

CHAPTERS

CHAPTER 1: INTRODUCTION

In engineering parlance, the term operation refers to the daily operation of the components of a sewerage system such as collection system, sewage pumping stations (SPS), pumping mains, sewage treatment plants (STP), machinery and equipment, etc., in an effective manner by various technical personnel, and is a routine function. The term maintenance refers to the art of keeping the structures, plants, machinery and equipment and other facilities in optimum working order and includes preventive maintenance or corrective maintenance of mechanical adjustments, repairs, and planned maintenance. However, replacements, correction of defects etc., are considered as actions excluded from preventive maintenance. For replacements with regard to sewerage and sewage treatment, the broad categories of infrastructure, which need to be addressed are as follows:

1. Collection System including house service connections and manholes
2. SPS
3. Pumping Mains
4. STP
5. Utilities for biological sludge management and containment of chemical sludge

There are standard Operation and Maintenance (O&M) manuals for these in developed countries. However, in India such a standard O&M manual has not yet been prepared in detail. Hence, the following conditions prevail:

1. Most of the towns are only partially sewered.
2. Most of generated grey water continues to flow into road side drains.
3. Per Capita water supply is low in many cities for providing conventional sewerage system.
4. Water is used mainly from local groundwater with high TDS, sulphates etc.
5. The sulphates are an agent of corrosion of concrete in sewers.
6. Wash basins, kitchen sinks etc. do not have blenders below the sink.
7. Detergent powders have significant grit content.
8. Cattle are also housed inside the cities and their dung washed into sewers.
9. The cattle shed washing occurs during noon times after the peak sewage flow has passed.
10. The dung from the cattle shed settles, builds up and chokes the sewers.
11. The budgets of most ULBs are inadequate for purchasing sewer cleaning machines.
12. Though sewer divers are banned, still manual labour is used to “rod” and clean the sewers.
13. Pumping stations are not connected by website to know of flooding in the command area.
14. Removing sewer blocks take longer times due to problem of manual work.
15. Instrumentation based remote operation of STPs is a far away prospect.
16. Except a few metro cities, all records continue to be in handwritten hard formats only.
17. There are no newsletters aimed at operators sharing their experiences.
18. The above position is further complicated by many local languages.
19. Disposal of solid wastes by the public into sewer manholes.

These issues as in Indian conditions are directly in contrast to the situations in advanced countries and makes it necessary to evolve an O&M manual specific to the Indian conditions.

1.1 NEED FOR O&M

According to the National Urban Sanitation Policy (NUSP), the proper operation & maintenance of all sanitary installations requires:

- a. Promoting proper usage, regular upkeep and maintenance of household, community and public sanitation facilities
- b. Strengthening ULBs to provide or cause to provide, sustainable sanitation services delivery

There is an O&M manual by CPHEEO for water supply systems, but there is no such manual for sewerage systems. Moreover, unless there is an O&M manual, ULBs cannot justify budget allocations to meet their obligations under such a manual. The net result is this lack of attention to the important aspect of O&M of sewerage systems leads to deterioration of the useful life of the systems necessitating premature replacement of many system components and also affecting overall sanitation. As such, even after creating the assets by investing millions of rupees, they are unable to provide the services effectively to the community for which they have been constructed, as they remain defunct or underutilized most of the time.

Some of the key issues contributing to the poor O&M have been identified as follows:

1. Lack of finance and inadequate data on O&M.
2. Multiplicity of agencies, overlapping in their responsibilities.
3. Inadequate training of personnel.
4. Lesser attraction to maintenance jobs in career planning.
5. Lack of performance evaluation and regular monitoring.
6. Inadequate emphasis on preventive maintenance.
7. Lack of operation manuals.
8. Lack of appreciation of the importance of facilities by the community.
9. Lack of real time field information, etc.
10. O&M contractors not having permanent staff.
11. Connection of road gullies to sanitary sewer systems, which are major contributors of silt and floating matter such as plastic bags, wood pieces, papers, etc.
12. Lack of storm sewer system.
13. Wastage of potable water, due to supply of unmetered water supply at cheap water tariff and free water connections, which add to the load of domestic sewage.
14. The silting of sewer system is a common phenomenon and is compounded by low per capita water supply.

