Auditing a DRE-Based Election

in South Carolina

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Elections in South Carolina

Statewide adoption of ES&S iVotronics DRE (2006-forward) with county-level accumulation on "Unity" ERM software

Absentee voting on paper or on DREs at county headquarters

No paper trail

No post-election auditing (as of 11/02/2010)

ES&S iVotronics

(From the Verified Voting website)

PEB

The Election Procedure

- Greenstripe master PEB to open and close iVotronic terminals
- Redstripe PEB used for individual votes
- Closing causes event log and vote image file to be written to a compact flash memory card as an audit trail
- Totals collected into PEB at closing
- PEB totals become paper tape total for posting at the precinct level at closing
- PEB totals accumulated at county HQ
- Results to be certified by Friday for a Tuesday election

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CANVASS CHECKLIST

Charleston Election Commission

Election: *Statewide General* Election Date: **Nov. 2, 2010**

Initials	N/A	
✓		All optical scan absentee ballots have been accounted for and properly scanned, including any provisional ballots found to be valid at the provisional ballot hearing; and the results have been imported into the Election Results Manager (ERM).
✓		All PEBs, or other media, from the in-office absentee/fail-safe voting machine(s) have been read into ERM, including any provisional ballots found to be valid at the provisional ballot hearing.
✓		All PEBs from all precincts have been read into ERM.
✓		All optical scan emergency ballots have been located and properly scanned, and the results have been imported into ERM.
✓		All non-optical scan paper ballots cast at a polling place have been located and counted, and the results have been manually entered into ERM in the proper precincts. *Note: When manually entering vote totals, ballots cast figures must also be manually updated. See Election Preparation & Results Accumulation Guide (EPRAG).*
✓		All optical scan ballots rejected by the scanner have been duplicated and scanned, attaching the duplicates to the originals, and the results have been imported into ERM; or the ballots have been counted by hand and manually entered into ERM. *Note: When manually entering vote totals, ballots cast figures must also be manually updated. See EPRAG.*
✓		All ballot boxes have been opened and thoroughly checked for any paper ballots cast at polling places.
✓		All precinct-level PEB results uploaded to ERM have been checked against the precinct-level paper tape results.
✓		The Managers Return of Paper Ballots form has been examined; and the number of emergency and provisional ballots cast at the polls has been reconciled with the number of emergency ballots counted, and the number of provisional ballots considered at the provisional ballot hearing.
	✓	All flash card audit data has been uploaded into ERM and securely saved to a CD for required 22-month retention period *(see EPRAG).* will be completed when info's ret'd
✓		The above steps were done in accordance with the applicable procedures set forth in the latest version of the EPRAG.
		Other steps taken:

This form must be presented to the Board of Canvassers prior to certification of results.

Signed: _[signature]_ Date: 5 Nov 2010

Observed Failures (1)

If two PEBs (or more) are used to open and close in a pct, then maybe only one gets uploaded to the totals.

Ward 21, Richland County

     339 votes counted from 3 terminals

     355 votes not counted from 3 terminals

Racepath Precinct, Horry County

     114 votes not counted from 1 terminal

Actually, several hundred terminals statewide opened and closed with different PEBs.

Given audit data, we can detect this.

Observed Failures (2)

If terminals are not closed, their votes are not collected.

Bluff Precinct, Richland County

> Six of eight machines not closed
>
> 772 votes not counted
>
> Multiple warnings overlooked

Given audit data, we can detect this.

OTOH, there is apparently a way to collect totals without leaving an audit trail.

Observed Failures (3)

The memory cards are supposed to be collected with their audit data at the county level.

Apparently this is frequently not done.

> Richland County, about 30/820 cards
>
> Horry County, 53 of 125 precincts
>
> Beaufort and McCormick, on 3/28/2011
>
> Charleston, not yet?

Existence of some problems can sometimes be detected by the absence of the data.

Correction of the problems seems to require the data.

Observed Failures (4)

Test votes wind up in the official file of votes
Lexington County, 25 votes over 17 precincts
Horry County, 3 votes in 3 different precincts

Two suggestions for how this could happen.

