Ballot Reconciliation Procedure Guide

One of the most important distinctions between the vote verification system employed by the Open Voting Consortium and that of the paper-trail systems proposed by most current commercial vendors can be seen in the methodology used in the *ballot reconciliation procedure* (BRP).

This guide will detail the procedure by introducing and explaining each step in the process. The BRP was carefully designed to provide an uncomplicated yet effective way of verifying and auditing the integrity of every ballot. It also seeks to be as simple and transparent enough to instill confidence of the results in voters, election workers, and candidates.

Ballot Reconciliation Steps

1. Operator & Witness Sign-In
2. Paper Ballot Manual Count
3. Paper Ballot Scan Count
4. Vote Station Data Loading
5. Test Ballot Registration
6. Spoiled Ballot Registration
7. Paper & Digital Ballot Comparison
8. Operator & Witness Sign-Out

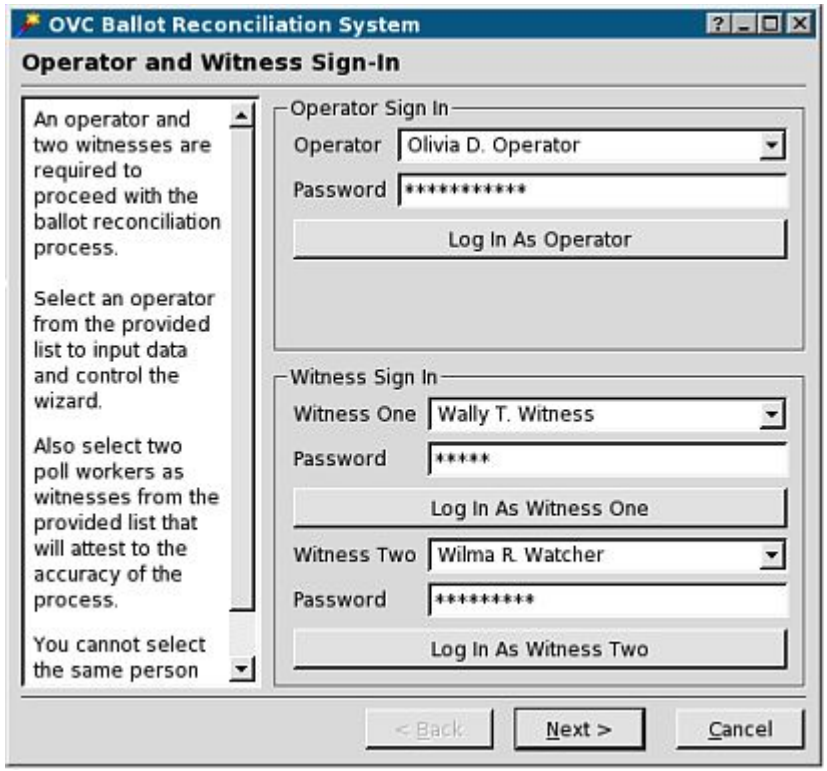
1 Operator & Witness Sign-In

An important part of the reconciliation procedure is ensuring that it is done with a high level of accountability. This requires that the operation and observation of the process be done by multiple people, each of which will be able to testify to the final result's accuracy.

To provide for this, the BRP system features a "chain of custody" requirement, which links operations with specific people. Three unique individuals from a list of pre-configured poll-workers must separately authenticate to unlock the application.

One user will serve as the application operator, responsible for inputting data and running the procedure commands. The two others will act as witnesses to the procedure, as well as assisting in the manual count of the paper ballots.

With this, there is no question as to who was present and responsible for the handling and verifying of the votes.



