OBSERVATIONS, INVESTIGATIONS AND RECOMMENDATIONS BY HIGH LEVEL FACTS FINDING COMMITTEE

SUBMITTED TO THE KERALA STATE ELECTION COMMISSION

Members of the committee

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1. Constitution and Terms of the High Level Facts Finding Committee

The State Election Commission (hereinafter referred to as SEC) of Kerala, vide Office Order No. 795/2015/SEC dated 19 Nov. 2015 duly constituted the 3-Members Facts Finding Committee comprising of Prof. K. R. Srivathsan, Prof. Rajat Moona and Sri B. Ramani to ascertain the causes of failure of several Electronic Voting Machines during the recently held local body polls in the districts of Malappuram and Thrissur in Kerala. The committee was to give the report within a period of one month.

2. Initial Investigations

The committee sought the report from SEC about the failures of EVMs at Malappuram and parts of Thrissur. These reports showing the time-wise failure of EVMs are attached in the annexures. The different documents submitted by the SEC to the Experts Committee showed that maximum failures of the EVMs on the day of polling occurred in the Malappuram District and in some of the northern parts of the Thrissur District.

Based upon this the Experts Committee requested a field investigation with the concerned officials in Malappuram Dt. The Chairman of the Experts Committee, the Assoc. Director of CDAC Shri P.M. Sasi (as co-opted expert), the Addtl. Secretary of SEC Shri Muraleedharan and the District Collector of Malappuram Shri T. Bhaskaran, IAS jointly conducted the field investigation. Accordingly a meeting was organized by the SEC at the Malappuram District Collectorate on 28 Nov. 2015. Reports of the proceedings of this meeting are provided in the annexures.

The field investigation was held in Malappuram Collectorate. Discussions were held throughout the whole day of 28 Nov. 2015. The ECIL technical staff headed by Addtl. General Manager and Head EMSD Shri R. Mahendran were also present. The investigation committee held detailed interviews with 27 Presiding Officers (PO) and Returning Officers (RO) from the various polling booths where faulty functioning of the EVMs were reported. The discussions with the POs and ROs are enclosed in the annexures.

Steps were taken to visit the Strong Room of the Malappuram Collectorate to take out sample faulty Ballot Units (BU) and Control Units (CU) for trial mock poll using these machines. These sample units passed the mock poll tests, except for one which showed the 'Press Error 3' fault on the CU.

The gist of these discussions were deliberated within the Facts Finding Committee (FFC) over tele-conversations. Based upon the findings, discussions within the FFC and ensuing request from ECIL for testing at their site, the following findings were made by the field investigation committee.

1. The areas where the machines failed reported rains of varying intensity, heavy to moderate with wind, between 11:00 PM on the eve of the polling day and 8:00 AM on the polling day. The humidity was very high – close to 100%. The polling booths had windows through which humid air pervaded the interiors as well.
2. The discussions with the POs and ROs as well as the data of EVMs failures evolving over time compiled every 30 mts on the polling day starting 6:00AM showed that there was high rate of failure in the early morning hours and declining towards the noon hours. This report from different polling areas is enclosed in the annexures giving details in graphic form as well as in numbers.

3. The unexpectedly large rate of failures during the early hours of the polling day created difficulties in getting replacements for the EVMs in time. The problem was compounded at places where even after replacement the new ones reported erratic 'press error' behaviour.
4. In some places there were 'Link Errors' that pertain to the data communication fault between the CU and the BUs. These errors were rectified in most places and appear to be due to lack of adequate training for the officers in handling the setup of the CU and the BUs.
5. One impact of the high rate of faults in the EVM was that the POs, ROs and polling officials on duty were overstressed by the additional workload to cope with replacement of CU and BUs, priming them for the local poll and commissioning them as per election manual. By and large the agents from the candidates' side cooperated and decision to conduct repoll was taken with the consensus of all concerned wherever the repolls were carried out. Some of the election duty staff had to work through late hours in the night to enable the repoll on the following day. The next-day repoll was conducted smoothly and reported heavy polling. This decision to conduct repoll the next day and the ability to manage repoll efficiently helped in maintaining schedule for poll results announcements.
6. Speedy decisions taken on the spot and with full logistics support provided by the SEC and local poll duty officials enabled the elections to be concluded and results declared on time, even though repolling was carried out at some polling stations.
7. The committee observed that this was the first time such a local body election of this magnitude spanning over 34,000 booths, and each hosting polling for multiple posts being conducted with multi-ballot EVMs. Adherence to the polling processes management and protocols approved under the election manual ensured the fairness and robustness of the poll process as a whole. The polling system as a whole had built-in mechanisms to cope with certain rate of EVM failure. However the rate of faults observed in Malappuram and Thrissur on polling day was much higher than what the system could cope with.
8. The failure chart shows that even after the substantial reduction of the fault rate by the afternoon and evening hours, the failures were not zero.

The field investigation committee in consultation with the members of FFC recommended the following to the SEC.

1. Six machines (each comprising of a CU and three BUs) be subjected to environmental testing at ERTL Thiruvananthapuram at 97% humidity conditions. The sets should be chosen to provide a mix of EVMs, the ones that reported failure and the ones that did not.
2. Another set of six machines be subjected to electronic tests of switches on the BUs at C-DAC Thiruvananthapuram for resistivity and continuity. These sets should be chosen to provide a mix of EVMs – the ones that reported failures and the ones that did not.
3. Another set of five machines to be released to ECIL for investigation and analysis in detail at their site.

