

Security and Audit Features of the Election Management System



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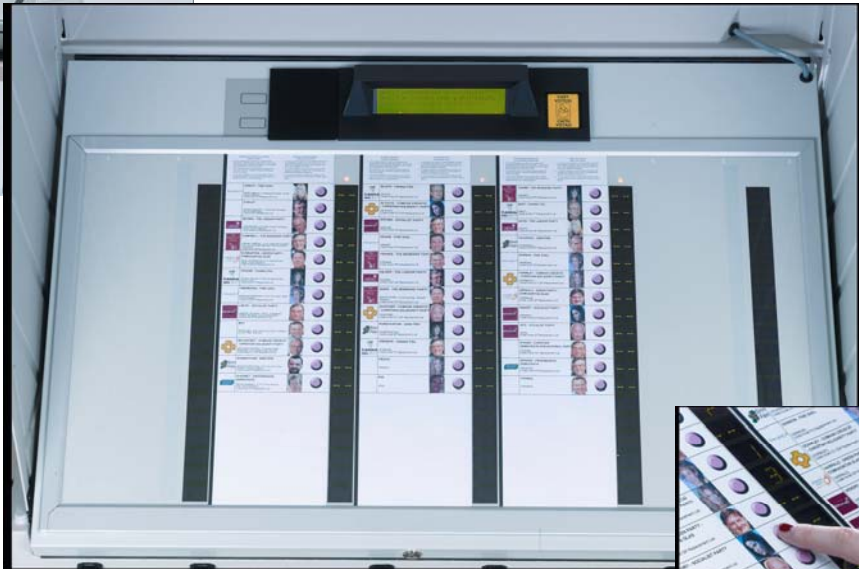
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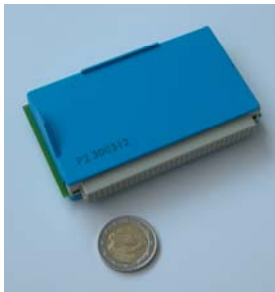
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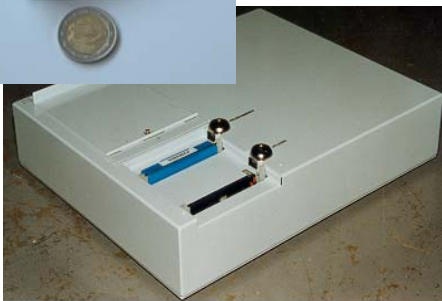
Voter at machine



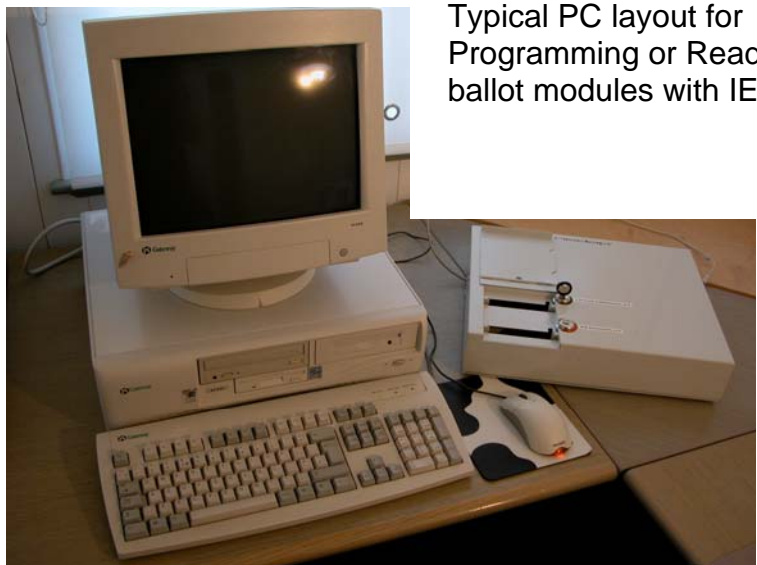
View of voters panel of machine with 3 ballots