Therefore, there is a need for clear-cut sector policies and legal framework and a clear demarcation of responsibilities and mandates within the water supply sub-sector.

From the Indian experience, it has been observed largely that about 20 to 40% of the total annual O&M cost goes towards the salary of the O&M staff, 30 to 50% of the cost is incurred on power charges and the balance alone is utilized for consumables, repairs and replacement of parts and machinery and miscellaneous charges. In most of the cities in India, the tariffs are so low that they do not even cover the annual O&M cost. Hence, it is a felt need to bring out this O&M Manual in sewerage systems encompassing various issues pertaining to an effective O&M such as technical, managerial, administrative, personnel, financial and social aspects etc. At present, there is no technical manual on this subject to benefit the field personnel and to help the O&M authorities to prepare their own specific manuals suitable for their organizations. Therefore, CPHEEO has under the aegis of the Japan International Cooperation Agency (JICA) made plans to publish the O&M manual for Indian sewerage system.

1.2 BASIC CONSIDERATIONS OF O&M

1.2.1 Laws and Regulations related to O&M of Sewerage System

In fact, there are no laws directly related to O&M of sewerage systems. The laws which are generally applicable are invariably the municipal bye-laws, that are of general nature. The GOA Sewerage System and Sanitation Services Management Act, 2008 mentioned in Appendix C 2.2 of part C of the manual may be suitably amended and adopted by the states to clearly mandate that not taking sewer connection can be a cognizable offence so that the levy of penalties or disconnection of other services will have the necessary legal validity to avail the central support.

1.2.2 Effluent Standards related to Sewage Treatment Plants

The effluent standards related to STPs are confined to BOD of less than 20 mg/L and SS of less than 30 mg/L and are more of historical nature.

1.2.3 Environmental Considerations

There are generally problems with industrial effluents which get into sewers and are difficult to control. A conflict exists between the prevention and control of Water Pollution Act and the Municipal Act or Jal Nigam Act or Water and Sewerage Board Act. The sewer system is to be maintained by the municipality, Jal Board or Water Supply and Sewerage Boards. However, the power to sanction a connection of the industrial effluent that is discharged in the sewers is not with these agencies, but with the Pollution Control Board (PCB). The trouble is when industries are detected to be discharging their effluents without the necessary treatment; the said local agencies do not have legislative powers to put the industry on notice. They have to write to the PCB but the PCB are in no hurry to immediately look into this specifically because for the entire metro city, the PCB may have only a handful of engineers and they have many other situations like these to handle. Hence, the backlog is high. Even if a legal process is initiated, getting the orders of the court to effect disconnection of sewer connection is difficult. It looks that one simple way of getting over these is to allow the industry to connect only their toilets, baths, canteen etc. But the real problem is the industries may be surreptitiously using that connection to discharge their effluents also. The monitoring of these is vested with the PCB. Thus, a very serious situation exists here. Hence, a joint subcommittee of ULB and PCB has to be created with legal powers to recommended interim disconnections.

1.2.4 Budget

Appropriate budgetary provisions for the O&M of sewerage system need to be provided so that O&M is carried out without any constraints such as human resources and finance. These are dealt with in part C of the manual.

1.2.5 Preventive Maintenance

Preventive maintenance is a set procedure whereby each component of the system goes through a systematic check and these components are brought into dependable use. An example can be, checking the volume of oil and its consistency in the gearbox after a specified number of hours of operation and correcting the situation either by topping up or by replacing fully as needed. The preventive maintenance issues, checking parameters and timings are all given by every equipment vendor as a manual. Carrying out these tasks is to be done by the respective equipment vendor under a separate contract called preventive maintenance contract and should be delinked from the O&M contract. Most often this is not fully recognized and what could have been saved by preventive maintenance finally ends up as “breakdown repairs.” This situation needs the required importance for improved efficiency.

1.2.6 Workmanship and Quality of Equipment

Workmanship is defined as the art or skill of a worker with which something is made or executed. Materials and equipment shall be new and of a quality equal to or superior to that specified or approved. Work shall be done and completed in a thorough and competent manner, in strict conformity with the plans and specifications. In general, the work performed shall be in full conformity and harmony with the intent to attain the best standards of construction and equipment of the work as a whole or in part.

