

The 1% Manual Audit in California[†]

Proposed Procedures and Rationale

Purpose of this Document

For many California counties, the November 2006 General Election will be one of the first elections in which they use Direct Recording Electronic (DRE) voting systems with Voter-Verified Paper Audit Trail (VVPAT) capabilities. In addition to the complexities of changing all or parts of their voting system, counties will also have to include VVPAT records in the 1% manual tally (manual audit) mandated by law, in which tallies of paper records of ballots cast in polling places must be reconciled with the electronic tallies from the equipment on which the ballots were cast.¹ In an effort to help San Mateo and Yolo Counties think about the proper process and necessary changes involved with this 1% manual audit, members of ACCURATE, the Verified Voting Foundation, and the California Voter Foundation have developed this policy document in direct consultation with the staff of these Counties. We hope that this document will help other counties develop their own policies, processes and best practices going forward.

This document is structured as a narrative rationale with an attached appendix that lists the proposed procedures for conducting the 1% manual audit. The narrative document is divided into six sections organized in order of when certain activities should take place. First, we cover activities that must be conducted in advance of the manual audit, then activities that happen during the random selection of precincts and the actual manual audit process. Then, the document discusses what should be released after the audit has taken place and, finally, additional considerations that might improve the effectiveness of the manual audit.

Review Last Audit Experience

The Jurisdiction should review its experience auditing the last election. It is frequently the case that election activities and procedures are not fully tested until used in an election cycle. The Jurisdiction should review the manual audit process that it conducted in the last election cycle; and the Jurisdiction should identify any problems that resulted in discrepancies or inefficiencies and address them in procedural changes, poll worker training, etc. This review should be used in order to understand the level of effort and

[†] This document was primarily authored by Joseph Lorenzo Hall, a PhD Student at the UC Berkeley School of Information and conducted in collaboration with researchers at A Center for Correct, Usable, Reliable, Auditable and Transparent Elections (ACCURATE), the Verified Voting Foundation and election officials in San Mateo and Yolo Counties. This work was supported by NSF grant CNS-0524745.

¹ The “one percent manual tally” is defined in §336.5 of the CA Elec. Code as:

[T]he public process of manually tallying votes in 1 percent of the precincts, selected at random by the elections official, and in one precinct for each race not included in the randomly selected precincts. ...

Elections Code §15360 states how to conduct the conduct the manual recount:

During the official canvass of every election in which a voting system is used, the official conducting the election shall conduct a public manual tally of the ballots tabulated by those devices cast in 1 percent of the precincts chosen at random by the elections official. ...

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resource commitment involved in doing manual counts. This review will also help the Jurisdiction assess how much leeway they may have to do more than the minimum audit.²

Procedural Commitments

For a number of reasons, it is important that the Jurisdiction publicly commit to the procedures it will use in the Manual Audit before the process begins. Changing the procedures during the process or announcing the procedures at the last minute will negatively impact the confidence that observers have in the Manual Audit. The necessary evidence, the types of ballots covered and the process for conducting the Manual Audit need to be clearly specified beforehand.

According to §19253(b)(2) of the California Election Code, the VVPAT record governs in case of a difference between the paper and electronic records of the vote.³ Any missing or damaged paper records will take precedence over the electronic records cast on the machine. Accordingly, many months before an election, special care should be taken to ensure that the voting system and poll workers are capable of keeping the evidence necessary for the 1% manual audit. The Jurisdiction needs to design policies and procedures that ensure that a paper record that can be included in the manual audit is stored for each ballot that is cast. The Jurisdiction needs to ensure that their voting systems will not allow electronic ballots to be cast when the VVPAT subsystem is not operational or not recording VVPATs.⁴ Also, they should ensure that poll worker documentation and training emphasizes that the VVPAT records are equally as important as the memory card “ballot boxes” and that there are clear guidelines about what to do in case of a printer jam, failure or other contingency that might affect the paper record of a voter’s ballot.

