THE LEAGUE OF WOMEN VOTERS OF SOUTH CAROLINA
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LWVSC Position on South Carolina's Voting Machines

Presentation to South Carolina General Assembly Legislative Audit Council
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Summary

Beginning with the adoption of a statewide study in 2005, the League of Women Voters of South Carolina (LWVSC) has gradually increased our understanding of the voting technology used in South Carolina. Our work began with the examination of general requirements for voting systems and expanded to considerable expertise in the operation of the SC system.

League standards call for the use of paper ballots that provide a paper record and are verifiable by the voter while still in the process of voting and retained for an audit or recount. As we studied the machines used in South Carolina, we discovered the existence of electronic data files that could be used to prevent some types of poll worker errors. We recommend procedures, including post-election audits, which will make voting on the current machines more reliable and transparent.

Recently we have begun to study technologies that could be used to replace our current voting machines, which are nearing the end of their expected life span[i].

League Involvement in Studying Voting Machines

In May 2005, the LWVSC Convention adopted a two-year member study of the iVotronic voting machines used in South Carolina[ii]. The study committee, led by Ms. Shan Rose and Dr. Eleanor Hare[iii], was instructed to include security from hacking and the availability of an auditable paper trail.

The study committee first developed a paper-and-pencil model[iv] of the operation of the iVotronic and presented this model to local leagues across South Carolina. This model demonstrated that the original ballot, seen on the screen of the voting machine, was erased when the "vote" button was pushed. The position of the voter's finger on the screen is translated into a vote, which is then stored in three internal memories. When the polls are closed, the contents of the internal memory are copied to the flash memory[v] and to a Personal Electronic Ballot (PEB). Hacking or other problems with the software or hardware could cause the vote cast to be recorded incorrectly in the computer memory[vi].

In January 2006, Ms. Rose and Dr. Hare met with Director Marci Andino, Ms. Donna Royston and Mr. Jim Lee of the South Carolina State Election Commission (SEC) concerning upgrades, maintenance and security of the voting machines[vii]

In June 2006, the National Convention of the League of Women Voters (LWVUS) adopted the following requirements for secure, auditable, reliable and recountable voting systems:

- they employ a voter-verified paper ballot or other paper record, said paper being the official record of the voter's intent; and
- the voter can verify, either by eye or with the aid of suitable devices for those who have impaired vision, that the paper ballot/record accurately reflects his or her intent; and
- such verification takes place while the voter is still in the process of voting; and
- the paper ballot/record is used for audits and recounts; and
- the vote totals can be verified by an independent hand count of the paper ballot/record; and
- routine audits of the paper ballot/record in randomly selected precincts can be conducted in every election, and the results published by the jurisdiction.

At the 2010 National Convention, the delegates added the principle of transparency, so that the League would support voting systems that are secure, accurate, recountable, accessible and transparent[viii].

The iVotronics did not meet LWVUS standards because there is no paper ballot, seen by the voter and retained for audits and recount. Since the iVotronics do not produce paper ballots, the vote totals cannot be verified by an independent hand count of paper ballots and audits of the paper ballots are not possible[ix],[x].

In May 2007, the LWVSC Convention adopted a position requiring that voting machines purchased in future include a paper audit trail and provide a reliable basis for a recount. The Convention also supported mandatory random testing of voting machines during every election and that source code of voting machines should be open for inspection.[xi]

In March 2008, Dr. Barbara Zia, Dr. Duncan Buell[xii] and Dr. Hare met with Director Andino and Ms. Donna Royston of SEC[xiii] to discuss current issues in voting technology, including problems in Horry County, responsibilities of the counties, and the weaknesses disclosed by the EVEREST Study in Ohio[xiv].

In the next two years we examined voting procedures, discovering that votes on the iVotronics were not recounted, even when a recount was required by law. Instead, the votes were retotaled. During this time we continued to publish articles in the SC Voter[xv],[xvi] and Op Eds in South Carolina newspapers[xvii].

In summer 2010, working with Mr. Frank Heindel[xviii] and Mr. Chip Moore[xix], the League began looking for ways to determine the correctness of the reported vote. Eventually, using Freedom of Information Act (FOIA) requests, we obtained electronic data voting files from 14 counties. Dr. Buell and Mr. Moore developed computer programs to process the electronic data files, revealing over 2000 incorrectly certified votes in that election.

