Report to the
Office of the Attorney General

Avante Vote-Trakker
Voter-verified Paper Record System
Assessment

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I. Summary

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.

Avante supplied three Vote-Trakker 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.

To appropriately test against the Criteria, and to fully exercise the machines, numerous testing approaches were designed and utilized: Single Test, 1200-vote Test, 14-hour Test, and 52-vote Test. The latter three are considered and referred to as Volume Tests. Testing was developed and performed based on accepted scientific practices and methodologies.

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 involves mock voters casting 1200 manual votes. At the time of testing, Avante did not have a script capability to enable programming this 1200-vote Test. This number of votes is chosen to exceed the guideline limit of one machine for 750 registered voters. This Volume 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.

The 52-vote Test is designed to force the paper ballot to extend to multiple pages, by using the long ballot in conjunction with a larger font size. This number of votes is based on the

same scenarios as the 14-hour test. Again, tally reports, close-poll reports, electronic records, and reports from scanned paper records are examined and compared with the paper records. The 52-vote test was also designed to test the capabilities of changing voter selections and fleeing voters.

Overall, the Avante Vote-Trakker complied with most of the criteria with 10 exceptions noted in the following table:

Avante Vote-Trakker: Exceptions to the Criteria

Exception #	Criteria and Result
1	**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 600 votes.
2	**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."
	A slit that exists between the storage unit and the printer may allow unauthorized or forged paper records to be slid into the storage unit
3	**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."
	If, during voting, the DRE detects the low paper supply, an error message window appears on the DRE screen. Pressing the "OK" button in the error message window closes this window and returns back the DRE screen as normal status. The voter has the opportunity to continue the voting operations and to cast the vote. However, a paper record is not printed out. This situation of no paper records being printed continues with subsequent votes, with no audio or visual signal to the poll worker, until the voter presses "cast ballot" twice, at which time the vote is electronically recorded but without a paper record. The machine has to be reset for the next voter.
4	**IV.A.1** The paper record shall include identification of the particular election, the election district, and the voting machine.
	The particular election name (e.g., Primary Election or General Election) is not printed on the paper record.
5	**IV.C.5** The paper records shall distinguish between accepted and non-accepted ballots. **IV.C.5.a.(5)** The voter shall have the opportunity to accept or reject the contents of his or her paper record.
	There is no clear acceptance information (e.g., "Voided" or "Accepted"): ▪ voided paper records have the same identifier number as the final approved paper record cast by the same voter. The VVPRS appends (1) and (2) to that identifier number for the 2nd updated and 3rd updated paper records, respectively. ▪ some voided paper records may be incorrectly considered as accepted paper records if some updated paper records are lost.

6	**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." **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."
	If a mechanical error or malfunction occurs (such as a paper jam, running out of paper, paper torn in half, or paper inserted improperly), the DRE displays an error message on the screen to the voter, but no warning signals are sent to notify the election officials at the polling place. The DRE does not suspend voting operations. The voter has the opportunity to continue voting and cast the vote but the paper record is not printed. The vote is, however, electronically recorded.
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."
	The printer connection between the printer and a particular voting machine is not completely concealed to prevent tampering. Furthermore, the exposed part of the connection between the VVPRS and the voting machine is covered with plastic wrap, but not completely, allowing access to the cable.
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."
	Although the DRE can detect problems that may prevent paper records from being correctly displayed, printed, or stored (like paper jams or low paper), no warning signals are sent to notify the election officials at the polling place.
9	**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."
	If the connection between the voting machine and the printer breaks during the voting process, the DRE displays an error message on the screen to the voter, but no warning signals are sent to notify the election officials at the polling place. The DRE does not suspend voting operations. The voter has the opportunity to continue voting and cast the vote without printing any paper record. The vote is, however, electronically recorded.
10	**Miscellaneous**
	For the fleeing voters who have yet not printed any paper records, the DRE displays the correct warning, which allows intervention by the poll worker to spoil or cast the ballot. However, once a paper record has been printed by the voter, the DRE will automatically cast the ballot as the fleeing voter left it, without review and approval by the voter, and without any intervention by the poll worker.

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.

Avante supplied three Vote-Trakker 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 three tests – 1200-vote, 14-hour and 52-vote 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 would typically entail having the machine generate 1200 votes continuously based on the short ballot through a scripted program. However, at the time of testing, Avante did not have the script capability, and thus this test was carried out by having mock voters cast 1200 votes manually. 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 is** designed to test the special case in which the paper record extends to multiple pages, i.e., the criteria III.B.2 and IV.A.3 of the State of New Jersey Criteria of Voter-Verified Paper Record for Direct Recording Electronic Voting Machines. It is applicable only to a VVPRS that uses the "Cut-and-Drop" method. The test adopts the long ballot with voting testing scenarios, same as the 14-hour test, and furthermore utilizes a large font size. A number of "mock" voters are recruited to cast various voting scenarios in the official election mode for 52 votes, which was determined to be an appropriate number of votes to test the "multiple page" criteria. 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.

III. Testing Results

a. Equipment Configuration

Vendor	DRE Hardware Model	DRE Hardware Version	DRE Firmware Version	DRE Machine ID	VVPRS Printer Model	VVPRS Print Driver Version	VVPRS Printer Interface
Avante	Vote-Trakker EVC308-FF	1.4.0	1.2.1A Full-Face	VTF 0300299 (ID: 03)	Seiko KPU S347	SII KPU-S347 80mm	USB
Avante	Vote-Trakker EVC308-FF	1.4.0	1.2.1A Full-Face	VTF 0300272 (ID: 04)	Seiko KPU S347	SII KPU-S347 80mm	USB
Avante	Vote-Trakker EVC308-FF	1.4.0	1.2.0 Full-Face	VTF 0300110 (ID: 02)	Seiko KPU S347	SII KPU-S347 80mm	USB

b. Volume Tests

Three 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 Avante machine, this test resulted in 560 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. In case of the Avante machine tested, since electronic voting option was not available, a manual voting was conducted by using mock voters to cast the votes to represent 1200 voters.

- The third test, called **52-vote test** to check the multiple-page ballot, changing selections after reviewing the paper ballot, and fleeing voter capabilities of the Avante machine.

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; we designed **12 voting scenarios** that are representative of 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,** we designed **12 voting scenarios** that are representative of 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.

52-vote Test

The **52-vote test** was conducted to check the following capabilities of the Avante machine:
- Multiple-page ballot,
- Changing selections after reviewing the paper ballot, and
- Fleeing voter.

Multiple-page

A larger size font was used to force the ballot to be printed on 2 pages.

Changing Selections

The following two scenarios were used for testing the capability of changing selections:
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

Fleeing Voters

We tested the following 4 scenarios of fleeing voters:
1. Voter flees after making the selection but before confirming the selection (i.e., before the 1st paper record could be printed) – 1 case
2. Voter flees after printing the 1st paper record – 2 cases
3. Voter flees after printing the 2nd paper record – 1 case
4. Voter flees after printing the 3rd paper record – 1 case.

Each of the above 4 scenarios should result in the following warning message: "The last voter has not finished voting. Election officials must intervene! Please insert the poll worker card".

Table 5

Lists the requirements and discusses the results of the 14-hour and 52-vote volume tests in terms of meeting those specific requirements.

Results of Fleeing Voters Test

Only Scenario 1 above had the correct warning, which was followed by an intervention by the poll worker to spoil the ballot. For the other 3 fleeing-voter scenarios listed above, instead of getting the warning message, "The last voter has not finished voting. Election officials must intervene! Please insert the poll worker card", the following warning message appeared, "There has been no selection made for the last 100 seconds. Please press anywhere on the screen to return to voting." Later the voting machine cast the ballot as the fleeing voter left it, without any intervention by a poll worker.

Results of Multiple-page Test

In the 52-vote test, a larger size font was used to ensure that the selections made by each voter were spread over 2 pages and all of these votes were recorded correctly on the paper ballot and also recorded correctly in the scanned paper ballots, electronic records, and close poll tally.

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 3 types of tests (i.e., 14-hour, 1200-vote, and 52-vote), we prepared a summary of the following:
- 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 Avante machine performed well under the three types of volume testing (14-hour, 1200-vote and 52-vote) and the 4 types of counts (Paper records, scanned paper records, electronic records, and close poll) were identical. The only exception is the handling of fleeing voters after a paper record is printed.

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 Avante Vote-Trakker EVC308-FF

[Note: Volume testing was performed on these Criteria only]

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	Results Avante VOTE-TRAKKER EVC308-FF
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 does 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.	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 do match 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.	• Each electronic ballot image record is matched to the corresponding paper record with the unique identified number of each vote. • Only the final approved vote is electronically recorded. The voided paper records have the same identifier number as that of the final approved paper record cast by the same voter. The VVPRS appends (1) and (2) to that identifier number for the 2nd updated and 3rd updated paper records, respectively. • Each electronic ballot image record does have a corresponding paper record if there are no mechanical errors or malfunctions during the voting operations.
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.