Ballot module



Programming / reading unit



Typical PC layout for Programming or Reading ballot modules with IES

Security and Audit Features of the Election Management System (EMS)

1. Overview of Election Management System

The Election Management System (EMS) consists of a voting machine, ballot module, program/reading unit (PRU) and Integrated Election Software (IES). IES software is run by returning officers and their staff on dedicated PC's for the preparation of elections and the counting of votes. The new system is being introduced to modernise the Irish electoral system which is virtually unchanged since the 1920's. The electronic system has four major benefits – easier voting by electors, no inadvertent spoilt votes, more accurate and earlier election results and improved electoral administration. It is not an “e-voting” system (i.e. it does not use the internet, touch-type telephones, text messages or interactive digital TV). International discussions are on-going on the security and other features of “e-voting”. The Irish approach to modernising the electoral system is evolutionary and the further use of technology will be considered when satisfactory solutions are found to security and secrecy aspects of “e-voting”. The voting machines and PC's for the elections in June 2004 are stand alone and will not be connected to the internet or to an internal network. Throughout the development of the system for its use in Ireland, the security and integrity of the electoral system used in this country have been of paramount importance. The system incorporates security and audit features at all stages of the process from initial set-up of a poll to the production of the count result. The system has also been benchmarked with the following five objectives – integrity, confidentiality, enfranchisement, availability and verifiability.

- a) **Integrity**: *preferences and votes should be recorded and counted as intended; it should not be possible to add, modify or delete votes.*

The voting machine software has been tested by an independent international accredited German testing institute, Physikalisch-Technische Bundesanstalt (PTB), and their report, which is available on the Department's electronic voting website, www.electronicvoting.ie, has confirmed that the voting machine software complies with the above requirements. The voting machine has physical security features to prevent tampering before, during and after polling day and it will be rigorously supervised and securely maintained throughout polling hours. The IES software has been subject to an architectural and code review by an independent Irish software company. The PR/STV count software has been further functionally tested by the Electoral Reform Society in the UK against their database of 425 elections. The count software passed all the tests.

- b) **Confidentiality**: *it should not be possible to associate a vote with a voter, duplicate a vote or view the results before the close of poll.*

To ensure voter confidentiality, there is no link between the marked register of electors and voting on the voting machine. Votes cast on the voting machine are stored randomly. PTB state in their report that no vote recorded in the voting machine can be associated with an individual voter. In addition, the count software further randomises the votes at constituency level after all the votes are read-in to the system and before vote counting commences.

- c) **Enfranchisement**: *each eligible voter should be able to vote once only.*

Access to the voting machine is controlled by the polling station staff. The number of voters who have voted on the machine can be audited at any time during polling day by checking the number of voters marked on the register of electors, the number of permit tickets issued and the number of votes stored in the ballot

module. When a voter presses the "Cast Vote" button and the vote is stored, the voting machine automatically deactivates itself until the polling staff activate it for the next voter. These procedures operated satisfactorily at the two polls in which the system was used in 2002.

d) Availability: *the system must be operational throughout the voting period.*

The voting machines will be available for use throughout the polling hours appointed for the poll or polls in question. Procedures will be in place for the security of the machines from the time they are programmed for an election until the count is finished. There will be a voting machine to replace every ballot box and spare machines on standby for use during busy periods, especially in large urban areas and on the off chance that a machine develops a fault. A portable battery will be provided in the event of a power failure.

e) Verifiability: *the four objectives at (a) to (d) above should be verified.*

The various test reports on the voting machine and software are available on the dedicated electronic voting website, www.electronicvoting.ie. Political parties and candidates will be facilitated with demonstrations and explanations on the security features of the system. Opportunities will be provided before the June 2004 polls for the public to familiarise themselves with the voting machines. Activity at a polling station can be monitored by personation agents appointed by candidates and by the candidates themselves. An information leaflet will be available on the count procedures to assist agents, candidates and political parties to monitor procedures at the count centre. An information book on the system is also available from the Department or on the website. Statistical information on the count will be available at each stage of the count and when the election result is declared.