No material shall be used in the work until it has been found satisfactory by the Engineer. All material and equipment are subject to test to determine their conformity with these specifications. Certified factory and mill tests normally will be acceptable for standard manufactured items. Whenever standard specifications are referred to, they shall be the latest revised edition. All work and materials shall be subject to inspection by the engineer.

The engineer may assign such assistants as he may deem necessary to inspect the materials to be furnished and the work to be done and to see that the same is strictly in conformity. The engineer shall be notified of the time and place of preparation, manufacture or construction of material for work or any part of the work, which he may wish to inspect, and of the time and place of making the factory tests required under the contract. Such notification shall be given a sufficient length of time in advance of the beginning of the work on such material or part or of the beginning of such test to allow arrangements to be made for inspecting and testing or witnessing, as the case may be, if such inspection and testing or witnessing are deemed practicable by the engineer.

All necessary machinery guards, railings and other protective devices shall be provided as specified by the Industrial safety authority, which would be the Inspectorate of Factories (IoF). Before final acceptance of the work, the contractor shall cause an inspection to be made by a representative of the IoF and got certified that all safety requirements have been complied with.

1.3 OUTLINES OF O&M

1.3.1 Overview and Contents of O&M

Thus, an overview of O&M is taking note of the above issues and suggest appropriate remedies to a given situation which includes finances and manpower and remote control.

1.3.2 Management of Facilities

Proper housekeeping, aesthetics and gardening are the requirement here. With the lifestyle in cities changing to fast-forward, nobody is able to find time for these. In addition, getting labour to do these is also difficult due to extra costs safety and security issues.

1.3.3 Schedule of O&M

A proper schedule shall have to specify what things are to be attended to at what intervals and to whom it is to be reported to in case of faults. Clearly, this is not the case and it is all emergency repairs all the way.

1.3.4 Response to Accidents

Mostly, the local staff may not even know how to do first aid. Hence, whenever an accident occurs, it is the fire brigade that is called to the site. Thereafter, it is a standard procedure of getting the victim to the hospital and thereafter the local agencies come into the picture only when defending the compensation money payable to the victim.

1.3.5 Management of Buildings and Sites

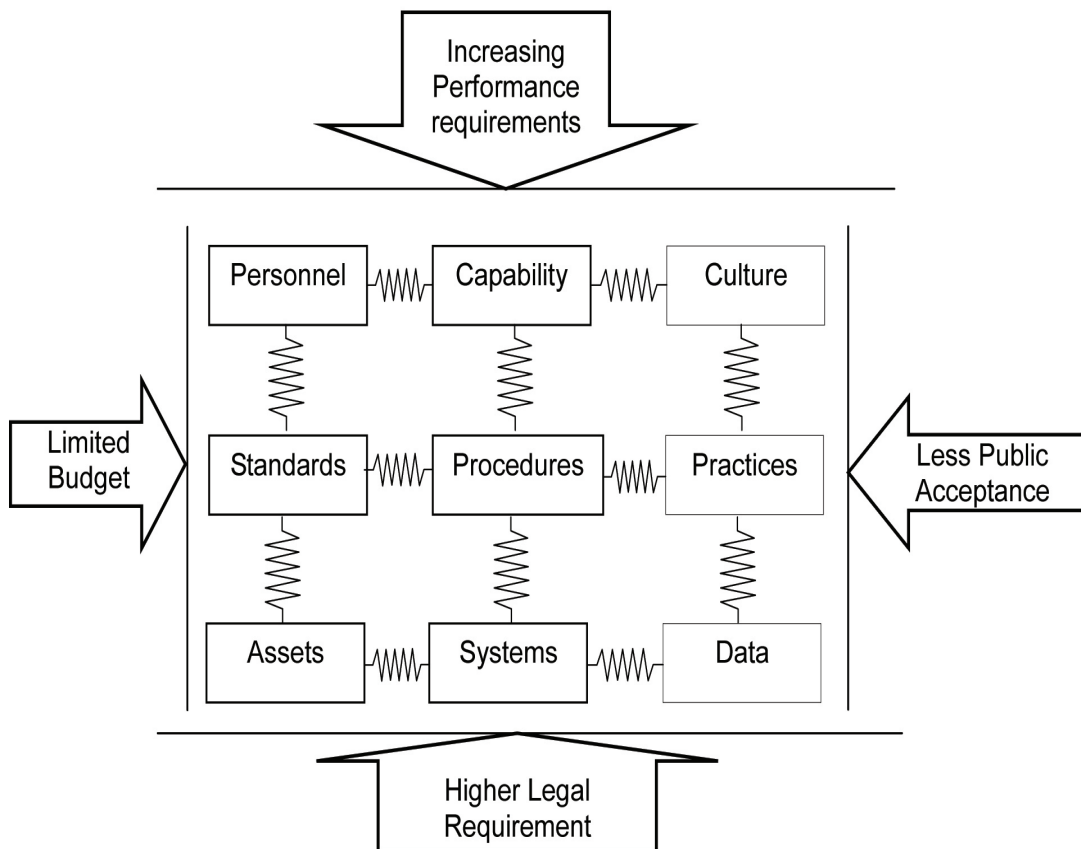
There is the century old practice in Public Works Department (PWD) that the age of civil works is 30 years and for equipments is 15 years. Hence, civil works in sewerage will need strengthening and renewal as the case may be. Similarly, equipments will need replacement in 15 years. However, in actual practice, this is not the case. Only when a civil work shows up a crack or a leaky roof, the position is reviewed as an ad hoc repair. Similar is the case of machineries.

