

## CHAPTER 2

# STRATEGY

### 2.1 INTRODUCTION

The large investments made to construct utilities intended to provide facilities for water supply are becoming unproductive in the sense that the objective for which they have been installed is not achieved mainly on account of poor Maintenance. Often the investments become unproductive, and a larger amount of money is required to replace and rebuild the system components. Interruptions in service occur owing to the breakdown of equipment as a result of poor maintenance. The utility control organisations are not able to ensure that the maintenance staff follow valid practices to achieve proper maintenance. The management of water supply systems in the water authorities is receiving relatively lower priority. Lack of funds coupled with lack of enthusiasm among the operation and maintenance staff to keep schemes in working condition; lack of training, lack of motivation among the staff may be reasons for the present status of the water supply systems.

### 2.2 DEFINITION OF OPERATION AND MAINTENANCE

In an engineering sense, operation refers to hourly and daily operations of the components of a system such as plant, machinery and equipment (valves etc.) which is done by an operator or his assistant. This is a routine work. The term maintenance is defined as the art of keeping the plant, equipment, structures and other related facilities in optimum working order. Maintenance includes preventive maintenance or corrective maintenance, mechanical adjustments, repairs and corrective action and planned maintenance. Often repairs, replacements and corrections of defects (of material or workmanship) are considered as actions excluded from preventive maintenance. In some organisations the normal actions taken by operation staff are considered as maintenance activities whereas a separate unit or cell does repairs and replacements. Often both corrective and preventive maintenance are included in the job functions of operators and limits to which operators are expected to do normal maintenance are set forth for various equipment. Budgetary provisions of operation and maintenance organisations also incorporate heads of expenditure under maintenance for cost of spare parts and cost of labour or contract amount for repairs and replacements.

### 2.3 STRATEGY FOR GOOD OPERATION AND MAINTENANCE

#### 2.3.1 INTRODUCTION

The minimum requirements for good operation and maintenance are:

- (a) Preparation of a plan for operation and maintenance.
- (b) Providing required personnel to operate and maintain.
- (c) Providing Capacity building programmes for the O&M personnel
- (d) Availability of spares and tools for ensuring maintenance.
- (e) Preparation of GIS based maps of the system
- (f) Preparation of a water audit and leakage control plan
- (g) Maintaining MIS records on the system including history of equipment, costs, life etc.
- (h) Action Plan for energy audit for saving on energy
- (i) Establishing a sound financial management system.

### **2.3.2 PREPARATION OF A PLAN**

A program or a plan has to be prepared for operation and maintenance of every major unit to be specifically written for that particular unit. The overall operation and maintenance plan of an organisation is made up of collecting operation and maintenance programmes of various individual units. This plan has to contain procedures for routine tasks, checks and inspections at intervals viz. daily, weekly, quarterly, semi-annually or annually.

The individual plans must be prepared for all units and all pieces of equipment. Each unit must have a plan to fix responsibility, timing of action, ways and means of achieving the completion of action and contain what objectives are meant to be achieved by this action. Generally actions recommended by the manufacturer or by the engineer who has installed the equipment or who has supervised the installation can be included. Often the contractor's recommended operation and maintenance procedures at the time of design or construction will be a good starting point for writing a sound programme. This plan has to be followed by the operation and maintenance staff and also will be the basis for supervision and inspection and also can be used for evaluation of the status of operation and maintenance.

If the labour costs for operation and maintenance are high compared to replacement cost, the latter course of action will be preferable. The managers shall realize that most of the operation and maintenance can be carried out without more staff. The existing operation and maintenance staff with little training can do the operation and maintenance work without any extra expense. Similarly, record keeping and analysing does not require any additional cost. However costs have to be provided in the budgets for spares, tools and plants, training to operation and maintenance staff and any specialized services for important equipment.

Briefly the plan shall contain what actions are required, when these actions are to be taken, who has to take these actions, how these actions are to be achieved and why these actions are required. The nature of maintenance can be described in a separate maintenance manual and related by numbers in the plan for reference, so that the maintenance staff know as to how to carry out the numbered actions. Checklists can be prepared for use by the supervision or inspecting officers to ensure that the actions indicated in the operation and maintenance plan are carried out promptly and properly. Check lists for various units of O&M of water supply and treatment are listed in the respective chapters.