At least one week before the selection and manual audit tally process, the Jurisdiction should publish the policy and procedures that will govern the selection and audit tally

² Recent research has shown that a small, fixed-percentage manual audit of paper records is only sufficient if the smallest margin in all races on the ballot is greater than 15%. For recent work on auditing elections, see: Ronald L. Rivest, On Estimating the Size of a Statistical Audit, November 13, 2006, available at: <http://theory.csail.mit.edu/~rivest/Rivest-OnEstimatingTheSizeOfAStatisticalAudit.pdf>; Kathy Dopp and Frank Stenger, The Election Integrity Audit, September 25, 2006, available at: <http://electionarchive.org/ucvAnalysis/US/paper-audits/ElectionIntegrityAudit.pdf>; Howard Stanislevic, Random Auditing of E-Voting Systems: How Much is Enough?, August 9, 2006, available at: <http://www.votetrustusa.org/pdfs/VTTF/EVEPAuditing.pdf>.

³ §19253 of the California Election Code reads:

19253. (a) On a direct recording electronic voting system, the electronic record of each vote shall be considered the official record of the vote, except as provided in subdivision (b).

(b) (1) The voter verified paper audit trail shall be considered the official paper audit record and shall be used for the required 1-percent manual tally described in Section 15360 and any full recount.

(2) The voter verified paper audit trail shall govern if there is any difference between it and the electronic record during a 1-percent manual tally or full recount.

⁴ For example, the eSlate DRE with Verifiable Ballot Option (VBO) unit used in San Mateo and Yolo Counties will display an error on the eSlate screen when there is a printer problem and not allow the voter to cast a vote. If the error is not reconcilable, then that eSlate is taken out of service and the voter is issued a new Voter Access Code (VAC). However, reports from Cuyahoga County’s 2006 primary show that the Diebold AccuVote-TSx will allow ballots to be cast regardless of the printing unit’s status.

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process. As the manual audit is intended to serve as a check of the paper records against the electronic vote data, the audit should be the very last step before certifying the vote. In a similar vein, the selection of precincts for the manual audit and the manual audit tally for classes of ballots (precinct-machine, precinct-provisional and absentee) should only begin after those ballots have been counted.

The Jurisdiction will need to decide what ballots will be included in the manual audit (regular ballots, absentee ballots, provisional ballots, duplicated ballots, military or fax ballots, etc.). Sec. 15360 of the Elections Code is vaguely worded, and County Clerks and Registrars of Voters have arrived at different interpretations regarding which ballots must be included in the 1% recount. Aaron Burstein (Samuelson Clinic research fellow) reads sec. 15360 to require that elections officials include regular ballots cast at a polling place on election day; under this reading, sec. 15360 does not require a broader ballot sample for the recount, though the statute does not prohibit other kinds of ballots, e.g., provisional and absentee. From the perspectives of security and transparency, all ballots that are tabulated by computerized or electro-mechanical systems should be included in the manual audit. Absentee and early voted ballots will become part of the manual tally for elections after January 1, 2007.⁵

The Jurisdiction will need to publish electronic tallies for ballots being audited before the random selection of precincts is performed (**Precinct Totals Master List**). The audit process involves comparing manual tallies of votes to electronic tallies of votes. Some types of ballots can be counted quickly (precinct-machine) while others are counted over a much longer period of time (precinct-provisional). Regardless of the ballot type, to preclude the possibility of hiding possible sources of discrepancy, the electronic tallies should not change during the audit. This means that the audit for certain precincts or ballots should only begin after those ballots are counted. If the Jurisdiction's election management system (EMS) can report precinct-machine, precinct-provisional and absentee numbers separately, then the precinct-machine numbers should be used for the VVPAT audit. If the EMS cannot separate the precinct-machine and precinct-provisional ballots, then the election-night precinct tally can serve as a precinct-machine tally. An alternative is to stagger the 1% audit such that the audit is done on a set of numbers where counting has been completed. For example, start the manual audit on precinct-machine ballots and complete those in order to give more time to complete the counting of precinct-provisional and absentee ballots.

The manual count of paper records should be a blind count. Those doing the counting should be unaware of the "expected" result (i.e., of the electronic tallies) or they might have a conscious or unconscious incentive to arrive at the "expected" result. The reader during the manual audit tally process should not tell the recorders the expected result.⁶

⁵ At the writing of this document, SB 1235, has been passed into law and has amended sec. 15360 of the Election Code to require that absentee and early voted ballots be included in the manual audit. This amendment will go into effect on January 1, 2007 as per California Constitution, Art. IV, Sec. 8(c). For the language of SB 1235, see: http://www.aroundthecapitol.com/Bills/SB_1235/.

