OVI, excluding the case and keypad, are COTS. All components of the FVT, excluding the case, tablet enclosure, and keypad, are COTS. All components of the OVCS are COTS. All OCS functions are handled by proprietary software running on COTS PS/laptop/servers.

4.3 Software System Functions

The Unisyn OpenElect OCS/OVO/OVI/OVCS are a set of Java applications that utilize open source libraries and run on a customized Linux operating system to take advantage of that platform's security and performance. The OVO and OVCS use the Java Native Interface (JNI) classes, which are C++ classes, to communicate with the native drivers (also C++) provided by the hardware manufacturer. This is required by the Optical Scanner in the OVO and the OVCS. The OpenElect system is designed for use in two distinct locales: Central Processing and In-Precinct Systems.

The FreedomVote Tablet (FVT) product is also written in Java, but compiled for use on the Google Android operating system, using different core libraries.

4.4 Test Case Design

Test cases are designed based on the manufacturer's design specifications and the relevant technical requirements set forth by the VVSG. Test cases shall be based on the following aspects of the voting system:

- Hardware qualitative examination design
- Hardware environmental test case design
- Software module test case design and data
- Software functional test case design
- System level test case design

Test cases shall provide information regarding the sequence of actions to be performed for the execution of a test, the requirements being met, the test objective, test configuration, equipment needed, special requirements, assumptions, and pass/fail criteria. Once the test cases are finalized, they will be validated and published for use in the test campaign. The validation of the test case will be accomplished by technical review and approval. This validation will include the following: confirmation of adequate test coverage of all requirements; confirmation that test case results are not ambiguous and gave objective pass/fail criteria; and confirmation that any automated test suites will produce valid results.

4.4.1 Hardware Qualitative Design

The OVS 2.0 is being evaluated as a new system and will require the full suite of hardware and electrical testing as detailed in the 2005 VVSG. These tests are listed below:

Electrical Tests:

- Electrical Power Disturbance
- Electromagnetic Radiation
- Electrostatic Disruption
- Electromagnetic Susceptibility
- Electrical Fast Transient
- Lightning Surge
- Conducted RF Immunity
- Magnetic Fields Immunity
- Electrical Supply

Environmental Tests:

- Bench Handling
- Vibration
- Low Temperature
- High Temperature
- Humidity
- Temperature Power Variation
- Acoustic

4.4.1.1 Mapping of Requirements to Specific Interfaces

This information shall be included in the EAC provided matrix.

4.4.2 Hardware Environmental Test Case Design

No previous examinations have been performed on the OVS 2.0. The voting system hardware shall be subjected to the tests specified in Section 4.4.1. Testing will be performed by personnel verified by Pro V&V to be qualified to perform the test. Pro V&V will utilize a third-party test

facility for performance of the electrical and environmental tests. All pre and post operational status checks shall be conducted by Pro V&V personnel.

4.4.3 Software Module Test Case Design

Pro V&V shall review the manufacturer's program analysis, documentation, and module test case design and shall evaluate the test cases for each module with respect to flow control parameters and entry/exit data. As needed, Pro V&V shall design additional test cases to satisfy the coverage criteria specified in Volume II, Section 7.2.1.

Component Level Testing will be implemented during the FCA for each component and subcomponent that were modified. During the Source Code Review, Compliance Builds, and Security Testing, Pro V&V will utilize limited structural-based techniques (white-box testing). Additionally, specification-based techniques (black-box testing) will be utilized for the individual software components.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted. If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.4 Software Functional Test Case Design

Pro V&V shall review the manufacturer-submitted test plans and data to verify that the individual performance requirements specified in the EAC 2005 VVSG and the TDP are reflected in the software. As part of this process, Pro V&V shall review the manufacturer's test case design and prepare a detailed matrix of system functions and the test cases that exercise them. Pro V&V shall also prepare a test procedure describing all test ballots, operator procedures, and the data content of output reports. Pro V&V shall define abnormal input data and operator actions and then design test cases to verify that the system is able to handle and recover from these abnormal conditions. During this review, emphasis shall be placed on those functions where the manufacturer data on module development, such as the system release notes and comments within the source code, reflects significant debugging problems, and on functional tests that resulted in high error rates.