2. Testing and Security Features of System's Components

2.1 Personal computers

The PCs used for the election set-up and vote counting are stand-alone machines complete with anti-virus software and each one will be "security hardened" for the election. This means that all unnecessary services and programs on the PC will be disabled or reconfigured to prevent any access to the PC. A two factor security procedure will be required to login to the PC's. The version of IES for use at each poll will be specified by Ministerial Order. Returning officers will ensure that the election PC's are securely stored and that only authorised access to and use of the PC's will be permitted.

2.2. Voting machines, Program/Reading units (PRUs) and ballot modules

This equipment, including the supporting software, has been tested in accordance with the documents, "Requirements for Voting Machines for use at election in Ireland" and the "Functional Specification" by the German institute, PTB, and two Dutch institutes, TNO Electronic Products and Services BV and KEMA Quality BV, who have granted the right to use the KEMA-KEUR certification mark on the voting machine. The voting machines are stand-alone and they are not connected to any network or internet. Returning officers will ensure that only authorised access to and use of the electronic election equipment will be permitted.

2.3 Testing of software for election

An architectural and code review of the IES software for the election set-up and counting process was carried out by Nathean Technologies Ltd., an independent software company in Ireland. A functional review of the count rules software was carried out by the Electoral Reform Society in the UK. Functional testing has also been carried out by Department staff and returning officers.

3. Pre-poll Procedures

3.1 Election set-up procedures

The ballot paper is compiled using a fixed template in the IES and it can be viewed by election staff on the PC screen or as a printed copy. During the set-up of the election, the returning officer will decide which column on the voting machine will be assigned and programmed for the poll. A print-out can be generated to show the column number and the row number on the voting machine programmed for each candidate. In a multiple polls situation, decisions on the voting machine columns to be used are taken by the returning officer responsible for taking the polls. At the elections in June 2004, the local European returning officer, who will be responsible for taking the polls, will carry out this function.

Once the candidate nomination process has closed and all the candidates' details have been entered into the IES program, the completed ballot paper is forwarded, (in pdf format), to a commercial printer for printing in accordance with a specific specification. Where ballot paper details are transferred from one level to another at the 2004 elections, e.g. from a local authority or European constituency returning officer to the local European returning officer responsible for taking the polls, the ballot paper details and other election data are copied to a CD which is hand-delivered to the local European returning officer, accompanied by a paper copy for verification. A separate back-up copy of the election set-up is retained for security purposes by the returning officer concerned.

The next stage for the local European returning officer is to read into the IES the ballot paper details received from the other returning officers and to program the poll data and ballot paper details in the individual ballot modules for insertion in the voting machines. When a ballot module has been programmed, a print-out is made to verify that the details loaded in the ballot module are the same as those approved by the returning officer concerned. The IES records the serial number of the module in the system along with the relevant polling station for security checking upon return of the module after the poll has closed.

3.2 **Preparation of voting machine for poll(s)**

Once the printed ballot papers have been inserted on the voting machine's front screen, the screen is locked by the returning officer. When the ballot module has been loaded in the voting machine and each time the power is switched on, start-up tests are executed which include a software self-check, a hardware check and a check of various aspects of the memory contents of the ballot module. If the ballot module contains invalid or inconsistent data at start-up or one of the two memory chips in it is faulty, the module will be "blocked" and the voting machine cannot be used for voting. An error message is displayed.

- 3.3 At machine start-up, the voting machine performs a number of automatic tests such as testing of the various circuits, ROM, RAM, keyboard and ballot module. As some of the tests are completed, a beep can be heard. Information relating to the progress of these tests is displayed on the control unit display. One of the automatic start-up tests is an integrity test of the primary ballot module in the voting machine. If any error is detected, a message is displayed on the display unit and the voting machine will not function. If the test results are satisfactory, information about the poll is displayed.