⁶ To facilitate this the Pre-Audit Tallying process in the Manual Audit Tally Process below has only the reader checking aggregate results before tallying begins so that the three recorders don't know the expected result.

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Random Selection of Precincts

To randomly select precincts for the Manual Audit, the Jurisdiction will need to conduct a publicly verifiable random selection process. An official from the Jurisdiction will need to announce the date and time – via press release, etc. – for the selection of precincts in advance to allow the public to know about and plan to observe the process.

In order to do the random selection, we recommend the following materials:

- **Master Spreadsheet:** Spreadsheet of precinct numbers, numbered in rows 1 through N (a precinct's row is called its "precinct row number"). Make available or otherwise publish this list. (Provide hardcopy printouts for observers of the selection process, and offer the spreadsheet on the Internet in CSV format.)
- **Contest Spreadsheets:** Spreadsheets of lists of all precinct numbers for each contest in the election, numbered in rows 1 through N (a precinct's row is called its "precinct row number"). Make available or otherwise publish this list. (Provide hardcopy printouts for observers of the selection process, and offer the spreadsheet on the Internet via CSV format.)
- A publicly verifiable random selection mechanism such as three (3) clear, colored 10-sided dice.⁷ Announce the relationship between color and digits; for example, the number on the red die corresponds to the hundreds place, the white to the tens place and the blue to the ones place in the precinct number.⁸

The presiding election official should announce the number of precincts in the Jurisdiction and the number of precincts that will be chosen for audit. Observers should be allowed to inspect the dice, cup and box as well as compare their copies of the spreadsheets to the official copies in order to convince themselves that the materials are legitimate.

The election official (or even an observer) will roll the dice once for each precinct to be audited. If a precinct row number is chosen that doesn't exist, the dice should be re-rolled. If a die falls off of the table or otherwise doesn't land in the box (or designated area), re-roll the dice. When a valid roll is made, the election official will read off the digits from the roll and record and witness the precinct row number in the master spreadsheet. The election official should then line through each precinct chosen on the contest spreadsheets to keep track of the contests included in the Manual Audit.

After the initial 1% of precincts are chosen, additional precincts will have to be chosen to cover all contests in the Jurisdiction. For each contest spreadsheet that does not have a precinct from the 1% selection being audited lined through on it, the die-roller will roll the appropriate number of dice. If a precinct row number is chosen that doesn't exist, the

⁷ Other good choices include drawing lots or using official lottery or jury ball selection machines. Three dice are appropriate for jurisdictions with between 100 and 1,000 precincts, while two dice can be used for jurisdictions with between 10 and 100 precincts. Please see the text of the interpretive document for more information.

⁸ For dice, it is recommended that new, translucent dice be used, and preferably with sharp edges (as they tumble better). A die-tumbler should be used to roll the dice, and the rolling surface should be clearly specified, so valid rolls are unambiguous.

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dice should be re-rolled. If a die falls off of the table or otherwise doesn't land in the box (or designated area), re-roll all of the dice. When a valid roll is made, the election official will read off the digits from each roll and record and witness the precinct row number in the master and contest spreadsheets.

When finished with the random selection process, the presiding election official should publicly announce the precinct row numbers, precinct numbers and whether or not the selection of that precinct was off of the master spreadsheet or a contest spreadsheet. The official should also announce the dates and times of the Manual Audit Tally before adjourning the selection process so that observers of the selection may also observe the manual tally. In addition, the Jurisdiction should publicly announce the dates and times – via press release, etc. – of the Manual Audit to the larger public.

Manual Audit Tally Process

Need to tally the precincts chosen for manual audit:

The Jurisdiction will need certain materials to conduct the Manual Audit Tally:

- 4 personnel per team: 1 reader and 3 recorders. The reader will call out each ballot and the recorders will mark their tally sheets.
- For each precinct, paper records cast inside the precinct (opscan ballots, VVPAT rolls), mail-in ballots from that precinct,
- **Precinct Totals Sheet:** for each precinct, copies of printouts that list the total ballots cast and numbers of votes cast for each contest on the ballot, for each type of paper record being audited.
- Tally sheets for each recorder.