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 DRE electronic ballot image records do correspond to the paper records without revealing the voters' identities.
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 7" diameter paper roll provided by the vendor is sufficient for about 600 paper records each with a length of 8 inches. Paper replacement is expected after about 600 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.	• If the paper record cannot be displayed in its entirety on a single page, each page is numbered and includes the total count of pages in the format of "Page: X/Y", where X is the page number and Y is the total count of pages. • The 52-vote test is the only volume test in which the paper records extend to more than a single page.
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 that its contents are machine readable.	The contents of the paper record are 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 paper record does have a unique identifier number, which is the same for all votes cast by one voter, however, with (1) and (2) appended to that identifier number for the 2nd updated and 3rd updated paper records, respectively. • The unique identifier number of the paper record is the same as that of the associated electronic ballot image record. • 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 associated electronic record does not contain an individual digital signature, i.e., not one-to-one. • The vendor has adopted a different scheme in creating digital signatures associated with electronic ballot image

			records. The scheme is proprietary. • The DRE does generate and store a digital signature for the entire set of electronic ballot image records.
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 entire set of electronic ballot image records of the election are digitally recorded in a file, which can be verified against the paper records, audited, and analyzed using a COTS text editing software such as Notepad. • However, the electronic ballot image records can only be generated by using the vendor's proprietary software. • Using the vendor's proprietary software, the electronic ballot image records can then be printed, audited, and analyzed by using any COTS software such as Microsoft© Word™ and Notepad©.
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 are indeed in a publicly, non-proprietary graphic format (i.e., .jpg).
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 group digital signature of the electronic record of the entire election is calculated on the entire set of electronic ballot image records, and their associated digital signatures (not one-to-one) in a proprietary manner.

4.0.34	IV.C.5. The paper records shall distinguish between accepted and non-accepted ballots.		• There is no clear acceptance information (e.g., "VOIDED" or "ACCEPTED"), except that "(1)" and "(2)" are appended to the unique identifier number on the top of the second (rejected) and 3rd (final and accepted) paper records, respectively.
			  * This number indicates the number of replacements of that paper record. The first paper record does not have such a number.
			  * If all paper records are not lost, certain inference is required to differentiate paper records with accepted ballots from those with non-accepted ballots.
			    ➢ If the voter casts 3 times and the third paper record (marked with (2)) is lost, the second paper record, marked with (1), may be incorrectly considered as the accepted paper record.
			    ➢ If the voter casts 3 times and the

		second and third paper records (marked with (1) and (2), respectively) are lost, the first paper record may be incorrectly considered as the accepted paper record. ➢ If the voter casts 2 times and the second paper record (marked with (1)) is lost, the first paper record may be incorrectly considered as the accepted paper record. • The event log kept in the DRE can reveal the unique identifier number of the paper records that have been rejected at least once. • The event log kept in the DRE can reveal how many attempts (called replacements) that have been used to cast this ballot. • The event log kept in the DRE does not reveal the unique identifier number of the paper records that have never been rejected.

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.	• After the voter presses the "cast ballot" button on the DRE screen to cast the ballot, the paper record is printed and the screen shows a message that instructs the voter to accept or reject that paper record.
		  * To accept the paper record, the voter presses that "cast ballot" button again.
		  * To reject the paper record, the voter simply presses any selection box on the DRE screen.

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 allows 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 voting machine warns the voter that the voter can print the paper record up to three times and two paper records have already been printed. • The voter can see and verify the selections on the 3rd 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	Upon rejecting a paper record, the voter is

		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.	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.	The paper record does have a unique identifier number, which is the same for all votes cast by one voter, however, with (1) and (2) appended to that identifier number for the 2nd updated and 3rd updated paper records, respectively.	

Table 6. Counts of Voting Scenarios for Changing Voter selections

Voting Scenario	Number of Votes Cast		Number of Votes Recorded Correctly	
	52-Vote Test	14-hour Test	52-Vote Test	14-hour Test
2-/2-2	2	18	2	18
8-1/8-2	1	17	1	17
4-1/4-2/4-3	1	15	1	15
Total	4	50	4	50

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

Office	Candidate	Count from Paper Records	Count from Scanned Records	Count from Electronic Records	Count from Poll Close
Total Votes		560	560	560	560
Office	**Candidate**				
President	R: Peter	266	266	266	266
	D: Kenneth	264	264	264	264
	BP1: William	8	8	8	8
	BP2:Michael	9	9	9	9
	WI:William	6	6	7	7
	unknow WI	1	1		
	Undervote	6	6	6	6
US Senate	R: John	267	267	267	267
	D: Phlip	263	263	263	263
	BP1: Joanna	0	0	0	0
	BP2:Christian	0	0	0	0
	WI:Ed lynch	13	13	14	14
	unknow WI	1	1		
	Undervote	16	16	16	16
House of Rep	R: David	264	264	264	264
	D: Larry	265	265	265	265
	BP1: Bernada	0	0	0	0
	BP2: Peter	0	0	0	0
	WI:Micheal	13	13	14	14
	unknow WI	1	1		
	Undervote	17	17	17	17
Freeholder 3yrs Vote 2	R: Bill	272	272	272	272
	R: Mike	266	266	266	266
	D: David	258	258	258	258
	D: Ray	263	263	263	263
	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	13	13	30	30
	WI-2: Bruce	16	16		
	unknow WI	1	1		
	Undervote	31	31	31	31
Freeholder 2yr Vote 1	R: Roy	264	264	264	264
	D: William	266	266	266	266
	BP1: Catherine	0	0	0	0
	BP2: Rebecca	0	0	0	0

	WI: Charles	13	13	14	14
	unknow WI	1	1		
	Undervote	16	16	16	16
Member Township Vote 1	R: Denver	263	263	263	263
	D: Baltimore	262	262	262	262
	BP1: Henry	0	0	0	0
	BP2: Katherine	0	0	0	0
	WI: Michael	14	14	15	15
	unknow WI	1	1		
	Undervote	20	20	20	20
Charter Study Vote 5	BP1: Herald	139	139	139	139
	BP1: Jessica	139	139	139	139
	BP1: Samuel	139	139	139	139
	BP1: Alfred	138	138	138	138
	BP1: Carlton	138	138	138	138
	BP2: Mario T	144	144	144	144
	BP2: Henry	144	144	144	144
	BP2: Mary	146	146	146	146
	BP2: Abraham	144	144	144	144
	BP2: Joel	137	137	137	137
	WI-1: Terrance	66	66	199	199
	WI-2: Mario	66	66		
	WI-3: Mildred	67	67		
	WI-4: Kenneth	0	0		
	WI-5: John	0	0		
	Undervote	1193	1193	1193	1193
Q1	Y	269	269	269	269
	N	260	260	260	260
	Undervote	31	31	31	31
Q2	Y	264	264	264	264
	N	265	265	265	265
	Undervote	31	31	31	31
Q3	Y	263	263	263	263
	N	265	265	265	265
	Undervote	32	32	32	32
Q4	Y	262	262	262	262
	N	265	265	265	265
	Undervote	33	33	33	33
Q5	Y	264	264	264	264
	N	263	263	263	263
	Undervote	33	33	33	33
Q6	Y	262	262	262	262
	N	267	267	267	267
	Undervote	31	31	31	31
Q7	Y	257	257	257	257

	N	272	272	272	272
	Undervote	31	31	31	31

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

Office	Candidate	Count from Paper Records	Count from Scanned Records	Count from Electronic Records	Count from Poll Close
Total Votes		1200	1200	1200	1200
Office	**Candidate**				
US Senate	R: John	498	498	498	498
	D: Phlip	500	500	500	500
	BP1: Scott	52	52	52	52
	BP2:Mary	49	49	49	49
	WI-1 USS	48	48	48	48
	Undervote	53	53	53	53
House of Rep	R: David	502	502	502	502
	D: Larry	496	496	496	496
	WI-1 HOR	105	105	105	105
	Undervote	97	97	97	97
Freeholder 3yrs Vote 2	R: Name7	508	508	508	508
	R: Name9	498	498	498	498
	D: Name8	490	490	490	490
	D: Name10	500	500	500	500
	WI-1 FR	105	210	210	210
	WI-2 FR	105			
	Undervote	194	194	194	194
SHERIFF	R: Denver	498	498	498	498
	D: Baltimore	500	500	500	500
	WI-1 SHERIFF	154	154	154	154
	Undervote	48	48	48	48
Q1	Y	498	498	498	498
	N	500	500	500	500
	Undervote	202	202	202	202
Q2	Y	492	492	492	492
	N	506	506	506	506
	Undervote	202	202	202	202
Q3	Y	504	504	504	504
	N	494	494	494	494
	Undervote	202	202	202	202
Q4	Y	496	496	496	496
	N	502	502	502	502
	Undervote	202	202	202	202

Note: For Freeholder 3 years 2 positions, the counts of paper records of write-in votes are split equally between WI-1 and WI-2. However, the other 3 counts show a single total for all vote write-ins. All 4 total counts for write-ins match exactly.

