CHAPTER V
WATER RESOURCES DEPARTMENT

Information System Audit on 'Enhanced Advanced Billing, Accounting and Collection Utility System' (eABACUS) in Kerala Water Authority

Executive Summary

Kerala Water Authority is entrusted with the task of providing quality drinking water and sewerage services in an eco-friendly and sustainable manner to the people of the State. Enhanced Advanced Billing, Accounting and Collection Utility System (eABACUS), is a billing, accounting and collection system developed by NIC[93] and put to use in Kerala Water Authority. The deficiencies observed in planning, system design, IT controls and security of eABACUS are given below:

Deficiencies in system design led to inaccurate mapping of business rules that resulted in non-collection of fees and fine amounting to ₹76.50 lakh.

(Paragraph 5.12.1.2)

Improper designing of database deprived the system from exercising online monitoring controls, which resulted in cash embezzlement of ₹6.42 lakh.

(Paragraph 5.12.2)

Bypassing segregation of duties exposed the system to the risk of irregularity and adversely affected accountability of transactions.

(Paragraph 5.13.1)

Failures in access controls exposed the system to the risk of exclusion of consumers from billing cycle.

(Paragraph 5.13.2)

Inadequate monitoring of service contract led to non-reversal of the amount of failed transactions and non-refunding of the service charges levied from consumers involving ₹8.50 lakh.

(Paragraph 5.14)

Inaccuracies and delay in mapping of business rules exposed the system to wrong processing of transactions involving short collection of sewerage and water charges of ₹450.66 lakh and excess collection of water charges of ₹1.35 lakh.

(Paragraphs 5.17.1 to 5.17.3)

Weak process controls and mistakes in software led to generation of inaccurate water bills resulting in loss of ₹17.38 lakh.

(Paragraph 5.17.4)

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[93] National Informatics Centre (NIC) has been instrumental in steering e-Government/e-Governance applications in government ministries/departments at the Centre, States, Districts and Blocks.

Failure in subjecting to standardisation testing exposed the system to major information security flaws.

(Paragraph 5.19.3.1)

5.1 Introduction

State of Kerala with a geographical area of 38,863 square kilometre has a total population of 3.34 crore as per Census of India 2011. There are 77.16 lakh households in Kerala, 23.40 *per cent* of which are using tap water from treated water sources. While 62 *per cent* of households rely on well as their source of drinking water, the remaining 14.60 *per cent* of households use water from other sources like spring, river, canal, lakes, ponds, etc.

Kerala Water Authority (KWA)[94] is entrusted with the task of providing quality drinking water and sewerage services in an eco-friendly and sustainable manner to the people of the State using tap water. KWA is responsible for the design, construction, execution, operation and maintenance of water supply schemes and for the collection and disposal of wastewater in the State of Kerala.

KWA has 1,078 water supply schemes (March 2016) with a total installed capacity of 3,367.13 million litres per day. Being a State owned Autonomous Body, KWA obtains water from various sources free of cost for supply to its consumers.

Enhanced Advanced Billing, Accounting and Collection Utility System (eABACUS), is a web based billing, accounting and collection system developed by NIC and put to use in KWA. It covers all the business processes of water charge receipts in Kerala Water Authority such as addition of consumers, management of consumer services, billing and collection of water charges. It handles the billing, collection and monitoring of 16 lakh KWA consumers across Kerala. The system was implemented in nearly 90 *per cent* of offices that are responsible for collection of water charges.

The project was originally conceived based on a decision taken in 1994 and a billing system was developed by NIC and put to use since 1995. The project was extended as a part of Rajiv Gandhi National Rural Water Mission in 2004. The modified web-based system named as ABACUS was completed by 2007 and put to use in pilot phase in Thiruvananthapuram. It was enhanced and renamed as eABACUS in 2010 and the rolling out in other Circles commenced in 2012. Currently, the system maintenance and modifications are done by the in-house team of KWA with the support of National Informatics Centre Services Inc[95].

5.2 Organisational Setup

The KWA is governed by a Board chaired by the Principal Secretary/Secretary to Government, Water Resources Department, Government of Kerala. The

[94] The Kerala Water Authority was constituted by the Government of Kerala on 01 April 1984 under the Kerala Water Supply and Waste Water Ordinance 1984 as a successor to the erstwhile Public Health Engineering Department of the Government of Kerala. The ordinance was replaced by the Kerala Water Supply and Sewerage Act, 1986.

[95] National Informatics Centre Services Inc. (NICSI) was established in 1995 as a section-25 company under National Informatics Centre.

board also includes the Principal Secretaries/Secretaries of the departments of finance, Local Self-Government, Managing Director, Accounts Member, Technical Member, two Members representing Local Self Government Institutions and one Member belonging to Scheduled Caste or Scheduled Tribe appointed by the Government of Kerala. Managing Director is the Chief Executive of Kerala Water Authority. The headquarters of the KWA is at Thiruvananthapuram. It has three regional offices at Thiruvananthapuram, Kochi and Kozhikode, each headed by a Chief Engineer. IT Unit, which is responsible for the implementation and maintenance of eABACUS, is headed by Chief Engineer (HRD&GL), who reports to the Managing Director. Executive Engineer (IT) and Database Administrator (DBA) coordinates the activities of the IT Unit of KWA.

5.3 The objectives of eABACUS

The main objectives of eABACUS were to

- generate timely and accurate bills;
- prepare reports on billing and collection;
- enable defaulter identification and analysis of collection pattern;
- reduce queuing time at counters through prompt display of accounts and automatic printing of receipts;
- facilitate on-line updation of Consumer Ledger Account;
- enable enforcement of collection by preparation of disconnection notice; and
- to provide the consumers the facility to make payment through any of the KWA counters in the network, payment kiosks, bank transfers and through online mode.

5.4 Hardware and software

eABACUS was developed in Oracle 11g. The web-based application is hosted in the State Data Centre-2 at Thiruvananthapuram and connectivity to KWA offices is established through KSWAN[96] along with BSNL[97] leased line as last mile connectivity[98]. eABACUS has 10 main modules[99] and 60 sub modules.

[96] Kerala State Wide Area Network (KSWAN) was setup as a backbone of the State Information Infrastructure (SII).

[97] Bharat Sanchar Nigam Ltd. is one of the largest and leading public sector units providing comprehensive range of telecom services in India.

[98] KSWAN connectivity is provided only up to Block level. Last level connectivity, the connectivity from Block offices to KWA offices, is provided through leased lines.

[99] Ledger, New connections, Consumer services, Receipts, Billing, Supervisory functions, Miscellaneous collection, Administrator, Code master, Query and Reports.