After the voting machine has completed its start-up phase, it automatically sets itself in "Pre-voting" mode. The machine can be set to "Functions" mode to execute tests other than those carried out automatically upon start-up. For example, programmed information such as the position and names of the candidates, poll information, etc., can be viewed in "Functions" mode. Preparation for voting is now complete.

- 3.4 When the ballot module is loaded in a voting machine, it is locked and sealed by the returning officer. Before the poll commences and at close of the poll, the presiding officer at a polling station is required to confirm in writing that the seal is intact. The electronic part of the voting machine is sealed so that any attempted interference can be detected. The ballot module and electronic parts of the

machine are protected by a cover during polling hours and are not visible to the public. The voting machine is positioned in such a way as to be always visible to the polling staff during polling hours and it is under continuous supervision throughout the day to ensure that there is no interference with the voting machine screen or ballot paper(s) on it.

3.5 **Procedures before opening of poll**

Before the poll commences, the presiding officer in a polling station is required to verify in writing that the seals on the voting machine and on the ballot module compartment are intact. When the voting machine is powered up, the next step is to generate a printed statement from the machine showing the data of the poll, a list of the candidates in the order in which they are programmed in the ballot module and verification that no votes are recorded on the voting machine. The list of candidates on the printed statement is compared to the number and order of candidates on the ballot paper on the voting machine screen. The printed statement must be signed by the presiding officer and witnessed by another polling station staff member as part of the election documentation. Any discrepancy in any of these matters is immediately reported to the returning officer and no voting is permitted on the machine until directions are received from the returning officer.

4. Polling Procedures

- 4.1 The voter records a preference for a candidate by pressing the button beside his or her photograph on the ballot paper on the front of the voting machine. The number of the preference recorded is displayed beside the button and the voter will also see the details of the preference on the bottom line of the display unit. The voter can delete a recorded preference by pressing on the button beside it a second time. Then before “casting” his or her vote(s), the voter can review the preferences he or she has recorded on the ballot paper on the machine. The voter then presses the “Cast Vote” button. The display screen will inform the voter that his/her vote is being stored and when it is stored. After the information is displayed, the voting machine then automatically deactivates, until it is activated by polling staff for the next voter. In the extremely unlikely event that the vote is not stored, an error message will be displayed and the voter will be permitted to vote on another voting machine in the polling station or when a replacement machine is delivered.

Polling station staff activate and de-activate the voting machine by use of a Control Unit separate from but attached to the voting machine itself. This unit does not display or store any details of the preferences recorded by voters but the Unit operator can confirm that a vote has been stored by observing the following information on the Control Unit display:

- (a) the backlight of the display goes out for a few seconds;
- (b) a text message is then displayed stating that the vote is stored and that the voting machine is awaiting activation for the next voter; and
- (c) the total number of votes cast increases by 1.

The number of votes stored in the ballot module can also be confirmed by checking the number of permit tickets issued to voters marked on the register of electors and handed to the Control Unit operator. If required during polling hours, the order of the candidates on the ballot paper and programmed in the ballot

module can be compared with the details on the opening voting machine statement. The presiding officer will also ensure that the voting machine screen is checked periodically throughout the polling day.

The voting machine does not provide a receipt or print-out of a ballot paper. The ban on removing ballot papers from a polling station or providing a receipt has been established practice for over 100 years to ensure that a voter is not subject to intimidation and to prevent any possibility of votes being bought or sold. Printing a ballot paper with the voter's preferences on it for storing at the rear of the voting machine could also be contrary to the constitutional requirement of secrecy of the ballot. Pressing the "Cast Vote" on the machine has the same effect as putting a ballot paper in a ballot box. The voter can have confidence that the software properly records his/her vote as it has been tested and certified by an independent international institute.

4.2 **Diagnosis during normal operation**

During normal operation, the voting machine performs the following tests automatically to check that it is continuing to function correctly, e.g.:

- a test to measure the supply voltage of the circuit which is used in the vote storage process to ensure that it is within the specification limits;
- a check of all devices (e.g. buttons, displays, ballot module, etc.) to ensure that the operational status is unchanged after start-up; and
- before storing a vote, checks the status of the ballot module to ensure that the vote will be stored correctly.