The votes have bizarre patterns and are thus identifiable.

Given audit data, we can easily detect this.

What Did We Do?

FOIA of EL68, EL68A, EL152, EL155 files from about 20 counties, mostly from 11/02/2010, but some from 6/8/2010 and 6/22/2010.

Not all counties complied, not all quickly, not all completely.

Programs by Buell and Moore separately, cross referencing results.

Lots of caveats about our results due to incomplete/insufficient data—WE VERY MUCH WISH WE COULD BE MORE AUTHORITATIVE AND LESS ANECDOTAL.

EL155 "Vote Image File"

5120350	5 *	10	Nikki R Haley	GOVERNOR
5120350	5	15	Ken Ard	LIEUTENANT GOVERNOR
5120350	5	19	Mark Hammond	SECRETARY OF STATE
5120350	5	23	Curtis Loftis	STATE TREASURER
5120350	5	27	Alan Wilson	ATTORNEY GENERAL
5120350	5	31	Richard A Eckstrom	COMPTROLLER GENERAL
5120350	5	36	Mick Zais	STATE SUPERINTENDENT
5120350	5	42	Bob Livingston	ADJUTANT GENERAL
5120350	5	45	Hugh Weathers	COMMISSIONER OF AGRIC
5120350	5	50	Jim DeMint	U.S. SENATOR
5120350	5	61	Jim Pratt	CON0006 U.S. House of
5120350	5	70	W/I CRAIG KITCHINGS	HOU074 State House of
5120350	5	73	W/I DAFFY DUCK	5TH CIRCUIT SOLICITOR
5120350	5	76	W/I JENNY KITCHINGS	PROBATE JUDGE
5120350	5	79	W/I MICKEY MOUSE	COUNTY AUDITOR
5120350	5	82	W/I BOB BARKER	COUNTY TREASURER
5120350	5	84	Mark W Huguley	Soil and Water
5120350	5	90	W/I GEORGE WASHINGTON	CCL0004 COUNTY COUNCIL
5120350	5	95	Joe Boyes	SAL0001 RICHLAND COUN
5120350	5	99	Rob Tyson	SCH0013 School Board
5126362	3 *	13	W/I JESSIE JOANNE SCHMITZ	GOVERNOR
5126362	3	16	Ashley Cooper	LIEUTENANT GOVERNOR
5126362	3	20	Marjorie L Johnson	SECRETARY OF STATE

EL152 "Event Log File"

```
5121076  152523  SUP  11/02/2010 06:01:41   0002808 Terminal - opening state
                 SUP  11/02/2010 06:02:30   0001303 Transfer PEB vote data to terminal
...
                 SUP  11/02/2010 06:03:17   0001672 Terminal Opened
                 SUP  11/02/2010 06:03:21   0001633 Terminal shutdown
         104621  SUP  11/02/2010 06:11:54   0001510 Vote cast by voter
         152604  SUP  11/02/2010 06:21:57   0001510 Vote cast by voter
5121076  153424  SUP  11/02/2010 17:47:05   0001510 Vote cast by voter
                 SUP  11/02/2010 17:56:20   0001510 Vote cast by voter
...
                 SUP  11/09/2010 14:30:03   0002810 Terminal - time to close voting
                 SUP  11/09/2010 14:30:15   0001626 Close terminal
                 SUP  11/09/2010 14:30:15   0002809 Terminal - closing state
                 SUP  11/09/2010 14:30:15   0001221 Collect terminal vote data to PEB
                 SUP  11/09/2010 14:30:44   0001303 Transfer PEB vote data to terminal
                 SUP  11/09/2010 14:30:51   0001208 Merge terminal & PEB vote data
                 SUP  11/09/2010 14:30:54   0002802 Terminal - open state
                 SUP  11/09/2010 14:30:54   0002803 Terminal - closed state
                 SUP  11/09/2010 14:30:54   0002809 Terminal - closing state
                 SUP  11/09/2010 14:30:58   0001210 Transfer terminal vote data to PEB
                 SUP  11/09/2010 14:31:24   0001211 Terminal votes to PEB successful
                 SUP  11/09/2010 14:31:24   0001214 Transfer terminal writein data to PEB
                 SUP  11/09/2010 14:31:36   0001215 Terminal write-in data to PEB successful
                 SUP  11/09/2010 14:31:36   0001222 Terminal vote collection successful
                 SUP  11/09/2010 14:31:36   0002803 Terminal - closed state
                 SUP  11/09/2010 14:31:36   0001673 Terminal Closed
                 SUP  11/09/2010 14:31:42   0001401 Copy terminal flash audit data to CF
                 SUP  11/09/2010 14:31:42   0001400 Verify terminal flash audit data
                 SUP  11/09/2010 14:31:50   0001416 Copy audit data from TF 1 to CF
```