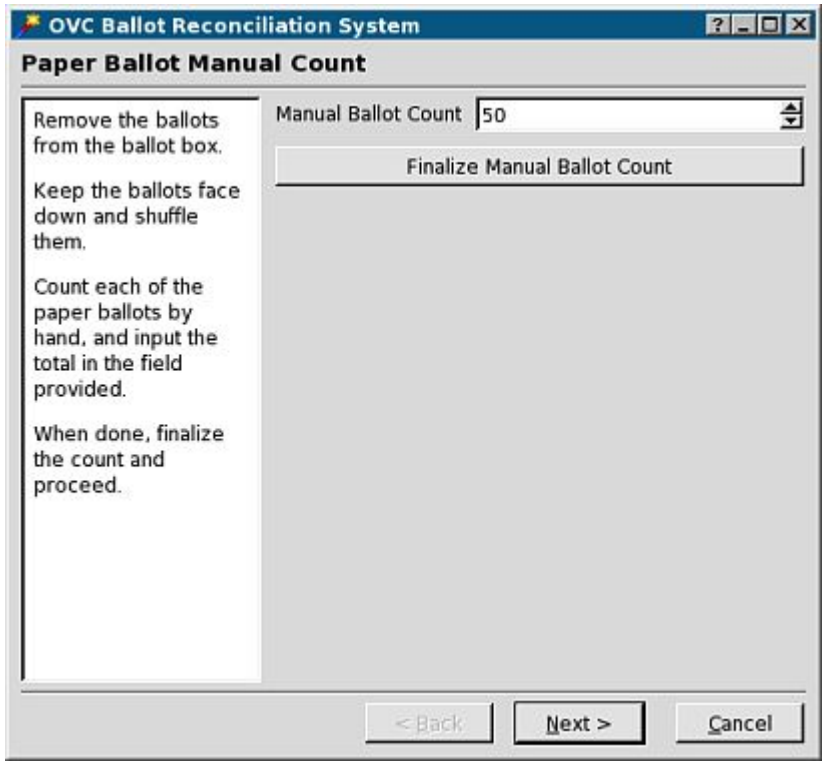
Poll-workers signing in to participate in the reconciliation procedure.

2 Paper Ballot Manual Count

The first step after authentication is the counting of the paper ballots. The ballots are removed from the ballot boxes, shuffled and stacked face down. Each ballot is then manually counted and double-counted.

When everyone comes up with the same total, that number is entered in the Manual Ballot Count field and stored by clicking the Finalize Manual Ballot Count button.

Throughout each step in the process are data input checks that validate the information as it is entered. This prevents most mistakes and ensures accuracy. It also enables the application to control the procedure's work flow: for instance, you cannot proceed to the third step unless the value entered is greater than zero. The field also disallows negative or alphanumeric data.



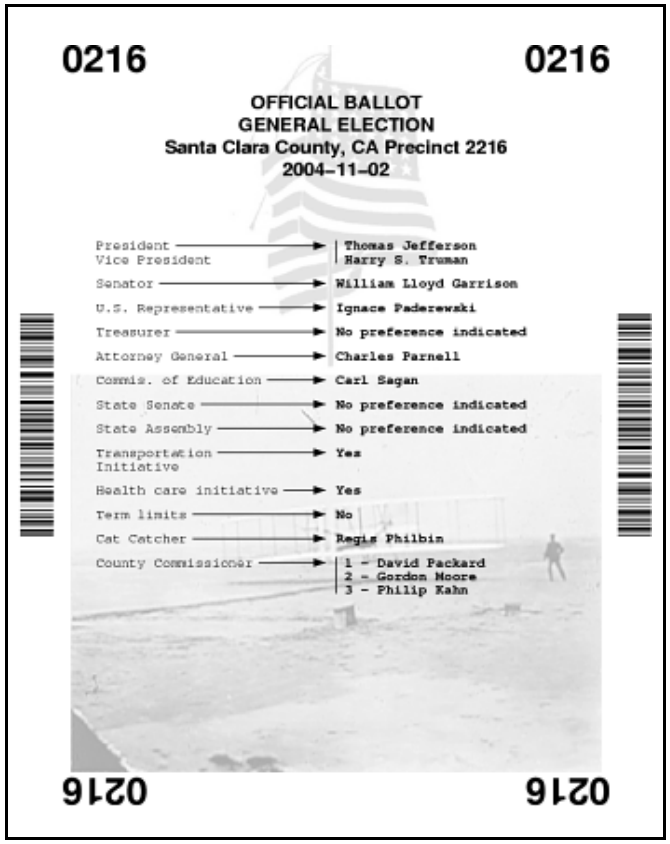
Participating poll-workers manually count the paper ballots and input the total.