Pro V&V shall define the expected result for each test and the ACCEPT/REJECT criteria for certification. If the system performs as expected, the results will be accepted. If the system does not perform as expected, an analysis will be performed to determine the cause. The test will be repeated in an attempt to reproduce the results. If the failure can be reproduced and the expected results are not met, the system will have failed the test. If the results cannot be reproduced, the test will continue. All errors encountered will be documented and tracked through resolution.

4.4.5 System-Level Test Case Design

System Level testing will be implemented to evaluate the complete system. This testing will include all proprietary components and COTS components (software, hardware, and peripherals) in a configuration of the system's intended use. For software system tests, the tests shall be designed according to the stated design objective without consideration of its functional specification. The system level hardware and software test cases shall be prepared independently to assess the response of the hardware and software to a range of conditions.

4.5 Security Functions

The objective of the Security Testing is to evaluate the effectiveness of the voting system in detecting, preventing, recording, reporting, and recovering from security threats. To evaluate the integrity of the system, Pro V&V shall develop specifically designed test cases in an attempt to defeat the access controls and security measures documented in the system TDP. A threat matrix shall be created to determine the risks and vulnerabilities. An evaluation of the system shall be accomplished by utilizing a combination of functional testing, source code review, and Fortify Static Code Analyzer. All findings will be reported to the EAC and OVS 2.0.

4.6 TDP Evaluation

In order to determine full compliance with the EAC 2005 VVSG, three phases of TDP review shall be conducted:

- **Initial TDP Review:** The first review is performed to determine whether the TDP submitted is complete enough to perform TDP review. This is an abbreviated review. Each document is read to determine whether it provides enough description of the submitted voting system components and whether it at least generically addresses VVSG requirements. The results of the review are used in determining contractual requirements for the test campaign.
- **Compliance Review:** This review is conducted on a document-by-document basis to determine if every Federal, State, or manufacturer-stated requirement has been met based on the context of each requirement. This review does not address consistency or completeness of documents. The review is more complex than the initial TDP review. Results of the review of each document are entered on the TDP Review Checklist and are reported to the manufacturer for disposition of any anomalies. This process is ongoing until all anomalies are resolved. Any revised documents during the TDP review process are compared with the previous document revision to determine changes made, and the document is re-reviewed to determine whether subject requirements have been met.
- **Consistency/Completeness Review:** The third TDP review is completed after the review for compliance has been performed (the Consistency/Completeness TDP Review may overlap the Compliance Review in part). This review is to ensure the information included in the TDP documents is consistent across documents, especially in component naming, software and firmware versioning, and the hardware, software, and firmware included with the voting system submitted for testing. Any revisions to a document

during the TDP review process which affect other documents must also be revised. As with the other TDP reviews, the TDP Review Checklist is utilized to report any anomalies to the manufacturer for resolution, if required. The TDP review continues until all anomalies have been satisfactorily resolved.

A listing of all documents contained in OVS 2.0 TDP is provided in Table 4-2.

Table 4-2. TDP Documents

Document Number	Description	Version
04-00512	Technical Data Package-Document List and Version Control	1.0
04-00446	OVS System Overview	1.0
04-00444	System Functionality Description	1.0
04-00458	System Hardware Specification	1.0
04-00464	Software Design and Specification	1.0
04-00447	System Security Specification	1.0
04-00453	System Test and Verification Plan	1.0
04-00460	Systems Operations Procedure: Warehouse Technician's Guide	1.0
04-00459	System Maintenance Procedures	1.0
04-00445	Personnel Training and Deployment Requirements	1.0
04-00448	Configuration Management Plan	1.0
04-00454	Quality Assurance Plan	1.0
04-00427	Election Manager User Guide	1.0
04-00428	Ballot Layout Manager User Guide	1.0
04-00429	Election Server User Guide	1.0
04-00430	Software Server User Guide	1.0
04-00431	Tabulator Client User Guide	1.0
04-00432	Tabulator User Guide	1.0
04-00433	Tabulator Reports User Guide	1.0
04-00495	OVCS User Guide	1.0
04-00530	Auditor Users Guide	1.0
04-00549	EOS Linux and OCS Installation Guide	1.0
04-00449	System Coding Standards	1.0
04-00462	Election Day Troubleshooter's Guide	1.0
04-00463	Election Day Pollworker's Guide	1.0
04-00494	OVS Acronyms	1.0
04-00503	OVS Paper Specification	1.0

4.7 Source Code Review

Pro V&V will review the submitted source code to the EAC 2005 VVSG and the manufacturer-submitted coding standards. Prior to initiating the software review, Pro V&V shall verify that the submitted documentation is sufficient to enable: (1) a review of the 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.