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EL68A "System Log File"

```
11-02  09:28 pm  START PACK ACCUMULATION   (Replace Mode - restarting)
11-02  09:29 pm  STOP PACK ACCUMULATION
11-02  09:39 pm       PRC 0009 MANUAL ENTRY
11-02  09:40 pm  STATS CANVASS - NUMBERED KEY WAS PRINTED TO LPT1
11-02  09:43 pm  START PROCESS PEBS
11-02  09:43 pm  PEB votes retrieved for P0153832
11-02  09:43 pm  SPP file record created for P0153832
11-02  09:43 pm  STOP PROCESS PEBS
11-02  09:43 pm  iVotronic GROUP 3 SELECTED FOR UPDATE
                   EQUIPMENT TYPE VTR - UPDATE PRECINCTS COUNTED:Y
11-02  09:44 pm  START PACK ACCUMULATION   (Replace Mode - restarting)
11-02  09:45 pm  STOP PACK ACCUMULATION
11-02  09:45 pm  CLEARED PEBS DATA
11-02  09:46 pm  START PROCESS PEBS
11-02  09:46 pm  PEB votes retrieved for P0153832
11-02  09:46 pm  SPP file record created for P0153832
11-02  09:46 pm  STOP PROCESS PEBS
11-02  09:46 pm  iVotronic GROUP 3 SELECTED FOR UPDATE
                    EQUIPMENT TYPE VTR - UPDATE PRECINCTS COUNTED:Y
11-02  09:46 pm  START PACK ACCUMULATION   (Replace Mode - restarting)
11-02  09:46 pm  0009-Time stamp mismatch (Reply was: Update)
11-02  09:46 pm       PRC 0009 PACK RECEIVED VTR   (BALS=340  TOT=375)
11-02  09:46 pm  STOP PACK ACCUMULATION
11-02  09:47 pm  STATS CANVASS - NUMBERED KEY WAS PRINTED TO LPT1
```

- 11-02 09:48 pm START PROCESS PEBS

Accounting for the PEBs

The 152 file records opening and closing the terminals by PEB number.

The 152 file has the "vote cast" events for existence of votes.

The 155 file has the actual votes (randomized).

The 68A file records (except in Beaufort!) uploads of totals from the PEBs, by number, to the county totals.

Given the data, we can reconcile the totals.

Accounting for the Terminals

If we had a list of terminals used in an election,

and the memory card data has been properly collected,

we can verify that all terminals were closed and track which PEB did the close.

Accounting for the Memory Cards

If the state certifies votes from the PEB totals,

but the memory card data isn't collected,

then the vote image file comes up short.

Totals can be collected a second time without leaving an audit trail?

Accumulating 152 and 155 data takes TWO steps by the operator.

Civic Action

LWVSC press release about Richland 2/14/2011.

State Election Commission is reproducing our results with a contract programmer.

Heindel & Buell addressed state Senate Judiciary subcommittee 4/14/2011. SC SEC has promised ongoing audits of this nature in future elections.

Future/Ongoing Work

REU student Cara Monical, summer 2011

Focused on mining the 152 event logs for "interesting" behavior (and to aid in quality control)

Detected hardware failures, bad devices, and procedural failures

(Collaboration with Edmundson/Quevedo/ Wagner of Cal-Berkeley)

The End