AFFIDAVIT OF DOUGLAS W. JONES

DOUGLAS W. JONES, being duly sworn, deposes and says the following under penalty of perjury.

1. I am an Associate Professor of Computer Science at the University of Iowa. I have a BS degree in physics from Carnegie-Mellon University and MS and PhD degrees in computer science from the University of Illinois. I have taught at the University of Iowa since 1980. I submit this affidavit in support of Jill Stein's Petition for a hand recount of all ballots in Wisconsin.

2. My involvement in elections began in late 1994 when I volunteered to serve on the Iowa Board of Examiners for Voting Machines and Electronic Voting Systems. I was appointed to the board in 1995 and resigned from the board in 2004. I was chairman of the board in 2000, when I testified before the U.S. Commission on Civil Rights about the Florida 2000 election, and before the House Science Committee about an early draft of what would later become the Help America Vote Act of 2002.

3. In 2004, I consulted with Miami-Dade County, Florida about problems they were having with their then-new voting system. In 2006, I helped investigate a problematic recount in Maricopa County, Arizona for a committee of the Arizona Senate. Earlier in 2016, I was a member of the Scott County, Iowa ad-hoc committee to select a new voting system for that county. I have served as an election observer in Kazakhstan in 2005 and 2007, and in Holland in 2006.

4. Between 2005 and 2011, I was a co-principal investigator in ACCURATE (A Center for Correct, Usable, Reliable, Auditable, and Transparent Elections), a 5-university research project funded by the National Science Foundation, and I served on

the U.S. Election Assistance Commission's Technical Guidelines Development Committee from 2009 to 2012 when the committee went dormant. I co-wrote, with Barbara Simons, the book Broken Ballots, published by the Center for the Study of Language and Information and University of Chicago Press in 2012.

5. My up to date curriculum vita is available online at http://homepage.divms.uiowa.edu/~jones/vita.pdf.

6. Many of my public statements about voting are indexed on-line at http://www.cs.uiowa.edu/~jones/voting/.

My Opinion

7. No optical scan technology, including that used in Wisconsin, is capable of perfectly uniform and reliable scanning and electronic tabulation of voter-marked ballots. The same ballot scanned by the same genuinely impartial machine may be seen as containing a vote on one pass through the scanner and not containing a vote on the next pass through the identical scanner. This is because a mark can be exactly at the threshold for discriminating between marked and unmarked ballots, so that even the slightest variation in paper alignment and other physical conditions can change the outcome. The potential for different interpretations by genuinely impartial scanners is even greater when ballots are initially scanned on one machine and recounted on another, or when marks in one candidate's voting target are compared with marks in a different candidate's voting target.

8. Ballot scanners are accurate only to a point. Most marks made with the intent of casting a vote will be counted, and most accidental marks and smudges will be ignored. However, problematic marks are possible, both marks intended as votes that

some scanners will ignore, and accidental marks that may be counted as votes. My analysis of the data from the unofficial Florida 2000 recount done by the media shows that from one to ten votes per thousand votes counted involved a problematic mark; with considerable variation between local jurisdictions. Mark Ritchie, who was the Minnesota Secretary of State during the 2008 senatorial hand recount of optiscan ballots, informed me that the rate of problematic marks in that election was on the order of one or two marks per thousand votes cast. In general, it is difficult for a voter to predict how such marks will be treated. A few marks that are obviously not votes, to a person, can be counted as votes by some scanners, and some that are obviously votes will be ignored by some scanners. When the margin in an election is wide, this is unlikely to make any difference, but when the margin is small, this can be a problem.

9. Variations in how ballots are handled from one local jurisdiction to another can exacerbate the degree to which scanners misread ballots, and these lead to significant differences in the likelihood that ballots will be interpreted as intended by the voter.

10. A manual recount of the ballots, using uniform standards statewide, can address these problems. For the reasons outlined here, a machine recount cannot correct for these problems. Such a recount cannot offer meaningful assurance that borderline marks on ballots are correctly interpreted, it cannot compensate for differences resulting from procedural differences in which absentee ballots are selected for duplication, and it cannot compensate for differences in how overvoted and blank ballots are handled.

Definitions

11. I use the term voting target to refer to the spot on the ballot where a voter is instructed to make a mark in order to indicate a vote. Typically, this is an oval, a box, or in the Optech line of scanners originally introduced by Business Records Corporation and later sold by both Election Systems and Software and Sequoia Voting Systems, a broken arrow where the voter is instructed to connect the two halves of the arrow.

12. I use the term ballot marking device as the generic term for the pencil, pen or marker used by the voter to mark the ballot. In polling places, ballot marking devices are typically supplied, but for absentee ballots, it is sometimes entirely up to the voter to provide a marking device.

Scanner Accuracy

13. Scanners are prone to at least two types of errors: failing to read votes that were cast, and reading votes where none were cast. These errors are triggered by the types of marks that voters make on their ballots, the type of ballot marking devices they use, and the ways in which ballots are fed into scanners.