4.8 QA and CM System Review

The Unisyn Quality and Configuration Management Manuals shall be reviewed for their fulfillment of Volume I, Sections 8 and 9, and the requirements specified in Volume II, Section 2. The requirements for these sections establish the quality assurance and configuration standards for voting systems to which manufacturers must conform and require voting system manufacturers to implement a quality assurance and configuration management program that is conformant with recognized ISO standards. As part of the review process, the Unisyn TDP documents will be reviewed to determine if the stated policies are being followed.

5.0 TEST DATA

The following subsections provide information concerning test data recording, criteria, and reduction.

5.1 Test Data Recording

All equipment utilized for test data recording shall be identified in the test data package. The output test data shall be recorded in an appropriate manner as to allow for data analysis. For source code and TDP reviews, results shall be compiled in reports and submitted to Unisyn for resolution.

5.2 Test Data Criteria

The OVS 2.0 shall be evaluated against all applicable requirements contained in the EAC 2005 VVSG. The acceptable range for system performance and the expected results for each test case shall be derived from the manufacturer-submitted technical documentation and the EAC 2005 VVSG.

5.3 Test Data Reduction

Test data shall be processed and recorded in the test log book and the relevant Test Cases.

6.0 TEST PROCEDURE AND CONDITIONS

The following subsections detail the facility requirements, test setup conditions, and sequence of testing.

6.1 Facility Requirements

Unless otherwise annotated, all testing shall be conducted at the Pro V&V test facility located in Huntsville, AL, by personnel verified by Pro V&V to be qualified to perform the test.

Unless otherwise specified herein, testing shall be performed at the following standard ambient conditions and tolerances:

- Temperature: 68-75° F ($\pm 3.6^\circ\text{F}$)
- Relative Humidity: Local Site Humidity

- Atmospheric Pressure: Local Site Pressure
- Time Allowable Tolerance: $\pm 5\%$

Testing performed at third-party laboratories will be subject to the test parameters and tolerances defined by VVSG. If not specified in VVSG, the test facilities' standard parameters and tolerances will be used. These will be reported in the final Test Report.

6.2 Test Set-up

All voting system equipment shall be received and documented using Pro V&V proper QA procedures. Upon receipt of all hardware, an inspection will be performed to verify that the equipment received is free from obvious signs of damage and/or degradation that may have occurred during transit. If present, this damage shall be recorded, photographed, and reported to the Unisyn Representative. Additionally, a comparison shall be made between the recorded serial numbers/part numbers and those listed on shipper's manifest and any discrepancies shall be reported to the Unisyn Representative. TDP items and all source code received shall be inventoried and maintained by Pro V&V during the test campaign.

During test performance, the system shall be configured as it would be for normal field use. This includes connecting all supporting equipment and peripherals.

6.3 Test Sequence

The OVS 2.0 will be evaluated against all applicable requirements in the EAC 2005 VVSG. There is no required sequence for test performance.

7.0 TEST OPERATIONS PROCEDURES

Pro V&V will identify PASS/FAIL criteria for each executed test case. The PASS/FAIL criteria will be based on the specific expected results of the system. In the case of an unexpected result that deviates from what is considered standard, normal, or expected, a root cause analysis will be performed.

Pro V&V will evaluate every EAC 2005 VVSG requirement applicable to the OVS 2.0 voting system. Any deficiencies noted will be reported to the EAC and the manufacturer. If it is determined that there is insufficient data to determine compliance, this test plan will be altered and additional testing will be performed.

7.1 Proprietary Data

All data and documentation considered by the manufacturer to be proprietary will be identified and documented in an independent submission along with a Notice of Protected Information.