### **2.3.3 MANAGEMENT REORIENTATION**

The management shall become service oriented and be prepared to run the organisations on a commercial basis. The management must be able to motivate the staff to perform better. It is essential that the organisation responsible for O&M is well qualified, experienced, efficient and still economical. Management is obliged to maintain the facilities in a reasonably good manner and hence they shall decide to produce a maintenance programme. Relevant persons with aptitudes must be chosen to work with available facilities. The persons should be trained to carry out the actions.

They should be supervised to ensure that all people do their duties. Spares and tools should be made available when needed. A good record system covering all equipment facilities and units should be established. The funds necessary to carry out the programme should be provided.

While in most of the cities, a large work force has been already created over a number of years and is being used for O&M of the systems, the suitability of skills and experience has not necessarily been tested. At the same time a radical change in the set up is also not possible in a short period. The strategy is therefore to define the optimum organisation required for O&M and work towards achievement of that, whenever there is opportunity available, to re-organise.

### **2.3.4 CATEGORIES**

The O&M function is performed by

- (a) operating staff and
- (b) supervisory staff.

While the former actually run the system, the latter monitor the operations and provide managerial support. It is difficult to propose a rigid organisational structure model for use at all places. It is likely to vary from place to place due to factors like site-specific requirements, availability of suitable manpower and age-old practices.

### **2.3.5 JOB DESCRIPTION**

When the plan or programme containing procedures to be adopted or actions to be taken is prepared for each piece of equipment, the person to carry out this action is to be identified. This person's job description should contain reference to the maintenance plan/programme. The job description of operating personnel shall clearly define the limits up to which these personnel can carry out normal maintenance. The job description of the Supervisor/Manager shall include the requirement that they shall ensure that the operating personnel conform to these limits and thus ensure the safety of the equipment.

### **2.3.6 TRAINING**

The personnel who are already available or chosen to carry out the actions contained in the programme may have to be trained through special courses or by "on the job training" to ensure that these personnel are thoroughly trained to carry out the actions listed in the plan of maintenance. This training is essential to prevent experimentation by operating personnel to meddle with equipment since often these operating personnel may not be capable to take

up the required maintenance. On the job training is preferred to class room training. The supervisors can be trained initially and they can later train their operators.

### **2.3.7 PRIVATIZATION**

Privatization of some or all functions of Operation and Maintenance can be considered to achieve (i) efficiency (ii) economy (iii) professionalism and (iv) financial viability of the system. In order to achieve the above stated objectives, the private entrepreneur needs to possess (i) adequately trained, qualified manpower for operation and supervision of the services (ii) infrastructure like equipment, material, testing and repairing facilities (iii) experience in operating similar systems (iv) financial soundness (v) capacity to meet the emergency situations.

### **2.3.8 COMPONENTS SUITABLE FOR PRIVATIZATION**

Based on the above requirements and the limited experience of a few organisations, the possibility of involvement of private agencies in O&M of entire or part of water treatment plants, pumping stations, distribution system and other components is analysed and indicated below.

### **2.3.9 STRATEGY FOR PRIVATIZATION**

There is a need to have alternative institutional mechanism for O&M of water supply utilities. In this regard, introduction of private agencies in O&M may be desirable to achieve efficiency and economy. It may make the existing O&M staff surplus. In most of the places operating staff has been appointed on a large scale in the permanent establishment and their removal or discontinuation of sanctioned posts will be a major hurdle in the effort of privatization. However when new systems are set up, it is possible to introduce some element of privatization. Suitable private agencies may develop in course of time, if they feel that they will work for a reasonably long period and if their fee is remunerative. Petty or minor repair and maintenance jobs can be let out on an annual contract basis. However the agency responsible for O&M should have a close control on the performance of private agencies and its own organisation. This calls for a set up somewhat similar to the one suggested below:

