Report to the Office of the Attorney General

Sequoia AVC Edge Voter-verified Paper Record System Assessment

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I. Summary

Introduction

The Attorney General's Office issued "Criteria for Voter-Verified Paper Record for Direct Recording Electronic Voting Machines" (the Criteria), and requested New Jersey Institute of Technology (NJIT) to test Voter-Verified Paper Record Systems (VVPRS) against certain items in the Criteria.

NJIT is New Jersey's Science and Technology University. Testing was developed and performed by experts with extensive experience and knowledge in computers, networks, electronics, security, data hiding, forensics and statistics. The project team was managed by the Center for Information Age Technology, which, since 1983, has advised government agencies on technology and related issues.

Sequoia supplied three AVC Edge machines to test, plus documentation, peripheral equipment and technical staff. Testing occurred in a secure NJIT lab. Vendor staff assisted the test team in understanding the machine and documentation, and were not involved in or present for the testing. Vendor documentation was maintained on a secure server.

Testing

To appropriately test against the Criteria, and to fully exercise the machines, numerous testing approaches were designed and utilized: Single Test, 1200-vote Test, and14-hour Test. The latter two are considered and referred to as Volume Tests. Testing was developed and performed based on accepted scientific practices and methodologies.

A **52-vote test,** to test the case in which the paper record extends to multiple pages, was not conducted because it did not apply to the Edge machine since Edge has rolling paper for printing paper ballots ("Continuous") – not individual sheets of paper.("Cut and Drop").

The **Single Test** is a one-time examination, inspection or review of equipment (e.g. printer, paper records display unit, seals, and locks), operations and configurations (e.g., certain mock elections with one or a few votes cast, paper records, electronic records, barcodes, error correction codes, digital signatures), and vendor documentation (e.g., technical manuals, operations guides, specifications).

The **14-hour Test** emulates voting situations during a typical election day. A long ballot is used, with completely balanced votes covering elections, questions, write-ins, undervotes and voided votes. Random shuffled scenarios cards are given to voters. Tally reports, close-poll reports, and reports from scanned paper records are examined and compared with the paper records.

The **1200-vote Test** entails having the machine generate 1200 votes continuously through a scripted program. This number of votes is chosen to exceed the guideline of one machine

for 750 registered voters. This test uses a short ballot, with major party and supplemental voting scenarios; each voted multiple times to reach, collectively, 1200 votes. Results generated in paper records, scanned paper records, and barcodes are examined and compared.

Results

Overall, the Sequoia AVC Edge complied with most of the criteria with 11 exceptions noted in the following table:

Exception #	Criteria and Result
1	**II.B.1** "The VVPRS may be designed in various configurations. In all configurations, prior to casting the ballot, the voter shall have the ability to verify his or her selections on a paper record in a private and independent manner." **II.B.5** "The electronic and paper records shall be created and stored in ways that preserve the privacy of the record." **III.B.1** "The paper record shall be displayed in a way that allows the voter to privately and independently inspect it." **IV.C.2** "Voter privacy shall be preserved during the process of recording, verifying, and auditing ballot selections. This includes a voter who uses an audio voting device. Voters using an audio voting device shall also be able to verify votes privately and independently."
	An observer may be able to read the screen or paper record if he or she stands behind the voter.
2	**II.B.2** "The VVPRS shall be designed to allow the voter to easily review, accept, or reject his or her paper record." **II.B.11.a** "The paper record shall be printed and the voter shall have the opportunity to verify the paper record in its totality prior to the final electronic record being recorded." **IV.C.5.a.(2)** "The voter shall have the opportunity to accept or reject the contents of his or her paper record."
	For the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but is only reviewable by the voter for a few seconds, and then advances to the storage reel. There is not enough time for the voter to verify the selections on the third paper record.
3	**II.B.11 "**An electronic ballot image record shall have a corresponding paper record." **IV.B.1**"The electronic ballot image record and paper records shall be linked by including unique identifiers so that an individual paper record can be identified with its corresponding electronic record. Unique identifiers are tools that will allow LPS to measure the reliability and accuracy of the voting system, as necessary. The electronic ballot image and the paper record shall not reveal the identity of the voter."
	The electronic ballot image records are saved in the ascending order of "VoterId" (an index referred by the vendor); the "VoterId" is contained in the barcode of the corresponding paper record. "VoterId" is the linkage of electronic ballot image record to the corresponding paper record. Matching the electronic ballot image records to the corresponding paper records is difficult for a large volume of votes.
4	**III.A.1.** "The printer shall be designed to have a sufficient amount of paper, ink, toner, ribbon or like supply for use in an election, taking into account an election district should have at least one voting machine per 750 registered voters."
	Paper replacement is expected after about 120 votes.

5	**III.A.1.a** "If any addition or replacement of paper, ink, toner, ribbon or other like supply is required, it shall be done with minimal disruption to voting and without circumvention of the security features of the Printer and Storage Unit which protect cast ballots and the secrecy of the vote."
	The printed paper records are accessible during the paper change process.
6	**III.D.1** "Security protections including, but not limited to, security seals or locking mechanisms, shall be built into the Storage Unit to prevent tampering at all times, including pre-election, election day, and post-election. The Attorney General, through the Department of Law and Public Safety ("LPS"), will issue chain of custody guidelines regarding the Storage Unit." [only "election day" scenario is tested]
	The storage reel of printed paper records is accessible upon removing the printer cover.
7	**IV.B.2** "The DRE should generate and store a digital signature for each electronic record." **IV.B.3.b** "The records should be exported with a digital signature which shall be calculated on the entire set of electronic records and their associated digital signatures."
	The DRE does not generate a digital signature for each electronic record (electronic ballot image record) of an accepted paper record. It does generate a digital signature for the entire set of electronic records (electronic ballot image records); this is calculated on the entire set of electronic records without their associated digital signatures.
8	**V.E.** "The printer shall be connected to the voting machine either by completely concealing the printer connection or via a security tag to prevent tampering."
	The cable connectors (of the printer cable and power cord) of the voting machine are exposed without any protection.
9	**V.F** "The DRE shall detect and notify the election officials at the polling place of any errors and malfunctions, such as paper jams or low supplies of consumables (e.g. paper) that may prevent paper records from being correctly displayed, printed, or stored." **V.G** "If a mechanical error or malfunction of the DRE occurs (such as, but not limited to, a paper jam or running out of paper), the DRE and VVPRS shall suspend voting operations, not record votes, and present a clear indication of the malfunction to the voter and the election officials.
	A mechanical error or malfunction of the VVPRS does not prompt any error message or warning signal, but 'freezes' the system.
10	**V.H** "If the connection between the voting machine and the printer has been broken, the voting machine shall detect and provide notice of this event and record it in the DRE's internal audit log. Voting operations shall be suspended and no votes shall be recorded."
	A printer disconnection is not recorded in the DRE's internal audit log.
11	**Miscellaneous**
	The machine does not accommodate fleeing voters. If the voter leaves without finishing the voting, there is no audio or visual signal to alert the poll worker to intervene.

II. Project Scope and Approach

a. Project Background

The Attorney General's Office issued "Criteria for Voter-Verified Paper Record for Direct Recording Electronic Voting Machines" (the Criteria), to be used by the Voting Machine Examination Committee as one measure of whether to certify the overall machines for elections in New Jersey.

Direct electronic voting machines with voter-verified paper record systems must each include a printer and a display unit that allows voters to view their votes before recording their electronic ballots. No vote should be recorded until the paper record is viewed and approved by the voter. If a voter rejects the contents of the paper records, he or she may recast a ballot up to two additional times. The paper receipts must then be stored securely in the machine. Lastly, electronic records and paper records must match and must both reflect the voters' actual votes.

New Jersey Institute of Technology (NJIT) was requested by the Attorney General's Office to test Voter-Verified Paper Record Systems (VVPRS) against certain items in the Criteria. NJIT is New Jersey's Science and Technology University. Testing was developed and performed by NJIT experts with extensive experience and knowledge in computers, networks, electronics, security, data hiding, forensics and statistics.

Three professors led the planning and testing efforts, assisted by four advanced Ph.D. candidates. Mock voting was performed by students. The entire project team was managed by NJIT's Center for Information Age Technology, which, since 1983, has advised government agencies on technology, project management, and business processes.

b. Test Environment

A secure lab was established at NJIT, dedicated to this project. The room was completely emptied before the project began. The door lock code was set to a new combination. Individual alarm codes were given to each project participant. Glass doors and panels to the hallway were covered with paper. Sign-in sheets were used for all team members, from the overall Project Manager down to mock voters. No visitors were allowed. The machines were brought directly into the lab. All electronic vendor documentation was maintained on a secure server, and physical items were kept under lock and key. Confidentiality agreements were executed between the participants and the University.

Sequoia supplied three AVC Edge machines to test. In addition, peripheral equipment was supplied, such as laptop with software, bar code reader, audio unit and voting cards. Vendor documentation included technical manuals, operations guides, equipment specifications, and various documents in response to questions. Vendor technical staff provided assistance in understanding the machine and documentation. They were available

by telephone, email and in person. While at NJIT, they were not involved in or present for any testing. Vendor documentation was maintained on a secure server.

c. Test Approaches

To test whether each machine type has satisfied the various requirements set forth according to the State of New Jersey Criteria for Voter-Verified Paper Record for Direct Recording Electronic Voting Machines, four testing approaches have been designed and conducted: Single Test, 1200-vote Simulated Test, 14-hour Test, and 52-vote Test. The latter two tests (1200-vote, and 14-hour) are considered Volume Tests. Testing was developed and performed based on accepted scientific practices and methodologies.

The **Single Test**, a one-time examination or review against a specific criteria, is conducted through different means; it is requirement specific/dependent. It can be a physical inspection of various components of the DRE and VVPR voting system such as the printer, the paper record display unit, the paper supply, the paper record storage unit, and the placement of seals and locks. It can also be an examination of the basic operations and various configurations of the VVPRS, in which case a mock election with one or a few votes is conducted. In many cases, paper records, electronic records, and barcodes are retrieved, studied, and compared. For instance, the deployment of error correction codes and digital signatures may be verified via close examination of these records. In some cases, incidental and procedural "hindrances" such as a paper jam are "forced" and then observed. Close examination of vendors' documents are often required.

The **14-hour test** emulates actual physical voting situations over a total time period of 14 hours, representing an entire election day. A number of mock voters are recruited to cast various voting scenarios; each voter votes for a 1- to 2-hour time slot. The test adopts the long ballot with 12 major voting testing scenarios: eight major party voting scenarios and four supplementary voting scenarios. These voting scenarios are completely balanced with respect to two parties for seven positions and yes/no votes for seven questions and designed to test all kinds of possibilities including write-ins and undervotes.

Furthermore, additional scenarios involving voided votes are included. Each mock voter is given a set of shuffled voting scenarios cards derived from eight sets of eight major party voting scenarios and one set of four supplementary voting scenarios. Some questionnaire cards are randomly inserted into the voting scenarios to ask the voter questions with respect to the last voting scenario. Finally, the tally reports from the cast voting scenarios, the close-poll reports, the electronic record reports, and the reports generated from the scanned paper records are examined and compared.

The **1200-vote simulated test** for each machine entails having the machine generate 1200 votes continuously based on the short ballot through a scripted program. This number of votes is chosen to exceed the guideline limit of one machine for 750 registered voters.

This test uses twelve vote testing scenarios, which are split into two parts:

(i) eight major party voting scenarios
(ii) four supplementary voting scenarios

Each of the eight major party voting scenarios is generated 125 times, while each of the four supplementary voting scenarios 50 times, totaling, collectively, 1200 votes. Results generated in paper records, electronic records, and barcodes are examined and compared.

The **52-vote test,** designed to test the special case in which the paper record extends to multiple pages, did not apply to the Edge machine since it has rolling paper for printing paper ballots ("Continuous") – not individual sheets of paper.("Cut and Drop").

III. Testing Results

a. Equipment Configuration

Vendor	DRE Hardware Model	DRE Hardware Version	DRE Firmware Version	DRE Machine ID	VVPRS Printer Model	VVPRS Printer Driver Version	VVPRS Printer Interface
Sequoia	AVC Edge	AVC Edge with VVPAT	5.0.31	5842	APS CP305	1.01	Parallel IEEE 1284
Sequoia	AVC Edge	AVC Edge with VVPAT	5.0.31	5848	APS CP305	1.01	Parallel IEEE 1284
Sequoia	AVC Edge	AVC Edge with VVPAT	5.0.31	5849	APS CP305	1.01	Parallel IEEE 1284

b. Volume Tests

Two types of volume testing were done by conducting mock elections.

- The first test, called **14-hour test**, consists of manual voting by mock voters to represent a large volume of votes over a 14-hour period by using a long ballot with 19 items to be voted upon. In case of the Sequoia AVC Edge machine, this test resulted in 414 voters.

- The second test, called **1200-vote test**, consists of electronic voting to represent 1200 voters by using a short ballot with 9 items to be voted upon. These votes were cast electronically without human intervention.

Since the Edge machine has rolling paper for printing paper ballots, it was not necessary to conduct a test to check the multiple-page ballot. Also, the Edge machine does not have a provision for fleeing voters. If the voter leaves without finishing the voting, there is no audio or visual signal to alert the poll worker to intervene.

14-hour Test

As indicated above, the long ballot for the **14-hour test** contains 19 items to be voted upon. The number of different ways a voter could vote on these 19 items is in millions; **12 voting scenarios** were designed to represent all possible choices for the long ballot as shown in Tables 1 and 2.

Table 1 contains 8 major party voting scenarios that are completely balanced with respect to:

(i) the 2 parties for the 7 positions,
(ii) yes/no votes for the 7 questions, and
(iii) the 10 names listed for the charter study commission.

In the case of the 8 major party voting scenarios, each position gets 4 Democratic and 4 Republican candidate votes. Similarly, each question gets 4 yes and 4 no votes. For the charter study commission, each of the 10 listed names is voted twice and 3 names are written in. Scenario 6 is no vote (i.e., undervote) for the charter study commission.

Table 2 contains 4 supplementary voting scenarios that are designed to test the possibilities that are not included in the balanced 8 major party voting scenarios. For the President, it includes a scenario with a vote for each of the 2 petition candidates, write-in, and no vote. For the other 6 positions it includes write-in/no vote. None of the questions are voted. For the charter study commission, one scenario is no vote and the other 3 scenarios split the 10 names among them. For the charter study commission, none of the scenarios include any write-ins, since they are tested in the eight major party voting scenarios.

1200-vote Test

For the short ballot used in the **1200-vote test, 12 voting scenarios** were designed to represent all possible choices for the short ballot as shown in Tables 3 and 4. The short ballot does not include the charter study commission.

Table 3 contains 8 major party voting scenarios that are completely balanced with respect to:

(i) the 2 parties for the 5 positions and
(ii) yes/no votes for the 4 questions.

In the case of the eight major party voting scenarios, each position gets 4 Democratic and 4 Republican candidate votes. Similarly, each question gets 4 yes and 4 no votes.

Table 4 contains 4 supplementary voting scenarios that are designed to test the possibilities which are not included in the balanced 8 major party voting scenarios. For the U. S. Senator, it includes a scenario with a vote for each of the 2 petition candidates, write-in, and no vote. For the other 4 positions it includes write-in/no vote. None of the questions are voted.

Changing Selections

The following two scenarios are used to test the capability of changing selections as a part of the 14-hour test:

1. Voter voids the first set of selections and casts a vote for the second set of selections
2. Voter voids the first two sets of selections and cast a vote for the final selection

Table 5 lists the requirements and discusses the results of the 14-hour and 52-vote volume tests in terms of meeting or not meeting the specific requirements.

Results of Changing Selections Test

Table 6 gives the number of votes cast for the following two scenarios used for testing the capability of changing selections:

- Voter voids the first set of selections and casts a vote for the second set of selections
- Voter voids the first two sets of selections and cast a vote for the final selection

As shown in Table 6, all of these votes were recorded correctly on the paper ballots and the final versions of these votes were reflected correctly in the tallies from the scanned paper ballots, electronic records, and the tally from poll close. The paper records of the rejected versions were printed by the machine.

Summaries of Vote Results

For each of the 2 types of tests (i.e., 14-hour and 1200-vote), summaries of the following were prepared:

- Paper ballots cast,
- Scanned records of the paper ballots cast,
- Electronic records, and
- Tally from poll close.

Each of these summaries gives a count of the number of votes cast for each candidate for a specific position or a question. These 4 sets of counts were identical, which indicated that we did not find any discrepancies in the 4 types of counts.

Counts of 14-hour Volume Test

For the 14-hour volume test, **Table 7** gives the counts of the paper ballots along with the tallies of the scanned paper ballots, electronic records, and the tally from poll close. All of these counts match perfectly. A few of the write-in votes were typed in incorrectly, which resulted in them being counted as unknown write-ins, but the total number of write-in votes match across the tallies.