1.4 ORGANIZATION OF O&M

1.4.1 Description of O&M Work

A simple understanding of O&M work is the relationship between human resources, equipment availability, financing the O&M and career opportunities for the staff. These are within the local body. The perception by the public and their payment of dues to the local body is the “other side of the coin” as in Figure 1.1 overleaf.

This illustrates O&M of sewerage as responding to the four-sided compression of (a) limited budget, (b) performance requirements, (c) less public acceptance and (d) higher legal requirements. If all these act at the same time, the system may collapse and if one of them increases the pressure, the ability of the other three needs to be resilient for the system to remain stable.



Source: Ype C Wijnia, 2009

Figure 1.1 Combined Tasks and Challenges with the O&M

If this resilience is not there, the shape of the rectangle will be altered and the system may respond without any control. Thus, the work of O&M involves the engineering, financing and administrative interface with the public.

1.4.2 Deployment of Manpower

There are limited promotional avenues for people in the O&M sector. Non-engineers in the O&M sector entering the service more often retire without any promotion if he has not advanced in academic qualifications. This does not give them any drive to exhibit an involvement in the job all the time as he will be doing a routine type of work.

Promotions by way of number of years of experience must be coupled with examination of his experience and given weightage.

The staff may be rotated between sewerage and water supply sectors by providing suitable training, so that he / she does not get into sickness from working in sewerage system throughout his career. Incentives for career advancement of operators like, for example, timescale in ULB services and additional allowances such as risk allowance or such other chances have to be explored to ensure efficient O&M of sewerage systems.

1.4.3 Outsourcing of O&M

Recent trend is to subcontract the O&M work. In this case, the contractor hires staff from local market and deploys them on the O&M work. He will only place the staff and earn the money and after paying to the staff earns his profit, but he may not have interest in O&M. If the contractor is also from the same firm who has built this sewerage system, his interests may be more sincere. In the case of exclusive O&M outsourcing not involving the potential O&M agency in the construction activity of the system involved, the proper qualifications, experience, personnel, etc., are to be ensured.

Improvements to the existing system for better O&M can be identified by the O&M contractor, but it has to be separately authorized by the ULB either to the O&M contractor himself or to another O&M contractor.

1.4.4 Key criteria for selection of O&M contractor

The qualification for a contractor to be awarded an O&M contract by the ULB shall include not only the qualification of the contractor firm itself in previous O&M works but also the CV and qualification and adequate experience of key personnel in the O&M staff mentioned in the document. The ULB should ensure that such personnel to be engaged for O&M shall be given training during the O&M period through the existing training institutes of major utilities / ULB's in the region and this should be mandated in the tender document for outsourcing of the O&M work.