5.5 eABACUS data and cash flow

In Thiruvananthapuram Corporation, where handheld[100] device is used, billing and route information[101] is ported directly from eABACUS application system. In respect of other offices, reports on billing and route information generated through eABACUS are handed over to the meter readers. The meter readers take the reading and issue water charge bills. Automated bills are generated by the handheld device, where they are used. Wherever handheld device is not used, system generated pre-printed bills are filled in with meter reading and water charges calculated with the help of ready reckoners. Within two days, the meter readings are updated to eABACUS, porting data in the case of handheld devices and entering data in the case of manual readings.

The consumers have the option to make payments from the third working day of receipt of bills up to 30 days without any fine. They can make payments through online mode, through ECS[102], FRIENDS Centres[103], Akshaya Centres[104], post offices or through KWA cash counters. In payments (cash/cheque) made through the above modes except online mode, the money is deposited/transferred to non-operative bank accounts[105] in respect of all the Sub-division offices of KWA. The balances from all the non-operative accounts are transferred daily to the account operated by Finance Manager and Chief Account Officer (FM&CAO) at KWA Headquarters. Payments made through Akshaya Centres are routed through FRIENDS Centres and post offices through the General Post Office, Thiruvananthapuram. Online payments are routed through BillDesk[106], a payment gateway service provider, and the amount is transferred directly to the account of FM&CAO. In respect of online payments and payments through KWA cash counters, the payment details are automatically updated in the eABACUS (online process). Whereas in respect of other modes of payments, text (CSV[107]) files are transmitted to database wing of KWA, where the eABACUS is updated through manual process. A graphic representation of data and cash flow is shown in **Appendix 5.1**.

[100] A handheld device is any computing or electronic device that is compact and portable enough to be held and used in one or both hands.

[101] Billing and route information is sequentially numbered consumers based on their geographical habitation/location.

[102] Electronic Clearing Service (ECS) is an electronic mode of payment/receipt for transactions that are repetitive and periodic in nature. Essentially, ECS facilitates bulk transfer of money from one bank account to many bank accounts or vice versa.

[103] FRIENDS (Fast Reliable Instant Efficient Network for Disbursement of Services) Jan Sevana Kendram is a single-window facility where citizens can make government related transactions.

[104] Akshaya, an innovative project implemented in the State of Kerala, aims at bridging the digital divide, addresses the issues of information and communication technology access and provides basic skill sets. Akshaya centres function as common service centres too.

[105] Non-operative accounts, operated by all Sub-division offices of KWA, can only be credited by Sub-divisions and no amount can be debited by them.

[106] BillDesk, a property of IndiaIdeas.com Ltd. facilitates online bill payment services.

[107] Comma-separated values (CSV) file stores tabular data (numbers and text) in plain text.

5.6 Audit objectives

The audit objectives were to assess

- the extent to which the implementation of eABACUS benefited KWA in improving the system of billing, collection and accounting of water charges and in improving consumer satisfaction;
- the Project and Contract Management; and
- whether IT, general and application, controls and information system security controls in place were adequate.

5.7 Audit criteria

- Kerala Water Supply and Sewerage Act 1986,
- Kerala Water Authority (Water Supply) Regulations 1991,
- IT Act, 2000 and IT (Amendment) Act, 2008,
- Information Technology (IT) Policy, 2012 of Government of Kerala,
- State Government Orders,
- Water Tariff Order,
- Circulars issued by KWA Board, and
- Citizen Charter

5.8 Scope of audit

IT Audit of Computerised Billing and Revenue Collection System in Kerala Water Authority was included in the Report of the Comptroller and Auditor General of India for the year ended 31 March 2006[108]. However, the report was discussed by the Committee on Public Undertakings of the State only on 02 August 2017. The recommendations of the Committee are awaited. The system underwent several modifications and was converted to a web-based application with a new name eABACUS. Audit assessed the performance of eABACUS for the period from 2012-13 to 2016-17.

5.9 Audit methodology

Audit was conducted during July to November 2017 in all the three regions, namely Thiruvananthapuram, Kochi and Kozhikode. An entry conference was held (24 July 2017) with the Secretary to Government, Water Resources Department, Government of Kerala. In addition to KWA Headquarters, the

[108] Chapter II of Audit Report – Government of Kerala (Civil) – for the year ended 31 March 2006 – Volume II.

audit team visited 48 selected offices[109] and scrutinised daily transaction records and Demand Collection Balance Statements. Audit checked the system controls for ensuring the accurate processing and integrity of data, front-end tool, online system and interviewed end-users. eABACUS backup data, obtained from KWA, was restored in an audit server and the entire data for the period from 2012-13 to 2016-17 was analysed in audit using CAATs[110]. Substantive testing of the results of data analysis was done in the above stated field offices with the available records. Depending on the number of billing cases relating to each office, the number of items tested ranged from five *per cent* to 20 *per cent*, chosen at random and written confirmation of the respective heads of offices on the accuracy of the results of data analysis obtained.

Draft report was furnished (December 2017) to the Government. An exit conference was held (15 December 2017) with Additional Secretary, Water Resources Department, Government of Kerala, wherein the audit findings were discussed. Views of the Government and their replies are suitably incorporated in the report.

5.10 Acknowledgement

Audit acknowledges the co-operation extended by the Secretary to Government, Water Resources Department, Government of Kerala, the Managing Director of KWA, Heads of Offices and staff members of the offices visited by Audit.

Audit Findings

IT General Controls

5.11 IT Governance

5.11.1 Absence of IT Strategy and Planning

Information Technology Strategy represents the mutual alignment between IT strategy and business strategic objectives. The strategy should consider the existing IT infrastructure and architecture, investments, delivery model, resourcing including staffing, and lay out a strategy that integrates these into a common approach to support the business objectives.

Budget allocation and expenditure under information technology head of KWA during the period from 2012-13 to 2016-17 is as shown in **Table 5.1**.