- i) Supervisory organisation of engineers, accountants, managers belonging to the O&M agency.
- ii) Day to day operation and maintenance of units like treatment plant, pumping stations and large transmissions with private agencies.
- iii) Day to day operation and maintenance of transmission mains and distribution system with private agency.
- iv) Repairs with private agencies: such as meter repairs, upkeep of chlorinators, chemical dosers, and instrumentation repair, maintenance and calibration.
- v) Supply of chemicals and spares to be arranged by O&M agency.
- vi) Payment of energy charges, raw water charges, telephone bills etc. to be made by O&M agency directly.
- vii) The organisation itself can decide to hand over to private agencies such duties which cannot be discharged by it economically/efficiently.

### **2.3.10 ROLE OF VOLUNTARY / NON GOVERNMENTAL ORGANISATIONS (NGOS)**

The role of Voluntary/NGOs can be important especially in the creation of public awareness on matters like water conservation, proper use of water by people and the need to pay price of water at affordable level. Water users' committees can be formed by active involvement of NGOs to periodically review the local problems, advise the agencies on improvements needed and future course of planning, upkeep of utilities within their jurisdiction, encourage the people to remit water charges regularly and encourage hygienic habits.

#### **2.3.10.1 Information Education Communication (IEC)**

The utility organisation can prepare Information-Education-Communication material and use the services of Voluntary organisation/NGOs in disseminating the information among the consumers and create awareness among the public

### **2.3.11 AVAILABILITY OF TOOLS & PLANTS AND SPARES**

The availability of spare parts for repairs and replacements is to be ensured by ordering and delivery of spare parts by organising an inventory system. Efficient management of stores is required to ensure that the required spare parts are available at all times. The list of spare parts to be procured can be drafted on the basis of manufacturers recommendations in the absence of which a list of spare parts can be prepared from the records of spare parts actually used in the previous years.

A good starting part is to start with the maintenance program and list item wise likely spares to be ordered for repairs and replacements. Spare parts which are difficult to be procured i.e. delivery times are longer shall be identified and the list of spares shall contain as to when these are to be ordered. Managers will have to review the list and take advance actions to ensure that spare parts are on hand when they are needed. Alternatively the required spares for five year periods are procured at the time the equipment is initially installed. The next important task is to ensure the availability of tools necessary to properly repair and correct both the routine problems and for facilitating repairs and replacements. Hence a list of tools and plants has to be prepared, again starting from the plan of maintenance for each unit and the final list of tools and plants is prepared to cover repairs of all the pieces of equipment. It will be also necessary to arrange for routine maintenance of tools and plants, for ensuring that they are in a fit state to be used when repairs and replacements are taken up.

A well organised stores unit shall be available, and accessible at all times to the operation and maintenance staff from which all required spare parts, tools etc., to enable the operation and maintenance staff to carry out the servicing, repairs or replacement, contained in the maintenance plan.

### **2.3.12 MAINTENANCE OF RECORDS**

The necessity for good maintenance records is often overlooked. The maintenance plan programme contains as to what should be done and when. But to decide as to how long an equipment is to be allowed to be kept in service requires information as to when it was installed, what is its normal life etc. Budgets for operation and maintenance can be prepared only on the basis of records of previous years maintenance. The managers shall realise that most of the maintenance can be carried out without more staff. The existing operation and

maintenance staff with little training can do the operation and maintenance work without any extra expense. Similarly, record keeping and analysing does not require any additional cost. However costs have to be provided in the budgets for spares, tools and plants, training to operation and maintenance staff and any specialised services for important equipment.

Good record system shall include the following minimum information to ensure the required maintenance.

1. Name of equipment and location of equipment
2. Number available or installed
3. Serial number
4. Type and class
5. Date of procurement/installation
6. Cost of procurement and installation
7. Name of manufacturer with address and telephone No.
8. Name of distributor/dealer if purchased through them with address and telephone number.
9. Name of servicing firm with address and telephone number.
10. Service manuals
11. Descriptive technical pamphlets
12. Major overhauls: Details of date, nature of cost
13. When next overhaul is due.
14. Date, type and cost of repairs and replacement
15. Cost of spares and cost of labour for repairs.