In order to preserve the chain of custody on the paper records, the reader in each tally team should check the tamper-evident seals on paper record containers against the appropriate seal log in front of witnesses, before beginning the Tally. The reader should then break the seal and place the paper records on the tally table in full view of observers.

If the Jurisdiction uses reel-to-reel VVPAT technology, it should consider cutting any VVPAT records off their rolls. This will make the VVPAT records much easier to recount. To do this, have one person pull out one ballot on the VVPAT tape, another cut and stack the VVPAT records. An observer should make sure the process is witnessed and that no VVPAT records are misplaced. Be careful to retain valid and voided VVPAT records but set the voided records aside. If the VVPAT roll cannot be sliced, the reader will have to roll and unroll the VVPAT tape.⁹

⁹ Some election officials have used four books to make an ad-hoc VVPAT roll counter. They would put two books down about a foot apart and then lay the beginning of the VVPAT tape down on top of them. Putting two more books on top of the first two books allows the VVPAT roll to be pulled through the books and the contents of the VVPAT records read between the front and back set of books. Note that the Election Sciences Institute, for their VVPAT audit of the recent Cuyahoga primary, developed a lexan enclosure with a crank device that allows for ease of reading VVPATs on rolls. To see this device, see page 91 (96 of the PDF) of this report: http://www.cuyahogacounty.us/bocc/GSC/pdf/esi_cuyahoga_final.pdf.

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First, the reader should conduct a pre-tallying process so that any gross discrepancies are found before the more laborious tally process begins. The reader should check the number of paper records for the precinct being audited with the number on the Precinct Totals Sheet for each type of paper record. If there is a discrepancy, the tally team should recount and justify (revisit precinct bins, poll worker notes, etc.) and suspend the tally until the discrepancy is explained. Then, the reader will count the number of ballots marked for each candidate, starting at the top of the ballot. The reader should tally votes for one candidate in one contest before moving on to the next candidate or contest. If the aggregate in each contest doesn't match the precinct totals sheet, recount and justify. As mentioned before, this should be a blind process so that the readers do not know beforehand what number they are trying to achieve in each contest.

If no discrepancies are found in the pre-tallying process, the tally team can then go on to the tally process. This process is designed so that small errors are noticed quickly and so that any tally errors can be "rolled back" if the tally team goes out of synchronization. The tally team should first divide the ballots by candidate/choice within each contest. The reader should call out the name of the candidate/choice to be tallied for each ballot marked and collate the ballots in multiples of ten. The recorders will mark their tally sheets each time the name is called. After every 10th tally mark, the three readers will call out "10" or "20", etc. If the team members get out of synch, the entire tally should go back 10 ballots to the last place in synch. When done with a candidate, each reader will mark the last number tallied and line out the rest of the numbers tallied for that candidate. The readers will then write the total tally for that candidate on the right of the tally sheet. After each contest, check if the total matches the precinct totals sheet. If there is a discrepancy, recount and justify.

When done with all the choices in a contest, each reader should draw a line through the next candidate row to separate the contests. Finally, Readers should sign and certify the bottom of each tally sheet. As an optional piece of data, the Jurisdiction should consider counting and reporting the number of spoiled VVPAT records as well, based on the Brennan Center Security Report.¹⁰ This will allow potential detection of very subtle, dynamic software-based attacks that might try and trick voters.

