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IN THE MATTER OF THE PETITION OF ERNEST ZIRKLE AND CYNTHIA ZIRKLE CONTESTING PURSUANT TO *N.J.S.A* 19:29-1 THE ELECTION OF VIVIAN HENRY AND MARK HENRY AS DEMOCRATIC EXECUTIVE COMMITTEE PERSONS FROM DISTRICT 3 OF FAIRFIELD TOWNSHIP (CUMBERLAND COUNTY),
 	
 ERNEST ZIRKLE AND CYNTHIA ZIRKLE
 	
     Petitioners,
 	
         vs.
 	
 VIVIAN HENRY, MARK HENRY, The CUMBERLAND COUNTY BOARD OF ELECTIONS, and GLORIA NOTO, CUMBERLAND COUNTY CLERK,
 	
     Respondents.
	SUPERIOR COURT OF NEW JERSEY CUMBERLAND COUNTY LAW DIVISION
	
	 Docket No. CUM-L-000567-11
	
	              Civil Action
	
	 RESPONSIVE CERTIFICATION OF ANDREW W. APPEL

I, Andrew W. Appel, of full age, do hereby certify:

1. I am employed as Professor of Computer Science and Chair of the Department of Computer Science at Princeton University.

2.   I am serving in this case as an expert on computer science, computer security, voting machines, and election technology.   I was qualified as an expert on these subjects by Judge Linda Feinberg during the Gusciora v. Christie case in 2006 and 2008. During the past decade I

have studied the technology of the Sequoia AVC Advantage voting machine and the Sequoia WinEDS ballot-preparation software in great depth.

3. In addition to incorporating the facts and conclusions set forth in my Certification to this Court of August 18, 2011, I will continue to use certain terms such as "WinEDS laptop" that I defined in that Certification.

4. I have studied the documents and equipment used in the Primary Election of June 7, 2011 in Cumberland County, NJ. Just based on these documents and equipment, it is very clear that there is anomaly. I will explain, based on the technical evidence that I examined, which kinds of error or fraud I believe *could have occurred*, which kinds of fraud *probably did not occur*, and which kinds of fraud *could perhaps have been indicated or excluded if certain computer files had not been erased in August 2011*.

5. On the AVC Advantage, it is possible that the voter can press a button for one candidate, but the vote is recorded for another candidate or not recorded at all. This can happen for several different reasons. Or, it can happen that the vote is recorded for the candidate that the voter actually intended.

6. Regarding the election on June 7, 2011 for Democratic County Committee in Fairfield District 3, I focused my technical analysis on excluding as many hypotheses as possible. These scenarios are:

Scenario (a) [excluded]. The votes recorded on the OFFICIAL ELECTION RESULTS REPORT are accurate. There are technical reasons that this scenario can be excluded, as I will explain.

Scenario (b) [excluded]. The internals of the AVC Advantage voting machine were manipulated, so that the election results bear no correspondence to the voters' actions. As I will

explain, while this scenario is always a significant danger to elections using the AVC Advantage and it can never be absolutely excluded, it is my opinion that it was *unlikely* to have occurred in this particular election.

Scenario (c) [excluded]. Pollworkers manipulated the AVC Advantage voting machine during the election so that some votes were not recorded. I have testified about this kind of manipulation in Judge Feinberg's court. However, I can rule it out in this case, because the number of Election Authority tickets matches the number of Democratic primary voters as recorded by the AVC Advantage.

Scenario (d) **[not excluded].** The positions of the Zirkles and the Henrys were swapped in the electronic ballot files by an unauthorized intruder wishing to flip the election results, either through Internet access to the WinEDS laptop or by physical access to the WinEDS laptop.

Scenario (e) **[not excluded].** The positions of the Zirkles and the Henrys were swapped by the county employee who prepared the electronic ballot files.

7. As I will explain, evidence has been destroyed that would have allowed me to distinguish between Scenario (d) and Scenario (e).

8. In either of these two scenarios (d) and (e), the votes as actually cast by the voters must have been:

Cynthia Zirkle	34	Vivian Henry	10
Ernest Zirkle	33	Mark A. Henry	9

Ways in which the AVC Advantage and WinEDS are vulnerable to error and fraud.