Counts of 1200-vote Volume Test

For the 1200-vote volume test, **Table 8** gives the counts of the paper ballots along with the tallies of the scanned paper ballots, electronic records, and the tally from poll close. All of these counts match perfectly.

Overall Summary for Volume Test

Overall, the Edge machine performed well under both types of volume testing (14-hour and 1200-vote) and the 4 types of counts (Paper records, scanned paper records, electronic records, and close poll) were identical.

Table 1. Long Ballot - Eight Major Party Voting Scenarios

Scenario Number									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Position	**PRES**	R	D	D	D	D	R	R	R
	US-S	D	R	D	D	R	R	R	D
	US-H	R	R	D	R	D	R	D	D
	F 3-YR-1	R	R	D	D	R	D	D	R
	F 3-YR-2	D	R	D	R	D	D	R	R
	F 2-YR	R	D	D	R	R	D	R	D
	TOWNSHIP	D	D	D	R	R	R	D	R
Question	**1**	NO	YES	NO	NO	YES	YES	NO	YES
	2	NO	NO	YES	NO	NO	YES	YES	YES
	3	NO	YES	NO	YES	NO	YES	YES	NO
	4	NO	YES	YES	NO	YES	NO	YES	NO
	5	NO	NO	NO	YES	YES	NO	YES	YES
	6	NO	YES	YES	YES	NO	NO	NO	YES
	7	NO	NO	YES	YES	YES	YES	NO	NO
Charter	**1**	N1	N6	N1	N4	N10		N6	N8
	2	N2	N7	N2	N5	W1		N7	N9
	3	N3	N8	N3		W2		W3	N10
	4	N4	N9						
	5	N5							
No. of Charter Voted		5	4	3	2	3	0	3	3

Notes:

1. For each position, R and D stand for a vote for a Republican or a Democratic name, respectively. A blank space means no vote for that position.
2. For the charter study commission, N1, N2, …, N10, stand for a vote for Name1, Name2,…, Name 10, respectively. W1, W2, and W3 are the three write-in names for the charter study commission. A blank space means no vote for that position.

Table 2. Long Ballot - Four Supplementary Voting Scenarios

Scenario Number					
		9	**10**	**11**	**12**
Position	**PRES**	PET1	PET2		WRITE-IN
	US-S	WRITE-IN		WRITE-IN	
	US-H	WRITE-IN		WRITE-IN	
	F 3-YR-1	WRITE-IN		WRITE-IN	
	F 3-YR-2		WRITE-IN	WRITE-IN	
	F 2-YR	WRITE-IN		WRITE-IN	
	TOWNSHIP	WRITE-IN		WRITE-IN	
Question	**1**				
	2				
	3				
	4				
	5				
	6				
	7				
Charter	**1**	N1	N6	N9	
	2	N2	N7	N10	
	3	N3	N8		
	4	N4			
	5	N5			
No. of Charter Voted		5	3	2	0

Notes:

1. For each position, R and D stand for a vote for a Republican or a Democratic name, respectively. A blank space means no vote for that position.
2. For each question, a blank space means no vote for that question.
3. For the charter study commission, N1, N2, …, N10, stand for a vote for Name1, Name2,…, Name 10, respectively. W1, W2, and W3 are the three write-in names for the charter study commission. A blank space means no vote for that position.

Table 3. Short Ballot - Eight Major Party Voting Scenarios

Scenario Number									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Position	**US-S**	R	D	D	D	D	R	R	R
	US-H	D	R	D	D	R	R	R	D
	F 3-YR-1	R	R	D	R	D	R	D	D
	F 3-YR-2	R	R	D	D	R	D	D	R
	SHERIFF	D	R	D	R	D	D	R	R
Question	**1**	NO	YES	NO	NO	YES	YES	NO	YES
	2	NO	NO	YES	NO	NO	YES	YES	YES
	3	NO	YES	NO	YES	NO	YES	YES	NO
	4	NO	YES	YES	NO	YES	NO	YES	NO

Notes:

1. For each position, R and D stand for a vote for a Republican or a Democratic name, respectively. A blank space means no vote for that position.

Table 4. Short Ballot - Four Supplementary Voting Scenarios

Scenario Number					
		9	**10**	**11**	**12**
Position	**US-S**	PET1	PET2		WRITE-IN
	US-H	WRITE-IN		WRITE-IN	
	F 3-YR-1	WRITE-IN		WRITE-IN	
	F 3-YR-2	WRITE-IN		WRITE-IN	
	SHERIFF		WRITE-IN	WRITE-IN	
Question	**1**				
	2				
	3				
	4				

Notes:

1. For each position, R and D stand for a vote for a Republican or a Democratic name, respectively. A blank space means no vote for that position.
2. For each question, a blank space means no vote for that question.

Table 5. Results of the Volume Testing for Sequoia AVC Edge

• An electronic ballot image record is an equivalent of the electronic record of an accepted paper record (see Requirements II.B.2.a, II.B.5, II.B.11, and II.B.11.b.)

• An electronic record of an election is the entire set of electronic ballot image records of the election (see Requirements IV.B.3 and IV.B.3.b.)

No.	Requirement	Results for Sequoia AVC Edge
2.0.20	II.B.9. The VVPRS shall mark the paper record precisely as indicated by the voter on the DRE and produce an accurate paper record and corresponding electronic record of all votes cast.	• VVPRS does mark the paper records as indicated by the voters on the DRE and produce accurate paper records. • The tally of the votes from the paper records does match the corresponding electronic records of all votes cast.
2.0.21	II.B.10. DRE electronic ballot image records shall include all votes cast by the voter, including write-ins and under votes.	• The electronic ballot image records retrieved by the vendor's WinEDS software are in text format with system-wide IDs (SWIDs) which can be cross-referenced to corresponding candidates. • DRE electronic ballot image records do include all votes cast by the voters. The write-in votes and under-votes are also included. The tally of the votes from the paper records does match that of the corresponding electronic records of all votes cast including write-ins and undervotes.
2.0.24	II.B.11. An electronic ballot image record shall have a corresponding paper record.	• The electronic ballot image records are listed in the ascending order of "VoterId" (an index referred by the vendor); the "VoterId" is contained in the barcode on each accepted paper record. • Only the final approved vote is electronically recorded. The corresponding paper record is marked "accepted" and contains a barcode. • By decoding the barcodes of all the paper records and sorting them in ascending order of the "VoterId", each electronic ballot image record can then be matched to the corresponding paper record. • Each electronic ballot image record does have a corresponding paper record if no paper record is lost.

2.0.25	II.B.11.a. The paper record shall be printed and the voter shall have the opportunity to verify the paper record in its totality prior to the final electronic record being recorded.	• The paper record is printed out for each vote cast by the voter. The voter does have the opportunity to verify the paper record in its totality prior to the electronic record being recorded. •For the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but is reviewable by the voter for only a few seconds, and then advances to the storage reel. This is not enough time for the voter to verify the selections on the third paper record.
2.0.26	II.B.11.b. The DRE electronic ballot image record shall correspond to the paper record in a manner that does not reveal the voter's identity.	• The electronic ballot image record only contains the corresponding system-wide IDs (SWIDs) in text format for each candidate, answers, write-ins and undervotes. No information in the electronic ballot image record reveals the voter's identity. • The electronic ballot image records are saved in the ascending order of "VoterId". "VoterId" is the linkage of each electronic ballot image record to the corresponding paper record provided no paper record is lost, in which case the DRE electronic ballot image records correspond to the paper records.
2.0.27	II.B.11.c. The paper record shall contain all voter selection information stored in the electronic ballot image record.	The paper records do contain all voter selection information stored in the electronic ballot image records.
3.0.2	III.A. The printer shall be designed to have a sufficient amount of paper, ink, toner, ribbon or like supply for use in an election, taking into account an election district should have at least one voting machine per 750 registered voters.	A new paper roll provided by the vendor is sufficient for about 120 single page paper records. Paper replacement is expected for an election with more than 120 single page votes.
4.0.8	IV.A.3. For the "Cut and Drop" Method, if the paper record cannot be displayed in its entirety on a single page, each page of the record shall be numbered and shall include the total count of pages for that ballot.	The voting machine uses the "Continuous Spool" method.
4.0.9	IV.A.4. The image created on the paper record shall include every contest that is displayed to the voter on the DRE, including write-ins and undervotes.	All selected contests that are displayed to the voter on the DRE screen are accurately printed on the paper record, including write-ins, and undervotes.
4.0.10	IV.A.5. The paper record shall be created such	The contents of the paper record are

	that its contents are machine readable.	encoded in a barcode which is machine readable.
4.0.14	IV.B.1. The electronic ballot image record and paper records shall be linked by including unique identifiers so that an individual paper record can be identified with its corresponding electronic record. Unique identifiers are tools that will allow LPS to measure the reliability and accuracy of the voting system, as necessary. The electronic ballot image and the paper record shall not reveal the identity of the voter.	• The electronic ballot image records are listed in the ascending order of "VoterId". • Only the final approved vote of each voter is electronically recorded. The corresponding paper record is marked "accepted" and contains a barcode. • By decoding the barcodes of all the paper records and sorting them in ascending order of the "VoterId", each electronic ballot image record can then be matched to the corresponding paper record. • Each electronic ballot image record does have a corresponding paper record provided no accepted paper record is lost. • Information in the paper record does not reveal the voter's identity. • Information in the electronic ballot image record does not reveal the voter's identity.
4.0.16	IV.B.2. The DRE should generate and store a digital signature for each electronic record.	• The electronic record of the entire election does contain the cumulative electronic ballot image records and does have a digital signature. • The electronic record of an accepted paper record does not contain an individual digital signature.
4.0.17	IV.B.3. The electronic ballot image records shall be able to be exported for auditing or analysis on standards-based and/or COTS (commercial off-the-shelf) information technology computing.	• The electronic ballot image records are digitally recorded in a proprietary file format. • The electronic ballot image records can only be accessed and processed by using the vendor's proprietary software. • Using the vendor's proprietary software, the electronic ballot image records can then be printed into the Audit Trail report which can be read by using a COTS software such as Adobe© Acrobat for auditing and analysis.
4.0.18	IV.B.3.a. The exported electronic ballot image records shall be in a publicly available, non-proprietary format.	The exported electronic ballot image records can be read by using a COTS software such as Adobe© Acrobat.
4.0.19	IV.B.3.b. The records should be exported with a digital signature which shall be calculated on the entire set of electronic records and their associated digital signatures.	• The electronic record of the entire election does contain the cumulative electronic ballot image records, and does have a digital signature.

		• The electronic ballot image record associated with a paper record does not contain an individual digital signature. • A group digital signature is calculated only on the entire set of electronic ballot image records.
4.0.34	IV.C.5. The paper records shall distinguish between accepted and non-accepted ballots.	• There is clear acceptance information: * "Voided" is printed on the rejected paper record, * "Accepted" is printed on the accepted paper record. • The Operator log stored in the cartridge does not reveal how many attempts that have been used to cast this ballot.
4.0.35	IV.C.5.a. The voter shall have the opportunity to accept or reject the contents of his or her paper record.	The voter does have the opportunity to accept or reject the contents of his or her paper record.
4.0.36	IV.C.5.a.(1) If the voter rejects the contents of the paper record, he or she may recast the ballot up to two additional times. This procedure is consistent with current State law, which limits the amount of time a voter has to cast a ballot. (See N.J.S.A. 19:52-3).	If the voter rejects the paper record, the voting machine does allow the voter to recast the ballot up to two additional times.
4.0.37	IV.C.5.a.(2) Before the voter causes a third and final paper record to be printed, the voter shall be presented with a warning notice on the machine that the selections on the DRE will be final. The voter will see and verify a printout of the votes, but will not be given additional opportunities to change any vote. The third ballot cast shall constitute the final and official ballot of such a voter.	• After the voter rejects the paper record twice, the DRE screen does show the warning message "This is your final chance to make changes to your ballot. Press RETURN TO BALLOT to proceed." • For the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but only is reviewable by the voter for a few seconds, and then advances to the storage reel. This is not enough time for the voter to verify the selections on the third paper record. • The voter cannot recast or modify the selections again.
4.0.38	IV.C.5.a.(3) Upon rejecting a paper record, the voter shall be able to modify and verify the selections on the DRE without having to reselect all choices in all contests on the ballot.	Upon rejecting a paper record, the voter is able to modify and verify the selections on the DRE without having to reselect all choices in all contests on the ballot.
4.0.40	IV.C.5.a.(5) The VVPRS shall be designed to indicate the paper record which the voter has identified and cast as his or her official ballot.	There is clear final and official information printed on the paper record: "accepted" is printed on the official paper record.

Table 6. Counts of Voting Scenarios for Changing Voter selections

Voting Scenario	No. of Votes Cast During14-hour Test	No. of Votes Recorded Correctly During14-hour Test
2-/2-2	6	6
8-1/8-2	6	6
4-1/4-2/4-3	7	7
Total	19	19

Note:
Here the final selection is the scenario number shown in Table 1 and the other scenarios are different from the final version. For example, Scenario 2-2 is Scenario Number 2 shown in Table 1, while Scenario 2-1 is somewhat different from Scenario Number 2 (Scenario 2-1 has a vote for the Republican candidate instead of the Democratic candidate for President in Scenario 2-2).

Table 7. Counts of Paper Records, Scanned Records, Electronic Records, and Poll Close for 14-hour Vote

		Count from Paper Records	Count from Scanned Records	Count from Electronic Records	Count from Poll Close
Total Votes		414	414	414	414
Office	**Candidate**				
President	R: Peter	193	193	193	193
	D: Kenneth	196	196	196	196
	BP1: William	6	6	6	6
	BP2:Michael	6	6	6	6
	WI:William	7	7	7	7
	Undervote	6	6	6	6
US Senate	R: John	193	193	193	193
	D: Phlip	196	196	196	196
	BP1: Joanna	0	0	0	0
	BP2:Christian	0	0	0	0
	WI:Ed lynch	12	12	12	12
	Undervote	13	13	13	13
House of Rep	R: David	195	195	195	195
	D: Larry	194	194	194	194
	BP1: Bernada	0	0	0	0
	BP2: Peter	0	0	0	0
	WI:Micheal	12	12	12	12
	Undervote	13	13	13	13
Freeholder 3yrs Vote 2	R: Bill	194	194	194	194
	R: Mike	192	192	192	192
	D: David	195	195	195	195
	D: Ray	197	197	197	197
	BP1:Jeffery	0	0	0	0
	BP1: Michael	0	0	0	0
	BP2: Antonio	0	0	0	0
	BP2: Richard	0	0	0	0
	WI-1:Kelly	12	13	13	13
	WI-2: Bruce	12	11	11	11
	Undervote	26	26	26	26
Freeholder 2yr Vote 1	R: Roy	194	194	194	194
	D: William	195	195	195	195
	BP1: Catherine	0	0	0	0
	BP2: Rebecca	0	0	0	0
	WI: Charles	12	12	12	12
	Undervote	13	13	13	13
Member Township	R: Denver	195	195	195	195
	D: Baltimore	194	194	194	194

Vote 1	BP1: Henry	0	0	0	0
	BP2: Katherine	0	0	0	0
	WI: Michael	12	12	12	12
	Undervote	13	13	13	13
Charter Study Vote 5	BP1: Herald	105	105	105	105
	BP1: Jessica	105	105	105	105
	BP1: Samuel	105	105	105	105
	BP1: Alfred	104	104	104	104
	BP1: Carlton	104	104	104	104
	BP2: Mario T	101	101	101	101
	BP2: Henry	101	101	101	101
	BP2: Mary	102	102	102	102
	BP2: Abraham	102	102	102	102
	BP2: Joel	103	103	103	103
	Write-in Candidates	145	145	145	145
	Undervote	893	893	893	893
Q1	Y	194	194	194	194
	N	195	195	195	195
	Undervote	25	25	25	25
Q2	Y	194	194	194	194
	N	195	195	195	195
	Undervote	25	25	25	25
Q3	Y	193	193	193	193
	N	196	196	196	196
	Undervote	25	25	25	25
Q4	Y	194	194	194	194
	N	195	195	195	195
	Undervote	25	25	25	25
Q5	Y	193	193	193	193
	N	196	196	196	196
	Undervote	25	25	25	25
Q6	Y	195	195	195	195
	N	194	194	194	194
	Undervote	25	25	25	25
Q7	Y	197	197	197	197
	N	192	192	192	192
	Undervote	25	25	25	25

Note: In case of the Charter Study commission, several write-in votes have been combined to show the total number of write-in votes.