14. The actual accuracy of the scanners in translating the voter's intent into an electronic record depends not only on the scanner technology but on the ballot marking instructions. I have seen significant variation in these instructions from one local election jurisdiction to another. For example, In Florida 2000, 16 counties used Global AccuVote-OS ballot scanners; the same model that is in widespread use in Wisconsin. Most had instructions that merely said to "completely fill in the oval." Only Leon County's instructions added "use only a #2 pencil or a blue or black pen." In the same election, 15 counties used Election Systems and Software central-count scanners. Most had

instructions saying “blacken the oval completely ... using only the pencil provided.” Charlotte County, however, said “... using only a #2 pencil.” Hendry and Lake Counties omitted the restrictions on marking device. 8 counties used Optech scanners, mostly with instructions that said “Complete the arrow(s) pointing to your choices ...” Baker, Escambia and Holmes counties added “... using only a #2 pencil or the special pen provided.”

15. While most voters conscientiously mark their ballots following the instructions they are provided, completely filling the voting targets for the candidates they prefer with the correct ballot marker and leaving the others unmarked, some do not. With absentee ballots, voters frequently use whatever pen or pencil is handy, without regard to the ballot marking instructions. When the marker provided at the polls fails, voters are likely to reach for whatever they have in their pockets, particularly when the polling place is busy.

16. Where the ballot marking instructions ask for the voter to completely darken the voting target, some voters will just make an X or a checkmark. Wisconsin’s Election Recount Procedures manual is not completely clear on what happens in such circumstance, placing the burden on the canvassing board to “use common sense to determine the will of the elector” (page 10). In my experience, ballot scanners can be programmed to count such marks, but they do not always accept them.

17. Unfortunately, some voters use their ballot marking pen or pencil as a pointer while they work their way through the ballot, leaving faint dots wherever they rest the tip while they are reading. These marks are common enough that they have a name, hesitation marks. Ideally, a scanner should not detect a hesitation mark as a vote,

but it is difficult for a scanner to distinguish between a dark hesitation mark and a light check or X.

18. When I tested ballot scanners for the state of Iowa, and in my tests in Miami-Dade County, Florida and Maricopa County, Arizona, I always tested the scanners with a wide range of pens and pencils and a wide range of marks. What I have found is that scanners made by different vendors can have distinctly different sensitivities to different markers.

19. For example, when I tested the Election Systems and Software M650 scanners used by Miami in 2004, I found small differences in sensitivity between pen and pencil.[1]

20. When I conducted more extensive tests on the Optech 4C scanners used by Maricopa County in 2006, I found larger differences. (Note that other models of Optech scanners are in use in Wisconsin.) The Optech 4C was almost entirely insensitive to red ink, extraordinarily sensitive to even the smallest pencil marks, and only marginally sensitive to some common ballpoint pen marks. Sadly, the marking device recommended by the county (a Black Bic Round-Stik pen) was among those the marking devices I found to be marginal.

21. A significant issue I noticed in Maricopa County was that different scanners had different sensitivities, so that a mark that was counted on one machine would be discounted on another. This is the probable explanation for the discrepancy between the first count and the recount in the election I was asked to investigate, although

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1 *See* Section 8 of my Observations and Recommendations on Pre-election Ttesting in Miami-Dade County, Sept. 9, 2004, available fromat http://www.cs.uiowa.edu/~jones/voting/miamitest.pdf

we will never know for certain because visual inspection of the voted ballots was never permitted. The *only* way to confirm that the sensitivity of a given scanner is properly calibrated is to manually examine ballots and compare them to the machine count.[2]

22. When we humans look at a ballot, we view it in the full range of colors visible to the human eye. In contrast, most of the scanners designed in the previous century use infrared light invisible to the human eye, and many current models use a single very sharply defined color. A mark may appear very dark to the human eye and yet be invisible to a scanner viewing the mark in infrared or a single narrowly defined color. For example, the reason that the scanners I tested in Maricopa County were insensitive to some red inks was that they used red LEDs to illuminate the ballot. Scanners that use infra-red light may be insensitive to some dye-based inks.

23. Voters cannot be expected to judge their marks on the ballot by the standards used by a voting machine. Voters can only judge such marks by eye.

24. Election officials' assurances that the scanners used in their jurisdictions are tested to rigorous federal standards is not sufficient to indicate that the scanners are reliable. The standards they cite do specify a target error rate of no more than one error per 10,000,000 votes. This figure comes from Section 3.2.1 of the Federal Election Commission Voting System Standards, Volume 1. Unfortunately, this is a target error rate, while the standards permit a much higher error rate of one error per 500,000 votes during testing[3].