9. The WinEDS system is used to prepare ballot cartridges before elections; these are installed into the AVC Advantage to "tell" the voting machine which candidates correspond to

which button-positions on the full-face ballot. The computer inside the voting machine does not display these names on the full-face ballot, because there is no full-face electronic display screen. Instead, a large sheet of paper is laid over the buttons on the face of the AVC Advantage. This printed ballot sheet has boxes marked on it that fall directly over buttons underneath the paper. If the ballot sheet has candidate Smith at column I and row 23, then it is crucial that the electronic file inside the ballot cartridge must associate the name Smith with position I23, otherwise the computer-reported results will not match the buttons pressed by voters.

10. At the close of the polls, the computer inside the AVC Advantage prints a report titled "OFFICIAL ELECTION RESULTS REPORT" onto a roll of thermal paper much like a cash-register tape. In this report it prints the number of votes recorded at each active button-position on the ballot. "Active" means that the electronic file "ballot definition" file in the ballot cartridge indicates that there is a candidate at this position in the current election.

11. Each row of the Results Report has the column-and-row designation of the ballot position, the name of the candidate *as recorded in the electronic ballot definition file,* and the number of votes recorded at that button. For example,

I23 Cynthia Zirkle   10

I24 Ernest Zirkle   9

J23 Vivian Henry   34

J24 Mark A. Henry   33

was printed in this election. It means that the button at column I and position 23 received 10 votes, and that in the ballot definition file the name "Cynthia Zirkle" is recorded for position I23.

12. I examined the poster-sized printed paper ballot sheet that was on the face of the AVC Advantage serial #23550 on August 17, 2011. I measured carefully the row and column positions of each of the candidates in this County Committee election. I found that the paper ballot lists the candidates as

Vivian Henry   [I23]   Cynthia Zirkle [J23]

Mark A. Henry [I24]   Ernest Zirkle   [J24]

13. This indicates that the Zirkles and the Henrys are swapped in the electronic ballot file, compared to the printed paper ballot—provided that Scenario (b) can be excluded. In any case, this evidence definitively excludes Scenario (a).

14. I will now discuss Scenario (b). The AVC Advantage contains a computer that interprets the voters' button presses, and calculates what to print on its Results Report when the polls close. If an unscrupulous person opened the AVC Advantage and replaced the computer program, then he could cause any results he desired to be printed on the Results Report.   This is a significant danger to elections in New Jersey. Judge Feinberg's Opinion does not rule out the possibility that this can be done. Indeed, many of the provisions of her Order are intended to limit access to the AVC Advantage machines so that fraudsters of this kind have less access to them.

15. Scenario (b) is that a person installed a fraudulent computer program inside the AVC Advantage to cheat in this election. However, almost certainly such a fraudulent program would *not* give itself away by showing the I23 and J23 ballot positions as it did on the Results Report. Such a fraudulent program would print a Results Report that gives no indication at all that something is wrong.

16. Criminals can make careless mistakes, and one might think that the designer of a fraudulent computer program might inadvertently give himself away by showing the I23 and J23 ballot positions on the Results Report as in this election. However, I have studied the design of the internal software of the AVC Advantage, and I can say that this would not be a natural mistake to make.

17. For these reasons, it is my opinion that Scenario (b) can be excluded *in this election.*

18. Therefore it is my conclusion that Scenario (d) or (e) occurred, and in either case, the majority of voters pressed buttons corresponding to the Zirkles, and the minority voted for the Henrys.

Was it fraud or was it inadvertent error?

19. Scenario (d) is that someone accessed the WinEDS laptop in an unauthorized way, before the ballot cartridges were programmed for this election, either by remote access through the Internet or by otherwise manipulating the software of the laptop computer. Someone might have done this to flip the votes between the Zirkles and the Henrys, if they believed that the Zirkles would get more votes but wanted the Henrys to win. Scenario (e) is that a county employee prepared the ballot definition file incorrectly. I have read the affidavit of Lizbeth Hernandez, dated July 5, 2011, in which she describes Scenario (e).