If any error is detected, the voting machine will display a message and no further voting at that machine will be possible until the problem is investigated and resolved. A help desk will be available to deal with any queries or problems with the voting machine. The details of the software for storing votes were checked and confirmed by PTB as satisfactory. Any unusual event in the operation of the voting machine is recorded in its memory and it can be checked if there is any doubt about the correct operation of the voting machine.

5. **Procedures at Close of Poll**

The presiding officer is required to check that the seal on the ballot module compartment has not been interfered with during the day.

When the presiding officer activates the “close poll” function on the machine, it automatically copies the data of stored votes to a back-up module within the sealed electronic section of the voting machine for use in emergencies (i.e. where the original ballot module is lost or damaged) and a printed statement is also made on the voting machine which lists:

- the candidates’ details which have been programmed in the module,
- the total number of machine activations,
- the total number of votes stored in the module,
- the number of voting machine deactivations, and
- other poll ID data.

As with the poll opening procedures, the printed statement must be signed by the presiding officer and witnessed as part of the election documentation.

The ballot module and voting machine statements are then sent by secure means to the returning officer at the read-in or count centre.

6. Count Centre Activities

6.1 Procedures at read-in of votes

The returning officer will maintain a strict access authorisation procedure to the area used by his or her staff for the receipt and processing of ballot modules.

After the receipt of the package containing the ballot module and voting machine statements, the ballot module and the printed statements are passed to different count staff. The ballot module is read into the IES. Before the module is accepted, the system verifies that it is a module programmed for the poll and for the correct polling station. If correct, the vote details in the module are read in and the time of read-in is entered on the control table in the IES system. The modules are stored in secure storage cases supplied for such purposes. The printed statements are reviewed separately and information on them compared with that extracted from the ballot modules in the IES.

Once the votes have all been read into the IES, they are then released for calculation and counting. Before the count can take place, a report on special and postal voting must be completed, followed by a report on the read-in of ballot modules to ensure that all modules have been accounted for. Both these reports are printed as part of the election documentation.

6.2 Multiple Polls

When there is more than one poll and the counts are being conducted for the different elections in separate locations, once all the modules have been read in, the vote data for each poll will then be distributed in a secure manner to the local authority or the European Constituency Returning Officer as appropriate for the purposes of vote counting. Before the transfer is effected, the software secures the election database as a safety precaution, thus enabling any data to be retrieved and verified if required. The data in each CD will be encrypted and the CDs will be collected or delivered personally to the relevant returning officer along with a paper reconciliation record.

6.3 **Election Count Procedures**

When all votes are stored in the IES at the count centre for each election, the count can then take place. Where there are multiple polls, the returning officer conducting the count first produces a verification statement to compare with the statement received from the local European returning officers. Both statements are retained as part of the election documentation. The first stage in the count process is the mixing and numbering of votes. This is a further protection for the secrecy of the ballot. After the votes have been mixed and numbered, the system saves a back-up of the election file database. Once these procedures have been performed, the count can begin.

The count is carried out on a count-by-count basis. When the first count is completed, the count result is displayed in graphic and numerical formats:

- count result details with candidates in alphabetical order as they appeared on the ballot paper;
- count result details with candidates in descending ranking order (the state of poll); and
- a statement of the actions and outcome of that count, along with the next steps to be taken.

Once the result of the first count is known, the returning officer will publicly announce the result and distribute the count sheets to those present. Following this announcement and a short period to enable those attending to consider the current position, the second count will then be run and the same procedures are followed until all the seats have been filled.