If the audit finds evidence of a discrepancy, an investigation should begin. The investigation can be relatively simple to relatively complex, depending on if the cause of the discrepancy can be identified. If the cause is identified as an error in the totals tally or in the software that computes the tally, remedial action will have to be taken to correct

¹⁰ As explained by the Brennan Center Task Force on Voting System Security, the most plausible and possibly most difficult-to-detect type of attack against a DRE with VVPAT system would involve an attacker modifying the software to display the correct ballot information on the screen of the DRE and writing different information to the VVPAT. Then, presumably, if the voter doesn't notice the change, the software would record an erroneous electronic vote that would correspond to the errant VVPAT record. In this case, there would be no discrepancy. However, certain voters will notice the screen/VVPAT discrepancy and they will void their vote and vote again. If the attacker is clever, the software would be smart enough to not do the switch again for this voter. This kind of "vote-flipping" attack would be evident during the audit process by noting machines that report a particularly high amount of spoiled VVPAT records. See page 17 of: Brennan Center Task Force on Voting System Security (Lawrence Norden, Chair). *The Machinery of Democracy: Protecting Elections in an Electronic World*, Brennan Center for Justice, (2006), available at: http://www.brennancenter.org/dynamic/subpages/download_file_36343.pdf.

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the tally for miscounted votes and any other votes that could have been affected by the same error. If the error was isolated to one precinct or set of ballots, then the Jurisdiction should recount and re-audit that precinct or those ballots. If it might affect more precincts or ballots, all affected precincts and ballots would have to be recounted and then audited. Another audit needs to be performed for all affected votes in order to ensure that the source of error has been reconciled. For example, if an optical scanner was found to be out of calibration, it would need to be recalibrated (rectifying the source of the error), all the ballots would have to be re-scanned and then a 1% audit performed on those ballots.

However, if the cause cannot be identified, an unexplained discrepancy should trigger a larger-scale, if not full, manual recount and investigation.

Post-Audit Disclosure

After the Manual Audit has been conducted successfully, the Jurisdiction will need to report the results of the audit. The reporting should match the way the audit was performed. For example, if the counting of VVPATs is done separately from the paper ballots for a precinct, the report should list both separately along with electronic totals and the tally from the manual tally process. The Clerk or Registrar of Voters should then make the final official Statement of Vote available on their website in both PDF and CSV format, and observers should be able to check that the unofficial report generated before the random selection (Precinct Totals Master List) matches the final certified official report.

The ideal case in auditing best practices would have the Clerk or Registrar of Voters publish a comprehensive canvass report. This report should include data such as the number of signed-in voters (from the roster sheet), the number of DRE votes recorded, the number of paper or provisional ballots handed out, the number of absentee votes received, and a report on how they reconciled all these figures along with an explanation of all discrepancies between the number of signed-in voters and the number of electronic votes recorded. Alternatively, one could imagine providing this information just for the precincts selected to be part of the 1% audit. This is optional and could be omitted for now, depending on time/resources/etc.

Going Beyond the Requirements of California Law

Jurisdictions that would like to aggressively audit their voting systems should consider going beyond the requirements of the California Elections Code. We offer two suggestions for additional activities and procedures that will lend more power to the audit process.

Audit at the Unit of the Machine

Most Jurisdictions use multiple voting systems per polling place. If the number of voting systems used in the Jurisdiction is greater than the number of precincts, a random selection of voting systems will cover more precincts than a random selection of precincts. From the perspective of statistics, this will lend more statistical power to the audit process for the same percentage of an audit. In this sense, the Jurisdiction should

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consider more careful checks of individual machines. For example, they could audit another 1% of the machines, on a machine-by-machine rather than precinct-by-precinct basis.

The modifications to the tally process would be to compare electronic vote totals for individual machines to paper records recorded by the machines. The Jurisdiction will have to check with the vendor of their EMS if it is able to produce reports of tallies broken down by machine, which is necessary for a machine-based audit.

Close Contests and Precinct-size Variation¹¹

As mentioned in note 2, as a general rule, the closer the race (or the higher the degree of confidence desired in the results), the higher percentage of an audit needs to be performed. Jurisdictions are free under California law to audit any percentage of precincts above the state-mandated 1% random audit. Ideally, a robust audit would use the smallest margin between candidates in an election as a rule for the percentage of an audit to conduct. The National Election Data Archive provides a calculator that allows election officials to enter the characteristics of an election and will calculate the percentage of audit (the number of polling places) needed to be sure at the 95% confidence level that no fraudulent polling places were present.¹² Ron Rivest has developed a simple approximation that allows election officials to do the same.¹³

Finally, Stanislevic has shown that audit design should take into account the different sizes of polling places.¹⁴ That is, an attacker that is looking to swing votes will probably target larger precincts, in order to concentrate the amount of fraud and minimize detection by audits. To take this into account, it would be reasonable for Jurisdictions to add a certain number of randomly-chosen large polling places to the manual audit procedure.