20. An examination of the WinEDS laptop computer should, in principle, be able to distinguish between Scenarios (d) and (e). However, when I examined the computer on August 17, 2011, I found that crucial information was erased on August 16. My certification of August 18 to this Court explains the kind of erasure that I believe occurred.

21. I have read the certification of Jason W. Cossaboon to this Court dated August 24, 2011. Mr. Cossaboon says that he erased many files from the laptop computer, and that he also

deleted log files. He describes the reason for his action as, "I noticed the computer was running very slowly." Mr. Cossaboon also makes it clear that he worked on this laptop on the day before my scheduled examination because County election officials were concerned about whether or not "Hardening Guidelines" had been applied to it. I will describe "hardening guidelines" below.

22. From a technical point of view, Mr. Cossaboon's interference with the laptop computer hindered my examination and did not help it. The fact that "the computer was running very slowly" would not have prevented my examination from proceeding. Furthermore, the very causes of the fact that "the computer was running very slowly" would have been relevant to my examination, as they could have been causes of the anomalous election result in the Primary Election.

23. Mr. Cossaboon says, "At no time did I delete any information concerning the programming of the voting machine used in the June 7, 2011 election." From a technical point of view, it is not possible to make this conclusion. If a hacker had interfered with ballot programming, then computer files that *nominally* should not be related to ballot programming might in fact contain evidence related to such interference.

24. Scenario (d) would very likely have left evidence on the laptop computer in the form of log entries and in the form of other files and folders. If there was evidence in the log files, then Mr. Cossaboon certainly erased that evidence. If there was evidence in other files and folders, it is possible that Mr. Cossaboon erased it.

25. In the field of computer security, the purpose of log files is to allow investigations post-facto of anomalous behavior. The swapping of candidates on the ballot is certainly

anomalous, and deserved investigation.   It is most unusual for a system administrator to delete log files when he knows that an investigation is pending. This defeats the purpose of log files.

26. The log files in question are not only a good idea, they are specifically part of the "Hardening Guidelines" that Judge Linda Feinberg ordered the State of New Jersey to institute. I explained these "Hardening Guidelines" in my Certification to this Court of August 18, 2011. It is my understanding that Judge Feinberg ordered these to be applied to all WinEDS laptops in the State of New Jersey more than a year in advance of the June 2011 Primary Election.

27. I have read the Certification of Robert Giles dated August 25.   Mr. Giles writes that he believes most counties installed the Hardening Guidelines in 2010, but he does not say he has direct knowledge of whether Cumberland County installed the Hardening Guidelines. In my examination, I attempted to determine whether the Hardening Guidelines had been installed to protect the computer before the Primary Election.

28. I was provided very limited access to the WinEDS computer—I was not allowed even to touch it. This, combined with the erasure of log files, means that *the technical evidence that I saw during my examination on August 17* cannot distinguish whether the Hardening Guidelines had never been installed before August 16, or that they had been installed in 2010 or 2011 but someone erased the log files on August 16.

29.   I believe that a much more thorough forensic examination of this computer might be able to determine whether computer files were deliberately destroyed that might have permitted me to inform the Court of what happened in preparing for the Primary Election.

30. If indeed the Hardening Guidelines were not installed before June 2011, then elections in Cumberland County would have been more vulnerable to Scenario (d) during this election.

Inadequate seals

31. Since 2008, the State of New Jersey has attempted to secure the internals of AVC Advantage voting machines from tampering with their internal software program by using a set of supposedly tamper-evident seals: a red adhesive tape and a wire cable seal.   In a Certification to Judge Feinberg's Court before the trial, I demonstrated that these seals are very insecure and easily defeated. That is, it is easy to remove them and replace them without evidence of tampering. After that certification, but before the trial began, the State represented to the Court that it would abandon those insecure seals and adopt different, more secure ones.