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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.		
1.0.0	I. Definitions		
2.0.0	**II. General Description of System**		
2.0.1	**II.A. Components**		

No.	Requirement	Test scenario	Test Result
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 booth is covered by a dark red curtain. • When the voter enters the booth, the 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. • Only the voter can observe his or her operations and selections, including the screen display and the paper record. • The voter can verify his or her selections on a paper record, which is printed out by a printer located to the right of the voter. • Prior to casting the ballot, the voter does have the ability to verify his or her selections on a paper record in a private and independent manner.
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 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 by making changes on the DRE screen after the paper record is printed out. • If the voter has rejected his or her selections twice (that means the voter has the last chance to change his or her selections), after the paper record is printed out, the voter cannot change any selection but can only approve the ballot. • The voter can easily review, accept, or reject his or her paper record.

No.	Requirement	Test scenario	Test Result
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.	• Both the protective and public counters do not change unless the voter has approved the paper record. • Therefore, 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 decide 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.	• The printer is located to the right of the voter where the voter is facing the DRE screen of the voting machine. • The paper record storage unit is right under the printer. • The voter can view and verify the paper record, which the VVPRS cuts and drops into the Storage Unit.
2.0.13	II.B.3.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.	• 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 "continuous spool" method.	N/A
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 voter uses a voter ID card to activate the voting machine to conduct voting, which is given to the voter by the poll worker. The voter ID has a randomly generated number which does not have any identity information of the voter. • The voter is not required to input any private information in casting his or her votes. • No voter identity information can be found in the paper record.

No.	Requirement	Test scenario	Test Result
			• No voter identity information can be found in the electronic record. • Thus neither the electronic record nor the paper record reveals 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 electronic record is created after the voter approves the ballot. • The DRE system writes the electronic record directly to the hard drive and the flash memory. • At the end of the election, the system writes into a CD-ROM all of the electronic records. • The DRE is only connected to the outside by a power cord for power supply purpose. • The hard disk drive, the flash memory, and the CR-ROM are securely in place during the voting process. • The printer prints out paper records once the voter presses "cast ballot" after he or she makes selections. • The paper records are stored in the storage unit, which is securely in place during the voting process. • The privacy of the record is preserved. • Therefore, the electronic and paper records are created and stored in ways that preserve the privacy of the record.
2.0.16	The VVPRS components shall conform to federal and state accessibility requirements.		
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	• 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 modified QWERTY keyboard with only a few control keys and the alphanumeric keys, is provided.

No.	Requirement	Test scenario	Test Result
	paper ballot to the voter.		• The key F9 activates the audio voting process when a valid voter ID card has been inserted into the voting machine. • The voter can hear the detailed instruction on how to operate the audio component. • The voice the voter hears is synthetic, the speed of which can be adjusted by the voter during the voting process. • The voter can use the control keys to make selection, change selection, switch between contests, review selections, and approve selections. • The voter can use either the control keys or the alphanumeric keys to input write-ins. The voter can change selections repetitiously. • When the voter makes selection or change selections, the screen displays the corresponding selections. • Only one (i.e., the official) paper record is printed out regardless of whether the voter has changed/voided earlier selections, and the paper record stays in the display unit momentarily (too transitorily to read) and is then dropped into the storage unit. • The audio component accurately relays the selection information on the paper record. • Thus the voting machine includes an audio component that accurately relays the 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	• Inspect the system to ensure that the VVPRS does draw its power either from the	• When the power cord of the VVPRS is connected to the DRE and the DRE has power

No.	Requirement	Test scenario	Test Result
	electrical circuit from which the DRE draws its power.	DRE or from the same electrical circuit from which the DRE draws its power.	supply, the printer is powered on. • When the power cord of the DRE is unplugged, the printer is powered off. • Thus, the VVPRS device does draw 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 USB cable. • The DRE and the printer communicate with each other using the USB communication protocol. • The voting machine does provide a standard, publicly documented printer port and uses a standard communication protocol.
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 Vote 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. •After the voter finishes reviewing the entire paper record, the voter can accept his or her selection by pressing "Cast ballot" a second time. The voter will be asked to confirm to cast the vote, the DRE shows a message on the touch screen confirming that the vote has been recorded. • The electronic ballot image record presented from the Tally software provided by the vendor looks the same as the display on the DRE screen. • The electronic ballot image record does have

No.	Requirement	Test scenario	Test Result
			the electronic 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 device/software provided by the vendor. •Verify the electronic ballot image records include all votes cast by the voter, including write-ins and undervotes.	• The electronic ballot image record presented from the Tally software provided by the vendor looks the same as the display on the DRE screen. • 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.
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 data CD with the specific Tally program provided by the vendor. • The electronic ballot image record presented from the Tally software looks the same as the display on the DRE screen. •Each electronic ballot image record can be matched to the corresponding paper record with the unique identifier number of each vote. •Only the final approved vote is electronically recorded. The voided paper records have the same identifier number as the final approved paper record cast by the same voter. The VVPRS appends (1) and (2) to that identifier number for the 2nd updated and 3rd updated paper records, respectively. •Each electronic ballot image record does have a corresponding paper record if there are no mechanical errors or malfunctions during the voting operations.

No.	Requirement	Test scenario	Test Result
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 Vote" 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. • The voter has the choice to prolong the time of reviewing each page. •The voter can accept his or her selection by pressing "Cast ballot" a second time after the paper record is reviewed. After the voter finishes reviewing the entire paper record and confirms to cast the vote, the DRE shows a message on the touch screen confirming that the vote has been recorded. The VVPRS cuts and drops the paper record to the storage unit.
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. •Verify that each electronic ballot image record is clearly identifiable on the corresponding printed paper record, but does not reveal the voter's identity.	•No obvious mark on the paper record reveals the voter's identity. •The electronic ballot image record contains the identifier number, all the selections from the voter, and related election information. •The electronic ballot image record does correspond to the paper record with the unique identifier number, which is the same for all votes cast by one voter, however with (1) and (2) appended to that identifier number for the 2nd updated and 3rd updated paper records, respectively. •No information in the electronic ballot image record reveals the voter's identity.
2.0.27	II.B.11.c. The paper record shall	•Open the poll in the official mode.	The printed paper record does contain all

No.	Requirement	Test scenario	Test Result
	contain all voter selection information stored in the electronic ballot image record.	•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 on the corresponding electronic ballot image record.	selection information stored on 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 voters.	• 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 record. • A 7" diameter paper roll provided by the vendor is sufficient for only about 600 paper records each with a length of 8 inches. • Paper records are legible. • Paper replacement is expected after about 600 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 only supply needed is the paper roll for paper record. • The printer and storage unit are protected by a cover which secures the VVPRS by different seals and locks. • The storage unit is secured by another seal located behind the cover; after removing this cover, a slit that exists between the storage unit and the printer may allow unauthorized or forged paper records to be slid into the storage unit.
3.0.4	III.A.2. The VVPRS shall have a low-	• Conduct a mock election with a low	• If, during voting, the DRE detects the low

No.	Requirement	Test scenario	Test Result
	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.	supply of papers and verify that VVPRS alerts.	paper supply, an error message window appears on the DRE screen. • Pressing the "OK" button in the error message window closes this window and returns back the DRE screen as normal status. • The voter has the opportunity to continue the voting operations and to cast the vote. However, a paper record is not printed. This situation of no paper records being printed continues with subsequent votes, and no audio or visual signal to the poll worker • System does not allow for the timely addition of paper so that each voter can fully verify, without disruption, all of his or her ballot selections.
3.0.5	III.A.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.	• Inspect the printer and check its sealing or locking mechanisms. • Examine the accessibility of the printer.	• The whole VVPRS is secured by 3 seals and 3 locks from the outside. • Upon removing the printer cover, there is another cover for the storage unit secured with a seal. • In order to access the paper record, one has to have a key to open the three locks, break 3 seals, and upon opening the cover, another seal has to be broken.
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	• 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 machine can be programmed to print different fonts. • In this observation, the font size is 10; the length of the printed characters is in 3.0-4.0mm range. • A magnification device is provided that show the printed paper with font in the range of 6.3-9.0 mm.