Early results of auditing the electronic files are described in the *SC Voter*[xx],[xxi]. A detailed account describing how the miscounting occurred was presented by Dr. Buell at the Usenix Workshop on Electronic Voting Technology/Workshop on Technologies for Elections in San Francisco, CA [xxii]. A complete assessment of the 2010 General Election was not possible because many counties could not produce complete data files.

As it became apparent that new technology must soon be purchased to replace the iVotronics, which are no longer being manufactured, LWVSC State Board created a task force[xxiii] charged with surveying the benefits, deficiencies and costs of currently available voting technologies[xxiv]. This task force is co-chaired by Dr. Buell and Dr. Hare. Their most recent publications concern election verification[xxv] and the integrity of voting technology[xxvi].

The ES&S iVotronic System

All voting in South Carolina is done on either iVotronic Direct Register Electronic (DRE) voting machines or paper ballots read by an optical scanner. Only Elections Systems & Software (ES&S) equipment is used.

Because the iVotronics have no paper ballots, it is not possible to reconstruct the vote cast if the machines fail or are hacked. Also, the vote can be incorrectly reported if poll workers fail to follow manuals precisely. If databases do not match ballots, elections workers may enter results manually into the totals, a process known to introduce inaccuracies.

A positive aspect of the iVotronics is that their electronic data files can be evaluated by computer programs and this evaluation will detect failure to collect all the votes and some other problems.

South Carolina uses Model 100 and Model 650 optical scanners, manufactured by ES&S, to read the paper ballots. Optical scanners are known to sometimes miss the intent of the voter and this problem has been demonstrated with the Model 650[xxvii]. The advantages of using paper ballots with optical scanners include the ability to verify the correctness of the optical scanner by audits of a random sample of the vote cast and, in very close elections, to check the correctness of the reported vote by hand-counting the ballots.

South Carolina does neither.

The integrity of the iVotronic voting system can be greatly increased if a post-election audit of the electronic data is performed after every election. The SEC currently is performing these audits.

To ensure the validity of an election, SEC should also institute procedures that call for hand counting of ballots in a close election and an audit (using a hand-count) of a random selection of paper ballots in every election.

Known Problems with the ES&S Technology – the EVEREST Report

Project EVEREST, a joint effort of the University of Pennsylvania, Pennsylvania State University and other groups for the Secretary of State of Ohio[xxviii], examined the internal programming code and hardware of several voting systems, including the ES&S equipment used in South Carolina. It identifies problems which could result in votes being incorrectly recorded in the internal memory of the iVotronics. This study concluded that the computer-based voting systems examined "do not meet computer industry security standards and are susceptible to breaches of security that may jeopardize the integrity of the voting process." Beginning on page 76, the EVEREST Report lists twelve recommendations for improving the integrity of elections. Recommendation #2, "Eliminate DREs" is a recommendation to eliminate the use of the iVotronics.

The ES&S equipment examined in the EVEREST Report, including version numbers, is identical to the equipment used in South Carolina.

The EVEREST Report documents problems and solutions that were known in 2007. In the years since its publication scientists and election officials have continued to propose methods of improving the integrity of the vote

Voting Problems in South Carolina

In the 2010 General Election, 1,127 votes in Richland County were not certified because they were not collected from the voting machines and another 1,389 certified votes in Colleton County were not cast on any ballot. These errors in these two counties represent over 2,516 votes incorrectly counted in a single election. Additional errors occurred in other counties.

Several thousand volunteer poll workers receive only a few hours of instruction, but must adhere meticulously to the Poll Workers Manual in order to avoid counting failures, supervise voting. Post-election audits are necessary because it is unrealistic to expect that every poll worker and every election official will function flawlessly under the pressure of an Election Day that begins before 7 a.m. and ends well after 7 p.m.

Audit files from the 2012 Presidential Primary reveal that poll worker problems are still present. There are a number of instances in which multiple PEBs were used. Since the use of multiple PEBs in a precinct was responsible some of the documented failures in 2010, this problem needs to be strongly addressed. Ward 21 in Richland, which failed to collect all its votes in 2010, used multiple PEBs in the presidential primary. Correcting these problems may require that SEC be given more authority over the operations of the counties.