¹¹ Adjusting the audit for close contests and precinct-size variation is an active area of research. Aaron Burstein and Joseph Lorenzo Hall are working to synthesize this research.

¹² See: <http://electionarchive.org/auditcalculator/eic.cgi>.

¹³ See Rivest, note 2.

¹⁴ See Stanislevic, note 2.

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Appendix A: Procedures for Manual Audit

Proposed Procedures for Jurisdictions in California

Review Last Audit Experience

- 1) Months before the next election, the Jurisdiction should review their experience auditing the last election:
 - a) Identify any problems that resulted in discrepancies or inefficiencies and address them in procedural changes, poll worker training, revision of the technology, etc.

Procedural Commitments

- 2) In election planning, many months before an election, special care should be taken to ensure that the voting system and poll workers are capable of keeping the evidence necessary for the 1% manual audit. The Jurisdiction needs to design policies and procedures that ensure that a paper record that can be included in the manual audit is stored for each ballot that is cast.
 - a) Ensure that their voting systems will not allow electronic ballots to be cast when the VVPAT subsystem is not operational or not recording VVPATs.
 - b) Ensure that poll worker documentation and training emphasizes that the VVPAT records are equally as important as the memory card “ballot boxes” and that there are clear guidelines about what to do in case of a printer jam, failure or other contingency that might affect the paper record of a voter’s ballot.
- 3) At least one week before the selection and manual audit tally process, the Jurisdiction should publish the policy and procedures that will govern the selection and audit tally process:
 - a) The audit should be the very last step before certifying the vote.
 - b) The Jurisdiction will have to decide what ballots will be included in the manual audit.¹⁵
 - c) The selection of precincts for the manual audit and the manual audit tally for classes of ballots (precinct-machine, precinct-provisional and absentee) should only begin after those ballots have been counted.
 - d) **Precinct Totals Master List.** The Jurisdiction will need to publish electronic tallies for ballots being audited before the random selection of precincts is performed.
 - i) The Jurisdiction could run an unofficial Statement of Vote (or other report that shows the totals for ballots by precinct in numbers that make sense for the audit) and make it available on their web site in both PDF and CSV formats.

¹⁵ According to E.C. §15360 as amended by the recently-passed SB 1235, all in-precinct cast votes, early votes and absentee votes have to be included in the 1% manual audit effective 1 Jan 2007. Please see the narrative at the beginning of this document for a discussion of what ballots to include in the audit.

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They could also hand it out on write-once media (CD-ROM or DVD-ROM) to observers.

- ii) This should be done before the start of the random selection, to make certain that the audit is committed to a single set of tallies and cannot be changed depending on which precincts are chosen.
- iii) If the Jurisdiction's election management system (EMS) can report precinct-machine, precinct-provisional and absentee numbers separately, then the precinct-machine numbers should be used for the VVPAT audit. If the EMS cannot separate the precinct-machine and precinct-provisional ballots, then the election-night precinct tally numbers can serve as a precinct-machine tally (as they will not yet have precinct-provisional ballots incorporated).
- iv) If the Jurisdiction is auditing ballots that are not sorted by precinct (e.g., absentee ballots by batches) then the Statement of Vote needs to be supplemented (both before and after the audit) by an appendix that reports tallies in the units of the 1% of ballots being audited (e.g., absentee ballot tallies broken down by batch).
- e) The manual count of paper records should be a blind count:
 - i) Those doing the counting should be unaware of the "expected" result (i.e., of the electronic tallies) or they might have a conscious or unconscious incentive to arrive at the "expected" result.
 - ii) The reader during the manual audit tally process should not tell the recorders the expected result.¹⁶

Random Selection of Precincts

- 4) To randomly select precincts for the 1% manual audit, the Jurisdiction will need to conduct a publicly verifiable random selection process:
 - a) Announce the date and time – via press release, etc. – for the selection of precincts in advance to allow the public to know about and plan to observe the process.
 - b) At the announced date and time, perform the selection:
 - i) Materials needed for the selection process:
 - (1) **Master Spreadsheet:** Spreadsheet of precinct numbers, numbered in rows 1 through N (a precinct's row is called its "precinct row number"). Make available or otherwise publish this list. (Provide hardcopy printouts for observers of the selection process, and offer the spreadsheet on the Internet in CSV format.)