Table 8. Counts of Paper Records, Scanned Records, Electronic Records, and Poll Close for 1200-Vote

		Count from Paper Records	Count from Scanned Records	Count from Electronic Records	Count from Poll Close
Total Votes		1204	1204	1204	1204
Office	**Candidate**				
US Senate	R: John	500	500	500	500
	D: Phlip	500	500	500	500
	BP1: Scott	51	51	51	51
	BP2:Mary	51	51	51	51
	WI-1 USS	51	51	51	51
	Undervote	51	51	51	51
House of Rep	R: David	500	500	500	500
	D: Larry	500	500	500	500
	WI-1 HOR	102	102	102	102
	Undervote	102	102	102	102
Freeholder 3yrs Vote 2	R: Name7	500	500	500	500
	R: Name9	375	375	375	375
	D: Name8	625	625	625	625
	D: Name10	500	500	500	500
	WI-1 FR	102	102	102	102
	WI-2 FR	102	102	102	102
	Undervote	204	204	204	204
SHERIFF	R: Denver	500	500	500	500
	D: Baltimore	500	500	500	500
	WI-1 SHERIFF	102	102	102	102
	Undervote	102	102	102	102
Q1	Y	0	0	0	0
	N	0	0	0	0
	Undervote	1204	1204	1204	1204
Q2	Y	0	0	0	0
	N	0	0	0	0
	Undervote	1204	1204	1204	1204
Q3	Y	0	0	0	0
	N	0	0	0	0
	Undervote	1204	1204	1204	1204
Q4	Y	0	0	0	0
	N	0	0	0	0
	Undervote	1204	1204	1204	1204

Note: In case of Questions 1 –4, our intension was to cast yes/no votes in the 1200-vote test. However, due to a programming error, all votes were programmed to be cast as undervotes.

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c. Single Tests

This following “legend” refers to the New Jersey Criteria for Verified Voter Paper Record for Direct Recording Electronic Voting Machines (the "Criteria"), and indicates the type of testing performed for each requirement:

- Sections marked in Yellow are covered by Volume Tests only.
- Sections marked in Gray are covered by Single Tests only.
- Sections marked in Green are covered by both Volume Test and Single Test.
- Sections marked in Red or not marked are not tested.

The following are defined for clarification purposes:

• An electronic ballot image record is an equivalent of the electronic record of an accepted paper record (see Requirements II.B.2.a, II.B.5, II.B.11, and II.B.11.b.)

• An electronic record of an election is the entire set of electronic ballot image records of the election (see Requirements IV.B.3 and IV.B.3.b.)

No.	Requirement	Test scenario	Test Result
	Pursuant to N.J.S.A. 19:48-1 and N.J.S.A. 19:53A-3, no later than January 1, 2008, each voting machine in New Jersey shall produce an individual permanent paper record for each vote cast, which shall be made available for inspection and verification by the voter at the time the vote is cast, and preserved for later use in any manual audit. In the event of a recount, the voter-verified paper records will be the official tally for the election.		
	To effectuate the intent of the statute, and to instill full public confidence in the electoral process, the Attorney General has established the following criteria for the design and use of a Voter-Verified Paper Record System in conjunction with a Direct Recording Electronic Voting Machine.		

No.	Requirement	Test scenario	Test Result
1.0.0	**I. Definitions**		
2.0.0	**II. General Description of System**		
2.0.1	**II.A. Components**		
2.0.7	**II.B. Operation**		
2.0.8	II.B.1. The VVPRS may be designed in various configurations. In all configurations, prior to casting the ballot, the voter shall have the ability to verify his or her selections on a paper record in a private and independent manner.	• Inspect the VVPRS to determine whether the voter shall have the ability to verify his or her selections on a paper record in a private and independent manner. • View the votes cast by a voter at a close distance. When the vote is being cast, an observer close by should not be able to view the voter's selection of preferences during the casting and recording of the ballot.	• The DRE screen and the paper record display unit are partially covered by some curtains and panels. • When the voter approaches the voting machine, the DRE screen displays a fresh empty ballot, and no paper record is displayed in the paper record display unit. That is, the voter cannot see the previous voter's paper record or selections. • The voter can verify his or her selections on a paper record, which is printed out by a printer located to the left of the voter. • Prior to casting the ballot, the voter has the ability to verify his or her selections on a paper record in a private and independent manner provided that the machine is strategically spaced such that no bystanders are allowed to peek into the DRE screen and the paper record display unit.
2.0.9	II.B.2. The VVPRS shall be designed to allow the voter to easily review, accept, or reject his or her paper record.	• Conduct a vote to see if the voter can review, accept, or reject his or her selections.	• The voter can review his or her selections on a paper record, which shows the contests and the selections, including the undervotes. • The voter can accept his or her selections after the paper record is printed out. • The voter can reject his or her selections twice. The voter can reject his or her selections by selecting "make changes"

No.	Requirement	Test scenario	Test Result
			when prompted to "cast ballot", or by selecting not to print the second page when the paper record has more than one page. • A "VOIDED" is printed out on the rejected paper record. • A barcode and the word "Accepted" are printed out on the accepted paper record. • Thus the voter can easily review, accept, or reject his or her paper records. However, for the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but is reviewable by the voter for only a few seconds, and then advances to the storage reel. This is not enough time for the voter to verify the selections on the third paper record.
2.0.10	II.B.2.a. The DRE shall not record the electronic record until the paper record has been approved by the voter.	• Conduct a vote to see if the record has been electronically recorded before the voter's approval.	• The public and protective counters do not change unless the voter has approved the paper record. • The DRE does not record the electronic record until the voter has approved the paper record.
2.0.11	II.B.3. VVPRS records may be printed and stored by two different methods:		
2.0.12	II.B.3.a. "Cut and Drop" Method: The voter views and verifies the paper record, which the VVPRS cuts and drops into a Storage Unit.	• Check the vendor documentation to determine which method is used in the to-be-tested system. • If it is the case, conduct a vote to see if the operation is consistent with respect to the "cut and drop" method.	N/A
2.0.13	II.B.3.b. "Continuous Spool" Method:	• Check the vendor documentation to determine	• The printer is located to the left of the

No.	Requirement	Test scenario	Test Result
	The voter views the paper record on a spool-to-spool paper roll. This method shall be used in a manner that fully protects the secrecy of all votes cast.	which method is used in the to-be-tested system. • If it is the case, conduct a vote to see if the operation is consistent with respect to the "continuous spool" method.	voter while the voter is facing the DRE screen of the voting machine. • The paper record storage reel, i.e., the printed paper roll, is located inside the VVPRS. • Once the voter finishes reviewing the paper record and approves the paper record, the paper advances until a blank paper is displayed in the paper record display unit. • The voter views the paper record on a spool-to-spool paper roll. • This method is used in a manner that fully protects the secrecy of all votes cast provided that the machine is strategically spaced such that no bystanders are allowed to peek into the DRE screen and the paper record display unit.
2.0.14	II.B.4. No electronic or paper record shall indicate the identity of a voter or be maintained in a way that allows a voter to be identified.	• Conduct a vote to check the paper record. • Check the electronic record.	• The poll worker activates the voting machine each time the voter approaches the voting machine. • The poll worker is not required to input any identity information of the voter into the voting machine to allow the voter to vote. • The voter is not required to input any private information during the voting procedure. • No voter identity information is found in the paper record. • No voter identity information is found in the electronic record. • Neither the electronic record nor the paper

No.	Requirement	Test scenario	Test Result
			record indicates the identity of a voter.
2.0.15	II.B.5. The electronic and paper records shall be created and stored in ways that preserve the privacy of the record.	• Examine how the electronic record is created and stored. • Examine how the paper record is created and stored.	• The voter's official selection is created once the voter approves the ballot. • The DRE system writes the electronic record directly to the cartridge. • The DRE is only connected to the outside by a power cord for power supply purpose. • The cartridge is securely in place during the voting process. • The printer prints out paper records after he or she makes or changes selections. • The paper records are stored in the storage reel which is securely in place during the voting process. • The privacy of the record is preserved. • The electronic and paper records are created and stored in ways that preserve the privacy of the record provided that the machine is strategically spaced such that no bystanders are allowed to peek into the DRE screen and the paper record display unit.
2.0.17	II.B.6.a. These requirements shall include, but are not limited to, an audio component that shall accurately relay the information printed on the paper ballot to the voter.	• Conduct a mock election to check if the audio information is consistent to the election and its integrity.	• An audio-assisted device, including a headphone and a keyboard with only a few control keys, is provided. • The poll worker activates the audio voting process for the voter. • The voter can hear the detailed instruction on how to operate the audio component. • The voter can use the control keys to make selection, input write-ins, change selection, switch between contests, review

No.	Requirement	Test scenario	Test Result
			selections, and approve selections. • When the voter makes selection or changes selections, the screen presents no corresponding display. • Only one (i.e., the official) paper record is printed out regardless whether the voter has changed/voided earlier selections, and the paper record is directly rolled into the paper record storage reel. • During the voting process the voter can adjust the voice speed. • The voter can change selections repetitiously. • The audio component accurately relays the selection information printed on the paper ballot to the voter.
2.0.18	II.B.7. The VVPRS device shall draw its power from the DRE or the same electrical circuit from which the DRE draws its power.	• Inspect the system to ensure that the VVPRS does draw its power either from the DRE or from the same electrical circuit from which the DRE draws its power.	• When the power cord of the printer is connected to the DRE and the DRE has power supply, the printer is powered on. • When the power cord of the printer is unplugged, the printer is powered off. • Therefore, the VVPRS device draws its power from the DRE.
2.0.19	II.B.8. The voting machine shall provide a standard, publicly documented printer port, or the equivalent, using a standard communication protocol.	• Inspect the interface between the printer and DRE to determine whether the voting machine provides a standard, publicly documented printer port, or the equivalent, using a standard communication protocol.	• The DRE and the printer are connected by a parallel cable. • This DRE and the printer communicate with each other using the standard IEEE1284 communication protocol. • Therefore, the voting machine provides a standard, publicly documented printer port and using a standard communication protocol.

No.	Requirement	Test scenario	Test Result
2.0.20	II.B.9. The VVPRS shall mark the paper record precisely as indicated by the voter on the DRE and produce an accurate paper record and corresponding electronic record of all votes cast.	• Setup a mock election. • Open the poll in the official mode. • Conduct a vote. • Review the paper record and verify that the VVPRS marks the paper record precisely as indicated by the voter on the DRE. •Cast the vote. •Close the poll and export electronic data from the electronic storage media with the device/software provided by the vendor. •Verify the electronic ballot image record is accurate as the paper record.	• When the voter presses “Cast Ballot” on the DRE screen, a paper record of the ballot selections is printed and shown at the VVPRS display window for the voter’s review. • The VVPRS does mark the paper record precisely as indicated by the voter on the DRE including every selection and associated contest names, if no candidate’s name is more than 24 characters. Only the first 24 characters of the candidate’s name will be printed out on the paper record. •After the voter finishes reviewing the entire paper record, the voter can accept his or her selection by pressing "Cast Ballot" on the DRE screen. The DRE screen shows a message confirming that the vote has been recorded. • The electronic ballot image record presented from the WinEDS software provided by the vendor is in text format with system-wide IDs (SWIDs) which can be cross-referenced to corresponding candidates. • The electronic ballot image record does have the record of all votes cast as marked on the paper record.
2.0.21	II.B.10. DRE electronic ballot image records shall include all votes cast by the voter, including write-ins and undervotes.	•Conduct a vote including write-ins and undervotes. •Close the poll and export electronic data from the electronic storage media with the	• The electronic ballot image record presented from the WinEDS software provided by the vendor is in text format with SWIDs which can be cross-referenced

No.	Requirement	Test scenario	Test Result
		device/software provided by the vendor. •Verify the electronic ballot image records include all votes cast by the voter, including write-ins and undervotes.	to corresponding candidates. • The information recorded in the electronic ballot image is accurate as marked on the paper record, and does include all votes cast by the voter, including write-ins and undervotes. •If the voter does not make any selections and cast the vote, the DRE will record this vote as undervotes for all contests.
2.0.24	II.B.11. An electronic ballot image record shall have a corresponding paper record.	•Open the poll in the official mode. •Conduct 10 votes including some voided cast votes. •Close the poll and export electronic data from the electronic storage media with the device/software provided by the vendor. •Match each electronic ballot image record to the corresponding paper record.	• The electronic ballot image records can be generated from the electronic records in the result cartridge with the specific cartridge reader and WinEDS program provided by the vendor. •The electronic ballot image record presented from the WinEDS software provided by the vendor is in text format with SWIDs which can be cross-referenced to corresponding candidates. •The electronic ballot image records are listed in the ascending order of "VoterId" (an index referred by the vendor), which are contained in the barcodes on accepted paper records. •Only the final approved vote is electronically recorded. The corresponding paper record is marked "accepted" and contains a barcode. •By scanning all the paper records with barcodes and sorting them in ascending order of the "VoterId", each electronic

No.	Requirement	Test scenario	Test Result
			ballot image record can then be matched to the corresponding paper record.
2.0.25	II.B.11.a. The paper record shall be printed and the voter shall have the opportunity to verify the paper record in its totality prior to the final electronic record being recorded.	• Setup a mock election. • Open the poll in the official mode. • Conduct a vote. • Review the paper record and verify that the VVPRS marks the paper record precisely as indicated by the voter on the DRE. • Cast the vote.	• When the voter presses "Cast Ballot" on the DRE screen, a paper record of the ballot selections is printed and shown at the VVPRS display window for the voter's review. • The VVPRS marks the paper record precisely as indicated by the voter on the DRE including every selection and associated contest names. •The voter can accept his or her selection by pressing "Cast Ballot" on the DRE screen after the paper record is reviewed. After the voter finishes reviewing the entire paper record and confirms to cast the vote, the DRE screen shows a message confirming that the vote has been recorded. •For the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but only is reviewable by the voter for only a few seconds, and then advances to the storage reel. This is not enough time for the voter to verify the selections on the third paper record.
2.0.26	II.B.11.b. The DRE electronic ballot image record shall correspond to the paper record in a manner that does not reveal the voter's identity.	•Open the poll in the official mode. •Conduct one vote. •Close the poll and export electronic data from the electronic storage media with the device/software provided by the vendor.	•No obvious mark on the paper record reveals the voter's identity. •The electronic ballot image record only contains the corresponding SWIDs in text format for each candidate, answers, write-

No.	Requirement	Test scenario	Test Result
		•Verify that each electronic ballot image record is clearly identifiable on the corresponding printed paper record, but does not reveal the voter's identity.	ins and undervotes. •The electronic ballot image records are saved in the ascending order of "VoterId"; "VoterId" is contained in the barcode of the corresponding paper record. • "VoterId" is the linkage of electronic ballot image record to the corresponding paper record provided no paper record is lost, in which case the DRE electronic ballot image records correspond to the paper records. •No information in the electronic ballot image record reveals the voter's identity.
2.0.27	II.B.11.c. The paper record shall contain all voter selection information stored in the electronic ballot image record.	•Open the poll in the official mode. •Conduct one vote. •Close the poll and export electronic data from the electronic storage media with the device/software provided by the vendor. •Verify that a printed paper record contains all selection information stored in the corresponding electronic ballot image record.	The printed paper record does contain all selection information stored in the corresponding electronic ballot image record.
3.0.0	**III. Design Requirements for a VVPRS**		
3.0.1	**III.A. Printer**		
3.0.2	III.A.1. The printer shall be designed to have a sufficient amount of paper, ink, toner, ribbon or like supply for use in an election, taking into account an election district should have at least one voting machine per 750 registered	• Inspect the printing unit to determine the capacity of ink and paper supply. • Determine if the provided capacity is sufficient for conducting an election. • Set up a mock election. • Cast at least 1200 votes.	• The only supply needed is the paper roll for paper records. • A paper roll provided by the vendor is sufficient for about 120 single page paper records. • Paper records are legible.