Incentives for career advancement of operators like, for example, timescale in ULB services and additional allowances such as risk allowance or such other chances have to be explored to ensure efficient O&M of sewerage systems.

1.4.5 Training

Development of operational skill is not taught in the schools, polytechnics or colleges. It has to be learnt. This again must be verified once a year to understand whether the operator has understood these correctly, and if not in order then he has to be put through a specific training. Thus, the training is a continual system. The training institutes should orient the training of the operators with specific reference to the O&M manual of the STP from which the operators are drafted for the training. In addition some of the fundamental aspects shall also be included.

1.4.6 Monitoring through Information Control Technology

Extracting sewage treatment conditions from water quality information of the treated sewage is very important for operating a STP effectively. An example of a Japanese STP implementing and using monitoring using control technology is in Appendix B 1.1

1.4.7 Database for Effective O&M

It is also important to create a database of information obtained through monitoring, and to use this database of past data for operation henceforth. Appendix B 1.2. contains such a database.

1.4.8 Problems in Existing O&M

The problems faced by O&M sector in sewerage are a combination of engineering, finance, staff and management. The engineering problems are absence of adequate innovations of economical design and construction of infrastructure that will reduce the costs and will still render the project functional to the stated goals in the required geographical coverage with lesser expenditure. Examples are possible usage of decentralized systems, twin drain systems and incremental sewerage etc. The finance problems are inadequate revenue as compared to expenditure and norms for budget allocation, which is more of historical nature than based on time and motion evaluations as also the symbiosis of the population, who are willing to pay only if they feel services are better on the one side and the ULB, who cannot bring up improvements unless the population contributes increased revenue upfront. The staff problems are the lack of promotional avenues for decades on end and also absence of at least the time based scale of pay resulting in inordinate stagnations in posts and staleness especially the field staff like operators, technicians, drivers and other such posts where practically they enter and retire in the same post. The management problems are frequent transfers from one headquarters to another resulting in disturbances to family establishment, education of wards and care of elderly at home and lack of incentives for exceptional performers. These are very easy to attribute but are very difficult to change given the service conditions, rules, regulations etc. Yet another situation which prevails in democratic governance is to appraise the political governance on the nuances of engineering projects while seeking funds and establishment by putting forth the engineering components and need to explain to them convincingly by the chief executive of the water and sewerage authority, depending on how equipped they are to comprehend the enveloping issues. There seems to be a need to position the officers of these organizations who would possess a basic qualification in related engineering whatever be their other attainments in management so that they can effectively conceive and communicate both ways between the political governance who are to deploy the necessary resources and the staff of these organizations who are to implement and carry out the O&M, an aspect in which a country policy seems to be not in place. In addition, please also refer to Appendix B 1.3, which is an extract from the Evaluation of O&M of STPs in India – CUPS/68/2007.

1.5 COMMUNITY AWARENESS AND PARTICIPATION

1.5.1 Public Relations and Public Opinion related to Sewerage Works

Meeting the public and directly answering their questions on sewerage problems is the solid foundation of goodwill. Mostly officials in charge of sewerage system feel hesitant to meet the public because they do not have the funds to rectify the defects pointed out by the public. Reference to Figure 1.1 is important. Only when the public are met directly, the system drawbacks will come to light. Only then, a basis for calculating the budget allocations can be known. Only then engineers in the field can carry out the remedies needed.

1.5.2 Complaint and Redressal

Most local bodies have launched the internet-based recording of complaints by the public. It will be good to also publish on the web the actions to solve them. Otherwise the public will not know.

1.5.3 Do's and Don'ts for Community

The public are also responsible to help maintain the system and must not put solid wastes, vegetable cut bits, meat, plastics, etc, into sewers. This is very well advertised by many ULB's, but the public continue to do so. Educating them continuously is needed.