¹⁶ To facilitate this the Pre-Audit Tallying process in the Manual Audit Tally Process below has only the reader checking aggregate results before tallying begins so that the three recorders don't know the expected result.

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- (2) **Contest Spreadsheets:** Spreadsheets of lists of all precinct numbers for each contest in the election, numbered in rows 1 through N (a precinct's row is called its "precinct row number"). Make available or otherwise publish this list. (Provide hardcopy printouts for observers of the selection process, and offer the spreadsheet on the Internet via CSV format.)
 - (3) A publicly verifiable random selection mechanism such as three (3) clear, colored 10-sided dice.¹⁷ Announce the relationship between color and digits; for example, the number on the red die corresponds to the hundreds place, the white to the tens place and the blue to the ones place in the precinct number.
 - (4) For dice, it is recommended that new, translucent dice be used, and preferably with sharp edges (as they tumble better). A die-tumbler should be used to roll the dice, and the rolling surface should be clearly specified, so valid rolls are unambiguous.
- ii) Announce the number of precincts in the Jurisdiction and the number that will be chosen for audit. Allow observers to inspect the dice, cup and box as well as compare their copies of the spreadsheets to the official copies.
 - iii) Roll the dice once for each precinct to be audited:
 - (1) Roll the dice. If a precinct row number is chosen that doesn't exist, re-roll the dice. If a die falls off of the table or otherwise doesn't land in the box (or designated area), re-roll the dice.
 - (2) Read off the digits from each roll and record and witness the precinct row number in the master spreadsheet.
 - (3) Line through each precinct chosen on the contest spreadsheets.
 - iv) For each contest spreadsheet that does not have a precinct from the 1% selection being audited, roll the appropriate number of dice.¹⁸
 - (1) Roll the dice. If a precinct number is chosen that doesn't exist, re-roll the dice. If a die falls off of the table or otherwise doesn't land in the box (or designated area), re-roll the dice.
 - (2) Read off the digits from each roll and record and witness the precinct row number in the master and contest spreadsheets.
 - c) When finished, publicly announce the precinct row numbers, precinct numbers and whether or not the selection of that precinct was off of the master spreadsheet or the contest spreadsheet.
 - d) Announce the dates and times of the Manual Audit Tally before adjourning the selection process. Announce the dates and times – via press release, etc. – of the Manual Audit Tally to the larger public.

¹⁷ See notes 7 and 8 in the narrative at the beginning of this document for modifications on using dice or for the use of dice with Jurisdictions that have fewer than 100 or more than 1000 precincts..

¹⁸ See note 17.

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Manual Audit Tally Process

- 5) Need to tally the precincts chosen for manual audit:
 - a) Resources needed for Manual Audit Tally:
 - i) 4 personnel per team: 1 reader and 3 recorders. The reader will call out each ballot and the recorders will mark their tally sheets.
 - ii) For each precinct:
 - (1) paper records cast inside the precinct (opscan ballots, VVPAT rolls),
 - (2) mail-in ballots from that precinct,
 - iii) **Precinct Totals Sheet:** for each precinct, copies of printouts that list the total ballots cast and numbers of votes cast for each contest on the ballot, for each type of paper record being audited.
 - iv) Tally sheets for each recorder.
 - b) Check tamper-evident seals on paper records against seal log in front of witnesses. Break seal and place paper records on a table.
 - c) Consider cutting VVPAT records off their rolls: Have one person pull out one ballot on the VVPAT tape, another cut and stack the VVPAT records and an observer to make sure the process is witnessed. This will make the VVPAT records easier to recount. Be careful to retain valid and voided VVPAT records but set the voided records aside. If the VVPAT roll cannot be sliced, the reader will have to roll and unroll the VVPAT tape.¹⁹
 - d) Pre-tallying process:
 - i) The reader checks the number of ballots for the precinct being audited with the number on the precinct totals sheet for each type of paper record. If there is a discrepancy, recount and justify (revisit precinct bins, poll worker notes, etc.)
 - ii) Starting at the top of the ballot, the reader will tally votes for one candidate in one contest before moving on to the next candidate or contest.
 - iii) As a check, the reader will count the number of ballots marked for each candidate. If the aggregate in each contest doesn't match the precinct totals sheet, recount and justify (revisit precinct bins, poll worker notes, etc.)
 - e) Tallying process:
 - i) Within each contest divide the ballots by candidate/choice.