3. Further investigations

The EVMs as per the recommendations of the field investigation committee were released to the agencies. The test reports are attached in the annexures. The test reports were seen by the committee on its meeting over two days – on 21st December, 2015 and on 22nd December, 2015.

The following are the major findings of the committee on the reports.

1. Environment test at ERTL clearly indicated that the humidity had a major role in the failure of the machines. Two sets of machines out of six reported failures after an exposure to the humidity. The failures were of the same type as reported in the Malappuram and Thrissur districts, i.e. “Pressed Error”. It is also noted that the machines given for testing had a mix of those which reported failure and those which did not.
2. The test reports from C-DAC Thiruvananthapuram demonstrated that the switches did not show any malfunction as such.
3. Results of detailed investigation by ECIL indicated that about 25% of the units exhibited the failures (i.e. “Pressed Error”) when subjected to 95% humidity. It is noted that ECIL carried out the mock-poll testing while the machines were exposed to high humidity while the tests at ERTL were carried out under normal condition but before and after the exposure to high humidity.

The committee in its meeting on the 21st and 22nd December examined the Printed Circuit Boards of two models of the BUs as follows.

Model 1: SEC_MP_BU_V2C, Date: 26-06-2014 M.No.: P0201406 (specifically the PCB with serial number 22182345).

Model 2: SEC_KERALA_BU_V1, Date: 06-01-2015 M.No.: P0201501 (specifically the PCB with serial number 23059711).

The following was informed by the representatives of ECIL to the committee.

1. A total of 1,12,653 BUs were supplied by ECIL to SEC Kerala.

2. First 20000 BUs with serial numbers SECKBU100001 to SECKBU120000 used the PCBs of Model 1.

3. All other BUs used the PCB of Model 2.

4. Only these two models of the PCBs were used in the BUs that were supplied to SEC Kerala.

The committee noted that in Malappuram all the BUs and in Thrissur many BUs were supplied from the first lot of 20000.

4. Findings of the committee

The committee inspected the PCBs of the two models and observed the following.

1. The switches used in the BUs had a wide leaf to connect to the PCB.
2. The PCB of model 1 used a ground track around the soldering areas for connecting to some of the switches. The ground track and the switches were mounted on the same side of the PCB.
3. The wider leaf of the switch was interfering with the clearance and was overlapping with the ground track.
4. With only a thin layer of lacquer insulation, it was possible for the leaf to short circuit with the ground track.
5. With high level of moisture and humidity, the insulation was not sufficiently thick to protect the circuit against unintentional short circuits.

6. It was noted that in the second model, the clearance was much higher and therefore, the switch leaf was not overlapping with the ground track and therefore the possibility of the short circuit was not there.
7. The tests reports from ERTL and ECIL corroborated with the physical observation of the printed circuit boards.

5. Summary

The most prominent error observed during the elections at Malappuram and Thrissur was "Press Error" which corresponds to the key found pressed during the scan of the vote cast by the voter. Another significant error observed was "Link Error" which is observed when the CU and BU are not able to communicate when they are required to do so.

The committee looked at several concurrent issues to find the reasons for the same. In particular the committee saw the failure charts and reports from the state election commission especially in Malappuram, distribution of errors with time and locations, statements from the polling officials etc. The committee then decided to probe the issue further. It requested the SEC to carry out the environmental tests (esp the humidity tests) on the CU and BU, both for functional and failed units. These tests were carried out at Electronic Regional Test Laboratory of STQC at Thiruvananthapuram. Another set of tests were requested from C-DAC Thiruvananthapuram on the functioning of the switches, esp. the in-circuit resistance between the contacts at ON and OFF conditions. Simultaneously a few defective machines were given to ECIL, the manufacturer of the equipment, to carry out tests and probe the cause of errors.

In summary, it was observed that the switches were all functional individually. However the BUs, especially those in the first lot of 20000 in numbers failed intermittently, but very frequently, during the moisture tests. This was established independently by ECIL also.

The committee then probed further to find the cause for the same. It was observed that the first 20000 BUs used a model of PCB in which the switch contacts could be short circuited with the Ground track as the clearance between the two was not enough. This was further aggravated as the only insulation provided between the wide contact leaf of the switch and the ground track was thin layer of insulating lacquer (*aka* solder mask) which is normally of few tens of micron in thickness. Under pressure due to environmental conditions such insulations are known to fail causing intermittent short circuits.

This finding is credible as the second model of the PCB did not suffer from this flaw in the design. It had a wider clearance and the errors were minimal. Further the errors were seen only under extreme environmental condition of humidity.

6. Recommendations

The committee makes the following recommendations.

1. The lot of 20000 BUs with the serial numbers SECKBU100001 to SECKBU120000 should be rectified by the manufacturer to the satisfaction of SEC. It is further recommended that the printed circuit boards of these BUs be replaced by a newer printed circuit board. The rectification should ensure absence of possibility of short-circuits.

2. The SEC should form a panel of experts to define test procedures and QC criteria for the machines. The panel should also define the first level check to be carried out by the manufacturers periodically as well as just prior to the elections.
3. From the remaining lot, a sample based testing must be carried out by organizations such as ERTL using the test procedure so defined.

7. Acknowledgements

The committee would like to acknowledge the efforts and support from the SEC in establishing the cause of failures and giving the committee an opportunity to analyze the same. The District Collector and other polling officials at Malappuram are acknowledged by the committee for their support and help. Officials at C-DAC Thiruvananthapuram, especially P M Sasi and his team and officials at ERTL, especially Beena S and her team are also acknowledged by the committee for their efforts. Committee would also like to acknowledge the team at ECIL for their cooperation in investigation.