1.6 POTENTIAL RISK WITH RESPECT TO SEWERAGE SYSTEM

1.6.1 Provision of Disaster Prevention Systems

Disaster by definition is something that occurs suddenly. For example, a corroded RCC sewer not properly attended to on time, will collapse all of a sudden in the crown and all the sewage upstream will get blocked. At the same time, if an earthquake occurs and the sewer collapses by lateral movement, then also, it is the same problem. The former situation can be avoided by monitoring the sewer condition once a year by an in-situ camera survey. The latter cannot be avoided. The lesson is the need for programmed monitoring of sewerage system components.

1.7 SEWERAGE LEDGER

The NUSP & SLB are explained in Sections 1.5 and 1.7 of Part-A of the manual. In order to keep track of their attainment, the upkeep of ledgers is necessary as explained below.

1.7.1 Preparation of Sewerage Ledger

A sewerage ledger can be either a simple ledger or a complicated ledger. The staff must receive situation reports of such activities, which they can control. There is a tendency to insist on receiving all sorts of data, whether that is meant for that person or not. This has to change. For example, an administrator must be more concerned about complaint redressal than how much sewage is pumped out. Similarly, the field engineer must know the sewage surface elevations in sewers and whether sewage is overflowing the roads and document the case and put up for funds to solve the situation.

1.7.2 Management and Use of Sewerage Ledger

This has to be done by an independent team not connected with the O&M team. Only then, the real problem will be known and remedies can be taken up. The sewer ledger for complaint redressal must be put on the website to increase the consumer satisfaction in the ledger system.

1.8 BUDGET ESTIMATION FOR O&M

Budget estimation has been explained in Chapter 5 of part C of the manual. Revenue generation to ensure self-sustainability is a political issue, and administrative will is needed to levy and collect practicable costs and there is nothing to strategize in it.

1.9 SUMMARY

This manual has been prepared with the aim of offering guidelines to workers/operators of sewerage systems on site for O&M and work performed by them, and to the field engineers for passing on instructions and judgments to the workers and operators.

In practice, a sewerage collection system or an STP requires its own proprietary O&M manual suitable for the work done, the local conditions and the scale of its own facility. It is anticipated that these facilities will refer to the contents of the present manual and prepare and make effective use of its own proprietary manual.

1.10 RELATIONSHIP BETWEEN PART-A (ENGINEERING), PART-B (OPERATION AND MAINTENANCE), AND PART-C (MANAGEMENT) OF MANUAL

The present manual is one of a set of three parts and which are interdependent as under:

- i) Part – A on ‘Engineering’
- ii) Part – B on ‘Operation and Maintenance’
- iii) Part – C on ‘Management’

Part – A on ‘Engineering’ addresses the core technologies and updated approaches towards the incremental sanitation from on-site to decentralized or conventional collection, conveyance, treatment and reuse of the misplaced resource of sewage and is simplified to the level of the practicing engineer for day to day guidance in the field in understanding the situation and coming out with a choice of approaches to remedy the situation. In addition, it also includes recent advances in sewage treatment and sludge & septage management to achieve betterment of receiving environment. It is a simple guideline for the field engineer.

Part – B on ‘Operation and Maintenance’ addresses the issues of standardizing the human and financial resources. These are needed to sustain the sewerage and sanitation systems which are created at huge costs without slipping into an edifice of dis-use for want of codified requirements for O&M so that it would be possible to address the related issues. These financial and related issues are to be addressed at the estimate stage itself, thus enabling to seek a comprehensive approval of fund allocations and human resources. This would also usher in the era of public private partnership to make the projects self-sustaining. This also covers aspects such as guidelines for cleaning of the sewers and septic tanks besides addressing the occupational health hazards and safety measures of the sanitation workers.

Part – C on ‘Management’ addresses the modern methods of project delivery and project validation and gives a continual model for the administration to foresee the deficits in allocations and usher in newer mechanisms. It is a tool for justifying the chosen project delivery mechanism and optimizing the investments on need based allocations instead of allocations in budget that remain unutilized and get surrendered at the end of the fiscal year with no use of the funds to anyone in that whole year. It is a straight forward refinement of a mundane approach over the decades.

It is important to mention here in the beginning of Part- B of the manual that trade names and technology nomenclatures, etc., where cited, are only for familiarity of explanations and not a stand alone endorsement of these.