No.	Requirement	Test scenario	Test Result
	voters.		• Paper replacement is expected after about 120 single page votes.
3.0.3	III.A.1.a. If any addition or replacement of paper, ink, toner, ribbon or other like supply is required, it shall be done with minimal disruption to voting and without circumvention of the security features of the Printer and Storage Unit which protect cast ballots and the secrecy of the vote.	• Inspect the process of paper replacement. • Examine the possibility of circumvention of security features. • Repeat the scenario for other printer supplies.	• The VVPRS is protected by a cover which can be sealed or locked through two provisioned slots. • In order to change the paper, the printer cover has to be removed first. • The printed paper records are rolled into the storage reel. • No other protecting mechanism is provided for printed paper records. The printed paper records are accessible during the paper change process. • No other printer supplies need to be replaced.
3.0.4	III.A.2. The VVPRS shall have a low-paper indicator that will allow for the timely addition of paper so that each voter can fully verify, without disruption, all of his or her ballot selections.	• Conduct a mock election with a low supply of papers and verify that VVPRS alerts.	• If the amount of paper reaches the minimum limit during the voting procedure of a voter, the VVPRS does give the voter the opportunity to finish voting and reject up to two paper records before accepting the final paper record. • After printing the last paper record, VVPRS sounds a beep and displays a message on the operator panel and DRE screen, informing the election official that the paper supply has reached the minimum limit. • The VVPRS cannot be activated unless a new paper roll is loaded in the printer.
3.0.5	III.A.3. The printer shall be secured by security seals or locking mechanisms to prevent tampering. The printer shall	• Inspect the printer and check its sealing or locking mechanisms. • Examine the accessibility of the printer.	• The printer is enclosed by a removable cover. • The cover of the printer can be locked or

No.	Requirement	Test scenario	Test Result
	be accessed only by those election officials authorized by the county commissioner of registration.		sealed through two provisioned slots. • To access the printer the cover shall be removed first. • Upon removing the cover, no other protection is provisioned for printed paper records.
3.0.6	III.A.4. The VVPRS shall be capable of showing the information on the paper record in a font size of at least 3.0 mm and should be capable of showing the information in at least two font ranges, 3.0-4.0 mm and 6.3-9.0 mm, under the control of the voter or poll worker. This criteria can be met by providing a magnification device with the VVPRS.	• Inspect the printed ballot for font size to ensure conformance with the standard. • Inspect the unit for capability of showing the information on at least two font sizes.	• The font size is set by the system firmware. • In this observation, the printer is printing with the font size of 14. The length of the printed characters is in 3.0-4.0mm range. • A magnification device is provided that shows the printed paper with font in the range of 6.3-9mm.
3.0.7	**III.B. Paper Record Display Unit**		
3.0.8	III.B.1. The paper record shall be displayed in a way that allows the voter to privately and independently inspect it.	• Observe how the paper record is displayed. • Observe whether the voters can privately and independently inspect the paper record.	• The DRE screen and the paper record display unit are partially covered by some curtains and panels. • An observer may be able to read the screen or paper record if he or she stands behind the voter.
3.0.9	III.B.2. If the paper record cannot be viewed entirely in the Display Unit at one time, the voter shall have the opportunity to verify the entire paper record prior to the electronic or the paper ballot being stored and recorded.	• Conduct a mock election with a sufficient number of contests/positions such that the paper record cannot be viewed entirely in the Display Unit at one time.	• The ballot can be designed in such a way that the total paper record of a long enough ballot extends more than one page of display. • In this case, the machine prints the total paper record in some pages and displays them on the paper record display unit page

No.	Requirement	Test scenario	Test Result
			by page. • The voter has the opportunity to review each page before being rolled into the storage reel. • The retrieved electronic record reflects the final selections only; voided selections are not recorded.
3.0.10	III.B.3. The Display Unit shall have a protective covering which shall be transparent and shall not obscure the voter's view of the paper record. This covering shall be in such condition that it can be made transparent by ordinary cleaning of its exposed surface.	• Inspect the display unit for protective cover and verify that it does not obscure the voter's view.	• The Paper Record Display Unit does have a protective covering which is transparent and does not obscure the voter's view of the paper record. • This covering is in such condition that it can be made transparent by ordinary cleaning of its exposed surface. • The transparent protective cover may be smeared if it is scratched by sharp objects.
3.0.11	**III.C. Paper**		
3.0.12	III.C.1. Any paper record produced by a VVPRS shall be readable by voters and election officials.	• Inspect the paper records for ink color, type size, type face and readability.	• The printed paper records are indeed readable when shown in the paper record display unit. • The election officials can read the paper records when the paper records are retrieved from the storage reel.
3.0.15	**III.D. Paper Record Storage Unit**		
3.0.16	III.D.1. Security protections including, but not limited to, security seals or locking mechanisms, shall be built into the Storage Unit to prevent tampering at all times, including pre-election, election day, and post-election. The Attorney General, through the	• Inspect the security protections of the storage unit.	• The VVPRS is protected by a cover. • Two locking slots are available on the VVPRS cover to secure the printer and printed paper records. • No separate protecting mechanism is available for printed paper records. • The roll of printed paper records is

No.	Requirement	Test scenario	Test Result
	Department of Law and Public Safety ("LPS"), will issue chain of custody guidelines regarding the Storage Unit.		accessible upon removing the printer cover.
4.0.0	**IV. Procedural and Usability Requirements**		
4.0.1	**IV.A. Paper Records**		
4.0.2	IV.A.1. The paper record shall include identification of the particular election, the election district, and the voting machine.	• Conduct a mock election. • Check the paper record for identification of the particular election, the election district, and the voting machine. • Verify whether the identification of the mock election, the election district, and the voting machine recorded on the paper record are accurate.	• The paper record does include the identification of the particular election (i.e., in the test ballot, Official General Election Test-1 Essex County November 4, 2008), the election district (i.e., in this test, Precinct ID and Polling Place ID), and the voting machine serial number, along with the date of election.
4.0.3	IV.A.2. The paper record shall include a barcode that contains the human-readable contents (shorthand is acceptable) of the paper record.	• Conduct a mock election. • Verify whether the paper record contains a barcode. • Verify whether the barcode contains the human-readable contents of the paper record by observing the readable contents. • Verify whether all human-readable contents of the paper record are accurately recorded and in consistent with the contents printed on the paper record.	• Only the accepted paper record contains a barcode. • The barcode contains all human-readable contents, including system-wide IDs (SWIDs) for the contest candidates and answers for questions, and write-in names, for all voted and undervoted contests. • The SWIDs represent the associated candidate names, write-in choice, undervote choice, and answer choice (for question) for each contest that have been defined in the Ballot Definition report. • The SWIDs associated with the voted selections match with the electronic ballot image records printed in the Audit Trail report. • The barcode can be decoded by any 2D PDF-417 barcode reader; the decoded

No.	Requirement	Test scenario	Test Result
			barcode data can be processed, verified, and tallied by using the vendor's proprietary software.
4.0.4	IV.A.2.a. The barcode shall use an industry standard format and shall be able to be read using readily available commercial technology.	• Conduct a mock election. • Verify whether the barcode can be read by using a readily available commercial barcode reader (given by the associated vendor). • Verify whether the barcode's format complies with an industry standard format approved by the Election Commission.	• According to the vendor's EDGE1 Compliance with NJ VVPAT Regulations (April 2, 2007 Draft version), page 3, the voting machine prints the barcode based on the 2D PDF417 barcode standard format • The barcode correctly complies with the industrial 2D PDF-417 standard format and can be read by readily available commercial barcode reader.
4.0.5	IV.A.2.b. If the corresponding electronic record contains a digital signature, the digital signature shall be included in the barcode on the paper record.	• Conduct a mock election. • Verify whether the electronic record contains a digital signature as stated in Requirements IV.B.2 and IV.B.3.b. • Verify whether the digital signature calculated and stored in the electronic record is the same signature contained in the barcode on the paper record.	• The DRE does not generate a digital signature per electronic record (i.e., electronic ballot image record). Refer to Requirement IV.B.2 for generating the digital signatures. • However, there is indeed a digital signature in the barcode; this digital signature is based on the contents of the barcode. Refer to Requirement IV.A.2.c for generating the digital signature in a barcode.
4.0.7	IV.A.2.c. The barcode shall not contain any information other than an accurate reflection of the paper record's human-readable content, error correcting codes, and digital signature information.	• Determine the adopted standard of the barcode. • Conduct a mock election. • Verify that the barcode contains only the paper record's human-readable content, error correcting codes, and digital signature information.	• The barcode contains all human-readable contents of the paper record, and some internal syntax used by the vendor's proprietary software. • The error correcting code is implemented as defined by the industrial 2D PDF-417 barcode standard format. • The associated digital signature in the barcode is calculated based on the contents

No.	Requirement	Test scenario	Test Result
			in the barcode.
4.0.8	IV.A.3. For the "Cut and Drop" Method, if the paper record cannot be displayed in its entirety on a single page, each page of the record shall be numbered and shall include the total count of pages for that ballot.	• Conduct a mock election with a sufficient number of contests or positions such that the paper record cannot be displayed in its entirety on a single page. • Observe the printed paper records. • Verify whether each page of the paper records shows the page number and the total count of pages for that ballot.	• The voting machine uses the "Continuous Spool" method.
4.0.9	IV.A.4. The image created on the paper record shall include every contest that is displayed to the voter on the DRE, including write-ins and undervotes.	• Conduct a mock election. • Verify whether every contest, write-ins and undervotes that are displayed on the DRE are precisely created and recorded on the paper record.	• All selected contests that are displayed to the voter on the DRE screen are accurately printed on the paper record, including write-ins, and undervotes.
4.0.10	IV.A.5. The paper record shall be created such that its contents are machine readable.	• Check the vendor documentation on how the contents of the paper record are made machine readable. • Conduct a mock election. • Observe whether the contents of the paper record can be machine readable by using any specific mechanism that complies with other requirements such as Requirements IV.A.2.a and IV.A.6.	• The contents of the paper record are encoded in a barcode which is machine readable.
4.0.11	IV.A.6. The paper record shall contain error correcting codes for the purpose of detecting read errors and for preventing other markings on the paper record from being misinterpreted when the paper record is machine read.	• Check the vendor documentation to determine the type of error correcting codes adopted. • Conduct a mock election. • Verify that error correcting codes can help detect read errors when the paper record is read by a machine. • Insert markings on the paper record after an error correcting code is calculated in an	• According to the vendor's Sequoia EDGE1 Compliance with NJ VVPAT Regulations (April 2, 2007 Draft version), page 3, "a barcode includes error detecting/correcting codes at both the barcode format (PDF-417) level and within the vote data." • According to the vendor's communication with NJIT on July 3, 2007 (Questions and

No.	Requirement	Test scenario	Test Result
		attempt to cause misinterpretation and check if the attempt is successful.	Requested Clarifications with answers for NJIT 20070703.doc), "the error correcting code contained in the barcode is the error correcting code as defined in the 2D PDF-417 specification." • The barcode does contain error correcting code as defined in the industrial 2D PDf-417 barcode standard (Refer to Information Technology AIDC Techniques Bar code symbology specification PDF-417: ISO/IEC 15438:2006 for the 2D PDF-417 barcode standard): • The barcode can be successfully read, even when there are a some markings on the barcode such as marking a line on the top of the barcode, a line at the bottom of the barcode, and a cross line (/) across the barcode (using a black-color permanent marker) with the width of 2 mm, 21 lines across the barcode (using a black-color 0.7mm pen) with the width of 1 mm between each line, and when the barcode is punched with a small hole (a diameter of 5 mm). • However, the barcode cannot be read when there are other markings: two lines by the left and right sides of the barcode and a cross (X) on the barcode with a black-color permanent marker with a width of 2 mm.
4.0.13	**IV.B. DRE Electronic Records**		
4.0.14	IV.B.1. The electronic ballot image record and paper records shall be	• Check the vendor documentation on how to generate the identifiers of the electronic	• No unique identifier number is printed on the paper record.

No.	Requirement	Test scenario	Test Result
	linked by including unique identifiers so that an individual paper record can be identified with its corresponding electronic record. Unique identifiers are tools that will allow LP S to measure the reliability and accuracy of the voting system, as necessary. The electronic ballot image and the paper record shall not reveal the identity of the voter.	ballot image record and the paper record. • Conduct a mock election. • Verify whether the identifiers of the paper record and electronic record for the ballot can be mutually linked.	• The electronic ballot image record does not have a unique identifier number associated with it. • The only identifier of the accepted paper record that can link to the associated electronic ballot image is the "VoterId" (an index referred by the vendor) contained in the barcode printed on the accepted paper record. • The procedure to reconcile the accepted paper record with the associated electronic ballot image record is difficult for a large volume of votes: * All the barcodes of the entire set of paper records must be decoded. * Sort the VoterIds from the decoded barcode data in ascending order. * Match the sorted decoded barcode data with the electronic ballot image records printed in the Audit Trail report. • Information in the paper record does not reveal the voter's identity. • Information in the electronic ballot image record does not reveal the voter's identity.
4.0.15	IV.B.1.a. Unique identifiers shall not be displayed in a way that can be easily memorized.	• Conduct a mock election with multiple voters. • Ask each voter to memorize the identifiers on the paper record.	• The VoterId value is invisible to the voter, and so it cannot be memorized. Refer to Requirement IV.B.1 for the VoterId.
4.0.16	IV.B.2. The DRE should generate and store a digital signature for each electronic record.	• Verify if this function is supported. • If this function is supported: * Conduct a mock election. • Verify whether the digital signature is	• According to the vendor's communication with NJIT on July 3, 2007 (Questions and Requested Clarifications with answers for NJIT 20070703.doc),

No.	Requirement	Test scenario	Test Result
		generated for the electronic record.	* "Individual electronic ballot image records are not signed and do not have a digital signature associated with them." * All electronic ballot image records are cumulatively compressed and stored in the proprietary file format. • DRE does not generate a digital signature for each electronic record (electronic ballot image record) of an accepted paper record. It does generate a digital signature for the entire set of electronic records (electronic ballot image records); this is calculated on the entire set of electronic records without their associated digital signatures.
4.0.20	IV.B.3.c. The voting system vendor shall provide documentation about the structure of the exported ballot image records and how they shall be read and processed by software.	• Review the vendor documentation about the structure of the electronic ballot image records and how the electronic record can be read and processed.	• According to the vendor documentation (AVC Advantage D-10 Ballot Image Export Data), pages 1-2, and the vendor's communication with NJIT on July 3, 2007 (Questions and Requested Clarifications with answers for NJIT 20070703.doc), the vendor describes the structure of the exported electronic ballot image records and how they can be accessed, read, and processed. • Note that Sequoia's Advantage D-10 and EDGE1 with VVPAT use the same cartridge technology, and all election results from both types of machines are stored in the same type of cartridge and can be accessed and processed in the same manner.
4.0.21	IV.B.3.d. The voting system vendor shall provide a software program that	• Review the provided software that displays the exported electronic records.	• The exported electronic ballot image records can be printed out to the "Audit

No.	Requirement	Test scenario	Test Result
	will display the exported ballot image records and that may include other capabilities such as providing vote tallies and indications of undervotes.	• Review the provided software if other capabilities, including providing vote tallies and indications of undervotes, are enabled.	Trail" report by using the vendor's proprietary software. • The "Results" report that contains the vote tallies can be generated by using the vendor's proprietary software. • The "ballot under and blank votes" report that contains undervote and blank records can be generated by using the vendor's proprietary software.
4.0.22	IV.B.3.e. The voting system vendor shall provide full documentation of procedures for exporting electronic ballot image records and reconciling those records within the paper records.	• Review the vendor documentation of procedures for exporting electronic ballot image records. • Review the vendor documentation of procedures for reconciling these electronic ballot image records within the paper records.	• The vendor documentation (AVC Advantage Ballot Image Export Data) addresses the procedures for exporting the "electronic ballot image records" on pages 1-2. • The vendor documentation (AVC Advantage Ballot Image Export Data) addresses the procedures for reconciling those electronic ballot image records within the paper records on pages 1-2.
4.0.23	IV.C. Voting with a VVPRS		
4.0.24	IV.C.1. LPS shall promulgate for voters instructions on how to use the VVPRS.		
4.0.25	IV.C.1.a. The VVPRS vendors shall provide, in plain language, any reference material requested by LPS to aid in the preparation of VVPRS instructions. These instructions shall be issued to each county board of election for board worker training.	• Check that the vendor documentation of procedures for preparing the VVPRS and training the county board of election worker is provided.	• According to Sequoia EDGE1 Compliance with NJ VVPAT Regulations (April 2, 2007 Draft version), the vendor states that "Sequoia has provided the required information to LPS. • According to the vendor's AVC Edge Operator manual, the procedures of the Election Day preparation are given.
4.0.29	IV.C.2. Voter privacy shall be	• Conduct a mock election.	• Voter privacy is preserved in many ways:

No.	Requirement	Test scenario	Test Result
	preserved during the process of recording, verifying, and auditing ballot selections. This includes a voter who uses an audio voting device. Voters using an audio voting device shall also be able to verify votes privately and independently.	• Verify whether the voting records (both electronic and paper records) can identify or trace back to the voter. • Verify whether the voting records are listed in no specific order and the voter is kept anonymous. • Try to view the votes cast by a voter at a close distance. When the vote is being cast, an observer close by should not be able to view the voter's selection of preferences during the casting and recording the ballot. • Inspect the DRE for the audio voting device and review the manual for the process of voting through the audio voting device. • Conduct an election by using the given audio voting device. • Observe that the voter who uses the audio voting device can cast the vote in a private and independent manner.	* The DRE screen and the paper record display unit are partially covered by some curtains and panels. * The machine is expected to be strategically spaced such that no bystanders are allowed to peek into the DRE screen and the paper record display unit. * No information on the paper record contains any identity-related information that can link to the voter; * No information on the associated electronic record (or the electronic ballot image record) contains any identity-related information that can link to the voter; • In case of audio-assisted voting, * After the tester casts the ballot, the paper record is printed and momentarily displayed on the Paper Record Display Unit before being rolled up.
4.0.34	IV.C.5. The paper records shall distinguish between accepted and non-accepted ballots.	• Conduct a mock election, cast and recast the votes up to two additional times, complying with the NJ state law N.J.S.A. 19:52-3 as addressed in Requirement IV.c.5.a.(1). • Check whether there is any acceptance information on a paper record. • Check whether the acceptance information items on both accepted and non-accepted paper records are clearly distinguished.	• There is clear acceptance information: * "voided" is printed on the rejected paper record, * "accepted" is printed on the accepted paper record. • The Event log stored in the cartridge does not reveal how many attempts that have been used to cast this ballot.
4.0.35	IV.C.5.a. The voter shall have the opportunity to accept or reject the	• Conduct a mock election. • Observe whether the voter can recast the	The voter does have the opportunity to accept or reject the contents of his or her