### **2.3.13 FINANCIAL MANAGEMENT**

It is essential to establish a sound financial management system to make the water supply system financially viable. This can be achieved by controlling expenditure and increasing the income. Control of O&M expenditure can be achieved by preparing an annual budget of income and expenditure of O&M, based on realistic estimates. The estimation of outlays on O&M varies from city to city and it is mainly a function of establishment and power charges for pumping schemes and often lesser or no power charges for gravity supplies. The break up of O&M cost varies from place to place. From the basis of available data the average breakup of O&M cost is likely to be as follows: Power Charges about 30 to 50%, Salaries as high as 36%, Chemicals such as Alum and Chlorine about 3 to 4%, Repairs and replacements about 10 to 15%, debt servicing about 20%, depreciation about 2%.

It will be possible to increase the revenue by reviewing water rates in case income is less and revise these in time to cover the losses. The organisation shall realise that full cost recovery of O&M cost by user charges is a must. The tariff structure is to be evolved to recover the O&M cost and have a surplus for debt servicing and depreciation. Though everyone shall contribute to the cost, it is still necessary that a survey on the paying capacity of consumers may be required to ensure that tariffs are affordable. It is always prudent to levy the minimum

payable charges by the economically weaker section and suggest higher rates to others who can afford. A review of free supplies through public stand-posts may be required. Perhaps the possibility of organised selling of water through public taps can also be studied. It will be necessary to establish a system of raising bills and recoveries to maintain the cash flow and also aim at a larger ratio of collection to billing. Cost recovery can also be achieved by reducing losses by applying better pipe laying and plumbing techniques, undertaking timely preventive maintenance, detecting and reducing losses and controlling illegal connections.

## **2.4 SUGGESTED STRATEGY**

This manual sets forth guidelines for maintenance programmes for most installations. This manual can be adopted as basis for the preparation of operation and maintenance programme.

### **2.4.1 ORGANISATION**

The organisation shall have sufficient autonomy with some checks and counter checks. Further the organisation shall be given the freedom to redeploy if not reduce the surplus personnel. Before attempting to reform the organisation, the managers shall be provided training. The managerial staff have to be trained in the management aspects so as to enable them to render customer oriented service. The need to manage the organisation to ensure financial viability shall be also taught to them. The need to have a performance evaluation to identify accountability for lapses and rewards for improved performance is to be highlighted. Training to managers shall also include financial, accounting, computer applications for efficient use of management information systems, apart from improved technologies.

### **2.4.2 OPERATION AND MAINTENANCE PLAN**

A comprehensive operation and maintenance plan shall be prepared to cover all the facilities. This plan shall contain what actions are to be taken, when these activities are to be taken, how these actions are to be taken and why these actions are required. Good house keeping is required to ensure that all equipment, buildings, surrounding areas and facilities are kept clean and orderly and shall look that it is being frequently cleaned and attended to. A central operation and maintenance cell shall be created which will have responsibility for supervision, monitoring and analysing all operation maintenance activities contained in the operation and maintenance plan. Supervisors shall be assigned duties to check the operation and maintenance by adopting check lists prepared by the management with reference to the plan. Officers shall be identified for monitoring whether the operation maintenance plans are followed or whether supervision of the plan is being done. The supervisor's check lists, checked by monitoring officers shall be analysed by the top management to locate persistent deficiencies and initiate corrective action. The first line supervisors shall be rewarded for timely identifying deficiencies in O&M.

### **2.4.3 TRAINING**

A job description shall be prepared for each operator, which shall contain detailed instructions as to how he will carry out the actions required of him in the operation and maintenance plan. The training shall evolve a personnel management policy, which will provide for a job training followed by performance evaluations and promotions. The supervisors shall be

trained to train the operators. Every operator who is assigned a job in the operation and maintenance plan/programme shall be given appropriate (on the job) training on how to perform the actions assigned to him. Inducements can be offered by way of incentives to those who have improved their performance by training.