6.4 **Post-Count Reporting Mechanisms**

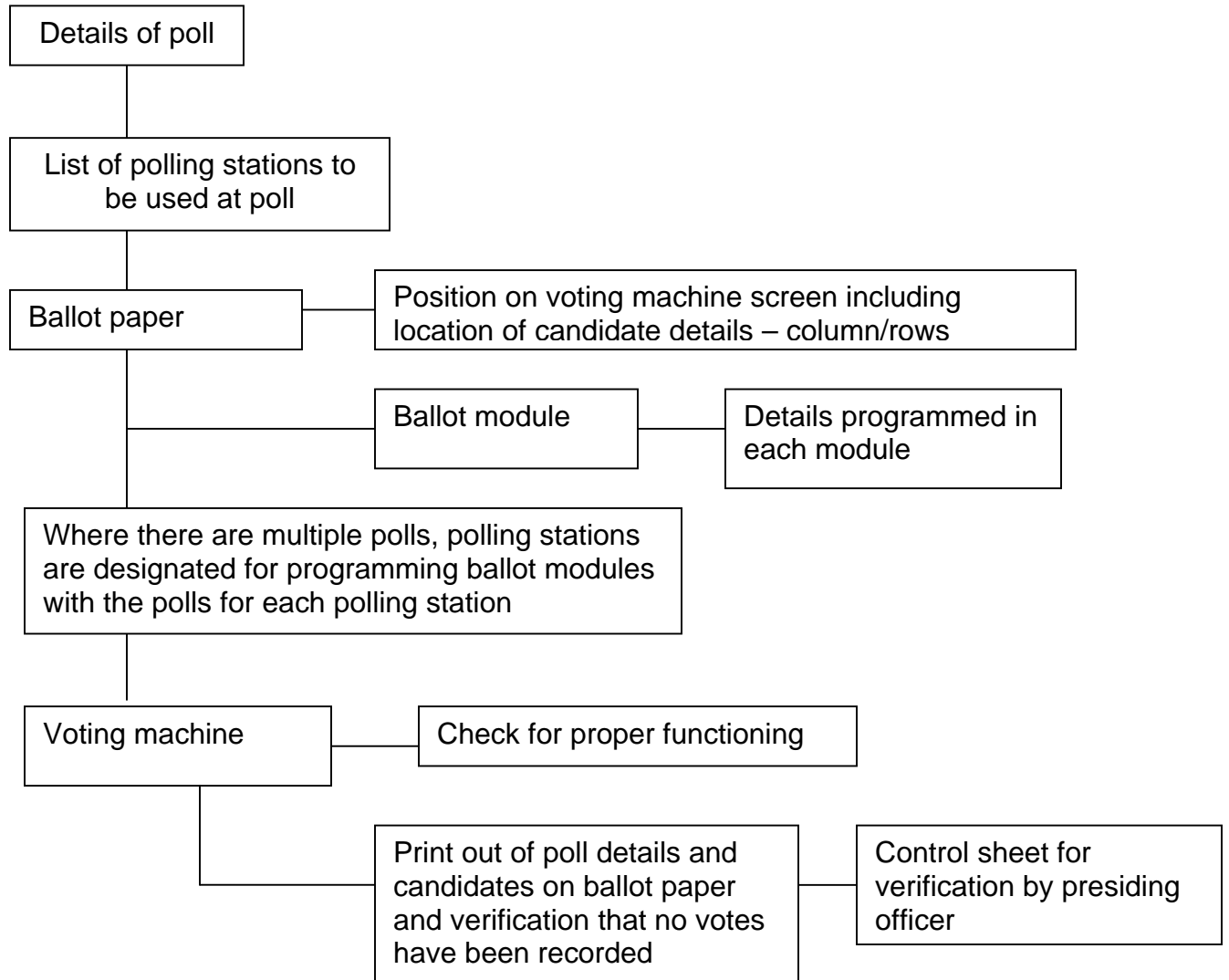
After the count has been concluded, the following information reports are created:

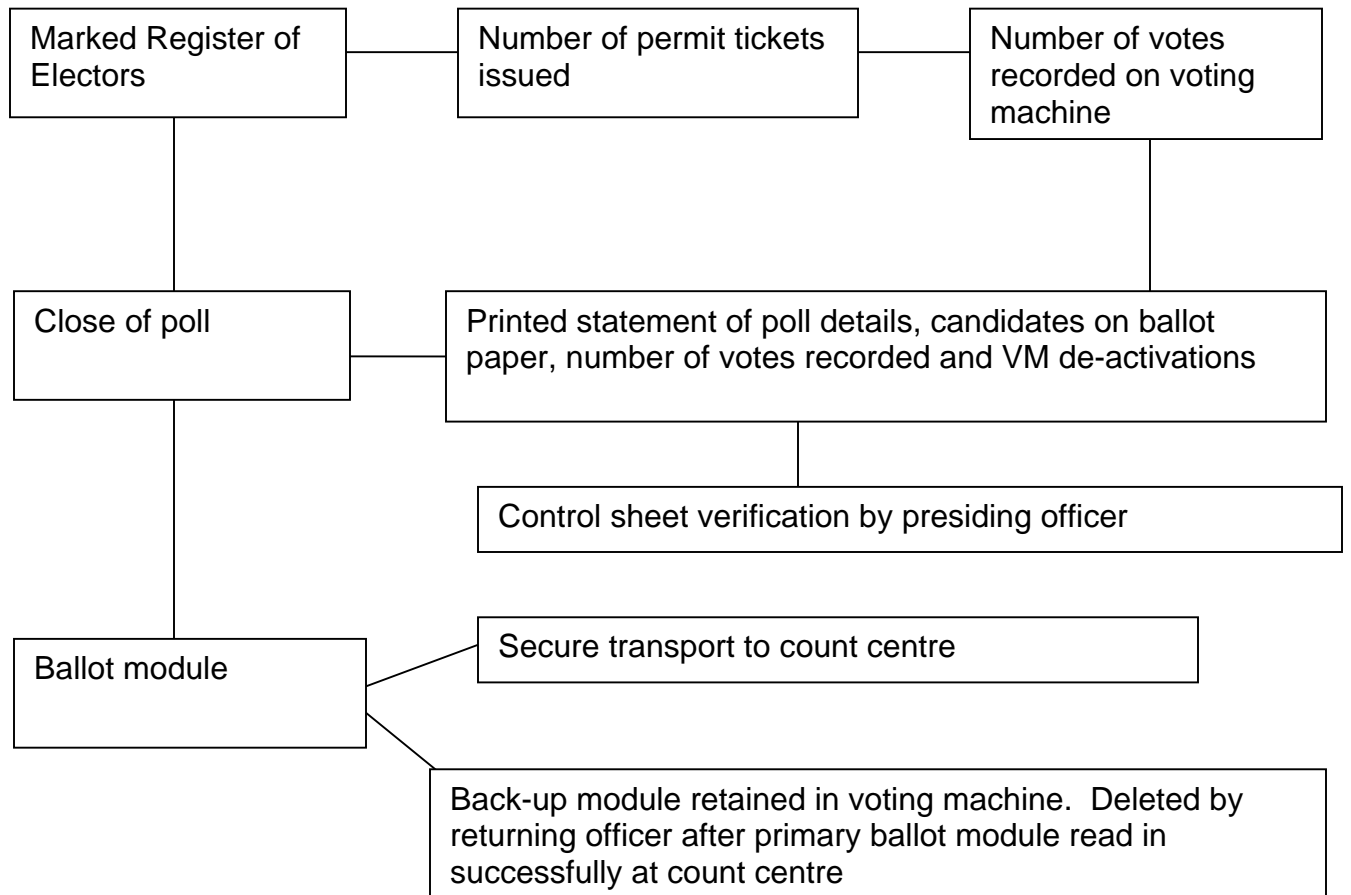
- declaration of the result of the poll,
- listing of votes with preferences for each constituency, and
- tables showing the number and percentages of different preferences received by each candidate.

The system can, for the purposes of manual counting at an election petition and if ordered by a Court, print a ballot paper for each vote cast complete with preferences. The ballot papers will be those which have been mixed at constituency level before the first count. Each ballot paper will be assigned a computer reference number on it and the count on which it moved, if appropriate.