No.	Requirement	Test scenario	Test Result
	contents of his or her paper record.	ballot after the ballot is printed and displayed on the DRE, complying with the NJ state law N.J.S.A. 19:52-3 as addressed in Requirement IV.c.5.a.(1).	paper record.
4.0.36	IV.C.5. a.(1) If the voter rejects the contents of the paper record, he or she may recast the ballot up to two additional times. This procedure is consistent with current State law, which limits the amount of time a voter has to cast a ballot. (See N.J.S.A. 19:52-3).	• Conduct a mock election. • Observe whether if the voter rejects the contents of the paper record, he or she may recast the ballot up to two additional times.	If the voter rejects the paper record, the voting machine does allow the voter to recast the ballot up to two additional times.
4.0.37	IV.C.5. a.(2) Before the voter causes a third and final paper record to be printed, the voter shall be presented with a warning notice on the machine that the selections on the DRE will be final. The voter will see and verify a printout of the votes, but will not be given additional opportunities to change any vote. The third ballot cast shall constitute the final and official ballot of such a voter.	• Conduct a mock election. • Verify that before a voter casts his or her third ballot, a warning notice is displayed informing the voter that this is the last attempt to cast his or her ballot.	• After the voter rejects the paper record twice, the DRE screen shows the message "This is your final chance to make changes to your ballot. Press RETURN TO BALLOT to proceed.", which warns the voter that the next ballot is the final ballot. • For the third paper record, once the voter presses the "cast ballot" button to cast the ballot, the paper record is printed but only is reviewable by the voter for only a few seconds, and then advances to the storage reel. This is not enough time for the voter to verify the selections on the third paper record. • The voter cannot recast or modify the selections again.
4.0.38	IV.C.5.a.(3) Upon rejecting a paper record, the voter shall be able to modify and verify the selections on the DRE without having to reselect all	• Conduct a mock election. • Verify that after rejecting a paper record, a voter can modify the selections from the last ballot and verify the new selections for	Upon rejecting a paper record, the voter is able to modify and verify the selections on the DRE without having to reselect all choices in all contests on the ballot.

No.	Requirement	Test scenario	Test Result
	choices in all contests on the ballot.	the new ballot on the DRE without having to reselect all selections in all contests on the ballot.	
4.0.39	IV.C.5. a.(4) If a mechanical error in recording or printing a paper record occurs, the record shall be counted as a spoiled paper record. It will not be counted as one of the voter's three attempted votes.	• Conduct a mock election. • Verify that the spoiled ballot is not counted as one of the voter's three attempted votes.	Most errors lead to the suspension of the machine that requires the poll worker's intervention. The record is spoiled if the poll worker restarts the machine, and the spoiled record is not electronically counted; in this case, the voter is automatically given another three attempts.
4.0.40	IV.C.5. a.(5) The VVPRS shall be designed to indicate the paper record which the voter has identified and cast as his or her official ballot.	• Conduct a mock election in which the voter accepts his or her ballot after the cast. That ballot is clearly indicated as an official ballot.	There is clear final and official information printed on the paper record: "accepted" is printed on the official paper record.
5.0.0	**V. Security and Reliability**		
5.0.1	V.A. The VVPRS shall not be permitted to externally communicate with any system or machine other than the voting system to which it is connected.	• Read the vendor documentation on the introduction of the components within the VVPRS. • Open the VVPRS. • Inspect all the components in the VVPRS for any external devices and accessible connection interfaces (e.g., serial, USB, or other ports). • Check whether the VVPRS can be connected to other systems other than the voting system.	• The VVPRS system consists of a printer and a storage reel for printed paper records. • Only the printer within the VVPRS has connections to external devices with a power supply cable and a parallel cable for data transmitting. • The only external system connected to the VVPRS is the DRE voting system.
5.0.2	V.B. The VVPRS shall only be able to function as a printer; it shall not contain any other services (e.g., copier or fax functions) or network	• Read the vendor documentation for the functions of all components in the VVPRS. •Open the VVPRS.	•The VVPRS is able to function as a printer to print out the paper record, and roll the paper records into the storage reel.

No.	Requirement	Test scenario	Test Result
	capability. The printer shall not contain any component with an external communication feature.	•Conduct one mock vote. • Inspect all the components in the VVPRS and verify that the VVPRS has a printer and is able to function as a printer. •Verify that the VVPRS does not have any external communication feature/port/interface for other services other than printing • Verify that the printer does not contain any component with an external communication feature other than printing from the voting machine.	•The only connections to the external system (the DRE system) are one power cable and one parallel cable for transmitting printing data. No other services (e.g., copier or fax functions) or network capability is observed. •No component within the printer is observed to have an external communication feature other than printing from the voting machine.
5.0.3	V.C. The paper path between the printing, viewing, and storage of the paper record shall be protected and sealed from access, except by election officials authorized by each county commissioner of registration.	•Conduct one mock vote. • Inspect the paper path of the VVPRS between the printing, viewing, and storage of the paper record. • Attempt to access the paper record along the paper path between the printing and the viewing. • Attempt to access the paper record along the paper path between the viewing and the storage.	•The VVPRS system is sealed when the voting machine is under official voting operations. •As the paper record is being printed, it can be viewed in the display window. The path of printing is locked and sealed, and the viewing area is behind a clear plexiglass cover. •The storage reel of printed paper records and the printer are enclosed within the same enclosure. •The paper path is sealed and protected from access between the print head and the storage reel.
5.0.7	V.E. The printer shall be connected to the voting machine either by completely concealing the printer connection or via a security tag to prevent tampering.	•Open the VVPRS. • Inspect the connection between the printer and the voting machine. • Observe if the cable connection at the	•The cable connectors of the printer are within the sealed VVPRS. •However, the cable connectors (of the printer cable and power cord) of the voting

No.	Requirement	Test scenario	Test Result
		printer interface is protected against tampering. • Observe if the cable between the printer and the voting machine is protected against tampering. • Observe if the cable connection at the voting machine is protected against tampering.	machine are exposed without any protection. •The exposed part of the cable connection between the VVPRS and the voting machine is concealed with plastic wrap.
5.0.8	V.F. The DRE shall detect and notify the election officials at the polling place of any errors and malfunctions, such as paper jams or low supplies of consumables (e.g. paper) that may prevent paper records from being correctly displayed, printed, or stored.	•Conduct one mock vote. •Open the VVPRS. •Create a paper jam at the VVPRS. •Check and verify if the DRE can detect the error and can send a warning signal.	•The VVPRS is suspended. •The DRE displays "please wait" instead of an error message on the DRE screen. •No other kind of warning signal has been observed. •No further action can be taken on the DRE screen. The voting operations are suspended and no vote is recorded.
5.0.9	V.G. If a mechanical error or malfunction occurs (such as, but not limited to, a paper jam or running out of paper), the DRE and VVPRS shall suspend voting operations, not record votes, and present a clear indication of the malfunction to the voter and election officials.	•Conduct one mock vote. •Open the VVPRS. • Create a situation with low paper supply to the printer. •Check and verify if the DRE and VVPRS can detect the error and can send a warning signal.	•The VVPRS is suspended. •The DRE displays "please wait" instead of an error message on the DRE screen. •No other kind of warning signal has been observed. •No further action can be taken on the DRE screen. The voting operations are suspended and no vote is recorded. A mechanical error or malfunction does not prompt any error message or warning signal, but 'freezes' the system.
5.0.10	V.H. If the connection between the voting machine and the printer has been broken, the voting machine shall	•Conduct one mock vote. •Open the VVPRS and disconnect the cable between the voting machine and the printer.	•The VVPRS is suspended. •The DRE displays "please wait" instead of an error message on the DRE screen.

No.	Requirement	Test scenario	Test Result
	detect and provide notice of this event and record it in the DRE's internal audit log. Voting operations shall be suspended and no votes shall be recorded.	• Check and verify how the DRE and VVPRS react properly to this error. • Close the poll. • Check the DRE's internal audit log.	•No other kind of warning signal has been observed. •No further action can be taken on the DRE screen. The voting operations are suspended and no vote is recorded. •A printer disconnection is not recorded in the DRE's internal audit log.
5.0.13	V.J. The vendor shall provide to LPS documentation for the DRE and the VVPRS that includes procedures for the recovery of votes in case of a malfunction. LPS shall be responsible for disseminating this information to the county commissioners of registration.	• Verify that the vendor documentation includes procedures for the recovery of votes in case of a malfunction.	• The vendor has provided the testing group at NJIT with electronic documents. • These documents contain procedures for the recovery of votes in case of a malfunction on the DRE and the VVPRS.
5.0.14	V.K. The vendor shall provide to LPS documentation for the DRE and the VVPRS that includes recommended procedures to enable the election officials to return a voting machine to workable status after the machine has malfunctioned, the printer needs to be replaced, or a voter has used it incompletely or incorrectly.	• Verify that the vendor documentation includes recommended procedures to enable the election officials to return a voting machine to workable status after the machine has malfunctioned, the printer needs to be replaced, or a voter has used it incompletely or incorrectly.	• The vendor has provided the testing group at NJIT with electronic documents. • These documents includes recommended procedures to enable the election officials to return a voting machine to workable status after the machine has malfunctioned, the printer needs to be replaced, or a voter has used it incompletely or incorrectly.
5.0.15	V.K.1. These procedures shall not cause discrepancies between the tallies of the electronic and paper records.	•Conduct one mock vote. •Open the VVPRS and disconnect the cable between the voting machine and the printer. • Check and verify how the DRE and VVPRS react properly to this error. • Follow the procedures recommended by the vendor to return the voting machine to	•The VVPRS is suspended. •The voting operations are suspended on the DRE and no vote is recorded. •Reconnecting the cable between the voting machine and the printer will return the voting machine to a workable status. •The voting operations continue from

No.	Requirement	Test scenario	Test Result
		workable status. •Close the poll and export electronic data from the electronic storage media with the device/software provided by the vendor. •Examine and compare the tallies of the electronic and paper records.	where it is suspended. •There are no discrepancies between the tallies of the electronic and paper records.
5.0.17	V.L. Vendor documentation shall include procedures for investigating and resolving printer malfunctions including, but not limited to, printer operations, misreporting of votes, unreadable paper records, and process failures.	• Verify that the vendor documentation includes procedures for investigating and resolving printer malfunctions including, but not limited to, printer operations, misreporting of votes, unreadable paper records, and process failures.	• The vendor has provided the testing group at NJIT with electronic documents. • These documents include procedures for investigating and resolving printer malfunctions.
6.0.0	**VI. Certification**		
6.0.3	VI.C. Whether conducted by the Examination Committee, technical advisors, or a combination of both, the examination of the VVPRS shall include, but not be limited to, the functionality, security, durability, and accessibility of the system. This examination shall also include volume testing, which is the investigation of the system's response to processing more than the expected number of ballots and/or voters or to any other similar conditions that tend to overload the system's capacity to process, store, and report data.		
6.0.4	VI.C.1. The vendor shall provide to the State, electronically and in hard	• Verify that the vendor has provided the state with both electronic and hard copy	• The vendor has provided the testing group with documents in the electronic form.

No.	Requirement	Test scenario	Test Result
	copy, all use and technical specifications and documentation relating to the function of the VVPRS.	technical specifications and documentations relating to the function of the VVPRS.	• These documents contain technical specifications and documentation relating to the function of the VVPRS.
6.0.9	VI.G. Vendor documentation shall include printer reliability specifications including Mean Time Between Failure estimates, and shall include recommendations for appropriate quantities of backup printers and supplies.	• Verify that the vendor documentation includes printer reliability specifications including Mean time between failure estimates and recommendations for appropriate quantities of backup printers and supplies.	• The vendor has included the information about printer reliability and specifications including MTBF in the "AVC Edge System Hardware Description" document. • The vendor documentation has recommendations including the quantity of the printer paper roll in the "OPERATORS MANUAL" document.

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IV. Appendices

a. Test Ballot Scenarios

Long Ballots: Scenarios 1-8

Scenario 1

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 2

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 3

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question7	YES	NO			

Scenario 4

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 5

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	TERRANCE JOHNSON
			JESSICA M. FORD	HENRY H. HOOLIGAN	MARIO JOHNSON
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 6

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 7

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	MILDRED WHITE
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 8

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Long Ballots: Scenarios 9-12

Scenario 9

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	EDWARD A LYNCH
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	MICHAEL WEIS
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	KELLY SMALL
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	CHARLES SCHULTZ
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	MICAEL McDONALD
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 10

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	BRUCE SPRINGSTEEN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 11

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	EDWARD A LYNCH
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	MICHAEL WEIS
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	KELLY SMALL
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	BRUCE SPRINGSTEEN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	CHARLES SCHULTZ
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	MICHAEL McDONALD
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 12

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J. DONALDSON	WILLIAM P. MORROW
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Long Ballot Special Scenarios

Scenario 2-1

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 2-2

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 4-1

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC *COLUMN B*	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 4-2

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 4-3

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question 7	YES	NO			

Scenario 8-1

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO
Local Question 5	YES	NO	Local Question 6	YES	NO	Local Question7	YES	NO			

Scenario 8-2

OFFICIAL GENERAL ELECTION TEST-1

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC *COLUMN B*	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
PRESIDENT (VOTE FOR ONE)	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WRITE-IN
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	WRITE-IN
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	WRITE-IN
FREEHOLDERS (2-YEAR TERM) (VOTE FOR ONE)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	WRITE-IN
Member of TOWNSHIP COMMITTEE (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENRY P. LINCOLN	KATHERINE P. ROSS	WRITE-IN
CHARTER STUDY COMMISSION (VOTE FOR FIVE)			HERALD D. MICHAELS	MARIO S. TREEBORO	WRITE-IN
			JESSICA M. FORD	HENRY H. HOOLIGAN	WRITE-IN
			SAMUEL T. JACKSON	MARY K. LINCOLN	WRITE-IN
			ALFREDA A. JONES	ABRAHAM B. LINCOLN	WRITE-IN
			CARLTON D. THOMPSON	JOEL C. CARSON	WRITE-IN

Local Question 1	YES	NO	**Local Question 2**	YES	NO	**Local Question 3**	YES	NO	**Local Question 4**	YES	NO
Local Question 5	YES	NO	**Local Question 6**	YES	NO	**Local Question 7**	YES	NO			

Short Ballot Scenarios 1-12

Scenario 1

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 2

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 3

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 4

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 5

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 6

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 7

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 8

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 9

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WI-1 HOR
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WI-1 FR
	NAME9	NAME10			WI-2 FR
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WI-1-SHERIFF

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 10

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WI-1 SHERIFF

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 11

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WRITE-IN
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WI-1 HOR
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WI-1 FR
	NAME9	NAME10			WI-2 FR
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WI-1 SHERIFF

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

Scenario 12

OFFICIAL GENERAL ELECTION TEST-2

OFFICE TITLE	REPBLICAN COLUMN A	DEMOCRATIC COLUMN B	BY PETITION COLUMN C	BY PETITION COLUMN D	WRITE-IN (USE KEYBOARD)
U. S. SENATE (VOTE FOR ONE)	JOHN P. DENVER	PHILIP B. OHIO–AND–GOLD –AND–TEXAS–MICHIGAN-AND-SILVER	SCOTT E. FITZGERNALD	MARY S. DAVID	WI-1 USS
HOUSE OF REP (VOTE FOR ONE)	DAVID K. ROSS	LARRY P. HALL			WRITE-IN
FREEHOLDERS (3-YR TERM) (VOTE FOR TWO)	NAME7	NAME8			WRITE-IN
	NAME9	NAME10			WRITE-IN
SHERIFF (VOTE FOR ONE)	DENVER P. COLORADO	BALTIMORE K. MARYLAND			WRITE-IN

Local Question 1	YES	NO	Local Question 2	YES	NO	Local Question 3	YES	NO	Local Question 4	YES	NO

b. Mock Voter Questionnaires

Questionnaire 1

Dear "Mock Voter":

Please answer the following questions about the vote you just cast (scenario_____):

1. Did you have an opportunity to review the paper record for each corresponding vote and verify your vote selection for each position or question before casting your vote?
Yes___No__If no, please describe your observation…….