Fortunately, SEC has the ability to perform post-election audits on the electronic data files from the iVotronics that will detect many of these errors and allow their correction.

Scanners are another problem. It is well known that scanners are not completely reliable in detecting the intent of the voter. If a voter circles the name, fills in the oval too lightly or too heavily, or marks an "X" through the oval instead of filling it in, the scanner may not detect the

voter's obvious intent. In the case of the Model 650 scanner, used in the larger counties in SC, failure to adequately report the intent of the voter has been observed and reported[xxix].

Scanners are also subject to hacking and incorrect programming. Fortunately, if a recount is required by law, a hand-count of the paper ballots will accurately report the intent of the voters. Simply rescanning the same ballots using the same scanner, the procedure used in South Carolina, is unlikely to ever give a different count.

Suggestions for Mitigating Voting Problems

South Carolina will continue to use the ES&S election technology for several years, both because there is little money available to purchase a new system and because there is no other system being proposed as a likely replacement. However, the lifetime of the current technology is quite limited. ES&S no longer manufactures the iVotronic and all "new" iVotronics, purchased by the counties in response to population growth, are actually used refurbished machines, purchased from counties that have discontinued their use.

Fortunately, there are procedures available to SEC that can mitigate or eliminate several known problems.

First, a post-election audit of the electronic data files after every election should eliminate the problem of uncollected votes. In addition to confirming when all votes cast have been collected, the post-election audit will help county election directors identify any machines which have uncollected votes. All votes can then be collected before certification. System messages (in the EL152 Event Log data) will alert county directors to potential failures so that preventative action can be taken.

Second, audit files and reports of post-election audits should be posted on the SEC website after every election. Posting the files and report improves voter confidence. SEC has posted these files for the 2010 General Election and the 2012 Presidential Primary[xxx]. The SEC site indicates that 2012 primary audit files are "coming soon." Our only suggestion is that the form in which these reports are presented could be easier to understand.

Third, an audit of a random selection of paper ballots should be performed in order to detect hacking or other problems with the scanners. This audit is a standard procedure that is recommended wherever scanners are used to count ballots.

Fourth, when a recount of paper ballots is required, the recount should be by hand or by some other process, such as using a different model scanner that is independently programmed. A second scan of the ballots on the same scanner is not acceptable as a recount.

Fifth, the SEC needs better funding and more authority to oversee statewide procedures.

Costs of Currently Available Technology

The Verified Voting website maintains a list of voting technologies used by states[xxxi]. ES&S, Premier Election Solutions (Diebold), Sequoia Voting Systems and Hart InterCivic are the primary manufacturers, although there are some others and some states count their ballots by hand.

The common factor is that these systems are expensive. For example, a new iVotonic (if a new one could be bought) costs around $3000. When equipped with audio, a new iVotronic can cost between $4000 and $5000. In addition to the original purchase price, the counties must pay an annual maintenance fee to ES&S for the right to use the machines they bought. This fee is common to all the manufacturers because all claim their code is proprietary and only they can maintain them. In South Carolina the annual maintenance fee is more than one million dollars. Election costs tend to be unavailable to the public because the counties, not the state, pay most of these costs.

Ballot programming is also proprietary. In South Carolina, only technicians who have attended ES&S training are permitted to program ballots, a process which includes programming the scanners to read the ballots correctly. Providing paper ballots, which must be supplied in excess of the expected demand, is also an expensive and wasteful process. Only companies approved by ES&S are permitted to print ballots.

Elections are not transparent because manufacturers do not permit election officials to have access to the working parts of their equipment, even when the equipment has failed to record votes correctly.

The Future of Voting Technology

Scientists are currently examining systems based on readily available multipurpose computers, printers, and scanners, called "commodity" hardware[xxxii]. The "voting machine" would be a pc, Mac, iPad, or other commonly available programmable computer or tablet. Manufacturers, scientists, or computer companies could write the software that turns the commodity hardware into a voting machine. It could be "open source," meaning that anyone could look at it and point out errors. The voting machine would print a ballot that is inspected by the voter, counted by a scanner and retained by the elections system. It is expected that commodity-based voting may be available in as few as three years.

Since commodity voting machines would cost about $500 each instead of $3000 to $5000 each, the cost of buying the equipment would be greatly diminished. The same cost savings would be generated in purchasing commodity printers and scanners. The commodity hardware would not be single purpose, but could be in use constantly for other tasks.