APPENDIX A
PROJECT SCHEDULE

Task Name	Start Date	End Date	Assigned To	% Complete	Duration	Predecessors
Readiness for Testing (TRR)	12/28/16	01/11/17		0%	11d	
EAC Application Submitted	12/28/16	12/28/16	William	0%	1d	
TDP Delivered	12/28/16	12/28/16	Diane	0%	1d	
Source Code Delivered	12/28/16	12/28/16	Jack	0%	0	
Equipment Delivered	01/16/17	01/16/17	William	0%	0	
TDP Verification	12/29/16	12/29/16	Diane	0%	1d	4
Source Code Verification	12/28/16	12/28/16	Jack	0%	1d	5
Equipment Verification	01/16/17	01/16/17	William	0%	1d	6
System Setup	01/17/17	01/18/17	William	0%	2d	9
Mark Reading Test	01/19/17	01/20/17	William	0%	2d	10
VRT Status Update	01/23/17	01/23/17	Walker	0%	1d	11
Application Approved by EAC	01/24/17	01/25/17	Walker	0%	2d	12
TDP	12/29/16	03/17/17		0%	57d	
Initial Review	12/29/16	01/04/17	Diane	0%	5d	4
Compliance Review	01/05/17	06/07/17	Diane	0%	110d	15
Final review	06/08/17	06/21/17	Diane	0%	10d	16
Test Plan	02/13/17	04/26/17		0%	53d	
Test Plan Creation	02/13/17	03/02/17	Wendy	0%	14d	
Vendor Review & Comments	03/03/17	03/06/17	Wendy	0%	2d	19
EAC Submission & Review	03/07/17	04/03/17	Wendy	0%	20d	20
EAC Comment Review & Update	04/04/17	04/11/17	Wendy	0%	6d	21
EAC Submission & Review of Revision	04/12/17	04/25/17	Wendy	0%	10d	22
EAC Approved Test Plan	04/26/17	04/26/17	Wendy	0%	1d	23
Source Code	03/13/17	03/21/17		0%	7d	
Automated Review	03/13/17	03/13/17	Jack	0%	1d	
Source Code Review	03/14/17	03/15/17	Jack	0%	2d	26
Source Code Re-Review	03/16/17	03/16/17	Jack	0%	1d	27
Document Review	03/17/17	03/17/17	Jack	0%	1d	28
Compliance Build	03/20/17	03/21/17	Jack	0%	2d	29
System Delivery & Setup	01/16/17	03/23/17		0%	49d	
PCA	01/16/17	01/16/17	William	0%	1d	6
System Setup	01/17/17	01/18/17	William	0%	2d	32
System Loads & Hardening	03/22/17	03/23/17	William	0%	2d	30
Hardware Testing	03/24/17	05/03/17		0%	29d	
Electrical Testing (OVO, OVI, FVT)	03/24/17	04/06/17	Walker	0%	10d	34
Environmental Testing (OVO, OVI, FVT)	03/24/17	04/20/17	Walker	0%	20d	34
Temp Power (OVO, OVI, FVT, OVCS)	04/21/17	04/27/17	Walker	0%	5d	37
Electrical Supply	04/28/17	05/01/17	William	0%	2d	38
Acoustic	05/02/17	05/02/17	William	0%	1d	39
Maintainability	05/03/17	05/03/17	William	0%	1d	40
System Level Testing	05/04/17	07/04/17		0%	44d	
FCA	05/04/17	06/14/17	William	0%	30d	41
Security (include SCAP)	06/15/17	06/20/17	Becky	0%	4d	43
Usability	06/21/17	06/22/17	William	0%	2d	44
Accessibility	06/23/17	06/26/17	William	0%	2d	45
Volume & Stress	06/27/17	06/29/17	William	0%	3d	46
Accuracy	06/30/17	07/04/17	William	0%	3d	47
Regression Testing	06/15/17	06/16/17	William	0%	2d	43
Trusted Build	06/19/17	06/20/17	Jack	0%	2d	49
System Loads & Hardening	06/21/17	06/22/17	William	0%	2d	50
System Integration	06/23/17	06/27/17	William	0%	3d	51
Test Report	04/27/17	07/04/17		0%	49d	
Test Report Creation	06/19/17	06/30/17	Wendy	0%	10d	49
Vendor Review & Comments	07/03/17	07/04/17	Wendy	0%	2d	54
EAC Submission & Review	04/27/17	05/24/17	Wendy	0%	20d	24
EAC Comment Review & Update	05/25/17	05/31/17	Wendy	0%	5d	56
EAC Submission & Review of Revision	06/01/17	06/14/17	Wendy	0%	10d	57
EAC Approved Test Report	06/15/17	06/15/17	Wendy	0%	1d	58