2. Have you observed any discrepancy between your vote selections for each position or question and the information on the corresponding paper record?
Yes___No__If yes, please describe your observation…….

"Mock Voter" Name:

"Mock Voter" Signature: Date

Questionnaire 2

Dear "Mock Voter":

Please answer the following questions about the vote you just cast (scenario_____):

3. Did you have an opportunity to accept or reject the contents of your paper record?
Yes___No__If no, please describe your observation…….

4. Once you accepted the contents of your paper record, were you able to see any indication on the paper record that it is your final vote?
Yes___No__If yes, please describe your observation…….

"Mock Voter" Name:

"Mock Voter" Signature: Date

Questionnaire 3

Dear "Mock Voter":

Please answer the following questions about the vote you just cast (scenario_____):

5. Upon rejecting a paper record, were you able to modify and verify the selections without having to reselect all choices in all contests on the ballot?

Yes___No__If no, please describe your observation…….

"Mock Voter" Name:

"Mock Voter" Signature: Date

Questionnaire 4

Dear "Mock Voter":

Please answer the following questions about the vote you just cast (scenario_____):

6. After having voided two vote selections, did you see a warning notice on the machine that the selections will be final?

Yes___No__If yes, please describe your observation…….

Did you have an opportunity to verify a paper record of the 3rd vote selections?

Yes___No__If no, please describe your observation…….

Did you have additional opportunities to change the 3rd paper record?

Yes___No__If yes, please describe your observation…….

"Mock Voter" Name:

"Mock Voter" Signature: Date

c. "Criteria"

State of New Jersey: Criteria for Voter-Verified Paper Records for Direct Recording Electronic Voting Machines

State of New Jersey
Criteria for Voter-Verified Paper Record for Direct Recording Electronic Voting Machines

Pursuant to N.J.S.A. 19:48-1 and N.J.S.A. 19:53A-3, no later than January 1, 2008, each voting machine in New Jersey shall produce an individual permanent paper record for each vote cast, which shall be made available for inspection and verification by the voter at the time the vote is cast, and preserved for later use in any manual audit. In the event of a recount, the voter-verified paper records will be the official tally for the election.

To effectuate the intent of the statute, and to instill full public confidence in the electoral process, the Attorney General has established the following criteria for the design and use of a Voter-Verified Paper Record System in conjunction with a Direct Recording Electronic Voting Machine.

I. Definitions

Direct Recording Electronic Voting Machine ("DRE"):

> A voting machine that records votes by means of a ballot display provided with mechanical or electro-optical components that can be activated by the voter and processes data by means of a computer program. Voting data and ballot images are recorded in internal and external memory components. A DRE produces a tabulation of the voting data stored in a removable memory component and a printed paper ballot.

Voter-Verified Paper Record ("VVPR" or "paper record"):

> Physical piece of paper on which the voter's ballot choices are recorded, cast, and preserved for later use in any recount or manual audit.

Voter-Verified Paper Record System ("VVPRS"):

> A system that includes a printer and storage unit attached to, built into, and/or used in conjunction with a DRE. This system produces, stores, and secures voter-verified paper records.

II. General Description of System[1]

A. Components

A DRE with VVPR capability shall consist of the following components:

1 This Criteria is for the use of a VVPRS with a DRE. The issuance of the Criteria does not preclude the use of any other voting system permitted under Title 19 and certified by the Attorney General.

1. Printer: a device that prints the voter's DRE selection on a paper record;

2. Paper Record Display Unit: a unit that allows a voter to view his or her paper record while preventing the voter from directly handling the paper record;

3. Paper: the paper used to produce the voter-verified paper record shall be sturdy, clean, and resistant to degradation; and

4. Storage Unit: a device that securely stores all paper records (including accepted and rejected ballots) during the course of the election and thereafter as required or necessary.

B. Operation

1. The VVPRS may be designed in various configurations. In all configurations, prior to casting the ballot, the voter shall have the ability to verify his or her selections on a paper record in a private and independent manner.

2. The VVPRS shall be designed to allow the voter to easily review, accept, or reject his or her paper record.

   a. The DRE shall not record the electronic record until the paper record has been approved by the voter.

3. VVPRS records may be printed and stored by two different methods:

   a. "Cut and Drop" Method: The voter views and verifies the paper record, which the VVPRS cuts and drops into a Storage Unit.

   b. "Continuous Spool" Method: The voter views the paper record on a spool-to-spool paper roll. This method shall be used in a manner that fully protects the secrecy of all votes cast.

4. No electronic or paper record shall indicate the identity of a voter or be maintained in a way that allows a voter to be identified.

5. The electronic and paper records shall be created and stored in ways that preserve the privacy of the record.

6. The VVPRS components shall conform to federal and state accessibility requirements.

    a. These requirements shall include, but are not limited to, an audio component that shall accurately relay the information printed on the paper ballot to the voter.

7. The VVPRS device shall draw its power from the DRE or the same electrical circuit from which the DRE draws its power.

8. The voting machine shall provide a standard, publicly documented printer port, or the equivalent, using a standard communication protocol.

9. The VVPRS shall mark the paper record precisely as indicated by the voter on the DRE and produce an accurate paper record and corresponding electronic record of all votes cast.

10. DRE electronic ballot image records shall include all votes cast by the voter, including write-ins and undervotes.

    a. Write-in votes are votes cast by a voter for an individual not listed on the ballot as a formal candidate.

    b. Undervotes are elective office and/or public questions on the ballot for which the voter has not cast a vote.

11. An electronic ballot image record shall have a corresponding paper record.

    a. The paper record shall be printed and the voter shall have the opportunity to verify the paper record in its totality prior to the final electronic record being recorded.

    b. The DRE electronic ballot image record shall correspond to the paper record in a manner that does not reveal the voter's identity.

    c. The paper record shall contain all voter selection information stored in the electronic ballot image record.

III. Design Requirements for a VVPRS

A. Printer

1. The printer shall be designed to have a sufficient amount of paper, ink, toner, ribbon or like supply for use in an election, taking into account an election district should have at least one voting machine per 750 registered voters.

    a. If any addition or replacement of paper, ink, toner, ribbon or other like supply is required, it shall be done with minimal disruption to voting and without circumvention of the security features of the Printer and Storage Unit which protect cast ballots and the secrecy of the vote.

2. The VVPRS shall have a low-paper indicator that will allow for the timely addition of paper so that each voter can fully verify, without disruption, all of his or her ballot selections.

3. The printer shall be secured by security seals or locking mechanisms to prevent tampering. The printer shall be accessed only by those election officials authorized by the county commissioner of registration.

4. The VVPRS shall be capable of showing the information on the paper record in a font size of at least 3.0 mm and should be capable of showing the information in at least two font ranges, 3.0-4.0 mm and 6.3-9.0 mm, under the control of the voter or poll worker. This criteria can be met by providing a magnification device with the VVPRS.

B. Paper Record Display Unit

1. The paper record shall be displayed in a way that allows the voter to privately and independently inspect it.

2. If the paper record cannot be viewed entirely in the Display Unit at one time, the voter shall have the opportunity to verify the entire paper record prior to the electronic or the paper ballot being stored and recorded.

3. The Display Unit shall have a protective covering which shall be transparent and shall not obscure the voter's view of the paper record. This covering shall be in such condition that it can be made transparent by ordinary cleaning of its exposed surface.

C. **Paper**

1. Any paper record produced by a VVPRS shall be readable by voters and election officials.

2. All paper records shall be stored in accordance with vendor specifications.

3. If stored in accordance with vendor specifications, the paper used to produce a paper record shall be readable for a period of at least two years after the election in which it is used.

D. Paper Record Storage Unit

1. Security protections including, but not limited to, security seals or locking mechanisms, shall be built into the Storage Unit to prevent tampering at all times, including pre-election, election day, and post-election. The Attorney General, through the Department of Law and Public Safety ("LPS"), will issue chain of custody guidelines regarding the Storage Unit.

IV. Procedural and Usability Requirements

A. Paper Records

1. The paper record shall include identification of the particular election, the election district, and the voting machine.

2. The paper record shall include a barcode that contains the human-readable contents (shorthand is acceptable) of the paper record.

   a. The barcode shall use an industry standard format and shall be able to be read using readily available commercial technology.

   b. If the corresponding electronic record contains a digital signature, the digital signature shall be included in the barcode on the paper record.

      (1) A digital signature is extra data appended to an electronic document which identifies and authenticates the sender and message data using public key encryption, or other means approved by LPS.

c. The barcode shall not contain any information other than an accurate reflection of the paper record's human-readable content, error correcting codes, and digital signature information.

3. For the "Cut and Drop" Method, if the paper record cannot be displayed in its entirety on a single page, each page of the record shall be numbered and shall include the total count of pages for that ballot.

4. The image created on the paper record shall include every contest that is displayed to the voter on the DRE, including write-ins and undervotes.

5. The paper record shall be created such that its contents are machine readable.

6. The paper record shall contain error correcting codes for the purpose of detecting read errors and for preventing other markings on the paper record from being misinterpreted when the paper record is machine read.

a. A read error is a separate code or piece of data that can be used to indicate whether the data printed on the paper record is different from the data created on the electronic record.

B. DRE Electronic Records

1. The electronic ballot image record and paper records shall be linked by including unique identifiers so that an individual paper record can be identified with its corresponding electronic record. Unique identifiers are tools that will allow LP S to measure the reliability and accuracy of the voting system, as necessary. The electronic ballot image and the paper record shall not reveal the identity of the voter.

a. Unique identifiers shall not be displayed in a way that can be easily memorized.

2. The DRE should generate and store a digital signature for each electronic record.

3. The electronic ballot image records shall be able to be exported for auditing or analysis on standards-based and/or COTS (commercial off-the-shelf) information technology computing.

a. The exported electronic ballot image records shall be in a publicly available, non-proprietary format.

b. The records should be exported with a digital signature which shall be calculated on the entire set of electronic records and their associated digital signatures.

c. The voting system vendor shall provide documentation about the structure of the exported ballot image records and how they shall be read and processed by software.

d. The voting system vendor shall provide a software program that will display the exported ballot image records and that may include other capabilities such as providing vote tallies and indications of undervotes.

e. The voting system vendor shall provide full documentation of procedures for exporting electronic ballot image records and reconciling those records within the paper records.

C. Voting with a VVPRS

1. LPS shall promulgate for voters instructions on how to use the VVPRS.

   a. The VVPRS vendors shall provide, in plain language, any reference material requested by LPS to aid in the preparation of VVPRS instructions. These instructions shall be issued to each county board of election for board worker training.

   b. Instructions for use of a VVPRS shall be made available prior to an election on the Division of Elections' website and shall be available to the voter at the polling place on an election day.

   c. Prior to an election, the county commissioners of registration will provide demonstration machines at convenient locations throughout the county for voter education purposes.

   d. The instructions for performing the verification process shall be made available to the voter on a location inside the voting machine. Where feasible, the instructions shall also be on the machine ballot face.

2. Voter privacy shall be preserved during the process of recording, verifying, and auditing ballot selections. This includes a voter who uses an audio voting device. Voters using an audio voting device shall also be able to verify votes privately and independently.

3. In any election where the ballot contains a language in addition to English, the paper record shall be produced in all such languages.

   a. To assist with manual auditing, candidate names on the paper record shall be presented in the same language as used on the DRE summary screen.

   b. Information on the paper record not needed by the voter to perform verification shall be in English.

4. The privacy of voters whose paper records contain an alternative language shall be maintained.

5. The paper records shall distinguish between accepted and non-accepted ballots.

   a. The voter shall have the opportunity to accept or reject the contents of his or her paper record.

      (1) If the voter rejects the contents of the paper record, he or she may recast the ballot up to two additional times. This procedure is consistent with current State law, which limits the amount of time a voter has to cast a ballot. (See N.J.S.A. 19:52-3).

      (2) Before the voter causes a third and final paper record to be printed, the voter shall be presented with a warning notice on the machine that the selections on the DRE will be final. The voter will see and verify a printout of the votes, but will not be given additional opportunities to change any vote. The third ballot cast shall constitute the final and official ballot of such a voter.

      (3) Upon rejecting a paper record, the voter shall be able to modify and verify the selections on the DRE without having to reselect all choices in all contests on the ballot.

      (4) If a mechanical error in recording or printing a paper record occurs, the record shall be counted as a spoiled paper record. It will not be counted as one of the voter's three attempted votes.

(5) The VVPRS shall be designed to indicate the paper record which the voter has identified and cast as his or her official ballot.

V. Security and Reliability

A. The VVPRS shall not be permitted to externally communicate with any system or machine other than the voting system to which it is connected.

B. The VVPRS shall only be able to function as a printer; it shall not contain any other services (e.g., copier or fax functions) or network capability. The printer shall not contain any component with an external communication feature.

C. The paper path between the printing, viewing, and storage of the paper record shall be protected and sealed from access, except by election officials authorized by each county commissioner of registration.

D. All cryptographic software in the voting system shall be approved by the U.S. Government's Cryptographic Module Validation Program, if applicable, prior to being certified in New Jersey.

1. As stated in the discussion portion of Section 7.9.3 of the United States Election Assistance Commission draft criteria for "Voter Verifiable Paper Audit Trail Requirement, "There may be cryptographic voting schemes where the cryptographic algorithms used are necessarily different from any algorithms that have approved CMVP (Cryptographic Module Validation Program) implementations, thus CMVP approved software should be used when feasible but is not required. The CMVP website is http://csrc.govicryptual."

2. The vendor shall provide a certification of CMVP approval, if applicable. If not applicable, the vendor shall provide a certification setting forth the reasons why CMVP approval does not apply.

E. The printer shall be connected to the voting machine either by completely concealing the printer connection or via a security tag to prevent tampering.

F. The DRE shall detect and notify the election officials at the polling place of any errors and malfunctions, such as paper jams or low supplies of consumables (e.g. paper) that may prevent paper records from being correctly displayed, printed, or stored.

G. If a mechanical error or malfunction occurs (such as, but not limited to, a paper jam or running out of paper), the DRE and VVPRS shall suspend voting operations, not record votes, and present a clear indication of the malfunction to the voter and election officials.

H. If the connection between the voting machine and the printer has been broken, the voting machine shall detect and provide notice of this event and record it in the DRE's internal audit log. Voting operations shall be suspended and no votes shall be recorded.

I. If the voter's selections on the DRE do not match the paper record, then the DRE shall immediately be withdrawn from service.

1. The affected voter shall be able to vote on another voting machine, if available, or by emergency ballot.

J. The vendor shall provide to LPS documentation for the DRE and the VVPRS that includes procedures for the recovery of votes in case of a malfunction. LPS shall be responsible for disseminating this information to the county commissioners of registration.

K. The vendor shall provide to LPS documentation for the DRE and the VVPRS that includes recommended procedures to enable the election officials to return a voting machine to workable status after the machine has malfunctioned, the printer needs to be replaced, or a voter has used it incompletely or incorrectly.

1. These procedures shall not cause discrepancies between the tallies of the electronic and paper records.

2. LPS shall be responsible for disseminating this information to the county commissioners of registration.

L. Vendor documentation shall include procedures for investigating and resolving printer malfunctions including, but not limited to, printer operations, misreporting of votes, unreadable paper records, and process failures.

M. If a machine malfunctions or becomes inoperable, voters will be entitled to vote by emergency ballots.

VI. Certification

A. A VVPRS shall conform to State requirements. These requirements shall include, but are not limited to, the submission to LPS of any and all reports concerning the VVPRS issued by a federally-certified Independent Testing Authority ("ITA").

B. The VVPRS shall be subject to examination by the State Voting Machine Examination Committee ("Examination Committee"). LPS, in its discretion, may also appoint or retain a technical advisor or a panel of technical advisors ("technical advisors") to evaluate and test the VVPRS or assist the Examination Committee in its examination.

C. Whether conducted by the Examination Committee, technical advisors, or a combination of both, the examination of the VVPRS shall include, but not be limited to, the functionality, security, durability, and accessibility of the system. This examination shall also include volume testing, which is the investigation of the system's response to processing more than the expected number of ballots and/or voters or to any other similar conditions that tend to overload the system's capacity to process, store, and report data.

1. The vendor shall provide to the State, electronically and in hard copy, all use and technical specifications and documentation relating to the function of the VVPRS.

2. The vendor shall submit a certification that the VVPRS satisfies the State's criteria.

D. VVPRS shall not, at any time, contain or use undisclosed hardware or software. The only components that may be used in the system are components that have been tested and certified for use in the State.

E. The vendor will be required to provide the source code for the DRE and the VVPRS to the State, and/or to place such source code in escrow, to allow for independent testing by the State, at its discretion. Upon request, the State will enter into a non-disclosure agreement with the vendor.

F. The vendor will be responsible for the cost of any testing of the VVPRS that the State deems necessary to achieve certification.