3a Paper Ballot Scan Count

The Benefits of a Paper Ballot

The use of a true paper ballot is one of the major features that sets this system apart from other e-voting solutions currently on the market. The challenge of producing a verifiable electronic ballot stems from the mandatory separation between the voter's identity and the votes she casts. The OVC's simple yet ingenious solution is built upon a fundamental principle of accounting, which requires at least two separate records of every transaction.

Unlike a voter "receipt", which holds no official value, an official paper ballot provides confidence to the voter that her vote will be accurately recorded and cross-audited against a digital version of the same ballot, termed an Electronic Ballot Image (EBI). Each EBI is stored on disk as a human-readable XML file.



An official ballot, which will be counted, scanned and matched during the reconciliation procedure.

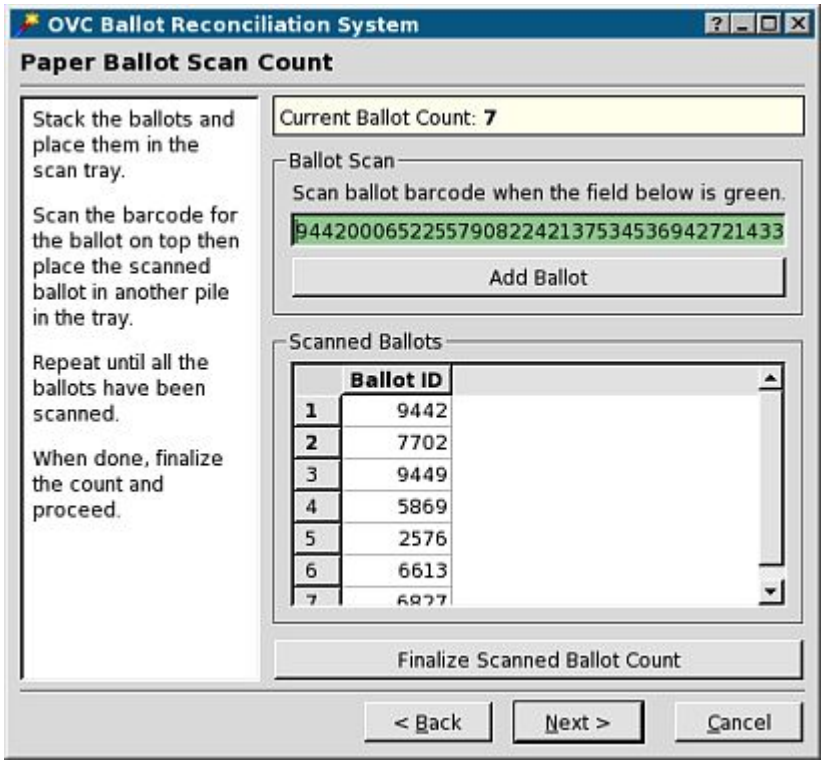
3b Paper Ballot Scan Count

Paper Ballot Scanning Process

Once the manual count is complete, the paper ballots are each scanned. The barcode printed on each paper ballot encodes the entire collection of vote choices for that ballot. After scanning a ballot, the BRP application rebuilds a digital copy of that ballot and stores it in the computer as a Reconstructed Electronic Ballot Image (REBI) file.

The application retains a list of REBIs, along with a count of the number of ballots scanned in to monitor the scanning process. It also checks the format of every barcode to verify that it is encoded properly and prevents ballots from being scanned twice. When all the ballots are scanned, you will then have a complete digital collection of the paper ballots cast during the election.

The REBIs will be matched for verification against another set of EBIs further in the BRP. The next step is to load the second set of EBIs into the application in preparation for ballot comparison.