No.	Requirement	Test scenario	Test Result
	by providing a magnification device with the VVPRS.		
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/VVPRS are covered by a curtain around the voting machine. • As long as the curtain is closed, nobody from outside can read the paper records.
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 programmed in such a way that the total printed record cannot be shown on the paper record display unit at one time. • In this case, the machine will print the total paper record in multiple pages and display them on the paper record display unit one page at a time. • The voter has the opportunity to review each page before depositing it in the storage unit. • The machine gives the voter extra time to review each page of the paper record upon pressing a button on the DRE touch screen.
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	• Inspect the paper records for ink color,	• The printed paper records are indeed readable

No.	Requirement	Test scenario	Test Result
	a VVPRS shall be readable by voters and election officials.	type size, type face and readability.	when shown on the paper record display unit. • The poll officials can read the paper records when the paper records are removed from the storage unit.
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 Department of Law and Public Safety ("LPS"), will issue chain of custody guidelines regarding the Storage Unit.	• Inspect the security protections of the storage unit.	• The whole VVPRS is protected by a cover which is secured by 3 seals and 3 locks from the outside. • Upon removing the printer cover, there is another cover for the storage unit which is secured with another seal.
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.	• Only the date of election is accurately recorded as the identification of the particular election. The particular election name (i.e., Primary Election and General Election) is not printed on the paper record. • The identification of the election district is accurately printed on the paper record. • The identification of the voting machine is included within the uniquely randomized identifier number, which is printed on the paper record and contained in the barcode.
4.0.3	IV.A.2. The paper record shall include a barcode that contains the human-readable contents (shorthand is	• Conduct a mock election. • Verify whether the paper record contains a barcode.	• The paper record contains a barcode. • The barcode contains all human-readable contents, including candidate IDs (number

No.	Requirement	Test scenario	Test Result
	acceptable) of the paper record.	• 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.	and/or character), write-in names, and numerical answers for questions for all voted and undervoted contests. • The barcode can be decoded by any 2D PDF-417 barcode reader; the decoded results are further processed and interpreted by the vendor's proprietary software to show the voter's selection. • The vendor's proprietary software displays all voted candidate and write-in full names along with their associated contest offices, and displays "Skipped" for any contests that have not been voted. • In addition, the vendor's software displays the answers for questions as Yes, No, or Skipped. • Multiple barcode symbols are generated and printed on the same paper record when there are many write-in's with long names.
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 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 "Tally and Reporting" manual, the barcode 2D PDF-417standard format is used. • 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	• The voting machine does not generate the digital signature per electronic record. • The vendor has adopted a different scheme in creating digital signatures associated with electronic records. Refer to Requirement IV.B.2 for details on digital signatures.

No.	Requirement	Test scenario	Test Result
		record is the same signature contained in the barcode on the paper record.	• No digital signature is contained in the barcode. • If the paper record is printed on multiple pages, the 8-digit error correcting code is calculated mainly based on voted contest information on each page of the paper record and printed at the bottom of each page of the paper record. • If the paper record is printed on a single page, the 8-digit code is calculated mainly based on voted contest information for the paper record and printed at the bottom of the paper record. • Digital signatures created for the associated electronic records are not the same as those 8-digit error correcting codes printed on the paper records. Refer to Requirement IV.A.6 for details of generating the error correcting codes.
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 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.
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.	If the paper record cannot be displayed in its entirety on a single page, each page is numbered and includes the total count of pages in the format of "Page: X/Y", where X is the page number and Y is the total count of pages.

No.	Requirement	Test scenario	Test Result
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 attempt to cause misinterpretation and check if the attempt is successful.	• According to the vendor documentation (VVPAT Criteria & Testing.pdf), page 10, the vendor indicated that "this requirement seems as if it is relevant to Op-Scan systems. The encryption code at the bottom of the paper record performs a comparable function." • According to the vendor's email communication with NJIT on June 15, 2007 (NJIT_Response_061107-Revision-A.doc), the vendor indicated that "the printer manufacturer handles the error correcting codes, not the vendor's proprietary software that translates the data stream being read from the barcode." • In addition, the vendor indicated that the paper record contains some error correcting codes for the purpose of detecting read errors. That, however, has not been verified because generating the error correcting codes requires

No.	Requirement	Test scenario	Test Result
			proprietary information which is not given. • Refer to Requirement IV.A.2.c for information about the error correcting codes in the barcode. • The paper record contains 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 few markings on the barcode such as marking 21 lines across the barcode (using a black-color 0.7mm pen) with the width of 1 mm between each line and marking a line at the bottom of the barcode (using a black-color permanent marker) with the width of 2 mm. • However, the barcode cannot be read when there are other markings: a line on the top of the barcode, a cross (X) on the barcode, and two lines by the left and right sides of the barcode, with a black-color permanent marker with a width of 2 mm, and when the barcode is punched with a small hole (a diameter of 5 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 linked by including unique identifiers so that an individual paper record can	• Check the vendor documentation on how to generate the identifiers of the electronic ballot image record and the paper record. • Conduct a mock election.	• The paper record does have a unique identifier number, which is the same for all votes cast by the voter, however, with (1) and (2) appended to that identifier number for the second updated

No.	Requirement	Test scenario	Test Result
	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.	• Verify whether the identifiers of the paper record and electronic record for the ballot can be mutually linked.	and third updated records, respectively. • The unique identifier number of the paper record is the same as that of the associated electronic record. • 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 unique identifier number of the paper record is not shown to the voter through the Paper Record Display unit, and therefore could not be memorized.
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 generated for the electronic record.	• According to the vendor documentation (VVPAT Criteria & Testing.pdf), item IV.B.2, page 10, the vendor documented that "the paper record contains one at the top and one at the bottom." • However, this requirement is related to an electronic record, not a paper record. • Even with respect to the paper record, only the 8-digit error –correcting code is printed at the bottom (not the top) of the paper record. • The associated electronic record does not contain an individual digital signature, i.e., these two items do not have a one-to-one correspondence.. • The DRE does generate and store a digital signature for the entire set of electronic ballot image records. • The vendor has adopted a different scheme in creating digital signatures associated with electronic ballot image records. The scheme is

No.	Requirement	Test scenario	Test Result
			proprietary.
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.	Vendor documentation on the "Tally and Reporting" process addresses the structure of the electronic ballot image records and how the electronic ballot image records can be generated, read and accessed, particularly on pages 28-32.
4.0.21	IV.B.3.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.	• Review the provided software that displays the exported electronic records. • Review the provided software if other capabilities, including providing vote tallies and indications of undervotes, are enabled.	• The vendor's proprietary software can display the exported electronic records. • The vendor's "Polling_Officials" manual, pages 38-41, instructs how to export the electronic records out of the DRE after the poll is closed. • The vendor's proprietary software can provide vote tallies and indications of undervotes. • The vendor's "Tally and Reporting" manual, pages 13-26, instructs how to generate vote tallies and indications of undervotes.
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's "Tally and Reporting" manual addresses the procedures for exporting electronic ballot image records on pages 9-12 and 26-27. • The vendor's "Tally and Reporting" manual addresses the procedures for reconciling these electronic ballot image records within the paper records on pages 29-31.
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	• Check that the vendor documentation of procedures for preparing the VVPRS and	• According to the vendor's New Jersey Criteria for Voter-Verified Paper Record for DRE

No.	Requirement	Test scenario	Test Result
	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.	training the county board of election worker is provided.	Documentation, page 11, such documentation will be provided when requested. • The vendor's "Ballot Preparation" manual addresses the preparation of the VVPRS and the ballot. • The vendor's "Polling Officials" manual addresses the training of the poll workers on functioning of the voting machine.

4.0.29	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.	• Conduct a mock election.
		• 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.
			• Voter privacy is preserved in many ways:
			  * The curtain is used to make the selections shown on the DRE screen and the paper record displayed on the Paper Record Display Unit invisible to outside observers;
			  * No information on the paper record contains any identity-related information that can link to the voter;
			  * No information on the associated electronic record contains any identity-related information that can link to the voter;
			  * The sequential order of the voting card issued to the voters is randomized;
			  * The paper records are mixed inside the Paper Record Storage Unit.
			• In addition, for audio-assisted voting, the DRE screen changes consistent with the selections input on the keyboard, but the selections displayed on the DRE cannot be seen by the observers outside the booth.

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.	• There is no clear acceptance information (e.g., "VOIDED" or "ACCEPTED") on paper records, except that "(1)" and "(2)" are

No.	Requirement	Test scenario	Test Result

		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.
			appended to the unique identifier number on the top of the second (rejected) and 3rd (final and accepted) paper records, respectively.
			  * This number indicates the times the voter selection has been changed. The first paper record does not have such a number.
			  * If all paper records are not lost, certain inference is required to differentiate paper records of accepted ballots from those of non-accepted ballots.
			    ► If the voter casts 3 times and the third paper record marked with (2) is lost, the second paper record, marked with (1), may be incorrectly considered as the accepted paper record.
			    ► If the voter casts 3 times and the second and third paper records (marked with (1) and (2), respectively) are lost, the first paper record may be incorrectly considered as the accepted paper record.
			    ► If the voter casts 2 times and the second paper record (marked with (1)) is lost, the first paper record may be incorrectly considered as the accepted paper record.
			• The Event log kept in the DRE can reveal the unique identifier number of the paper records that have been rejected at least once.
			• The Event log kept in the DRE can reveal how many attempts (called replacements) that have been used to cast this ballot.
			• The Event log kept in the DRE does not reveal the unique identifier number of the paper

No.	Requirement	Test scenario	Test Result
			records that have never been rejected.