G. Vendor documentation shall include printer reliability specifications including Mean Time Between Failure estimates, and shall include recommendations for appropriate quantities of backup printers and supplies.

1. Mean Time Between Failures, which measures the reliability of a voting system device, is the average time that a component works without failure. It is the value of the ratio of operating time to the number of failures which have occurred in the specific time interval.

VII. Pre-Election Procedures

A. A VVPRS's components shall be integrated into the existing local logic testing procedures performed by county election officials, which are performed in preparation for an election.

VIII. Post-Election Procedures

A. The county commissioner of registration will be required to perform a full and complete examination of any machine that malfunctioned or became inoperable on an election day.

B. Unless there is an amendment to the current statutory law, LPS will issue procedures for mandatory, post-election, random manual audits of election results. These procedures will be published for public comment prior to their effective date.

1. These procedures will be consistent with the statutory impoundment period for voting machines following an election.

2. The audit process shall be open for public observation.

C. In the case of a recount, the votes cast on the paper records shall serve as the official ballot, pursuant to N.J.S.A. 19:48-1 and N.J.S.A. 19:53A-3.

D. In case the machine cartridge becomes unreadable or is damaged for an audit or recount, the county commissioner of registration shall produce the ballot image audit log from the machine. The vendor shall provide to LPS documentation regarding the production of such audit log.

E. The paper record shall be created such that its contents are machine readable for purposes of any recount, audit, or initial tallying of an election in the event that the machine cartridge containing the electronic record is not usable.

1. The paper record shall contain error correcting codes for the purpose of detecting read errors. This may be done by barcode.

F. If a county employs a "Continuous Spool" VVPRS, it shall conduct any audit or recount in accordance with the procedures established by LPS to fully protect the

secrecy of all votes cast. Such procedures may include, but not be limited to, cutting the spool-to-spool paper roll into individual paper records, and restricting public access to the uncut paper roll.

G. The vendor shall provide to LPS written procedures to identify and resolve any discrepancy between an electronic record and its corresponding paper record. LPS shall be responsible for disseminating this information to the county commissioners of registration.

H. The vendor shall provide written procedures for determining what constitutes clear evidence that a paper record is inaccurate, incomplete, or unreadable. LPS shall be responsible for disseminating this information to the county commissioners of registration.

LPS may, in its discretion, revise, amend, or otherwise modify any of the criteria set forth in this document.

d. Resumes of Team Leaders

NIRWAN ANSARI
Summary

Nirwan Ansari received the B.S.E.E. (summa cum laude) from the New Jersey Institute of Technology (NJIT), Newark, in 1982, the M.S.E.E. degree from University of Michigan, Ann Arbor, in 1983, and the Ph.D. degree from Purdue University, West Lafayette, IN, in 1988.

He joined NJIT's Department of Electrical and Computer Engineering as Assistant Professor in 1988, and has been Full Professor since 1997. He has also assumed various administrative positions including the current appointment as the Newark College of Engineering's Associate Dean for Research and Graduate Studies at NJIT.

He authored Computational Intelligence for Optimization (Springer, 1997, translated into Chinese in 2000) with E.S.H. Hou, and edited Neural Networks in Telecommunications (Springer, 1994) with B. Yuhas. His current research focuses on various aspects of broadband networks and multimedia communications including network security, traffic modeling, QoS routing, switch architecture and scheduling, congestion control, and buffer management. He has also contributed approximately 300 technical papers including over 100 refereed journal/magazine articles.

He is a Senior Technical Editor of the IEEE Communications Magazine, and also serves on the editorial board of Computer Communications, the ETRI Journal, and the Journal of Computing and Information Technology.

He was the founding general chair of the First IEEE International Conference on Information Technology: Research and Education (ITRE2003), and was instrumental, while serving as its Chapter Chair, in rejuvenating the North Jersey Chapter of the IEEE Communications Society. This chapter received the 1996 Chapter of the Year Award and a 2003 Chapter Achievement Award, served as Chair of the IEEE North Jersey Section and in the IEEE Region 1 Board of Governors during 2001-2002, and has been serving in various IEEE committees such as Vice-Chair of IEEE COMSOC Technical Committee on Ad Hoc and Sensor Networks, and Chair/Vice-chair and TPC Chair/Vice-chair of several conferences/symposia.

He has been frequently invited to deliver keynote addresses, distinguished lectures, tutorials, and talks. His awards and recognitions include the NJIT Excellence Teaching Award in Graduate Instruction (1998), IEEE Region 1 Award (1999), IEEE Leadership Award (2007, from IEEE Princeton and Central Jersey Section), and designation as an IEEE Communications Society Distinguished Lecturer.

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- L. Zhu, G. Cheng and N. Ansari, "Delay Bound of Youngest Serve First Aggregated Packet Scheduling," *IEE Proc. Communications*, Vol. 150, No. 1, pp. 6-10, Feb 2003.
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- J. Zeng and N. Ansari, "Virtual Queue Occupancy and Its Applications on Periodic Bandwidth On Demand Schemes for IP/SONET," *IEICE Trans. Communications*, Vol. E85-B, No. 9, pp. 1749-1755, Sep. 2002.
- H. Zhao, N. Ansari, and Y.Q. Shi, "Transmission of Real-time Videos over IP Differentiated Services," *IEE Electronics Letters*, Vol. 38, No. 19, pp. 1151-1153, September 2002.
- Y. Luo and N. Ansari, "Restoration with Wavelength Conversion in WDM Networks," *IEE Electronics Letters*, Vol. 38, No.16, pp. 900-901, August 2002.
- J. Bang, N. Ansari and S. Tekinay, "Performance Analysis of an ATM MUX with a New Space Priority Mechanism under ON-OFF Processes," *Journal of Communications and Networks* (technically co-sponsored by IEEE COMSOC), Vol. 4, No. 2, pp. 128-135, June 2002.
- J. Li and N. Ansari, "Enhanced Birkhoff-von Neumann Decomposition Algorithm for Input Queued Switches," *IEE Proc. Communications*, Vol. 148, No. 6, pp. 339-342, December 2001.

- D. Liu, N. Ansari, and E.S.H. Hou, "A Novel Fairness Criterion for Allocating Resources in Input Queued Switches," *IEE Electronics Letters*, Vol. 37, No. 19, pp. 1205-1206, September 2001.
- H. Liu, N. Ansari and Y.Q. Shi, "Modeling MPEG Coded Video Traffic by Markov-Modulated Self-Similar Processes," *Journal of VLSI Signal Processing Systems* (special issue on Multimedia Signal Processing), Vol. 29, No. 1/2, pp. 101-113, August/September 2001.
- L.C. Zhong, Z. Siveski, R.E. Kamel and N. Ansari, "Adaptive Multiuser CDMA Detector for Asynchronous AWGN Channels — Steady State and Transient Analysis," *IEEE Transactions on Communications*, Vol. 8, No. 9, pp. 1541-1549, September 2000.

INVITED TALKS (2000-2007)

- "On Tracing and Mitigating Distributed Denial of Service Attacks," **Distinguished Invited Talk**, *2007 IEEE International Conference on Computer Communications (ICCN 2007)*, August 13-16, 2007.
- "On TCP-Jersey," Invited Talk, *2007 Wireless and Optical Communications Conference (WOCC 2007)*, April 27-28, Newark, NJ.
- "On Tracing and Mitigating Distributed Denial of Service Attacks," delivered at Hong Kong, Macao, and Tokyo, as an **IEEE COMSOC Distinguished Lecture Tour**, during March 8-16, 2007. (3 talks)
- "WiMAX: Privacy Key Management," **Distinguished Lecture**, 2007 *Sendai International Workshop on Network Security and Wireless Communications*, Sendai, Japan, January 24, 2007.
- "Congestion Control in Heterogeneous Network Environment," **tutoria**l, *6th Annual VI Winter Workshop Series,* Warren, MI, January 8-11, 2007.
- "On Tracing and Mitigating Distributed Denial of Service Attacks," *IEICE Joint Technical Meetings,* Sendai, Japan, September 14, 2006. (Presentation slides were produced in three IEICE Technical Reports, Vol. 106, No. 236-238, NS2006-76, IN2006-56, CS2006-22(2006-9))
- "Tracing Cyber Attacks by Deterministic Packet Marking," University of Texas at San Antonio, May 8, 2006.
- "TU-02 - Tracing Cyber Attacks," **tutorial**, *2005 IEEE Global Telecommunications Conference Globecom2005,* St. Louis, MO, USA, Nov. 28, 2005.
- "TCP-Jersey for the Emerging Hybrid Network," Hong Kong Applied Science and Technology Research Institute (ASTRI) Company Limited, Hong Kong, July 8, 2005.
- "TCP-Jersey for the Emerging Hybrid Network," Shangdong University, Jinan, Shangdong, PRC, July 5, 2005.
- "Dynamic Upstream Bandwidth Allocation over Ethernet Passive Optical Networks," Shangdong University, Jinan, Shangdong, PRC, July 4, 2005.
- "TCP-Jersey: A Reliable Transmission Protocol for Next Generation Networks," **Keynote Speech**, 2005 IEEE International Conference on Information Technology: Research and Education, Hsinchu, Taiwan, June 28, 2005.
- "TCP in Heterogeneous Environment," **tutorial**, 2005 IEEE International Conference on Information Technology: Research and Education, Hsinchu, Taiwan, June 27, 2005.

- "TU19: Enterprise Network Security: Managing And Tracing Cyberattacks," (with Pradeep Ray) **tutorial**, *2004 IEEE Global Telecommunications Conference Globecom2004,* Dallas, Texas, USA, Nov. 29-Dec. 3, 2004.
- "Toward Identifying the Sources of IP Packets," Electrical and Computer Engineering Lecture Series, Polytechnic University, Brooklyn, NY, November 11, 2004.
- **"**Toward Identifying the Attack Source by Deterministic Packet Marking," **Keynote Speech**, *IEEE/ACM International Conference on e-Business and Telecommunication Networks ICETE2004*, Setúbal, Portugal, August 25-28, 2004.
- "TU09: QoS in Multimedia Networks," **tutorial**, *IEEE International Conference on Communications ICC2004,* Paris, France, June 20-24, 2004.
- "On Traffic Assembly and Transport Mechanisms for IP over WDM Burst-switched Networks," University of Zagreb, Croatia, June 16, 2004.
- "On IP Traceback," **tutorial**, *IEEE International Workshop on High Performance Switching and Routing*, April 18, 2004.
- "IP Traceback by DPM," Overseas **Distinguished** Speech, *2nd Sendai International Workshop on Internet Security and Management*, Sendai, Japan, January 29, 2004.
- "QoS in Multimedia Communications," **tutoria**l, *3rd Annual VI Winter Workshop Series,* Warren, MI, January 12-16, 2004.
- "On Deterministic Packet Marking," ISS Seminar, DIMACS Series-Joint Rutgers and Princeton, Princeton University, December 11, 2004.
- "On IP Traceback," in the Security in Wireless Systems and Networks Panel, in conjunction with the 12th Annual Wireless and Optical Communications Conference (WOCC'2003), Newark, NJ, USA, April 25-26, 2003. (panelist & speaker)
- "Research in Advanced Networking," IT Industry Forum and Tours, sponsored by NJ Technology Council and NJIT, September 27, 2002.
- "Traffic Scheduling," a **tutorial** given at the Seventh International Conference on Distributed Multimedia Systems DMS'2001, Taipei, Taiwan, September 26-28, 2001.
- "Emerging Issues in Broadband Networks," an 8-hour invited **short course** conducted at Tamkang University, Taipei, Taiwan, ROC, September 24-25, 2001. (Over 50 attendees)
- "On Traffic Scheduling for High Speed Switches," presented at Industrial Technology Research Institute, Hsinchu, Taiwan, ROC, September 28, 2001.
- "On Modeling MPEG Videos," presented at National Tsing Hua University, Hsinchu, Taiwan, ROC, September 28, 2001.
- "Emerging Topics on Broadband Networks," a 4 half-day short course, as part of the Telecommunications Engineering Management Program for UTStarcom, Oct. 2-13, 2000.

ARIDAMAN K. JAIN

Summary

Teacher, consultant, and researcher in a wide variety of statistical fields, including Reliability Analysis, Applied Statistics, Design of Experiments, Statistical Modeling, and Sampling Surveys, as well as Network Security, and Cost Modeling

Professional Experience

New Jersey Institute of Technology (NJIT), Newark, NJ 2003 -

Special Lecturer

- Currently teaching 3 courses - undergraduate and graduate - in Statistics.
- Coordinator of Probability & Statistics Course.
- Coordinator of the Statistics Consulting Lab.

Lucent Technologies - Bell Laboratories, Holmdel, NJ 1997 – 2001

Member of Technical Staff

Represented Lucent in the Measurements Working Group of the Telecom Industry specific TL 9000 Forum on quality and reliability standards and IEEE Reliability Prediction Working Group; conducted reliability studies of several Lucent products.

- Led the development of the "Product Performance Indicator". Played a key role in the development of the "Return Rate" and "System Outage" measurements in TL 9000.
- Convinced the TL 9000 Measurements Group to reduce the number of metrics from 30 to 10 most critical, which resulted in a multi-million dollar savings for Lucent.
- Led the development of a security profile of Lucent computer network that resulted in the filing of two patent applications.
- Developed a sampling plan for Factory EST of DDM-2000 system that reduced the manufacturing test interval and the testing costs by 50% - 70%.
- Teamed with a cross-functional group to develop the new balanced scorecard that is a key tool being used by the Executive Committee to manage the Lucent turn around.
- Coauthored several sections of the "Reliability Prediction Guide", being developed by the IEEE Reliability Prediction Working Group.
- Developed and presented a tutorial on reliability prediction during1995-2001 Annual Reliability and Maintainability Symposiums, each attended by more than 100 people.

Bellcore (now Telcordia Technologies), Red Bank, NJ 1984 - 1996

Distinguished Member of Staff /District Manager

Provided industry consulting on reliability of electronic equipment and conducted Reliability Review Forums (RRFs) for tracking the reliability performance of Telecom products.

- Conducted RRFs for tracking the reliability performance of large transmission systems deployed by the Regional Bell Operating Companies and developed corrective action programs with several large telecommunications suppliers.

- Coordinated and conducted the first telecommunications industry study of the Cost of Poor Quality that provided a quantitative measure of the potential cost savings.
- Prepared Issues 4 & 5 of the Bellcore Reliability Prediction Procedure that is used by the Telecommunications industry for estimating the reliability of products.
- Authored three issues of the Bellcore Field Reliability Performance Study Handbook, which was the first telecommunications industry document on the subject.
- Developed and presented a tutorial on reliability prediction at the 1995-1997 RAMS, each of these was attended by more than 100 people.

Bell Laboratories, Holmdel, NJ 1967 - 1983

Member of Technical Staff

Made a broad range of technical contributions: modeled computer performance, developed sampling plans for measurement of billing accuracy, designed experiments for optimum phrasing of telephone-intercept messages, and estimated telecom demand in the health-care segment. These contributions had a major impact on the design of telecommunications systems and provided estimates of potential demand for making important decisions on offerings of new telecommunications services.

Course Development & Teaching Experience

- Taught at NJIT: Probability, Applied Statistics, and Sampling Theory 2003 -
- Developed and presented a tutorial: "Reliability Prediction" at the Reliability and Maintainability Symposium (sponsored by IEEE, ASQ, IIE, SRE, and 8 other professional societies) for 7 consecutive years during 1995 – 2001.
- Developed and taught: "Advanced Statistics" at Stevens Institute of Technology, 1995-1996; "Statistical Process Control" at Monmouth Univ., 1994; "Business Statistics" at Monmouth Univ., 1993 - 1994; "Engineering Reliability" at NJIT, 1993; "Design and Analysis of Sampling Surveys" at Bell Laboratories, 1978 & 1979.
- Taught at Bell Laboratories: two-semester sequence of "Data Analysis", 1975-1976 & 1976-1977; two-semester sequence of "Design of Experiments", 1971-1972 & 1973-1974; and "Linear Statistical Models", 1968.

Professional Activities

- NJ Chapter of American Statistical Association, Past President, 1996-1997; Continuing Education Committee Chairman , 1986-1987 & 1994-1996; Chairman of the Election Committee, 1998-2001; and Science Fair Judge, 2004 & 2005.
- Senior Member of both the American Society for Quality and the Institute of Electrical and Electronics Engineers (IEEE).
- American Society for Quality (ASQ), Chair of two Writing Committees, "An Attribute Skip-Lot Sampling Program: ANSI/ASQ S1-2003" and "Chain Sampling Procedures for Inspection by Attributes: ANSI/ASQ S3-2004".

Education

- Ph.D., Statistics and Industrial Engineering, Purdue Univ., Lafayette, IN, 1968.
- M.S., Statistics, Indian Statistical Institute, Calcutta, India, 1960.
- B.Sc. with Honors, Mathematics, Delhi University, Delhi, India, 1957.