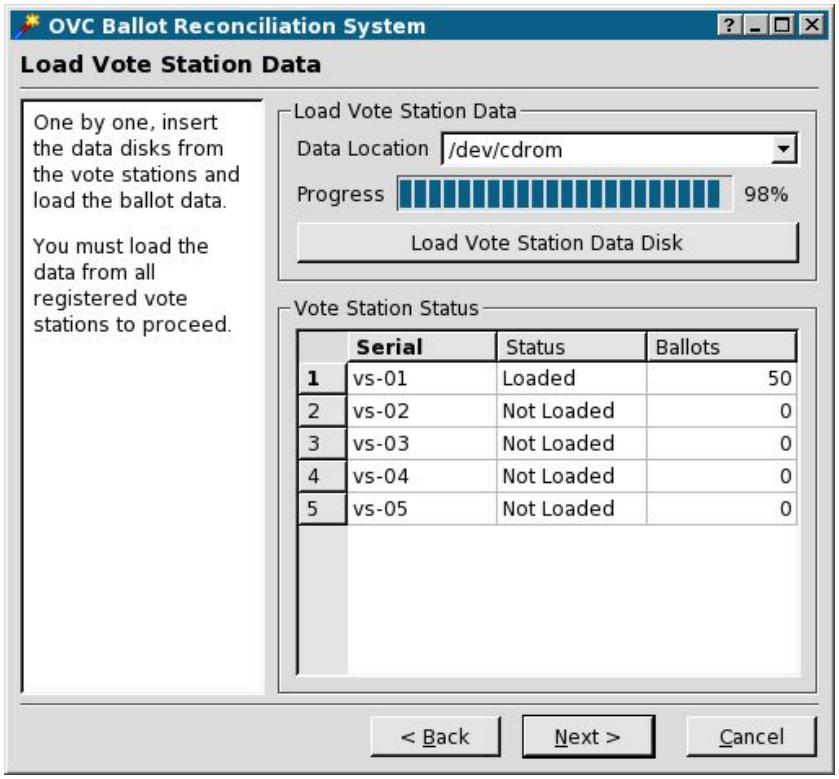
Unlike voter receipts, paper ballots are integral to verifying the accuracy of every vote from the beginning, not just during a recount.

4 Vote Station Data Loading

The BRP system uses two sources to verify the election records. With the paper ballots and their digital equivalents registered with the application, the second set is collected off the actual vote stations.

Every vote station produces two versions of each ballot: a paper ballot, which is printed, displayed for and received by the voter, and a digital ballot, that remains stored on the vote station until the polls are closed. At the end of the election, each vote station produces an archive of the ballots casts on that machine.

After collecting the archives, which may be stored on a recordable CD, USB drive, or other forms of removable media, the poll-workers load the archives into the BRP system, which verifies the archive is acceptable and transfers the ballots onto the computer. Each vote station must be loaded and accounted for before the system can proceed.

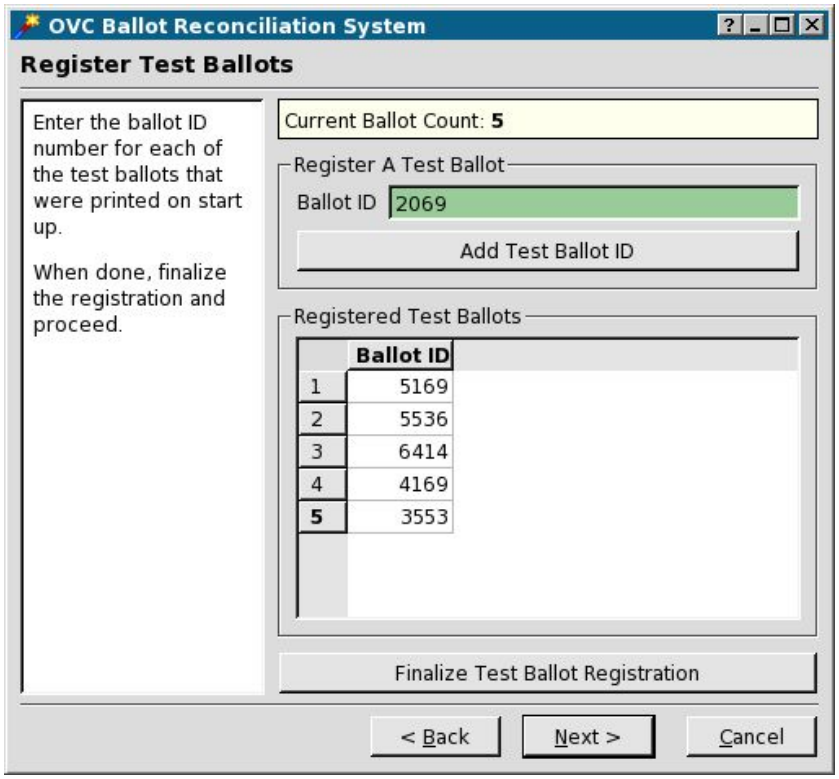


The BRP system aggregates the Electronic Ballot Images (EBIs) from all vote stations.