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.	• Conduct a mock election.
		• Observe whether the voter can recast the 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).
			• After the voter presses the "cast ballot" button on the DRE screen to cast the ballot, the paper record is printed and the screen shows a message that instructs the voter to accept or reject that paper record.
			  * To accept the paper record, the voter presses the "cast ballot" button again.
			  * To reject the paper record, the voter simply presses any selection box on the DRE screen.

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 allows the voter to recast the ballot up to two additional times.
			• When the ballot is cast and the corresponding paper record is printed and displayed on the Paper Record Display Unit, the DRE screen shows a message, reading "Please review the paper record on the adjacent printer unit. To finish voting, press the "Cast Ballot" button. To make a change, press on the specific selection box on the review screen. Each time you make a change and press "Cast Ballot", a new paper record will be presented. You may print up to 3 paper records. This is number X". Note that X is the number of paper records printed so far. In this test, X can be 1 and 2.
			  * This message warns the voter that the ballot can be printed up to three times.
			  * This message warns the voter how many paper records have been printed so far.

4.0.37	IV.C.5. a.(2) Before the voter causes a third and final paper record to be	• Conduct a mock election. • Verify that before a voter casts his or her	• After the voter rejects the paper record twice, the voting machine warns the voter that the

No.	Requirement	Test scenario	Test Result
	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.	third ballot, a warning notice is displayed informing the voter that this is the last attempt to cast his or her ballot.	voter can print the paper record up to three times and two paper records have already been printed. Refer to Requirement IV.c.5.a.(1) for the warning message. • Once the voter presses the "cast ballot" button to cast the ballot, a message is shown on the DRE screen that this paper record is for reviewing only, reading "A paper record is presented for your review only. When you are finished reading your record, press "Deposit Paper Record" button to deposit your ballot. You may not remove the paper record from the voting machine". • The voter can see and verify the selections on the 3rd 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.	• 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 the new ballot on the DRE without having to reselect all selections in all contests on the ballot.	• To reject the paper record, the voter simply presses any selection box on the DRE screen. • All previous selections are displayed on the DRE screen. • To modify the selection that has been completely cast (i.e., two candidates cast for two offices), the voter has to press the previous candidate to deselect the previous one before selecting the new candidate. • To modify the selection that has not been completely cast (i.e., one candidate cast for two offices), the voter can simply press on any remaining candidate to complete the selection of the contest.
4.0.39	IV.C.5. a.(4) If a mechanical error in	• Conduct a mock election.	• If there is no activity on the DRE screen for a

No.	Requirement	Test scenario	Test Result

	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.	• Verify that the spoiled ballot is not counted as one of the voter's three attempted votes.	certain period of time (considered as the "fleeing voter scenario"), the voting machine is locked. However, there is no audio or visual signal to alert the pool worker to intervene.
			  * The poll workers are required to reactivate the voting machine.
			  * The poll workers can cast or spoil the ballot.
			    • If the ballot is spoiled, there is no paper record and electronic record.
			    • If the ballot is cast, the electronic record is recorded at the moment but the paper record is printed after the poll is closed.
			• When the paper is torn at half or inserted improperly (above the "side guide R" slit, into which the paper is supposed to be inserted),
			  * The DRE acts as if the paper record is printed and deposited into the Paper Record Storage Unit.
			  * No paper record is printed. However, sometimes, only part of the paper record (such as the barcode) is printed.
			  * The electronic record is recorded (The counter increases by one).
			• When the USB cable connected between the DRE and VVPRS is pulled off,
			  * The DRE shows the "Printer Error!" message. However, if the tester presses the "OK" button, and immediately following with the "Cast Ballot" button, the DRE hangs up. The DRE needs to be rebooted.
			  * When the DRE reboots, and if the USB cable is still disconnected, and after the poll

No.	Requirement	Test scenario	Test Result

			worker cards are inserted, the DRE shows two messages that there is no printer connected and the DRE needs to be shut down automatically.
			  * Even if the poll worker connects the USB cable after being warned that the printer is disconnected, the DRE still shuts down automatically.
			  * No paper record is printed.
			  * The electronic record is recorded, and the counter increases by one.
			  * Once the USB cable is re-inserted, the paper record is printed out immediately, but barcode is not printed on the paper record.
			• If the paper is low and the printer error message is shown on the DRE screen, the voter is allowed to modify the selections. However, no paper record is printed and the electronic record is not recorded.
			  * If the voter presses the "cast ballot" button twice (the first for printing the paper record, and the second for casting the vote), the electronic record is recorded, but no paper record is printed.

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 no clear indication on the paper record (e.g., "final" or "official") to identify it as final or official.
5.0.0	V. **Security and Reliability**		
5.0.1	V.A. The VVPRS shall not be permitted to externally communicate	• Read the vendor documentation of the introduction of the components within the	• The VVPRS system consists of a printer and a storage box for printed paper records.

No.	Requirement	Test scenario	Test Result
	with any system or machine other than the voting system to which it is connected.	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.	• Only the printer within the VVPRS has connections to external devices with a power supply cable and a USB cable for data transmission. • 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 capability. The printer shall not contain any component with an external communication feature.	• Read the vendor documentation for the functions of all components in the VVPRS. •Open the VVPRS. •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 VVPRS is able to function as a printer to print out the paper record, and cut and drop the paper record into the storage box. •The only connections to the external system (the DRE system) are one power cable and one USB 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	•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.

No.	Requirement	Test scenario	Test Result
		viewing. • Attempt to access the paper record along the paper path between the viewing and the storage.	•The storage box is enclosed within the VVPRS that is sealed. The paper path is sealed and protected from access between the display window and the storage box. •The paper path is sealed and protected from access between the print head and the storage box.
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 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.	•The cable connectors of printer are within the sealed VVPRS. •The cable connectors at the voting machine are behind the locked rear door. •The printer connection between the printer and a particular voting machine is not completely concealed to prevent tampering. Furthermore, the exposed part of the connection between the VVPRS and the voting machine is covered with plastic wrap, but not completely, allowing access to the cable.
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 DRE does detect the error and display an error message "printer error" on the DRE touch screen to the voter. •However, no other kind of warning signal has been observed for the election officials. •Touch "OK" button in the error message window on the DRE screen, and the DRE system will resume to the voting process. •The voter can cast the vote or make changes to the selections, and cast the vote again. •The voter can cast the vote without reviewing

No.	Requirement	Test scenario	Test Result
			the paper record, but no paper record is printed out. The DRE shows a message on the screen confirming that the vote has been recorded. Both the protective and public counters increase by one. •After the vote is recorded, the DRE system is suspended.
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 does detect the error and display an error message "printer error" on the DRE touch screen to the voter. •No other kind of warning signal has been observed. •Touch "OK" button in the error message window on the DRE screen and the DRE system will resume to the voting process. •The voter can cast the vote or make changes to the selections and cast the vote again. •The voter can cast the vote without reviewing the paper record, but no paper record is printed out. The DRE shows a message on the screen confirming that the vote has been recorded. Both the protective and public counters increase by one. •After the vote is recorded, the DRE system is suspended.
5.0.10	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	•Conduct one mock vote. •Open the VVPRS and disconnect the cable between the voting machine and the printer. • Check and verify if the DRE and VVPRS	•The VVPRS is suspended. •The DRE does detect the error and display an error message "printer error" on the DRE touch screen to the voter.

No.	Requirement	Test scenario	Test Result
	audit log. Voting operations shall be suspended and no votes shall be recorded.	react properly to this error. • Close the poll. • Check the DRE's internal audit log.	•However, no other kind of warning signal has been observed. •Touch "OK" button in the error message window on the DRE screen, and the DRE system will resume to the voting process. •The voter can cast the vote or make changes to the selections and cast the vote again. •The voter can cast the vote without reviewing the paper record, but no paper record is printed out. The DRE shows a message on the screen confirming that the vote has been recorded. Both the protective and public counters increase by one. •After the vote is recorded, the DRE system is suspended. •The DRE does record this printer disconnection in its 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 both electronic and hard copy versions of 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	• 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	• The vendor has provided the testing group at NJIT with both electronic and hard copy versions of documents. • These documents include recommended procedures to enable the election officials to return a voting machine to workable status after

No.	Requirement	Test scenario	Test Result
	malfunctioned, the printer needs to be replaced, or a voter has used it incompletely or incorrectly.	incompletely or incorrectly.	the machine malfunctions, 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 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.	•The VVPRS is suspended. •The DRE does detect the error and display an error message "printer error" on the DRE touch screen to the voter. •Shut down the voting machine and reconnect the printer cable. •Restart the voting machine and following normal operation procedures to return the machine to workable status. •Provided that the recommended procedures are followed and no other actions are taken on the DRE screen, 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 both electronic and hard copy versions of 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		

No.	Requirement	Test scenario	Test Result
	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 copy, all use and technical specifications and documentation relating to the function of the VVPRS.	• Verify that the vendor has provided the state with both electronic and hard copy technical specifications and documentations relating to the function of VVPRS.	• The vendor has provided the testing group at NJIT with both electronic and hard copy versions of documents. • These documents contain technical specifications and documentations relating to the function of 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 "Maintenance & Repair Manual". • The vendor documentation contains recommendations on the quantities of printer paper roll in the "Maintenance & Repair Manual".