[109] Ten Divisions (Kochi (PH), Aluva, Kozhikode, Vatakara, Thodupuzha, Muvattupuzha, Pathanamthitta, Thiruvalla, Thiruvananthapuram North and Attingal); eighteen Sub Divisions (Kaloor, Pallimukku, Angamali, Aluva, Malaparamba, Kozhikode (Distribution), Vatakara, Painav, Thodupuzha, Kothamangalam, Muvattupuzha, Pathanamthitta, Mallappally, Thiruvalla, Kowdiar, Pongummoodu, Varkala and Attingal); and twenty Revenue Collection Centres (Kaloor, Pallimukku, Angamali, Aluva, Koduvally, Kozhikode (Distribution), Purameri, Vatakara, Painav, Thodupuzha, Kothamangalam, Muvattupuzha, Konni, Pathanamthitta, Mallappally, Thiruvalla, Kowdiar, Pongummoodu, Varkala and Attingal) from five (Thiruvananthapuram, Thiruvalla, Kochi, Muvattupuzha and Kozhikode) out of twelve Circles (Alappuzha, Kannur, Kochi, Kollam, Kottayam, Kozhikode, Malappuram, Muvattupuzha, Palakkad, Thiruvalla, Thiruvananthapuram and Thrissur) were chosen using probability proportional to size sampling without replacement method for conducting substantive testing of results of data analysis, operations and application of general IT controls.

[110] Computer-assisted audit techniques. The tools used were KNIME, IDEA, Tableau and MS Access/ Excel.

Table 5.1: Budget allocation and expenditure under IT head during the period from 2012-13 to 2016-17

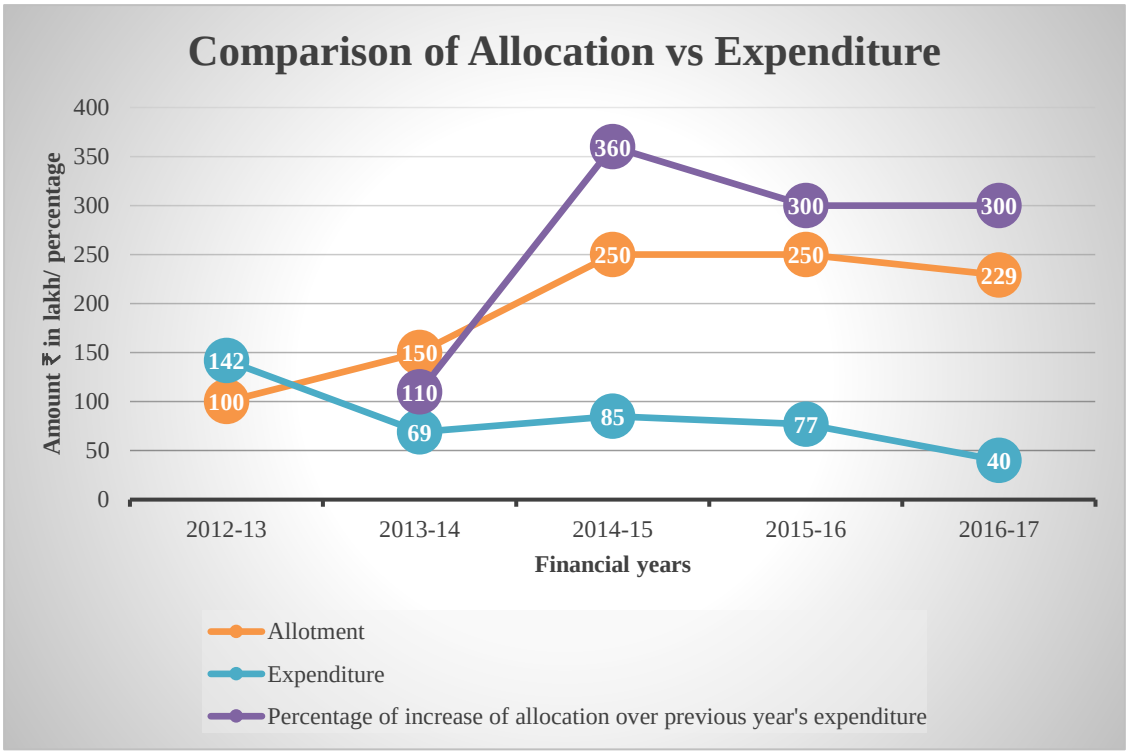
(₹in lakh)

Financial year	Budget Allocation	Expenditure
2012-13	100	142.34
2013-14	150	68.50
2014-15	250	84.67
2015-16	250	76.96
2016-17	229	39.93
Total	**979**	**412.40**

(Source: Information obtained from KWA Headquarters.)

- Audit observed that there was no clear-cut strategic planning. The absence of strategic planning was evident from the fact that during the period covered under audit, the expenditure under IT head was only 42.13 *per cent* of the budget allocated by KWA. Except for the financial year 2012-13, the expenditures were below the allocations. Only 46 *per cent* of budget allotment was spent in 2013-14, 34 *per cent* in 2014-15, 30.80 *per cent* in 2015-16 and 17.47 *per cent* in the financial year 2016-17. Interestingly, while the expenditure was decreasing over the years since 2013-14, the allocation for the subsequent years continued to be three times or more of the expenditure relevant to the previous years as depicted in **Chart 5.1**.

Chart 5.1: Comparison of allocation versus expenditure for the period from 2012-13 to 2016-17



(Source: Audit analysis of data obtained from KWA Headquarters)

- As per the roll out plan, the rolling out was to be completed in December 2013. However, only 70 *per cent* of the then consumers were brought under eABACUS by December 2013. Audit also observed that out of 297 offices, eABACUS was yet to be installed in 15 offices (December

2017). Out of 18 offices test-checked, where eABACUS was used, in two Sub-division Offices, due to the delay in capturing basic legacy data, like name, address and other details of consumers, details of the last billing information, etc., manual system was used simultaneously.

The Government stated (December 2017) that the budget allocation was as per plan, but as many of the software applications were developed in-house, there was considerable savings. The reply was not correct on two counts. Firstly, the gap between the allocation and expenditure was widening continuously for the last four years. Secondly, the budget proposals for the succeeding years continued to be three times or more than the expenditure during the current years. Both of these establish absence of proper planning. The Government also stated that the delay of roll out was attributed to non-availability of last mile connectivity. Thus, absence of a predetermined IT strategy resulted in non-achievement of optimum benefits of eABACUS like providing facility for real time updation of the system at the time of taking water meter reading, developing web interface for system updation, when payments were made through NEFT, RTGS and IMPS, considering more online payment service providers so as to take advantage of competition, revamping the system for fixing bugs in the software, etc.

5.11.2 Documentation Deficiencies

User Requirement Specifications (URS) document obtained from users and System Requirement Specifications (SRS) document developed by the software development team ensure that the needs of the users of the system are taken care of and the software developed meets the business requirements.

Audit observed that URS document was not prepared. Though System Requirement Specifications were prepared by the developer, the same were not formally accepted by the department. In addition, there was no signing-off[111] of the project. Absence of well documented URS deprived a benchmark both for the developer and KWA. This led to ad-hoc system development and design deficiencies as detailed in subsequent paragraphs (Paragraph 5.12). In the absence of URS, Audit could not assess precisely whether full functionality of the software and the intended benefits of computerisation were achieved.