This system would no longer require the preprinting of large quantities of paper ballots. The voting machine would print the official ballot. Since the paper ballot is counted and retained as the official record, there is no longer a need for secrecy of the voting machine software. As with any voting system, a post-election audit of randomly selected ballots would protect against hacking and poorly functioning systems.

A voting system built on the use of commodity hardware and voting software would be more accurate, secure and cheaper than our current system. The ballot printed by the voting machine would be examined by the voter, counted by the scanner, and retained for an audit or recount.

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[i] Marci Andino, Statement to the South Carolina State Elections Commission, Sept. 22, 2010.

[ii] Studies for 2005 – 2007, page 5, *SC Voter*, Spring 2005.

[iii] Associate Professor Emerita of Computer Science, Clemson University.

[iv] "Counting and Recounting the Vote," page 6, *SC Voter*, Fall 2005.

[v] A removable memory similar to those used in digital cameras.

[vi] Project Everest, a study of the same system as used in SC performed for the Secretary of State of Ohio demonstrated problems with the ES&S iVotronic system that can not be corrected by better voting procedures. http://www.sos.state.oh.us/sos/upload/everest/00-SecretarysEVERESTExecutiveReport.pdf

[vii] LWVSC Meets with SC State Election Commission, page 9, *SC Voter*, Spring 2006.

[viii] Impact on Issues 2010-2012, page. 12. This is referred to as SARAT.

[ix] Statement of LWVSC position on voting equipment (in Editor's Note), page 7, *SC Voter*, Fall 2006.

[x] Electronic Voting – Security From Hacking, page 7, *SC Voter*, Fall 2006.

[xi] LWVSC position paper. http://lwvsc.org/files/electiontech.pdf

[xii] Professor of Computer and Engineering, University of South Carolina, Columbia, SC.

[xiii] SC Voting Machines: LWVSC Interviews Elections Officials, page 9, *SC Voter*, Fall 2008.

[xiv] EVEREST Report, http://www.sos.state.oh.us/sos/upload/everest/00-SecretarysEVERESTExecutiveReport.pdf

[xv] Voting Machine Certification and Software Independence, page 5, *SC Voter*, Winter 2007.

[xvi] Safeguarding the Vote, reprinted from *The State* newspaper, page 10, *SC Voter*, Summer 2010.

[xvii] Votes miscounted, laws ignored, *The Post and Courier*, Sept. 15, 2011, http://www.postandcourier.com/article/20110925/ARCHIVES/309259973

[xviii] Mount Pleasant, SC.

[xix] Boston, MA.

[xx] "South Carolina's Voting Machines II: Auditing the Voting Machines," page 10, SC Voter, Spring 2011.

[xxi] South Carolina's Voting Machines: A Post-Election Status Report, page 9, *SC Voter*, Winter 2011.

[xxii] "Auditing a DRE-based election in South Carolina," http://static.usenix.org/event/evtwote11/tech/final_files/Buell.pdf

[xxiii] http://clemsonarea.sc.lwvnet.org/Voting_Systems.html

[xxiv] Voting Equipment: An Overview, page 7, *SC Voter*, Fall 2011.

[xxv] Election Verification in South Carolina, page 10, *SC Voter*, Spring 2012.

[xxvi] Ensuring the Future Integrity of the Vote, page 10, *SC Voter*, Spring 2012.

[xxvii] Jones, Douglas & Simons, Barbara (2012). *Broken Ballots*, Stanford, CA: CSLI Publications, Figure 24, page 83.

[xxviii] http://www.sos.state.oh.us/sos/upload/everest/00-SecretarysEVERESTExecutiveReport.pdf

[xxix] http://clemsonarea.sc.lwvnet.org/Scanners.html

[xxx] http://www.scvotes.org/2010/09/08/election_results

[xxxi] http://www.verifiedvoting.org/verifier/searched.php?ec=allall&state=AZ&equipment_type%5B%5D=All+Types&vendor%5B%5D=All+Vendors&model%5B%5D=All+Models&vvpat=all&submit=Search&rowspp=50&topicText=&stateText=

[xxxii] "Commodity" hardware is hardware that is easily and affordably available. A device that is said to use "commodity hardware" is one that uses components that were previously available or designed and are thus not necessarily unique to that device.