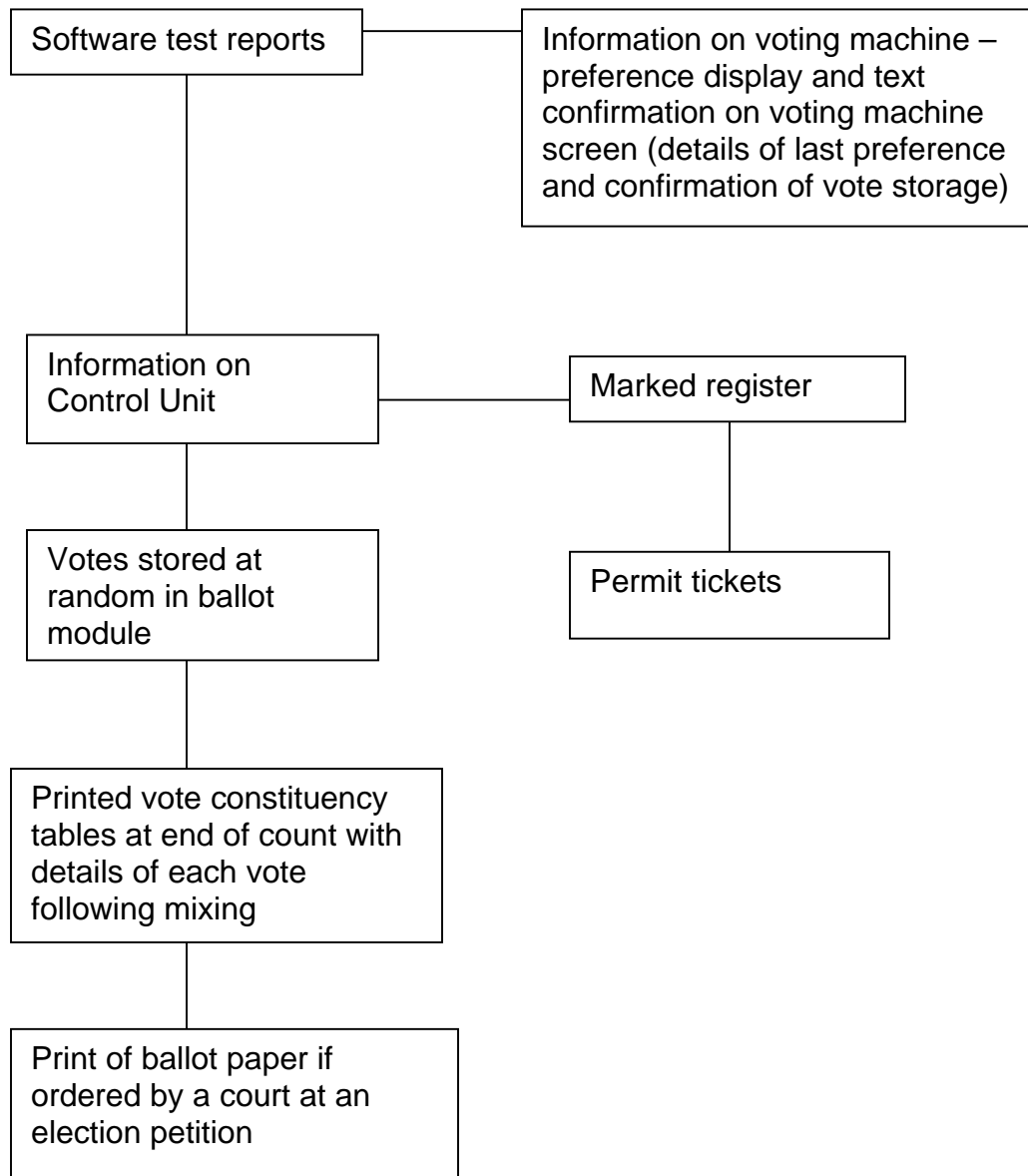
APPENDIX
AUDIT- PAPER TRAIL

Pre-poll arrangements



Poll

Vote verification



Count Centre