#### **2.4.4 EVALUATION**

The success of operation and maintenance programme is shown by a decline of frequency of prearranged shutdowns, and emergency repairs. Improved O&M may result in increased availability of water to be sold, hence yielding more revenue and may also obviate the need to revise the tariffs. Further, the cost of repairs may also decline and equipment life may increase by the proper implementation of a maintenance program. However, funds required for upkeep and maintenance of the system components should be provided for, without which any strategy is bound to fail.

#### **2.4.5 RECORDS AND REPORTS**

A record and report system shall be enforced to list all basic data of each piece of equipment and the history of the equipment. A separate wing may be created to update information on the maps, and coordinate with local Municipal authorities, Urban Development authorities, Housing Boards, Industries, Infrastructure Corporations, Electricity Boards and Telecom Departments. A reporting system shall be provided for the operator to inform the supervisor/manager the problems of each equipment requiring the attention of repair and replacement crew or other specialised service personnel.

### **2.5 LIMITATIONS OF O&M STRATEGY**

#### **2.5.1 TYPE AND SCALE OF ORGANISATION**

Financial sustainability may not be feasible for the utility/organisation which is found to be overstaffed. Actions may have to be initiated to redeploy or reduce the excess staff.

#### **2.5.2 RECORDS**

Though an awareness can be created among the managers of water supply system about the importance of good maintenance, it will not be easy to initiate action in writing down the maintenance procedures. The foremost reason for such situation is the lack of reliable records, in the absence of which one may be forced to take decisions purely on guess work instead of taking decisions on the basis of reliable records.

#### **2.5.3 INADEQUACY OF FUNDS**

Inadequate investments in O&M is a common feature in several organisations which may say that there are no funds for maintenance of facilities or training of staff. Often, they may say that budgets meant for such items as procurement of spare parts or for painting to prevent corrosion or for training have been diverted to other works, on the premise that these works are not important. However lack of funds may not be a valid reason for routine maintenance, house keeping or minor adjustments etc., which can be attended to by the operation and maintenance staff even in the absence of funds. Maintenance of infrastructure is required to enhance the revenues which also requires budgetary provisions.

#### **2.5.4 METERING POLICY**

In most of the utilities the supply is intermittent and often this is cited as a reason for non working of meters. Correct selection of meters and good practice of fixing meters may obviate this. Meters are owned by consumers in several utilities and hence are not repaired promptly. Often there may be no bulk-flow meters available to provide data for evolving a policy regarding metering. Attention to metering may be initially required in high/bulk consumption areas. Several organisations may be having a metering policy regarding ownership and provision of bulk meters. A review of the metering policy may be required to ensure financial sustainability of the organisation.

#### **2.5.5 REMOTE LOCATION**

The facilities may be located at inaccessible places and it may take more time for qualified personnel to reach such places for attending to repairs or replacements.

#### **2.5.6 AGE OF EQUIPMENT**

In several installations the equipment might have outlived its life or out of previous neglect or misuse might have deteriorated up to a stage at which replacement of the equipment is absolutely necessary.

#### **2.5.7 TRAINED PERSONNEL**

The water works utilities are so diversified that simple training methods cannot be prescribed for general application. Sometimes it is difficult to find, in the utilities, well motivated personnel and the available staff may not be amenable for training. The availability of trained personnel who possess the knowledge to undertake the maintenance of complicated equipment may also become a limitation. Often those engineers who are accustomed to dealing with the equipment might have been transferred, making it difficult to maintain the continuity.

#### **2.5.8 STRENGTH OF ORGANISATION**

Some of the limitations, in trying any new strategy are organisations which are not ready to change its management attitude to run the water utility on financially viable lines, lack of motivation on the part of the staff etc.