The Government stated (December 2017) that the system was developed based on group discussions with NIC, who assessed the user requirements. The reply was not correct as documentation of User Requirement Specification was essential in the system development process and was required for both business and regulatory reasons.

5.11.3 Absence of IT Security policy

Any good IT system should have specifically laid down IT security policy indicating minimum standards and compliance requirements for specific areas like assets classification, data security, personal security, physical, logical and environmental security, communications security, legal, regulatory and contractual requirements, business continuity planning, security awareness and

[111] Project sign-off is referred to mean that the developed application software is delivered and the project is closed after successful trial run of the software.

training, security breach detection and reporting requirements, violation of enforcement provisions, etc.

Audit observed that KWA did not have a specifically laid down IT security policy. The Government stated (December 2017) that a security policy would be formulated as part of the revised IT master plan.

5.11.4 Lack of adequate training

For effective operation of an IT system, 100 *per cent* of the employees involved in the operation of the system are required to be trained. However, in 18 sub-divisions test-checked, Audit observed that only 55 employees were trained in eABACUS out of 303 employees assigned with the operation of eABACUS.

The Government stated (December 2017) that training was provided to staff at the time of roll out. Consequent on transfers, new incumbents were trained by experienced persons. Periodic trainings have since been conducted. However, the fact remains that only 18.15 *per cent* of employees operating eABACUS in the test-checked offices were trained.

5.12 System Development and Design Deficiencies

5.12.1 System design deficiency

System design is concerned with how the functional requirements will actually be provided and provides the definition how the programmers will go on to build the system. Audit observed the following deficiencies in the system design.

5.12.1.1 Avoidable fine on consumers

In the case of unavailability of eABACUS due to disruption in network, payments are received by issuing manual receipts and entered in the system on resumption of eABACUS services. Audit observed that the system did not have a provision to operate offline by storing the values in the local grid[112] and transmit the same to the central server, when the connectivity is established. Absence of the provision resulted in levying of fine in the case of consumers, who paid their dues within the stipulated date. Due to non-availability of network connectivity, the payment details were entered in the system only after the due date of payment. Thus, such consumers were penalised for no fault of theirs.

Audit observed that Vadakara Sub-division office started maintaining a manual register to record the cases of remittances, while the system was offline. It was observed that in three cases, fines were levied from consumers though they remitted water charges before the due date. Through interaction with consumers and KWA office staff, Audit observed that there were similar cases in all the Sub-divisions test-checked.

While admitting the lapse, the Government stated (December 2017) that action would be initiated to rectify the design deficiency.

[112] Local grid is referred to mean that, when the online server connectivity is not temporarily available, the updation information is stored in the local system and subsequently synced with the server as and when the server connectivity is established.

5.12.1.2 Absence of provision for calculating renewal fees for casual connection

According to the extant regulations[113], when a casual connection is provided on account of commercial consumption of water like that of house construction, repair, etc., applicants should deposit an amount equal to the cost of 2.50 kilolitres of water for each square meter of plinth area of the building proposed to be constructed at the prevailing non-domestic rates, subject to a maximum of ₹20,000. According to Regulation 10 *ibid*, if the casual connection is continued as such after completion of one year, a renewal fee of ₹250 is to be charged from the consumer.

Audit observed that the system did not have a provision to calculate the annual renewal fees on completion of every year and raise the demand through subsequent bills as an automated process. In all the test-checked offices, there were omissions in collection of renewal fees. As per the data analysis, the amount that escaped collection was ₹76.50 lakh in respect of 5,686 cases.

The Government replied (December 2017) that provision would be made in the system to include renewal fees annually, in the subsequent bills.

The Government also stated that there was no revenue loss as renewal fees were collected at the time of conversion or disconnection. The reply was not correct as the fees were required to be collected annually as per the rules thereon and not at the time of conversion/disconnection.

5.12.2 Improper designing of database

Audit observed the following deficiencies in database designing.

- The practice followed in KWA is that collection of cash towards water charges in the Revenue Collection Sections is closed each day at 3.00 PM and remitted to the respective Sub-division on the same day. The Sub-division consolidates the collection received from all the Sections under them and remits the amount to the non-operative account maintained for the purpose. Audit observed that at the Sub-division level, eABACUS did not contain any table/column to capture the remittances into bank. In the absence of proper online monitoring mechanism, the system was exposed to misappropriation of money. Audit observed instances of embezzlement of cash[114] amounting to ₹6.42 lakh in three out of 18 Sub-divisions test-checked. Embezzlement of cash included delayed remittances and partial remittance to bank. The deficiencies in the database design deprived the system of the facility of monitoring at various levels.
- There was a provision for levy of penalty of ₹250 in the case of dishonoured cheques. However, there was no column to store the penalty levied and hence, it was included among other items in the column for storing other adjustments. It lacked audit trail adversely affecting exercise of internal controls and execution of audit.

[113] Regulation 5 of KWA (Water Supply) Regulations, 1991.

[114] Delayed remittance of cash was ₹5.79 lakh in Aluva and Angamaly Sub-divisions. There were short remittances of cash amounting to ₹0.63 lakh in Aluva, Angamaly and Varkala Sub-divisions.

- Number of occupied dwelling units in an apartment complex varies from time to time. As narrated in the succeeding paragraph 5.17.4, the total number of dwelling units is required for calculation of water charges in the case of apartment complexes. Audit observed that the system did not have a provision for storing the number of dwelling units for every billing period. The system replaced the previous value with the latest number of dwelling units, instead of storing the respective value for every bill. This lacuna leaves the system without audit trail.
- Revenue recovery (RR) proceedings are initiated on disconnected consumers because of long pending dues. Once RR proceedings are initiated, the consumers concerned are permitted to make arrear payment only after remitting RR proceeding charges[115]. However, Audit observed that the system did not have a provision to capture initiation of RR proceedings. Hence, the counter staff members, unaware of the RR proceedings, accepted remittance of arrears by consumers, where RR proceedings were initiated without remitting the RR proceeding charges. During the course of and finalisation of RR proceedings by Revenue Officers, while approaching the consumers for attachment of movable or immovable properties, disputes arose between Revenue Officers and consumers as the payments were already made by the consumers through the cash counters.

The Government stated (December 2017) that action would be initiated to rectify the deficiencies.