¹⁹ Some election officials have used four books to make an ad-hoc VVPAT roll counter. They would put two books down about a foot apart and then lay the beginning of the VVPAT tape down on top of them. Putting two more books on top of the first two books allows the VVPAT roll to be pulled through the books and the contents of the VVPAT records read between the front and back set of books. Note that the Election Sciences Institute, for their VVPAT audit of the recent Cuyahoga primary, developed a lexan enclosure with a crank device that allows for ease of reading VVPATs on rolls. To see this device, see page 91 (96 of the PDF) of this report: http://www.cuyahogacounty.us/bocc/GSC/pdf/esi_cuyahoga_final.pdf.

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- ii) The reader calls out the name of the candidate/choice to be tallied for each ballot marked. The reader collates the ballots in multiples of ten.
- iii) The recorders mark their tally sheets each time the name is called.
- iv) After every 10th tally mark, the three team members call out “10” or “20”, etc. If the team members are out of synch, go back 10 ballots.
- v) Mark the last number tallied and line out the rest of the numbers tallied for that candidate. Write the total tally for that candidate to the right.
- f) Check if the total matches the precinct totals sheet. If there is a discrepancy, recount and justify (revisit precinct bins, poll worker notes, etc.)
- g) When done with all the choices in a contest, draw a line through the next candidate row to separate the contests.
- h) Readers sign and certify the bottom of each tally sheet.
- i) (*OPTIONAL*) They should consider counting the number of spoiled VVPAT records as well, based on the Brennan Center Report.²⁰
- j) If the audit finds evidence of a discrepancy, an investigation should begin:
 - i) If the cause can be identified:
 - (1) If it is an error in the totals tally, remedial action will have to be taken to correct the tally for miscounted votes and any other votes that could have been affected by the same error.
 - (2) Another audit needs to be performed for all affected votes to ensure that the source of error has been reconciled. For example, if an optical scanner was found to be out of calibration, it would need to be recalibrated (rectifying the source of the error), all the ballots would have to be re-scanned and then a 1% audit performed on those ballots.
 - (3) If the error was isolated to one precinct or set of ballots, then recount and re-audit that precinct or those ballots. If it might affect more precincts or ballots, all those precincts and ballots would have to be recounted and then audited.
 - ii) If the cause cannot be identified:
 - (1) An unexplained discrepancy should trigger a larger-scale, if not full, manual recount and investigation.

Post-Audit Disclosure

- 6) What should be disclosed about the results of the audit?
 - a) The reporting should match the way the audit will be performed. If counting of VVPATs is done separately from the paper ballots for a precinct, the report

²⁰ Please see the narrative at the beginning of this document for a discussion as to why this might be useful.

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- should list both. To compare the manual count to the electronic count, observers have to be comparing like to like.
- b) After the audit, the Clerk or Registrar of Voters should then make the final official Statement of Vote available on their website in both PDF and CSV format, and observers should be able to check that the unofficial report generated before the random selection (Precinct Totals Master List) matches the final certified official report.
 - c) *(OPTIONAL)* The ideal case in auditing best practices would be that the Clerk or Registrar of Voters publish a comprehensive canvass report listing, for each precinct, things like the number of signed-in voters (from the roster sheet), the number of DRE votes recorded, the number of paper or provisional ballots handed out, the number of absentee votes received, and a report on how they reconciled all these figures along with an explanation of all discrepancies between the number of signed-in voters and the number of electronic votes recorded. Alternatively, one could imagine providing this information just for the precincts selected to be part of the 1% audit. This is optional and could be omitted for now, depending on time/resources/etc.

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