5 Test Ballot Registration

To aid in ensuring that the vote stations perform accurately and reliably, a number of test ballots can be run at any point during the election. When the test paper ballots are generated, their IDs are noted and are kept with other election records that will be used to check the final results, such as the voter roster.

While they are scanned in together with the official ballots, the test ballots are also registered as such to differentiate them during the tabulation procedure.This prevents them from being included in the precinct-level vote results.



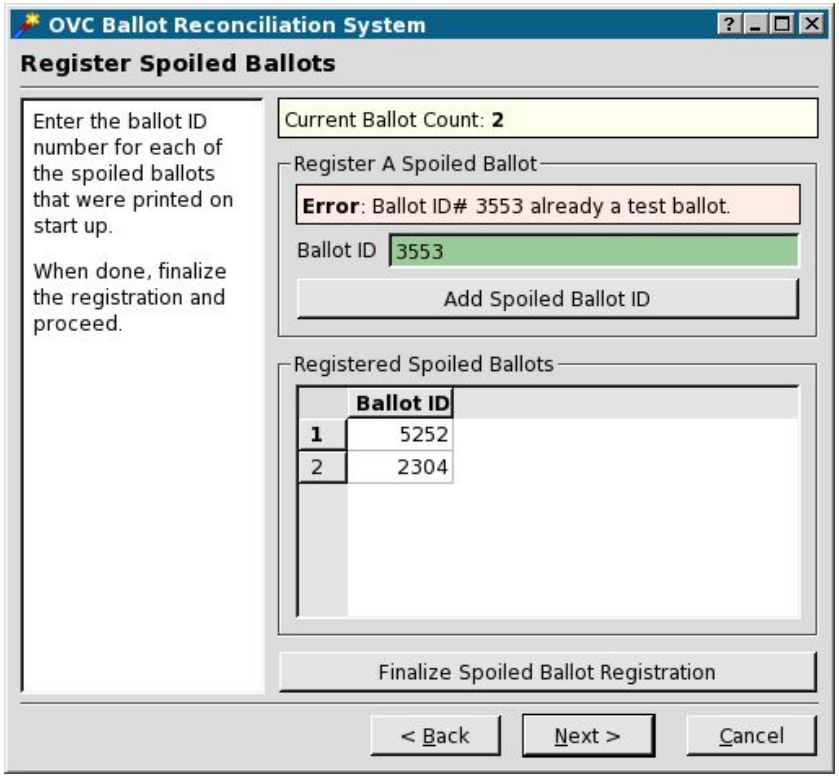
Test ballots provide an extra safeguard in ensuring accurate and reliable voting.

6 Spoiled Ballot Registration

One of the biggest benefits of a paper ballot is that the voter can verify their selections by checking the final official output before the ballot is placed in the box. If for some reason the voter isn't satisfied with their ballot it can be marked "spoiled" and another turn at a vote station can be provided.

The spoiled ballots are still important to the integrity of the entire election. Like a cash register that must be totaled out at the end of the day, errors and all, the spoiled ballots are also recorded and accounted for during the reconciliation process. Registering spoiled ballots prevents them from being tabulated in the final results.

As added checks, ballots already registered as test ballots cannot be marked as spoiled within the application. Also, along with test ballot IDs, spoiled ballots must be already stored on disk within the BRP system, and are looked up as each one is inputted. An invalid ID will not be registered.



Like every other ballot, spoiled ballots must be properly accounted for.