Major Awards/Patents

- Lucent Technologies Standards Excellence Award (2001)
- Reliability and Maintainability Symp., Best Continuing Tutorial Award (2000)
- Co-author of two patent applications on Cyber Security (1998)
- Distinguished Member of Staff Award, Bellcore, 1984.
- Outstanding Presentation Award at the Annual meetings of the American Statistical Association, 1980.

Journal Articles and Papers in Proceedings

1. "Sampling and Short Period Usage in the Purdue Library," *College and Research Libraries,* Vol. 27, p. 211 -218, May 1966.

2. "A Statistical Study of Book Use," *PhD Thesis,* Purdue University, Distributed by U.S. Clearinghouse (PB-176525), 1967.

3. "Sampling and Data Collection Methods for a Book-Use Study," *The Library Quarterly,* Vol. 39, p. 245-252, July 1969.

4. "A Statistical Model of Book Use and its Application to the Book Storage Problem," *Journal of the American Statistical Association,* Vol. 64, p. 1211-1224, December 1969 (Co-authors: V. L. Anderson and F. F. Leimkuhler).

5. "Sampling In-Library Book Use," *Journal of the American Society for Information Science,* Vol. 23, p. l50-155, May-June 1972.

6. "Monte-Carlo Simulation of Cross-talk in Communication Cables," *Proceedings of 1973 Winter Simulation Conference, p.* 844-857, January 1973.

7. "Statistical Modeling of Computer Performance," *Proceedings of the Ninth, Tenth and Eleventh Meetings of the Computer Performance Evaluation Users Group, p.* 19-29, 1974-1975 (Co-author: T. W. Potter).

8. "Statistical Modeling of Computer Performance (A Cost Benefit Approach)," *Proceedings of the Twelfth Meeting of the Computer Performance Evaluation Users Group, p.* 171-178, November 1976 (Co-author: T. W. Potter).

9. "Estimation from a Stratified Random Sample Under Changes in Strata Composition," *Proceedings of the Section on Survey Research Methods,* American Statistical Association, Washington, D.C., p. 642-646, August 1978.

10. "A Guideline to Statistical Approaches in Computer Performance Evaluation Studies," *Performance Evaluation Review,* Vol. 8, No. 1-2, p 63-77, 1979.

11. "Quantitative Methods in Computer Performance Evaluation," *Proceedings of the 15th Meeting of the Computer Performance Evaluation Users Group,* October 1979.

12. "Computer System Migration Planning Through Benchmark Performance Evaluation," *Proceedings of the 15th Meeting of the Computer Performance Evaluation Users Group,* p. 89-104, October 1979 (Co-authors: A. Mukherjee and B. A. Ketchledge).

13. "Design of a Rotation Scheme for a Stratified Multi-Stage Sample," *Journal of Statistical Planning and Inference,* Vol. 5, No. 1, p. 57-69, 1981.

14. "Estimation in Stratified Sampling: Adjustment for Changes in Strata Composition," *Annals of the Institute of Statistical Mathematics,* Vol. 34, No. 1, Part A, p. 91-103, 1982.

15. "A Multivariate Methodology for Analyzing Data from Stratified Multi-Stage Sampling Surveys," *Proceedings of the Section on Survey Research Methods,* American Statistical Association, Washington, D.C., p. 111- 116, August 1982 (Co-author: R. E. Hausman).

16. "Stratified Multi-Stage Sampling," *Encyclopedia of Statistical Sciences,* Vol. 9, p. 8-12, John Wiley and Sons, Inc., 1985 (Co-author: R. E. Hausman).

17. "Quantification of the Cost of Poor Quality for Selected Telecommunications Products," *Proceedings of the Business and Economic Statistics Section,* American Statistical Association, Washington, D.C., p. 289-293, August 1985 (Co-author: B. S. Liebesman).

18. "The Cost of Poor Quality for Selected Operating Telephone Company Products," *Proceedings of the IEEE Global Telecommunications Conference,* IEEE Communications Society, p. 1393-1397, December 1985 (Co-author: B. S. Liebesman).

19. "What is the Cost of Poor Quality?", *Bell Communications Research EXCHANGE,* Vol. 2, Issue 6, p. 18-22, November/December 1986 (Co-author: B. S. Liebesman).

20. "Conducting Quality and Reliability Field Performance Studies," *Bell Communications Research EXCHANGE,* Vol. 3, Issue 3, p. 19-23, May/June 1987.

21. "Improved Quality of Protocol Testing Through Techniques of Experimental Design," *Proceedings of the IEEE International Conference on Communications, p.* 745-752, May 1994 (Co-authors: K. Burroughs and R.L. Erickson).

22. "Quality Assurance Cost Effectiveness as a Measure of Customer Satisfaction", *Annual Review of Communications,* Volume XLVIII, p. l013-l018, 1994-95 (Coauthor: R. N. Brigham).

23. "Reliability Prediction", A Best Continuing-Excellence-Award-Winning Tutorial at Seven Consecutive *Reliability and Maintainability Symposiums - Tutorial Notes,* During 1995-2001 (Coauthors: John Healy and Jay Bennett).

24. "The Realism of FAA Reliability-Safety Requirements and Alternatives", IEEE AES Systems Magazine, February 1998 (Coauthors: Michael Pecht, et al).

25. "Improving the Manufacturing Test-Interval and Costs for Telecommunications Equipment", *Proceedings of the Reliability and Maintainability Symposium,* January 1999 (Coauthor: Harry Saraidaridis).

26. "Managing Cyber Security Vulnerabilities in Large Networks", Bell Labs Technical Journal, Volume 4, Number 4, October-December 1999 (Co-authors: Edward S. Chang, David M. Slade, and S. Lee Tsao).

27. "Development of Quality Index for TL 9000 Measurements", *Proceedings of the Reliability and Maintainability Symposium,* January 2002.

28. "Reliability Predictions Based on Criticality-Associated Similarity Analysis", *Proceedings of the Reliability and Maintainability Symposium,* January 2002 (Coauthors: Alazel Jackson and Tyrone Jackson).

29. "Development and Use of Quality Index for Reliability Improvement", *Reliability, Maintainability, and Supportability (RMS) Newsletter*, Volume 6, Number 2, April 2002.

30. "Quality Index for Feedback and Reliability Improvement", *Proceedings of the Annual Quality Congress,* May 2003.

31. "Small-sample Non-parametric Tests for the Effectiveness of Liposuction Breast-Reduction Surgery in African American Women" (Coauthors: Martin J. Moskovitz, Sherwood A. Baxt, and Robert E. Hausman), Journal of Plastic Reconstruction Surgery, January – February, 2007.

Selected Reports at Bell Labs, Bellcore, and Lucent Technologies

1. Effect of Twist Lengths and Distances between Pairs on Cross-talk, Bell Laboratories Report, October 29, 1968.
2. Sampling and Data Collection Methods for Book Use Studies, Bell Laboratories Report, February 6, 1969.
3. Optimum Twist Length Selection, Bell Laboratories Report, May 12, 1969.
4. An Experiment to Investigate the Phrasing of Automatic Intercept Messages, Bell Laboratories Report, July 31, 1969.
5. Analysis of a Completely Balanced Lattice Square Experiment for Investigating the Phrasing of Automatic Intercept Messages, Bell Laboratories Report, July 15, 1970.
6. A Likelihood Analysis of Time Dependent Models for Customer Revenue Lifetime, Bell Laboratories Report, September 3, 1971 (Coauthor: J. A. Tischendorf).
7. Investigation of Possible Sources of Bias in MDF Activity Study, Bell Laboratories Report, July 23, 1973 (Coauthors: P. S. Miller and J. A. Tischendorf).
8. Application of Asymptotic Normality of Power Sums to Communication Crosstalk Studies, Bell Laboratories Report, November 13, 1974 (Coauthor: B. Saperstein).
9. Analysis of Possible observer Bias in the Final NAP - Installation Data Base for Bell of Pennsylvania, Bell Laboratories Report, December 23, 1974 (Coauthor: P. A. Groll).
10. Formulas for Estimates of Billing Error Probabilities for operator Handled Calls, Bell Laboratories Report, March 4, 1977.
11. Revenue Impact of Billing Errors in Direct-Distance-Dialed Calls, Bell Laboratories Report, November 11, 1977.

12. Estimation of Potential Demand for Advanced Mobile Phone Service, Bell Laboratories Report, October 26, 1979.
13. The Nationwide Credit - Classification Study: Study overview and Sampling Plan, Bell Laboratories Report, December 20, 1979 (Coauthor: W. H. Elliott).
14. Estimation of Potential Demand in the Health Care Segment, Bell Laboratories Report, July 24, 1981 (Coauthor: P. Agarwala).
15. Integrity of Special Services Forecast Data Base, Bell Laboratories Report, October 21, 1981.
16. Special Services Forecasting Reports: Survey Results, Bell Laboratories Report, November 23, 1982
17. Specifications for a Field Quality Data Base, Bellcore Report, May 17, 1984.
18. Cost of Poor Quality: Fiber optic Regenerators, Bellcore Report, December 31, 1984.
19. Field Performance Study Handbook, Issue 1, Bellcore Report, December 1988.
20. Field Reliability Performance Study Handbook, Issue 2, Bellcore Report, September 1989.
21. An Economic Model of the Life Cycle Cost of Repairing Defective Plug-ins vs Buying. New Plug-ins, Bellcore Report, July 30, l990 (Coauthor: R. G. Wingerter).
22. Reliability Prediction Procedure for Electronic eqiupment, Issue 4, Bellcore Technical Reference, September 1992.
23. A new Procedure for Supplier Data Validation for the case of Small Number of Defectives, Bellcore Report, May 1993.
24. Quality Cost Management Using QuACE, Issue 2, Bellcore Report, February 1994.
25. Economic Impact of Increasing the operating Temperature Range Within Telecommunications Central offices: The Wide-Band Study, Bellcore Report, November 1994 (Coauthors: G. G. Neuburger, et al).
26. Reliability Prediction Procedure for Electronic Equipment, Issue 5, Bellcore Technical Reference, December 1995.
27. Statistical Analysis of DDM-2000 Factory and Field Data During 1996-1997, Lucent Technologies Report, April 1998 (Coathors: F. R. Forgit, J.P. Maceachern, and C. I. Saraidaridis).
28. WNG Production Sampling EST – Proposed Production Sampling Plan and Analysis of Factory and Field Data, Lucent Technologies Report, December 1998 (Coathor: C. I. Saraidaridis).
29. Reliability Information Notebook, Edition 7, Revision 1, Lucent Technologies Report, October 1999.
30. Reliability Information Notebook, Edition 8, Lucent Technologies Report, October 2001 (Coauthor: Lou Dechiaro).

Dr. Yun Qing Shi

Summary

Dr. Yun Qing Shi has joined the Department of Electrical and Computer Engineering at the New Jersey Institute of Technology (NJIT), Newark, NJ since 1987, and is currently a professor there. He obtained his B.S. degree and M.S. degree from the Shanghai Jiao Tong University, Shanghai, China; his M.S. and Ph.D. degrees from the University of Pittsburgh, PA. His research interests include visual signal processing and communications (motion analysis, video compression and transmission), multimedia data hiding and security (robust watermarking, fragile- and semi-fragile lossless data hiding, authentication, steganalysis, and data forensics), applications of digital image processing, computer vision and pattern recognition to industrial automation and biomedical engineering, theory of multidimensional systems and signal processing (robust stability of linear systems, 2-D spectral factorization, 2-D/3-D interleaving). Prior to entering graduate school, he had industrial experience in a radio factory as a principal design and test engineer in numerical control manufacturing and electronic broadcasting devices. Some of his research projects have been supported by several federal and New Jersey State funding agencies.

He is an author/coauthor of 200 papers in his research areas, a book on Image and Video Compression, three book chapters on Image Data Hiding, and one book chapter on Digital Image Processing. He holds two US patents and has 20 US patents pending (among which 11 have been licensed to another party by NJIT). He is the chairman of Signal Processing Chapter of IEEE North Jersey Section, the founding editor-in-chief of *LNCS Transactions on Data Hiding and Multimedia Security* (Springer), an editorial board member of *International Journal of Image and Graphics* (World Scientific) and Journal on *Multidimensional Systems and Signal Processing* (Springer), a member of IEEE Circuits and Systems Society (CASS)'s Technical Committee of Visual Signal Processing and Communications, Technical Committee of Multimedia Systems and Applications, and Technical Committee of Life Science, Systems and Applications, the chair of Technical Program Committee of IEEE International Conference on Multimedia and Expo 2007 (ICME07), the chair of Technical Program Committee of International Workshop on Digital Watermarking 2007 (IWDW07), a fellow of IEEE since 2005.

He was an Associate Editor of IEEE Transactions on Signal Processing, IEEE Transactions on Circuits and Systems Part II, the guest editor of special issue on Image Data Hiding for *International Journal of Image and Graphics*, the guest editor of special issue on Multimedia Signal Processing for *Journal of VLSI Signal Processing Systems*, the guest editor of special issue on Image Sequence Processing for *International Journal of Imaging Systems and Technology,* a formal reviewer of the *Mathematical Reviews*, a contributing author in the area of Signal and Image Processing for the *Comprehensive Dictionary of Electrical Engineering* (CRC), an IEEE CASS Distinguished Lecturer, a member of IEEE Signal Processing Society's Technical Committee of Multimedia Signal Processing, a co-general chair of IEEE 2002 International Workshop on Multimedia Signal Processing (MMSP02), a co-technical chair of IEEE 2005 International Workshop on Multimedia Signal Processing (MMSP05), a co-chair of Technical Program Committee of International Workshop on Digital Watermarking 2006 (IWDW06).

Three Pieces of Related Works:
Barcodes, Digital Signature and Error Correction Codes

Yun Q. Shi

(I) My team has worked with a barcode company for Postnet Barcode in our past work.
One patent resulting from one-month intensive work in 1994 for ACCU-SORT Systems, Inc. Allenton, PA (a barcode company) by my team under my leadership.

> Y. Q. Shi, C. Chang, S. Lin, and W. Su
> US 6,708,884 B1, awarded on March 23, 2004
> "Method and Apparatus for Rapid and Precision Detection of Omnidirectional Postnet Barcode Location"

(II) My team has used Digital Signature in our past work.
A joint proposal by Institute of Infocomm Research, Singapore and NJIT, entitled "A Unified Authentication System for JPEG2000 Images", has been included into the Security Part of JPEG2000 (JPSEC), Final FDIS (Final Draft, International Standard), ISO/IEC JTC 1/SC 29/WG 1 N3853, February 2006.

At NJIT side, it was my team. The following two patents and one paper are the base of the Authentication Framework adopted by JPEG2000 for lossless compression mode. In this proposal to JPEG2000, we have used digital signature technology.

1. One patent NJIT #03-019
   Y. Q. Shi, Z. C. Ni and N. Ansari
   "Systems and Methods for Robust Reversible Data Hiding and Data Recovery in the Spatial Domain"
   US Non-Provisional Patent was filed on December 3, 2004, serial no: 11/004,041
   PCT/US2004/040528 (December 2004)

2. Another patent NJIT #03-030
   Y. Q. Shi, D. K. Zou and Z. C. Ni
   "System and Method for Robust Lossless Data Hiding and Recovery From The Integer Wavelet Representation"
   US Non-Provisional Patent was filed on December 3, 2004, serial no: 11/004,040
   PCT/US2004/040442 (December 2004)

3. Z. Zhang, Q. Sun, X. Lin, Y. Q. Shi and Z. Ni, "A unified authentication framework for JPEG2000 images," *IEEE International Conference and Expo (ICME04)*, Taipei, Taiwan, June 2004.

(III) My team has used Error Correction Codes in our past work.
In the works reported in the following papers, BCH error correction codes have been used intensively.

1. Y. Q. Shi, X. M. Zhang, Z. Ni and N. Ansari, "Interleaving for combating bursts of errors," *IEEE Circuits and Systems Magazine*, vol. 4, no. 1, pp.29-42, First Quarter, 2004.

2. Y. Q. Shi and X. M. Zhang, "A new two-dimensional interleaving technique using successive packing," *IEEE Transactions on Circuits and Systems*, *Part I: Fundamental Theory and Application,* Special Issue on Multidimensional Signals and Systems, vol. 49, no. 6, pp. 779-789, June 2002.

3. F. Elmasry and Y. Q. Shi, "2-D interleaving for enhancing the robustness of watermarking signals embedded in still images," *Proceedings of IEEE International Conference on Multimedia & Expo*, New York, July 31 to August 2, 2000.

4. F. Elmasry and Y. Q. Shi, "3-D interleaving for enhancing the robustness of watermarking signals embedded in video sequences," *Proceedings of IEEE International Conference on Multimedia & Expo*, New York, July 31 to August 2, 2000.