5.12.3 Non-capturing of electronic fund transfers through banks

The consumers can make payment of their water bills in any of the modes like, cash, cheques, demand draft, online transactions using net banking, credit cards, debit cards and bank transfers through NEFT[116], RTGS[117] and IMPS[118]. However, the system did not provide any interface for consumers to make bank transfers through NEFT, RTGS and IMPS. Audit observed that consumers obtained the non-operative account number of the Sub-division concerned and made electronic funds transfer. However, in the absence of any web interface, in respect of bank transfers through NEFT etc., the Sub-division could credit consumers' ledgers only in respect of those consumers, who made subsequent representations. In the test-check of records for the period from May 2016 to October 2017 in Sub-division, Painavu, Audit observed 51 NEFT transactions. Of these, the Sub-division could not identify the remitters and credit the respective ledgers in five instances amounting to ₹6,180 even after 205 days (November 2017).

The Government stated (December 2017) that an interface would be provided in eABACUS.

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[115] As per Rule 5 of the Kerala Revenue Recovery Rules, 1968, the charges include 5 *per cent* of arrears to be collected, when the amount does not exceed ₹5 lakh and 7.5 *per cent* when it exceeds ₹5 lakh and ₹75 per every notice issued.

[116] National Electronic Funds Transfer (NEFT) is an electronic funds transfer system maintained by the Reserve Bank of India.

[117] In Real-Time Gross Settlement (RTGS) transfer of money takes place from one bank to another, where transactions are settled as soon as they are processed and payments are final and irrevocable.

[118] Immediate Payment Service (IMPS) is an instant interbank electronic fund transfer service.

5.12.4 Deficiencies in software

Billing and route information are ported to handheld devices, where they are used or reports generated and handed over to meter readers for taking meter reading as narrated in paragraph 5.5. The system is configured in such a way that once the route information is ported/generated, payments cannot be accepted until the meter reading is ported back to the system, due to locking of consumers' ledgers. Through interaction with consumers and KWA office staff, Audit observed that in such circumstances, if a consumer intended to remit water charges relating to any previous bill issued, the reading of which had been uploaded earlier, the system could not accept payments, unless the latest meter reading was uploaded to the system and thereby unlocking of consumers' ledgers.

The Government replied (December 2017) that a mobile application was planned to be introduced that would settle the issue.

Recommendation 5.1: Design deficiencies may be remedied by comprehensive mapping of business rules.

5.13 IT operations

5.13.1 Bypassing segregation of duties

Segregation of duty at various levels of officers is the basic requirement for any good system. Every user is given certain privileges and rights according to the role they perform, data confidentiality and the related risks. The details entered in the system, if required to be modified or deleted later, should be done by a competent authority with adequate documentation.

Audit observed in 17 out of 18 test-checked offices that the Assistant Executive Engineers (AEE) shared their login credentials to subordinate counter staff members, who cancelled the receipts, adversely affecting the accountability of transactions made. This exposed the system to the risk of irregularity. The accountability could also not be fixed for the transactions made. Audit also observed in the above offices that counter staff members were cancelling receipts, bypassing the segregation of duties.

The Government stated (December 2017) that action would be initiated to rectify the deficiency.

5.13.2 Access control failure

Access controls are measures and procedures, aimed at protecting the IT resources against unauthorized access attempts. Audit test-checked the access controls in eABACUS and found that an employee logging in with his user credentials was able to alter the route information of any consumer falling under any other Sub-division exposing the system to the risk of excluding consumers from billing cycle either inadvertently or deliberately. For example, an employee working in Sub-division office Vadakara in the northern district of Kozhikode was able to modify the route information in respect of a consumer belonging to Sub-division Pongummodu in the southernmost district of Thiruvananthapuram.

The Government stated (December 2017) that action would be initiated to rectify the anomalies.

Recommendation 5.2: Access controls may be ensured by defining and enforcing access rights.

5.13.3 Irrelevant data of unidentified consumers

Previous IT Audit Report[119] contained an observation that there were 2,198 unidentified consumers[120] in Kowdiar and Pongummoodu Sub-divisions and that the Government agreed to remove those consumers from the billing cycle, if they could not be identified even after a special drive. However, Audit observed that the number of unidentified consumers in Kowdiar and Pongummoodu sub divisions increased to 3,019. Analysis of the entire data showed that there were a total of 69,321 unidentified consumers, all over Kerala. The amount of arrears from these consumers was ₹15,489.94 lakh. The ageing analysis of arrears in respect of unidentified consumers is shown in **Table 5.2**.

Table 5.2: Ageing analysis of arrears in respect of unidentified consumers

Ageing	No. of unidentified consumers	Arrear amount *(₹ in lakh)*	Percentage of arrear amount
Above one year but below five years	41,972	7,333.26	47.34
Five years and above but below ten years	9,087	5,650.17	36.48
Ten years and above	18,262	2,506.51	16.18
Total	**69,321**	**15,489.94**	**100**

(Source: Analysis of eABACUS data.)

The above ageing analysis shows that 52.66 *per cent* of the arrear amount in respect of unidentified consumers remained untraceable for five years or more. Hence, the possibility of collecting the arrears from these consumers is remote. Maintenance of non-existing consumers in the database adversely affects data integrity and leads to generation of Management Information System Reports. Sundry debtors shown in the accounts include ₹155 crores as arrears receivable from the above unidentified consumers, which is a non-performing asset. As such, the balance sheet does not reflect a true and fair view of the accounts.

The Government stated (December 2017) that action would be initiated to remove unidentified consumers from the billing cycle.

5.13.4 Change management

Change management ensures that all changes to system configurations are authorised, tested, documented and controlled so that the systems continue to support business operations in the manner planned, and that there is an adequate trail of changes.

[119] Paragraph 2.6.2 of Report of the Comptroller and Auditor General of India – Government of Kerala (Civil) – for the year ended 31 March 2006 – Volume II.

[120] Normal billing period is bimonthly. Monthly billing is done in the case of consumers, who consume bulk quantity of water. Billing is done once in six months in remote villages. Even in the case of households kept locked for years, meter reading would be taken and the status stored as 'door locked'. Audit, therefore, quantified the number of consumers, in whose cases there were no activities (meter reading/bill generation/payment) for more than one year.

Before making any modification and alteration of business rules, in the live environment, they should be tested, put to trial run, documented and reviewed in the testing environment. However, Audit observed that no version numbers were marked in the application. There was no formal/documented system for complaint reporting. Whenever, any bugs were observed, users were lodging complaints through telephone calls to database administration (DBA) wing. The DBA wing made changes in the system based on the complaints. These changes were neither recorded nor was there any evidence of conducting trial run. The system, thus modified, was put to use even without approval of competent authorities. The consequences of improper change management are pointed out in paragraphs 5.17.1 to 5.17.4.