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IV. Appendices

a. Test Ballot Scenarios

Long Ballots: Scenarios 1-8

Scenario 1

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	date

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)

Local Question 4 Press Here: YES NO Skip Choice (s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 2

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3 -YR TERM) Vote for no more than T...	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2 -YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made ...te	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 3

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	te

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 4

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	te

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)
Local Question 4 Press Here	YES	NO	Skip Choice (s)								
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 5

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3 -YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2 -YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	TERRANCE JOHNSON	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	MARIO JOHNSON	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made ...te	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 6

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	te

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 7

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3 -YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2 -YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	MILDRED WHITE	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 8

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	**PETER B. RANDALL**	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	**PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN**	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	**LARRY P. HALL**	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	**BILL ANDERSEN**	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	**WILLIAM K. WILLIAMS**	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTE	**DENVER P. COLORADO**	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	**MARY K. LINCOLN**	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	**ABRAHAM B. LINCOLN**	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	**JOEL C. CARSON**	Nomination Made	

Local Question 1 Press Here	**YES**	NO	Skip Choice(s)	Local Question 2 Press Here	**YES**	NO	Skip Choice(s)	Local Question 3 Press Here · YES · **NO** · Skip Choice(s) · Local Question 4 Press Here · YES · **NO** · Skip Choice(s)
Local Question 5 Press Here	**YES**	NO	Skip Choice(s)	Local Question 6 Press Here	**YES**	NO	Skip Choice(s)	Local Question 7 Press Here · YES · **NO** · Skip Choice(s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	**Cast Ballot**

Long Ballots: Scenarios 9-12

Scenario 9

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	EDWARD A LYNCH	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	MICHAEL WEIS	Skip Choice (s)
FREEHOLDERS (3 -YR TERM) Vote for no more than	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	KELLY SMALL	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2 -YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	CHARLES SCHULTZ	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	MICHAEL McDONALD	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made date	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 10

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3 -YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	BRUCE SPRINGSTEEN	
FREEHOLDERS (2 -YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made date	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 11

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	EDWARD A LYNCH	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	MICHAEL WEIS	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	KELLY SMALL	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	BRUCE SPRINGSTEEN	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	CHARLES SCHULTZ	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	MICHAEL McDONALD	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made date	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 12

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	WILLIAM P MORROW	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made date	

Local Question 1 Press Here	YES	NO	Skip Choice(s)	Local Question 2 Press Here	YES	NO	Skip Choice(s)	Local Question 3 Press Here	YES	NO	Skip Choice(s)	Local Question 4 Press Here	YES	NO	Skip Choice(s)
Local Question 5 Press Here	YES	NO	Skip Choice(s)	Local Question 6 Press Here	YES	NO	Skip Choice(s)	Local Question 7 Press Here	YES	NO	Skip Choice(s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Long Ballot Special Scenarios

Scenario 2-1

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM) Vote for One	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTEE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	omination Made	date

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)
Local Question 5 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 6 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 7 Press Here to See Detail	YES	NO	Skip Choice(s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 2-2

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	te

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 4-1

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM) Vote for One	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTEE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	No Nomination Made	date

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)
Local Question 5 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 6 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 7 Press Here to See Detail	YES	NO	Skip Choice(s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 4-2

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM) Vote for One	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTEE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	omination Made	date

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)
Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)								
Local Question 5 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 6 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 7 Press Here to See Detail	YES	NO	Skip Choice(s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 4-3

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

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Scenario 4-3

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 8-1

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice(s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM) Vote for One	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice(s)
Member OF TOWNSHIP COMMITTEE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice(s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice(s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	N CARLTON D. THOMPSON	JOEL C. CARSON	omination Made	date

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)
Local Question 5 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 6 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 7 Press Here to See Detail	YES	NO	Skip Choice(s)				

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 8-2

Press Office Title to Enlarge Text	REPUBLIC	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
PRESIDENT Vote for One	PETER B. RANDALL	KENNETH P. ROBINSON	WILLIAM D. FITZGERALD	MICHAEL J DONALDSON	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	JOANNA G. SCOTT	CHRISTIAN B. CHRISTANSEN	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL	BERNAD A. JONES	PETER GENOVA	Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	BILL ANDERSEN	DAVID PROWN	JEFFERY H. JOHNSON	ANTONIO B. GUTTENBERG	Write-In Candidate	Skip Choice (s)
	MIKE DELL	RAY HAYES	MICHAEL B. SMITH	RICHARD D. DeLEON	Write-In Candidate	
FREEHOLDERS (2-YR TERM)	ROY K. GOODMAN	WILLIAM K. WILLIAMS	CATHERINE A. PETERSON	REBECCA M. CHARLESTON	Write-In Candidate	Skip Choice (s)
Member OF TOWNSHIP COMMITTE	DENVER P. COLORADO	BALTIMORE K. MARYLAND	HENERY P. LINCOLN	KATHERINE P. ROSS	Write-In Candidate	Skip Choice (s)
CHARTER STUDY COMMISSION Vote for no more than Five	No Nomination Made	No Nomination Made	HERALD D. MICHAELS	MARIO S. TREEBORO	Write-In Candidate	Skip Choice (s)
	No Nomination Made	No Nomination Made	JESSICA M. FORD	HENRY H. HOOLIGAN	Write-In Candidate	
	No Nomination Made	No Nomination Made	SAMUEL T. JACKSON	MARY K. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	ALFREDA A. JONES	ABRAHAM B. LINCOLN	Write-In Candidate	
	No Nomination Made	No Nomination Made	CARLTON D. THOMPSON	JOEL C. CARSON	Nomination Made	te

Local Question 1 Press Here	YES	NO	Skip Choice (s)	Local Question 2 Press Here	YES	NO	Skip Choice (s)	Local Question 3 Press Here	YES	NO	Skip Choice (s)	Local Question 4 Press Here	YES	NO	Skip Choice (s)
Local Question 5 Press Here	YES	NO	Skip Choice (s)	Local Question 6 Press Here	YES	NO	Skip Choice (s)	Local Question 7 Press Here	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 01, 01) (Ballot Type 1) | For Black/White Display | Reverse Tone Display | For Standard Display | Cast Ballot

Short Ballot Scenarios 1-12

Scenario 1

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)
		NO				NO				NO				NO	

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 2

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1) | For Black/White Display | Reverse Tone Display | For Standard Display | Cast Ballot

Scenario 3

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 4

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)
		NO				NO			YES					NO	

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 5

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)
	YES	NO	Skip Choice (s)		YES	NO	Skip Choice (s)		YES	NO	Skip Choice (s)		YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)

| For Black/White Display | Reverse Tone Display | For Standard Display | Cast Ballot |

Scenario 6

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1) | For Black/White Display | Reverse Tone Display | For Standard Display | Cast Ballot

Scenario 7

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 8

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice(s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice(s)

	YES	NO	Skip Choice(s)		YES	NO	Skip Choice(s)		YES	NO	Skip Choice(s)		YES	NO	Skip Choice(s)
Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 9

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			WI-1 HOR	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			WI-1 FR	Skip Choice (s)
	F9 NAME9	F10 NAME10			WI-2 FR	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			WI-1 SHERIFF	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 10

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice(s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice(s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice(s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice(s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			WI-1 SHERIFF	Skip Choice(s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice(s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice(s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 11

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	Write-In Candidate	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			WI-1 HOR	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			WI-1 FR	Skip Choice (s)
	F9 NAME9	F10 NAME10			WI-2 FR	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			WI-1 SHERIFF	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

Scenario 12

Press Office Title to Enlarge Text	REPUBLICAN	DEMOCRATIC	BY PETITION 1	BY PETITION 2	Write-In Candidate	Skip Choice (s)
U.S. SENATE Vote for One	JOHN P. DENVER	PHILIP B. OHIO-AND-GOLD-AND-TEXAS-MICHIGAN	SCOTT E. FITZGERALD	MARY S. DAVID	WI-1 USS	Skip Choice (s)
HOUSE OF REP Vote for One	DAVID K. ROSS	LARRY P. HALL			Write-In Candidate	Skip Choice (s)
FREEHOLDERS (3-YR TERM) Vote for no more than Two	F7 NAME7	F8 NAME8			Write-In Candidate	Skip Choice (s)
	F9 NAME9	F10 NAME10			Write-In Candidate	
SHERIFF Vote for One	DENVER P. COLORADO	BALTIMORE K. MARYLABD			Write-In Candidate	Skip Choice (s)

Local Question 1 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 2 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 3 Press Here to See Detail	YES	NO	Skip Choice (s)	Local Question 4 Press Here to See Detail	YES	NO	Skip Choice (s)

ESSEX, NJ (NEWARK, 02, 02) (Ballot Type 1)	For Black/White Display	Reverse Tone Display	For Standard Display	Cast Ballot

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 <u>N.J.S.A.</u> 19:48-1 and <u>N.J.S.A.</u> 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:

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[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.