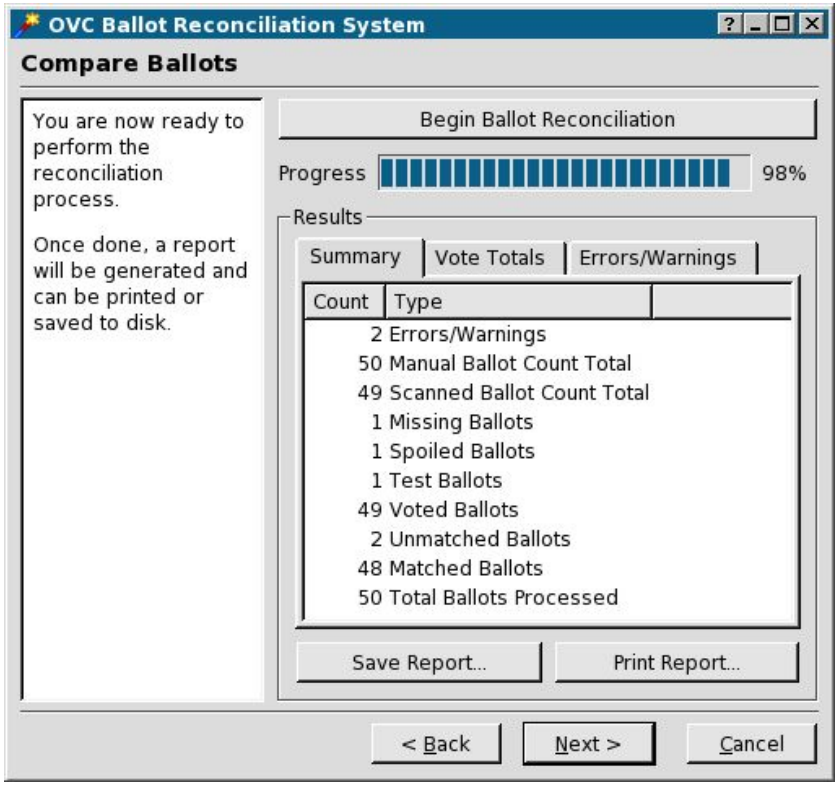
7a Paper & Digital Ballot Comparison

Reconciling the Data

Once all the data is entered, the actual reconciliation process can begin. At this point all that is necessary to activate the process is the click of a button. Behind the scenes the application processes the two sets of Electronic Ballot Images, reading and comparing each pair. If the pair matches, a copy of the file gets placed in a verified ballot archive.

During comparison, the system intelligently detects problems with or inconsistencies in the files. If a pair of ballots do not match exactly, they get marked and counted as such. If a ballot is missing its duplicate altogether, it gets marked as missing. Ballots flagged with errors are listed for inspection after the process is complete.

The cross-auditing of the ballots make tampering nearly impossible. Any inconsistencies across the totals will appear immediately.



By cross-auditing the manual, scanned, and vote station ballot records, a detailed and complete verification of every vote cast is possible.