The Government stated (December 2017) that major changes were made with the concurrence of High Level Committee and minor changes were made by database administrator maintaining logs. The reply was not correct as any changes made in the system should be after proper testing, trial run and approval of competent authority. The deficiencies in processing controls were the consequences of lapses in change management.

Recommendation 5.3: Change management procedures may be as per the best practices in the industry and properly documented.

5.14 Contract management: Inadequate monitoring of service providers

KWA entered into an agreement (February 2011) with BillDesk, a payment service provider, for facilitation of online payment, as per which consumers had to pay service charges to BillDesk for each transaction. It requires at least a five-way communication[121] in an online transaction. First, a consumer's computer has to communicate to KWA server. KWA server has to communicate to BillDesk server to provide online payment service. BillDesk server, in turn, communicates to consumer's bank server to fetch the money. Once the money is credited to BillDesk by debiting consumer's bank account, the fact is to be communicated to KWA server for generating and issue of receipts to the consumer. If communication in all the above four channels are successful, the consumer can view his receipt and take the printout by the final communication from KWA server to the consumer. Once a receipt is generated, the system does not permit any more transaction of that particular bill. If the receipt is not generated, the option to make payments in the KWA interface will be active and the consumer gets to know that the transaction is not successful, even though the money was debited from the bank account.

The consumers, therefore, resort to repeating the bill remittance process with the expectation that the amount of failed transactions would be credited back to their accounts as per the industry best practices. However, Audit observed that in respect of unsuccessful transactions, instead of paying back the amounts

[121] For simplicity, only the vital channels of communications relevant for the above narration are discussed. A Payment Service Provider can connect to multiple acquiring banks, card, and payment networks. An acquiring bank is a bank or financial institution that processes credit or debit card payments on behalf of a merchant by allowing merchants to accept credit card payments from the card-issuing banks within an association like, Visa, MasterCard, Discover, Indian Rupay, American Express, Diners Club, etc.

debited from consumers' bank accounts along with the debited service charges, BillDesk credited the multiple remittances to KWA accounts. The duplicate amounts were given credit to the consumers' ledgers as advances by KWA. KWA did not direct BillDesk to rectify their application for reversing the money debited from the consumers' bank accounts on account of the failed transactions. Though the duplicate amounts were given credit to the consumers in eABACUS as advances, no interest was paid or discount given to consumers for advance remittances.

There were 2,272 multiple transactions credited to KWA account by BillDesk involving an amount of ₹8.50 lakh excluding service charges as observed in data analysis. Data analysis also revealed that in eleven transactions made on 28 January 2016, the money (₹859) debited from consumers' accounts was not transferred to KWA by BillDesk. Audit observed that the settlement details in respect of these cases were demanded from BillDesk (10 February 2016). However, there was no follow up action to effect the payment from BillDesk and the money was not transferred to KWA (December 2017).

Audit also observed that KWA did not initiate any action to take advantage of competition among payment service providers and consider the ones that provide services free of cost like eTreasury, etc.

While accepting the observation, the Government stated (December 2017) that action would be initiated to avoid the drawbacks in future.

5.15 Business continuity planning

5.15.1 Lapses in business continuity planning and disaster recovery planning

Business continuity planning is the process an organisation uses to plan and test the recovery of its business processes after a disruption and how an organisation will continue to function under adverse conditions like natural or other disasters. Disaster recovery planning is a subset of business continuity planning. It is the process of planning and testing for recovery of information technology infrastructure after a natural or other disaster.

Audit observed that adequate measures were adopted for backup of data and its offsite storage. However, there was no prescribed procedure for regular disaster recovery testing. Audit observed that the lone data recovery conducted (28 January 2016) was consequent on corruption of database.

For proper maintenance of any good IT system, a log register is required to be maintained for recording the duration of network failures. Log registers of availability of network connectivity were not maintained in 17 out of 18 offices test-checked. In the absence of log registers, Sub-division offices could not ascertain the up/downtime and initiate action for ensuring undisrupted business. However, during discussion with eABACUS users, Audit observed average network downtime of five hours per week. Absence of log registers brought to light the lapses in exercising monitoring controls.

The Government accepted the observation and stated (December 2017) that immediate action would be initiated for maintenance of logs.

Recommendation 5.4: Immediate action may be initiated to maintain log registers for recording the duration of network failures.

5.15.2 Preventive and Environmental Controls

Environmental controls prevent or mitigate potential damage to facilities and interruptions in service. It was observed that none of the offices visited by Audit were equipped with fire alarms, smoke detectors, fire extinguishers and fire-suppression systems.

The Government stated (December 2017) that action would be initiated to provide fire alarms, smoke detectors, fire extinguishers and fire suppression systems.

IT Application controls

5.16 Input controls: Delay in updating meter reading

As narrated in paragraph 5.5, after taking the reading, the meter reader issues bills to the consumers, which are payable from the third working day. Once billing and route information is generated/ported to handheld devices, the system locks the consumers' ledger from accepting payments. The system will further enable payment only after uploading the latest reading. Audit observed that, when a consumer approached a KWA cash counter to pay water charges, if there was delay in uploading of reading information, the system could not accept payment and prompted: "Reading not posted". In such circumstances, the counter staff made telephone calls to the meter reader and uploaded the meter reading information for enabling the system to accept payments. However, for consumers resorting to other modes of payments like ECS, FRIENDS Centres, Akshaya Centres etc., there was no option other than to wait until the system is updated for making payments. Malfunctioning of handheld devices is one of the reasons for delay in updation of the system. Another reason for the delay is lapses in exercising of management controls. Data analysis revealed that in 3,59,857 billing instances, there was delay of more than two weeks in uploading of route information in the system causing hassles to consumers.

While accepting the observation, the Government replied (December 2017) that they were planning to introduce a mobile application to capture reading and synchronise it with server immediately.

Recommendation 5.5: Meter reading procedure may be automated and it should be in sync with the billing procedures.

5.17 Processing controls

5.17.1 Non-collection of sewerage charges on account of delay and mistake in mapping of business rules

Along with revision of water tariff with effect from 01 October 2014, KWA introduced collection of sewerage charges for consumers having sewerage connections. The revised rates are shown in **Appendix 5.2**. The rates of

sewerage charges are 10 percentage of water charges payable by all categories of consumers.

Data analysis revealed that sewerage charges were included in the water bill only from June 2015 owing to delay in mapping of business rules. In addition to that, there was delay in capturing data since June 2015. On account of the above delays, the sewerage charges that escaped collection amounted to ₹311.50 lakh.