25. Moreover, as rigorous as these standards may at first glance appear, they

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2*See* Statement of Douglas W. Jones Regarding the Optical Mark-Sense Vote Tabulators in Maricopa Couty, Jan. 12, 2006, available at http://www.cs.uiowa.edu/~jones/voting/ArizonaDist20.pdf

3*See* Fed. Elec. Comm'n Voting System Standards, Volume 1 § 3.2.1

are used to measure machines' ability to measure ballots that are perfectly filled out, and do not account for the normal variation with which humans record their votes. In reality, therefore, federal standards do not effectively police error rates for scanners reading ballots actually completed by voters. This problem was created by the Help America Vote Act of 2002 ("HAVA"). HAVA contains this text: "The error rate of the voting system in counting ballots (determined by taking into account only those errors which are attributable to the voting system and not attributable to an act of the voter) shall comply with the error rate standards established under section 3.2.1 of the voting systems standards issued by the Federal Election commission ... [Section 301 (a) (5)]." That is to say, human factors are explicitly excluded from the accuracy requirements set by the FEC standards.

26. Because the Election Assistance Commission's authority to establish Voluntary Voting Systems Guidelines is founded on HAVA, this effectively forbids the EAC from setting accuracy guidelines that are based on human-factors considerations such as how real voters actually mark their ballots. In practice, what this means is that the accuracy of optical mark-sense ballot scanners is tested with perfectly marked ballots. In testing, unmarked voting targets are left entirely blank, while marked voting targets are filled in exact compliance with the voting machine manufacturer's recommendations.

27. Crucially, the FEC standards and later EAC guidelines cannot address the issue of whether a ballot scanner has been hacked with malware. Testing cannot reveal such problems, and the security requirements of the current standards are rudimentary at best. The AccuVote OS scanners used in Wisconsin are vulnerable to several hacks, and we know that we cannot rely on pre-election testing to detect these hacks. Therefore,

again, examination of the ballots is essential.

Procedural Uniformity

28. The degree to which scanners erroneously read ballots can be exacerbated by the decisions and procedures guiding election officials' use of the machines. With precinct-count ballot scanners, each voter typically marks their own ballot and then inserts it in the scanner, without allowing any other person to inspect the ballot. In contrast, with absentee ballots, envelopes are typically opened by bipartisan teams that, after separating the ballots from their envelopes, unfold and inspect the ballots to assure that they will scan properly. The law is generally clear in stating that defective ballots should be re-made, but the definition of a defective ballot may leave room for interpretation.

29. I have seen significant variation between jurisdictions in how absentee ballots are processed. In some jurisdictions, the inspection is perfunctory, merely flattening the creases and checking for torn paper or other gross problems that could cause scanning problems. In other counties, the inspection is closer. Inspectors may sort out ballots that contain write-in votes where the write-in oval is not marked. They may sort out ballots that are marked using pens that the inspectors suspect will not scan correctly, and they may sort out ballots that have marks that look too faint to scan reliably or that contain hesitation marks that look dark enough to scan.

30. When it comes to scanning, additional variations are possible. Typically, the scanner will be set to sort out all ballots containing write-in votes. These must, of course, be examined by humans. Unfortunately, except for some of the newer scanners on the market, scanners can only detect write-in votes if the voting target next to the

write-in blank is marked. Voters do not always do this.

31. Scanners used for absentee ballots may be set to sort out ballots that scan as blank or that contain overvotes, or they may simply be set to count blank ballots and report overvotes in each race. Unfortunately, a ballot may scan as blank because the voter used a marking device to which the scanner was insensitive, and a ballot may scan as containing an overvote when the real problem was a hesitation mark made with a device to which the scanner was overly sensitive. Human examination of such ballots can typically determine obvious voter intent.

32. It is noteworthy that the 2015 Wisconsin Act 261 allows election inspectors significant discretion in the use of the override function when overvotes are encountered. This means that in some Wisconsin jurisdictions, overvoted ballots may have been simply counted, while in other jurisdictions, overvoted ballots will have been returned to voters or to the canvassing board for re-making. The Wisconsin Election Day Manual, on page 98, recommends but does not require uniformity of treatment within any one jurisdiction.

33. Although there are several explanations for a large number of overvotes and high blank-ballot rates, such as bad ballot design, when there are large variations in their occurrence in the reported overvote and blank-ballot rates from one jurisdiction to another, I would suspect expect that these kinds of procedural variations I have described here are the most likely explanation. I should note, however, that bad ballot design can lead voters to interpret a single race as two, leading to an overvote, and it can lead voters to skip a race, leading to an undervote.

Need for a Hand Recount

34. Only a manual recount of the ballots, using uniform standards statewide, can address these problems. A machine recount simply compounds the problem of the scanning machine's failing to read votes that were cast, and reading votes where none were cast that I described above. Uniform rules for the recount are crucial. I have long cited Michigan's law for human interpretation of hand marked ballots as a good example of how to draft such rules. (See Public Acts of 2015, Act No. 268, Section 803 for a recent revision of these rules.)

This affidavit was executed on the 28th day of November, 2016, in Iowa City, Iowa.

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DOUGLAS W. JONES

Sworn to before me this 28th day of November, 2016.

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Notary Public

My Commission Expires: _____