32.   During the trial, Judge Feinberg heard evidence that it is easy to defeat even the more secure seals, and that the State has inadequate protocols for choosing, applying, and inspecting seals. Her Opinion indicates that her Order will direct the State to formulate a "seal-use protocol" (page 190). She writes "While the new seals proposed by the State will provide enhanced security and protection against intruders, it is critical for the State to provide a seal protocol…"

33. When I examined Cumberland County's voting machine #23550 on August 17, 2011 I found that the seals in place were the same insecure ones in use in 2008: the red adhesive tape and the wire cable seal. These are the very seals that the State represented to Judge Feinberg that it would abandon in favor of better seals. They are not the "new seals" she refers to in her Opinion.

34. To the extent that people with criminal intent have access to the internals of AVC Advantage voting machines, because inadequate seals are used or for any other reason, elections in New Jersey are more vulnerable to fraud.

Unreliable checking procedures upon which Judge Feinberg relied

35. The AVC Advantage produces incorrect results if the printed ballot sheet does not correspond to the ballot definition file in the cartridge. Therefore, before each election it is important to check the correspondence, otherwise the AVC Advantage system is unreliable.

36. In her Opinion of February 1, 2010 about whether the AVC Advantage is sufficiently accurate to use in New Jersey elections, Judge Feinberg relied on testimony by James Clayton, an employee of the Ocean County, NJ Board of Elections. Mr. Clayton testified about the procedure used in Ocean County to check the correspondence:

> "the buttons are pressed and the lights compared to the names on the ballot … Next, the
>
> pre-accuracy and logic test [sic] ('Pre-LAT') is performed." [Feinberg Opinion, p. 16]

37. I have read the transcript of Mr. Clayton's testimony and I fully understand what Judge Feinberg is referring to in her summary. The affidavit of Lizbeth Hernandez indicates that this very procedure was performed in Cumberland County, and it failed to detect the error.

38. I will explain the procedure. There is a small LCD display on the ledge underneath the full-face ballot of the AVC Advantage voting machine. During an election, the main purpose of this display is to allow the voter to cast write-in vote. However, in "diagnostic mode" (and in some other modes), when a voter pushes a button (such as I23) on the full-face ballot, the AVC Advantage shows on this LCD display the name of the corresponding candidate in the electronic Ballot Definition file. The process that Mr. Clayton testified to is this: for each candidate shown on the printed ballot paper, the technician presses the button. While holding down the button, he reads the name shown on the LCD, and verifies that it is the same as the name shown on the printed ballot paper.
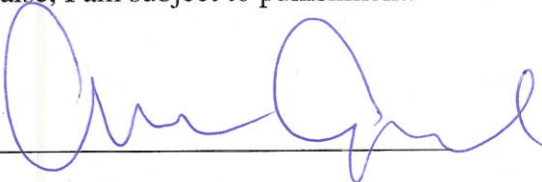
39. The affidavit of Lizbeth Hernandez dated July 5, 2011 contains as an attachment a letter dated June 24, 2011 signed by Lizbeth Hernandez in which she writes, "… the voting machine technicians inserted the cartridge into the voting machine and began the necessary testing. Along with hardware and software tests that are performed, this examination involves the technicians pushing every button for the contests, candidates, and personal choice selections to check for accuracy. Like me, these voting machine technicians are human and did not catch the error that I had made. Consequently, the machine was sent to the polling location with this error undetected."

40. Ms. Hernandez does not describe the process in much detail, but to the sketchy level of detail she describes, this is consistent with Mr. Clayton's testimony.

41. It is clear that this procedure is not reliable, because it did not catch the mismatch between paper ballot and electronic files in this election. Therefore elections that use AVC Advantage remain vulnerable to error (in the case of Scenario (e)) or fraud (in the case of Scenario (d)).

42. I certify that the foregoing statements made by me are true. I am aware that if any of the foregoing statements made by me are willfully false, I am subject to punishment.

Dated: August 29, 2011

Andrew W. Appel

Pursuant to the provisions of *R.* 1:4-4, I, Samuel J. Serata, Attorney for Petitioners, hereby certify that Andrew W. Appel acknowledged the genuineness of the above signature and that a copy with the original signature will be filed if requested by the Court.

Dated: August ___, 2011

Samuel J. Serata