Moreover, in Kochi Division, even capturing of data in respect of consumers with sewerage connections began only in January 2017. Details of only 41 out of 1,184 consumers were entered into the system in Kochi (November 2017). Owing to this non-inclusion of 1,143 consumers in the system, sewerage charges were not collected from 1,143 consumers in Kochi Division for the period from October 2014 to March 2017. The sewerage charges that escaped collection in Kochi Division due to non-inclusion alone was estimated to be ₹17.47 lakh[122].

Data analysis further revealed that there was error in calculating the sewerage charges. Based on meter reading, the monthly average consumption was first calculated, which was multiplied with the applicable rates and the number of months in the billing period. However, while 10 *per cent* of the monthly water charges were rightly worked out, multiplying the same with the number of months in the billing period was omitted. Consequent short collection of sewerage charges was ₹107.52 lakh. Thus, total sewerage charges that escaped collection on account of delay and error in mapping of business rules was ₹436.49 lakh.

The Government stated (December 2017) that action would be initiated to collect arrears.

Regarding the error in calculating sewerage charges, the Government stated that the anomaly was rectified in 2016. The reply was not correct as data analysis revealed errors for the period up to April 2017.

5.17.2 Short collection of water charges on account of delay in mapping of business rules

Government of Kerala revised (September 2014) water tariff with effect from 01 October 2014. The revised rates are shown in **Appendix 5.2**. As the billing of water charges up to 31 October is generally done with effect from 01 November, the revised rates were mapped to the system effective from the billings made since 01 November. However, Audit observed that in 2,581 cases billings done in October 2014 (on account of consumer services[123]) contained water consumption for the months of September and October 2014. In those

[122] Audit quantified the sewerage charges which escaped collection in the following method. During the quarter January to March 2017, sewerage charges (₹2,089) were seen levied on 41 consumers. The average monthly amount per consumer was calculated (₹50.95). The average amount was multiplied with 30 months (period from October 2014 to March 2017). That amount was further multiplied with the number of consumers, whose details have not been captured (1,143).

[123] Consumer service is the term used in KWA to denote honouring of service request from consumers like, change of consumer category, replacement of water meter, etc. A prerequisite for performing a consumer service is that the consumers are required to clear all the arrears. Under such circumstances, the system generates a bill in advance for the current bimonthly billing period based on up-to-date meter reading.

cases, the consumption since 01 October 2014 should have been charged at the revised rates. As there was delay in mapping of business rules in the system, adjustment bills could have been issued in these cases. However, the system was not enabled to revise bills based on the revised tariff for issue of adjustment bills. The consequent loss incurred by KWA was ₹14.17 lakh.

The Government accepted (December 2017) that there was a delay in making changes in the software. However, the reply was silent about the intended course of action on short collection.

Recommendation 5.6: KWA may initiate action to settle the outstanding dues from the consumers.

5.17.3 Excess collection due to inaccurate mapping of business rules

While mapping the water tariff revised with effect from 01 October 2014 mistakes crept in the program in respect of calculation of water charges consequent on consumer service. The tariff contained several slabs *viz.*, consumption of water up to 5 kilolitres (KL), above 5 KL and up to 10 KL, above 10 KL and up to 15 KL, etc. However, while writing the program, the upper limit of each slab was wrongly applied with the rates of the subsequent slab. For example, domestic rate for consumers falling in the slab 'above 10 KL and up to 15 KL' was '₹40 plus ₹5 per KL in excess of 10 KL'; rate for slab 'above 15 KL and up to 20 KL' was ₹6 per KL for the entire consumption'; etc. Thus, a domestic consumer, whose meter reading is 15 KL had to pay ₹65 {40 + (5 x 5)}. However, due to the inclusion in the subsequent higher slab, he was required to pay ₹90 {15 x 6}. Similarly, consumers, with consumption of 20, 25, 30 and 40 kilolitres, were incorrectly required to pay excess amounts. Data analysis revealed that during this period, the excess amount of water charges collected from consumers was ₹1.35 lakh in 1,805 cases.

The Government stated (December 2017) that the anomaly was rectified. However, the reply was silent about the intended course of action on the excess amounts collected from consumers.

Recommendation 5.7: KWA may adjust the future bills to be issued to the affected consumers by giving credit for the excess amount collected from them.

5.17.4 Mistakes in billing

The objectives of processing controls are to ensure that processing of transactions is accurate and complete. Audit observed weak process controls and mistakes in software that led to generation of inaccurate water bills.

Data analysis revealed variation in the water charges collected with that of the right calculation as per the tariff in some cases. Detailed substantive testing brought to light various types of mistakes in system calculated figures due to non-uniformity in processing, some of which are narrated below.

- There is only one water meter in an apartment complex. Meter reading is normally taken bimonthly or with a higher interval. The total consumption of water has to be apportioned to various distinct units for applying the respective slab. Hence, the course of action followed is dividing the total consumption in respect of an apartment complex by

the number of months pertaining to the billing period to arrive at the monthly consumption. The monthly consumption is then divided by the number of distinct units and is stored in the system as the monthly consumption of a unit. The monthly water charge is then calculated by applying the relevant rate. The monthly charge is then multiplied with the number of units and the number of months pertaining to the billing period for generating bill for the respective flat. However, Audit observed mistakes in bill generation in the cases, where current reading was not captured. In such cases, system adopted the latest available consumption stored (a figure that was arrived at by dividing the total monthly consumption by the number of occupying units) and wrongly divided it again by the number of units and generated the bill. This resulted in short billing and short collection of water charges amounting to ₹17.38 lakh.

- As various procedures or modules are prepared by different programmers and as per changes in business rules, proper processing controls should ensure that there should be integration of all the modules in an application system so that the results of the processing should be uniform. Rounding off of values is required to be done only at the final stage of generation of bills for easy facilitation of collection of money and is not to be followed in between the processing stages. However, Audit observed that rounding off to the nearest Rupee was followed in some of the intermediary procedures. The aggregate difference in the water charges on account of wrong application of rounding off was ₹21,029.

- There is a table for storing water meter reading details and another for storing provisional invoice card details. The former table stores the reading taken and the date of taking the reading. The latter table, a system generated table based on the values in the former table, is used for calculating provisional invoice. Obviously, both the tables should have the same date of reading in respect of every consumer, for a particular billing period. While the former table stores meter reading, the latter generates the quantity and cost of monthly water consumption. However, Audit observed that in certain instances, the system stored multiple dates, quantity and amount of monthly consumption in the latter table in respect of the same consumer for the same billing period. Consequently, the invoice was seen generated with inaccurate consumption. The aggregate difference in the water charges on account of the above was ₹6,257.