PATENTS

N. Ansari, A. Arulambalam and X. Chen, "Method For Providing A Fair-Rate Allocation For Available Bit Rate Services," U.S. Patent Number 6052361, issued 04/18/2000.

Eleven US Non-provisional Patents have been filed to US Patent Office (in review).

SELECTED PUBLICATIONS

Published Books

- Nirwan Ansari and Edwin S. H. Hou, *Computational Intelligence for Optimization*, Kluwer Academic Publishers, ISBN-0-7923-9838-6, 1997, (225 pages). Chinese Version published by Tsinghua University Press, PRC, ISDN 7-302-03635-7/TP.2019, 2000.
- Ben Yuhas and Nirwan Ansari (eds.), *Neural Networks in Telecommunications*, Kluwer Academic Publishers, ISBN-0-7923-9417-8, 1994. (369 pages)

Published Conference Proceedings

- N. Ansari, F. Deek, C. Lin, and H. Yu, *Proceedings of 2003 IEEE International Conference on Information Technology: Research and Education*, IEEE.

Published Book Chapters (2000-2007)

- C. Zhang, N. Ansari, and E.S.H. Hou, "Chapter 8: Node Clustering in Wireless Sensor Networks," *Wireless Sensor Networks: A Networking Perspective* (J. Zheng and A. Jamalipour, ed.), Wiley/IEEE Press, to appear in 2008.
- N. Ansari, C. Zhang, Y. Luo, and E.S.H. Hou, "Chapter 12: WiMAX Security: Privacy Key Management," *WiMAX Standards and Security* (Syed Ahson and Mohammad Ilyas, ed.), CRC Press, 2007.
- J. Liu and N. Ansari, "Public Switched Telephone Network," *The Handbook Of Computer Networks* (Hossein Bidgoli, ed.), John Wiley & Son, to appear in 2007.
- N. Ansari and Si Yin, "Storage Area Networks Architectures and Protocols," *The Handbook Of Computer Networks* (Hossein Bidgoli, ed.), John Wiley & Son, to appear in 2007.
- N. Ansari and Y. Luo, "Passive Optical Networks for Broadband Access," *The Handbook Of Computer Networks* (Hossein Bidgoli, ed.), John Wiley & Son, to appear in 2007.
- Z. Guo, R. Rojas-cessa, and N. Ansari, "Packet Switch with Internally-Buffered Crossbars," *High-Performance Packet Switching Architectures* (I. Elhanany, M. Hamdi, eds.), Springer-Verlag, ISBN: 1-84628-273-X, 2007.
- Y. Luo, P. Sakarindr, and N. Ansari, "On the Survivability of WDM Optical Networks," in *E-Business and Telecommunications Networks* (J. Ascenso, L. Vasiu, C. Belo, M. Saramago, eds.), pp. 31-40, Springer, ISBN: 1-4020-4760-6, 2006.
- D. Wei and N. Ansari, "Chapter 6: On IP Traffic Monitoring," in *Intelligent Virtual World: Technologies and Applications in Distributed Virtual Environments* (T.K. Shih and P.P. Wang, ed.), pp. 113-124, World Scientific Publishing Co., ISBN 981-238-618-1, July 2004.
- S. Li and N. Ansari, "Chapter 1.3: Switch Architectures and Scheduling Algorithms," in *ATM Handbook* (F. Golshani and F. Groom, ed.), pp. 37-54, *International Engineering Consortium*, Chicago, IL., 2000.

Refereed Journal Articles (2000-2007)

- Y. Luo, S. Yin, N. Ansari, and T. Wang, "Resource Management for Broadband Access over TDM PONs," *IEEE Network*, accepted.
- N. Ansari, C. Zhang, R. Rojas-Cessa, S. De, P. Sakarindr, and E.S.H. Hou, "Networking for Critical Conditions," *IEEE Wireless Communications*, accepted.
- H. Nakayama, N. Ansari, A. Jamilipour, and N. Kato, "Fault-resilient Sensing in Wireless Sensor Networks," *Computer Communications*, accepted.
- P. Sakarindr and N. Ansari, "Security Services in Group Communications over Wireless Infrastructure, Mobile Ad-Hoc, and Wireless Sensor Networks," *IEEE Wireless Communications,* accepted.
- Z. Wang, L. Liu, M. Zhou, and N. Ansari, "A Position-Based Clustering Technique for Ad-hoc Inter-vehicle Communication," *IEEE Transactions Systems, Man and Cybernetics*, accepted.
- S. Yin, Y. Luo, N. Ansari, and T. Wang, "Stability of Predictor-Based Dynamic Bandwidth Allocation over EPONs," *IEEE Communications Letters*, to appear.
- A. Belenky and N. Ansari, "On Deterministic Packet Marking," *Computer Networks*, Vol. 51, No. 10, pp. 2677-2700, July 11, 2007.
- T.N. Chang and N. Ansari, "Passband Control of Lightly Damped Systems with Mode Separation," *IEEE Transactions on Industrial Electronics*, accepted.
- Z. Gao and N. Ansari, "A Practical and Robust Inter-domain Marking Scheme for IP Traceback," *Computer Networks*, Vol. 51, No. 3, pp. 732-750, Feb. 21, 2007.
- P. Sakarindr and N. Ansari, "Adaptive Trust-based Anonymous Network," *International Journal of Security and Networks* (*IJSN*), Special Issue on Computer & Network Security, Vol. 2, No. 1/2, pp. 11-26, 2007.
- G. Cheng and N. Ansari, "Rate-distortion Based Link State Update," *Computer Networks*, Vol. 50, No. 17, pp. 3300-3314, Dec. 5, 2006.
- R. Rojas-cessa, Z. Guo, and N. Ansari, "On the Maximum Throughput of a Combined Input-Crosspoint Queued Packet Switch," *IEICE Trans. on Communications*, Vol. E89-B, No. 11, pp. 3120-3123, Nov. 2006.
- Z. Gao and N. Ansari, "Differentiating Malicious DDoS Attack Traffic from Normal TCP Flows with Proactive Tests," *IEEE Communications Letters*, Vol. 10, No. 11, pp. 793-795, Nov. 2006.
- D. Gozupek, S. Papavassiliou, and N. Ansari, "Enhancing Quality of Service Provisioning in Wireless Ad Hoc Networking Using Service Vector Paradigm," *Journal of Wireless Communications and Mobile Computing*, Special Issue on Wireless Ad hoc Networks: Technologies and Challenges, Vol. 6, No. 7, pp. 1003-1015, Nov. 2006.
- G. Cheng and N. Ansari, "On Selecting the Cost Function for Source Routing," *Computer Communications*, Vol. 29, No. 17, pp. 3602-3608, 2006.
- W. Yan, E.S.H. Hou, and N. Ansari, "Description Logics for an Autonomic IDS Event Analysis System," *Computer Communications*, Vol. 29, No. 15, pp 2841-2852, Sep. 5, 2006.
- G. Cheng, N. Ansari, and L. Zhu, "Enhancing ε approximation Algorithms with the Optimal Linear Scaling Factor," *IEEE Transactions on Communications*, Vol. 54, No. 9, pp. 1624 – 1632, September 2006.