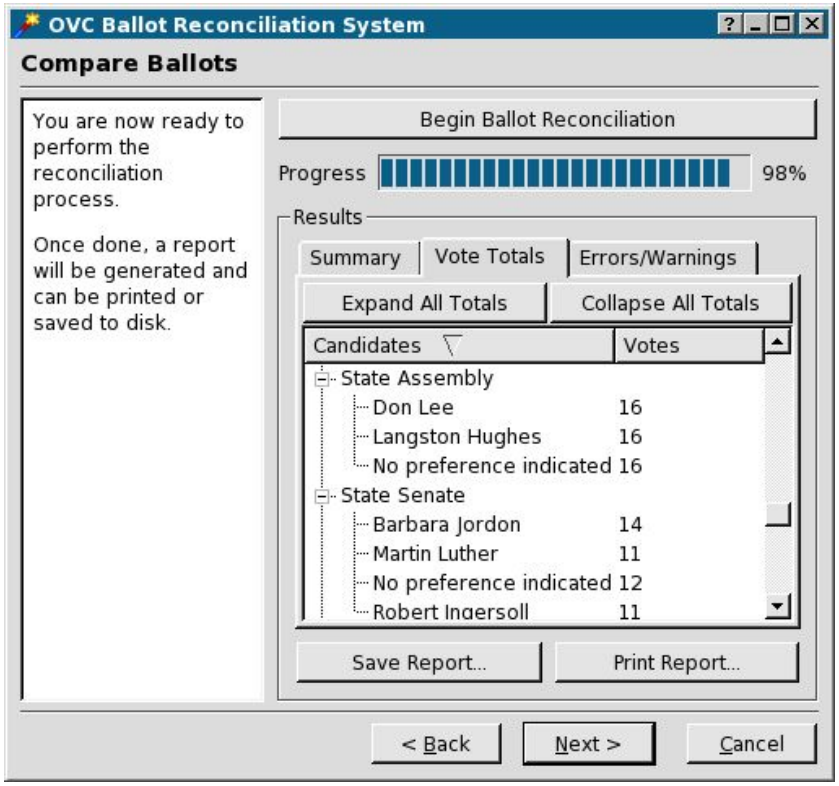
7b Paper & Digital Ballot Comparison

Precinct-level Vote Tabulation and Report Generation

For jurisdictions that allow them, precinct-level tabulation is provided as a convenience. The ability to browse the vote returns for candidates provides an opportunity to catch potential inconsistencies with typical voting trends in that precinct.

By examining ballot totals, turnout attendance numbers, and vote returns, poll-workers will be able to have a clear picture of the accuracy and results of the election.

At the click of a button, an election report complete with all the information used within the BRP system can be printed or saved to disk.

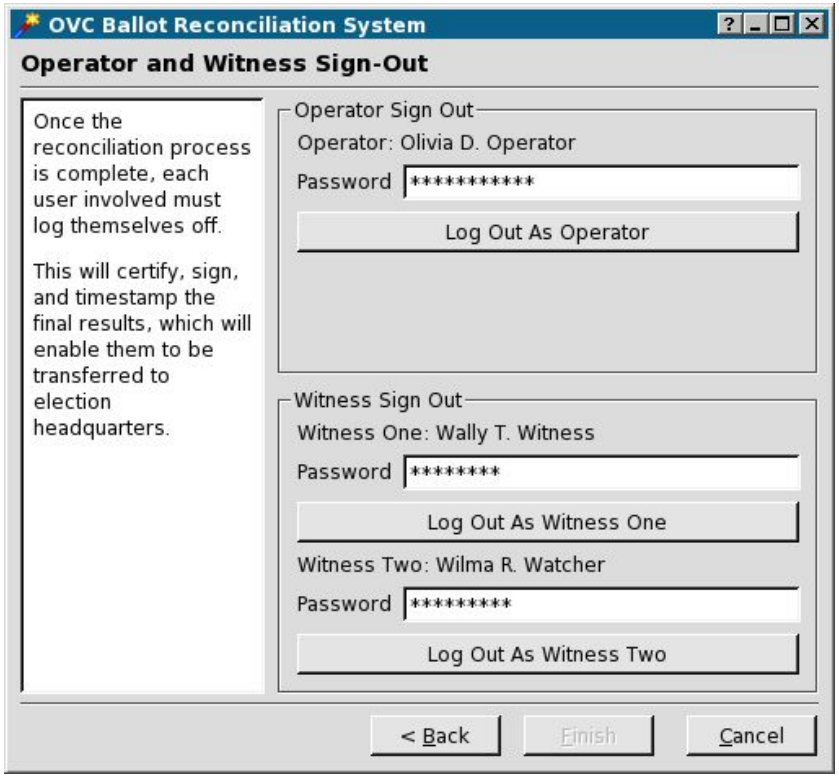


Among other data in the results of the reconcilation process, precinct-level vote totals are made available for posting and review.

8 Operator & Witness Sign-Out

After the reconciliation process is complete, each of the users participating in the process must individually sign out. This completes their participation in the chain of custody of the ballots, and signs, seals, and certifies the results, which are archived, digitally signed with an encrypted security signature, and transferred to the election headquarters using a secure network transmission protocol such as SSL. The digital signature, such as SHA or PGP, will ensure that the transmitted archive is the same one sent, and hasn't been swapped or manipulated during transmission.

The paper ballots are then re-sealed along with other important election materials including the voter roster, all test and spoiled ballots, a CD archive of the verified EBIs, the final report and tabulation list. Under the supervision of constables or other law enforcement officials, these materials are then securely transported to the election headquarters for further processing.



By signing out, the users declare the results satisfactory and complete the reconciliation process.