While agreeing to audit comment, the Government stated (December 2017) that immediate action would be initiated to rectify the anomalies.

Recommendation 5.8: The system may be revamped to ensure that all the business rules are accurately mapped in the system.

5.18 Output controls: Inaccurate generation of Management Information System (MIS) reports

Management Information System reports[124] are effective tools for managing any system. eABACUS has provision to generate status reports on 'Reading Monitoring' and 'Amount Monitoring' that provide information on the details of water meter reading captured in the system and the relevant money collected in a particular Revenue Collection Section respectively, during a particular period. However, Audit observed that whatever be the parameters pertaining to a particular Revenue Collection Section selected from the list box[125], the system generated the status for the entire State. Further, Audit observed inaccuracies in generation and unavailability of the required MIS reports.

The reliability of MIS reports is vital for management decisions. In the absence of reliable MIS reports, the revenue monitoring such as dues and arrears by each Sub-division will not be possible.

The Government stated (December 2017) that action would be initiated to rectify the deficiencies.

5.19 Application security controls

5.19.1 Non-deactivation of users

Application security controls require that on transfer or termination of services of employees because of retirement or otherwise, the login-ids provided to them should be deactivated. However, in nine out of 18 offices test-checked, the number of active login-ids were 374 as against 203 employees assigned with operation of eABACUS. Non-deactivation of past users is a clear indicator of risk of intrusion into the system by unauthorised persons. It would also cause serious IT security risks and adversely affect accountability.

The Government stated (December 2017) that action would be initiated to deactivate such login-ids.

5.19.2 Master file and standing data protection

5.19.2.1 Presence of junk data in master file

Master tables contain data of a permanent nature that seldom changes like, consumer ID, name, address, etc., the accuracy of which is of vital importance. Standing data errors have a far-reaching effect on the application, since this data might be used for a very large extent of the application's transactions. The previous IT Audit Report[126] contained an observation on storage of junk data in master tables. Data analysis revealed continuance of the presence of junk data. The column relating to consumer name contained junk characters in 889 rows. There were test data in the consumer ID column in respect of eight rows and the key ID column contained junk character in one row. Storage of junk data in the

[124] Management Information System reports provide a concise view on the various parameters that are vital to the business and are effective tools for managing any system.

[125] A list box is a graphical control element that allows a user to select one or more items from a list contained within a static, multiple line text box.

[126] Paragraph 2.6.1 of Report of the Comptroller and Auditor General of India – Government of Kerala (Civil) – for the year ended 31 March 2006 – Volume II.

system had adverse effect in processing and consequent non-integrity of the MIS reports generated.

The Government stated (December 2017) that action would be initiated to correct errors.

5.19.2.2 Absence of storage of vital data in master file

Status of water meters is stored in master file. However, a vital piece of information of meter status – 'No meter', in the case of absence of water meter owing to theft or otherwise, is not available in the master file. For categorisation of consumers, certain inputs like office, labour camp, bachelor, etc., are required as these are the decisive factors in categorising a consumer into domestic or non-domestic. Audit noticed that these values were not stored in Master files.

The Government stated (December 2017) that action would be initiated to rectify the deficiencies.

5.19.3 Information security issues

5.19.3.1 Flaws in web security

- Audit observed that eABACUS did not undergo STQC[127] audit. In its absence, several lapses in access controls, data security and web security of eABACUS pointed out elsewhere in the audit observations remained unnoticed. But, an STQC testing process of the KWA website was initiated by KWA. As per the report (February 2013), there were 35 vulnerabilities with high severity[128]. However, no follow up actions were initiated to rectify the vulnerabilities pointed out in the report and complete the testing process. The Government stated (December 2017) that action would be initiated to complete certification process and to rectify the flaws.
- Audit observed major flaws in information security. It was observed that when a user, say Assistant Executive Engineer (AEE) assigned with the highest privileges in a Sub-division, exited the application by clicking the close button without logging off the system, anybody else could login to the system by keying in any characters, say 'abcd' as user-id and the same or any other characters as password. It indicated that there was no automatic session log-off, when a user exits the application by clicking the close button. The flaws are serious, which are prone to misuse as AEEs are assigned with the role of cancellation of paid bills.
- The risk of interception of passwords sent over the Internet can be reduced by using cryptographic protection and all passwords stored in the system should be encrypted. Audit observed that KWA did not have laid down password policy. Data analysis revealed that the passwords used for online transactions were stored in the database tables in unencrypted format. Minimum length was not ensured. Easily guessable

[127] Standardisation Testing and Quality Certification is an organization under the Ministry of Electronics and Information Technology, Government of India, which provides quality assurance services in the area of Electronics and IT through countrywide network of laboratories and centres.

[128] In the case of vulnerabilities with high severity, any failure would cause impairment of critical system functions, for which no workaround solution exists.

text like, names, mobile phone numbers, email ids, etc., were seen stored as passwords, which was a serious security flaw.

- Use of USB[129] storage devices is one of the main reasons for virus infiltration. Industry best practices demand disabling of USB drives from organisational networks. Audit observed that USB drives were not disabled and antivirus applications were not installed in any of the systems in the offices visited. Thus, the system was exposed to the risk of loss of vital data due to virus infiltration, adversely affecting the business continuity.

The Government stated (December 2017) that action would be initiated to rectify the flaws.

Recommendation 5.9: The flaw in the system login may be addressed immediately to prevent unauthorised login and the system subjected to STQC audit. Data security may be ensured by defining and enforcing password policy and a robust system of backup and recovery.

5.20 Conclusion

Audit observed that the designing and implementation of eABACUS benefitted both KWA and consumers. The introduction of a web based application, facilitating more payment options like online mode, bank transfers and payments through common service centres benefitted KWA by enhanced collection of dues and benefitted the consumers with the comfort of making payments from home rather than visiting KWA counters. However, Audit noticed the following deficiencies in the process of billing, collection and accounting of water charges, in improving consumer satisfaction, in project and contract management and in IT controls, which stood in the way of eABACUS becoming a robust IT system.

- Design deficiencies and lapses in monitoring controls led to cash embezzlement.
- Lapses in change management resulted in deficiencies in processing controls.
- Inadequate accessories, coupled with lack of password policies led to unauthorized access rights provisioning in the system.
- Non-automated meter reading hindered timely collection of dues from consumers.
- Insufficient providing of facilities of various online modes of payments caused difficulties to consumers in timely remittance of their dues.

[129] Universal Serial Bus (USB) is a plug-and-play interface that allows a computer to communicate with peripheral and other devices.