- H. Zhao, N. Ansari, and Y.Q. Shi, "Network Traffic Prediction Using Least Mean Kurtosis," *IEICE Trans. Communications*, IEICE Transactions on Communications, Vol.E89-B, No.5, pp.1672-1674, May 2006.
- F. Alharbi and N. Ansari, "SSA: Simple Scheduling Algorithm for Resilient Packet Ring Networks," *IEE Proc. Communications*, Vol. 153, No. 2, pp. 183-188, April 2006.
- G. Cheng, L. Zhu, and N. Ansari, "A New Deterministic Traffic Model for Core-stateless Scheduling," *IEEE Transactions on Communications*, Vol. 54, No. 4, pp. 704-713, April 2006.
- J. Zeng, L. Zakrevski, and N. Ansari, "Computing the Loss Differentiation Parameters of the Proportional Differentiation Service Model," *IEE Proc. Communications*, Vol. 153, No. 2, pp. 177-182, April 2006.
- Z. Ni, Y.Q. Shi, N. Ansari, and W. Su, "Reversible Data Hiding," *IEEE Transactions on Circuits and Systems for Video Technology*, Vol. 16, No. 3, pp. 354-362, March 2006.
- L. Zhu, N. Ansari, G. Cheng, and K. Xu, "Edge-based Active Queue Management (EAQM)," *IEE Proc. Communications*, Vol. 153, No. 1, pp. 55-60, February 2006.
- G. Cheng and N. Ansari, "Finding a Least Hop(s) Path Subject to Multiple Additive Constraints," *Computer Communications*, Vol. 29, No. 3, pp. 392-401, Feb. 1, 2006.
- F. Alharbi and N. Ansari, "Distributed Bandwidth Allocation for Resilient Packet Ring Networks," *Computer Networks*, Vol. 49, No. 2, pp. 161-171, October 5, 2005.
- D. Wei and N. Ansari, "A Novel Modified Secant Method for Computing the Fair Share Rate," *Journal of Computing and Information Technology*, Vol. 13, No. 3, pp. 247–254, September 2005.
- Y. Luo and N. Ansari, "Survivable GMPLS Networks with QoS Guarantees," *IEE Proc. Communications*, Vol. 152, No. 4, pp. 427-431, August 2005.
- Y. Luo and N. Ansari, "LSTP for Dynamic Bandwidth Allocation and QoS Provisioning over EPONs," *OSA Journal of Optical Networking*, Vol. 4, No. 9, pp. 561-572, August 2005.
- L. Zhu, N. Ansari, and J. Liu, "Throughput of HighSpeed TCP in Optical Burst Switching Networks," *IEE Proc. Communications*, Vol. 152, No. 3, pp. 349-352, June 2005.
- Z. Gao and N. Ansari, "IP Traceback from the Practical Perspective," *IEEE Communications Magazine*, Vol.43, No. 5, pp. 123-131, May 2005.
- A. Shevtekar, K. Anantharam, and N. Ansari, "Low Rate TCP Denial-of-Service Attack Detection at Edge Routers," *IEEE Communications Letters*, Vol. 9, No. 4, pp. 363-365, April 2005.
- K. Xu and N. Ansari, "Stability and Fairness of Rate Estimation Based AIAD Congestion Control in TCP," *IEEE Communications Letters*, Vol. 9, No. 4, pp. 378-380, April 2005.
- Y. Tian, K. Xu, and N. Ansari, "TCP in Wireless Environment: Problems and Solutions," *IEEE Communications Magazine*, Vol.43, No. 3, pp. S27-S32, March 2005.
- J. Yang, J. Ye, S. Papavassiliou, and N. Ansari, "A Flexible and Distributed Architecture for Adaptive End-to-End QoS Provisioning in Next Generation Networks," *IEEE Journal on Selected Areas in Communications*, Vol. 23, No. 2, pp. 321-333, February 2005.
- Y. Luo and N. Ansari, "Bandwidth Allocation for Multi-service Access on EPONs," *IEEE Communications Magazine*, Vol. 43, No. 2, pp. S16-S21, February 2005.

- K. Xu, Y. Tian, and N. Ansari, "Improving TCP Performance in Integrated Wireless Communications Networks," *Computer Networks*, Vol. 47, No. 2, pp. 219-237, February 4, 2005. (12th in the Top 25 hottest articles reported in June 2005)
- H. Zhao, N. Ansari, and Y.Q. Shi, "Delay Guaranteed Bandwidth Allocation for Real Time Video Delivery," *IEE Proc. Communications*, Vol. 151, No. 6, pp. 553-558, December 2004.
- D. Wei and N. Ansari, "Implementing Fair Bandwidth Allocation Schemes in Hose-modeled VPS," *IEE Proc. Communications*, Vol. 151, No. 6, pp. 521-528, December 2004.
- G. Cheng and N. Ansari, "An Information Theory Based Framework for Optimal Link State Update," *IEEE Communications Letters*, Vol. 8, No. 11, pp. 692-694, November 2004.
- J. Liu and N. Ansari, "A New Control Architecture with Enhanced ARP, Burst-based Transmission, and Hop-based Wavelength Allocation for Ethernet-supported IP-over-WDM MANs," *IEEE Journal on Selected Areas in Communications*, Vol. 22, No. 8, pp. 1419-1431, October, 2004.
- B. Fong, N. Ansari, A.C.M. Fong, G.Y. Hong, and P.B. Rapajic, "On the Scalability of Fixed Broadband Wireless Access Network Deployment," *IEEE Communications Magazine*, Vol. 42, No. 9, pp. S12-S18, September 2004 (Also, *IEEE Radio Communications Magazine*, Vol. 1, No.3, pp. S12-S18, September 2004).
- L. Zhu and N. Ansari, "Local Stability of a New Adaptive Queue (AQM) Management Scheme," *IEEE Communications Letters*, Vol. 8, No. 6, pp. 406-408, June 2004.
- N. Ansari, G. Cheng, and Ram N. Krishnan, "Efficient and Reliable Link State Information Dissemination," *IEEE Communications Letters*, Vol. 8, No. 5, pp. 317-319, May 2004.
- K. Xu, Y. Tian, and N. Ansari, "TCP-Jersey for Wireless IP Communications," *IEEE Journal on Selected Areas in Communications*, Vol. 22, No. 4, pp. 747-756, May 2004.
- X. Zhang, Y.Q. Chen, N. Ansari, and Y.Q. Shi, "Mini-Max Initialization for Function Approximation," *Neurocomputing*, Vol. 57, pp. 389-409, March 2004.
- G. Cheng and N. Ansari, "Finding All Hop(s) Shortest Path," *IEEE Communications Letters*, Vol. 8, No. 2, pp. 122-124, February 2004.
- 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, 1st quarter, 2004.
- Y. Luo and N. Ansari, "A Computational Model for Estimating Blocking Probabilities of Multifiber WDM Optical Networks," *IEEE Communications Letters*, Vol. 8, No. 1, pp. 60-62, January 2004.
- N. Ansari, H. Liu, Y.Q. Shi, and H. Zhao, "Dynamic Bandwidth Allocation for VBR Video Transmission," *Journal of Computing and Information Technology*, Vol. 11, No. 4, pp. 309-317, December 2003.
- L. Zhu, G. Cheng and N. Ansari, "Local stable condition for random exponential marking," *IEE Proc. Communications*, Vol. 150, No. 5, pp. 367-370, October 2003.
- J. Liu, N. Ansari and T. Ott, "FRR for Latency Reduction and QoS Provisioning in OBS Networks," *IEEE Journal on Selected Areas in Communications*, Vol. 21, No. 7, pp. 1210-1219, September 2003.
- N. Ansari, "The Infrastructure for E-Business," *IEE Communications Engineers*, Vol. 1, No. 4, pp. 36-39, August/September 2003.

- J. Liu and N. Ansari, "On Aggressive Resource Reservation for OBS systems," *IEE Proc. Communications*, Vol. 150, No. 4, pp. 233-238, August 2003.
- A. Belenky and N. Ansari, "On IP Traceback," *IEEE Communications Magazine*, Vol. 41, No. 5, pp. 142-153, July 2003, rated "Award Quality".
- A. Belenky and N. Ansari, "IP Traceback with Deterministic Packet Marking," *IEEE Communications Letters*, Vol. 7, No. 4, pp. 162-164, April 2003.
- J. Zeng and N. Ansari, "Towards IP Virtual Private Network (VPN) Quality of Service: A Service Provider Perspective," *IEEE Communications Magazine*, Vol. 41, No. 4, pp. 113-119, April 2003.
- D. Wei, Y. Jie, N. Ansari and S. Papavassiliou, "Guaranteeing Service Rates for Cell-based Schedulers with a Grouping Architecture," *IEE Proc. Communications*, Vol. 150, No. 1, pp. 1-5, Feb. 2003.
- G. Cheng, Y. Tian and N. Ansari, "A New QoS Routing Framework for Solving MCP," Special Issue on Internet Technology, *IEICE Trans. on Communications*, Vol. E86-B, No. 2, pp. 534-541, Feb. 2003.
- D. Wei, Y. Jie, N. Ansari and S. Papavassiliou, "Cell-based Schedulers with Dual-rate Grouping," Special Issue on Internet Technology, *IEICE Trans. on Communications*, Vol. E86-B, No. 2, pp. 637-645, Feb. 2003.
- 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.
- H. Zhao, N. Ansari and Y.Q. Shi, "Efficient Predictive Bandwidth Allocation for Real Time Videos," *IEICE Trans. on Communications*, Vol. E86-B, No. 1, pp. 443-450, Jan. 2003.
- N. Ansari, H. Liu, Y.Q. Shi and H. Zhao, "On Modeling MPEG Video Traffics," *IEEE Trans. on Broadcasting*, Vol. 48, No.4, pp. 337-347, Dec. 2002.
- G. Cheng and N. Ansari, "On Multiple Additively Constrained Path Selection," *IEE Proc. Communications*, Vol. 149, No. 5, pp.237-241, Oct. 2002.
- J. Li and N. Ansari, "Credit-Based Scheduling Algorithms for Input Queued Switches," *IEICE Trans. Communications*, Vol. E85-B, No. 9, pp. 1698-1705, Sep. 2002.
- 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.