### **2.6 IMPROVING O&M**

#### **2.6.1 ASSESSING THE STATUS OF O&M**

The status of O&M of any existing system can be assessed through a deficiency analysis after which the improvements can be planned. A possible line of action is indicated below:

#### **2.6.2 INSTITUTIONAL STUDY**

An institutional study is done wherein the parameters for operating and maintaining the facilities are fixed and the job requirements of various O&M personnel are identified along with their qualifications and or experience. The study should also explore possibility of providing on the job training to make up for the lack of qualifications and experience to discharge the job requirements. A realistic assessment of staff required is made and surplus

personnel if any are identified. In case of deficit of staff, the possibility shall be examined for entrusting some of the O&M activities to outside agencies on contract basis.

### **2.6.3 TRAINING REQUIREMENTS**

As a result of the institutional study it would be possible to list out the training requirements of individual personnel. Prepare a programme of training with time bound targets. Identify the facility to train and prepare training material. Implement the training programme. Assess the performance of O&M staff after training. Change or update the training programme to suit the situation as per the assessment.

### **2.6.4 MANAGEMENT INFORMATION SYSTEM (MIS)**

Quite often there is an acute dearth of information on material inventories, tools, spares, staffing pattern, costs etc. Hence setting up a Management Information System is one of the most important tasks in the institutional development which could lead to sustainable O&M. The authority must decide what information is important, who is to keep the record, periodicity of reporting system and formats of reporting. MIS is used to analyse and evaluate the performance of system. The MIS could also be used in assigning responsibilities and in distribution of human, material and financial resources to ensure sustainable O&M.

### **2.6.5 WATER AUDIT**

There are considerable losses in the water produced and distributed which leads to reduction in the income of the utility. Some of these losses are physical leakage of water and some are revenue losses. Hence a water audit will be required to be done to get fairly accurate figures of the following - Water production, Water assessed, Losses both Physical and revenue. Water audit could lead to prioritizing actions required to reduce the physical and revenue losses.

### **2.6.6 ENERGY AUDIT**

Power charges are likely to be as high as 30 to 50% of the total O&M cost. Hence an efficient use of power and reducing wastage of power will go a long way in efficient functioning of the utility. This could be achieved by a systematic energy audit which can identify the possible means to save energy and reduce power consumption.

### **2.6.7 PLANNING FOR EMERGENCIES**

It is possible that normal water supply may be disrupted due to any event, natural or man-made. Such disruptions occur suddenly leaving no time for planning to meet such contingencies. It is therefore essential that an advance plan be prepared to meet such exigencies. Past experience of emergencies in the system as well as of other systems is very useful in drawing up an emergency plan. Some of the events or emergencies that may arise are: power failure, storms and flooding, fire, earthquakes, explosions, breakdown of water supply system units like pumps and pumping mains, strikes by workmen, sabotage or vandalism and water supply bio-terrorism.

### **2.6.8 SAFETY IN O&M OPERATIONS**

Operations in O&M of a Water Supply System also may result in accidents. Hence there is a need for safety practices to be followed by the O&M personnel. Adoption of safe practices

and use of safety equipment may largely minimize accidents. Many accidents occur due to the human factor. Though the ultimate responsibility may be that of management, the operator cannot also be relieved of his responsibility. Hence a Safety Programme is to be written down for every organisation and it must be ensured that every one in the organisation scrupulously follows the safety practices.

### **2.6.9 PLUMBING PRACTICES**

In most Water Supply System, the leakages are occurring in consumer connections. This is mainly attributed to poor plumbing practices. The water supply regulations shall provide for a correct practice of giving connections and fixing meters, which shall be strictly enforced.

### **2.6.10 IMPROVEMENTS IN WATER QUALITY CONTROL**

At several places though the water treatment plants are equipped with good water testing laboratories, the required water quality control by testing is not followed or achieved. This has to be ensured.

### **2.6.11 COST RECOVERY**

For any water utility to be financially self sustained the tariffs should be reasonably fixed and water charges levied and collected and accounted as accurately as possible. The cost of production of water shall be worked out inclusive of debt servicing and expenditure incurred for O&M shall be reviewed. Reasonable tariffs shall be provided to ensure for full cost recovery.

### **2.6.12 ROLE OF PUBLIC PRIVATE PARTNERSHIP**

Improving the efficiency of O&M depends to a great extent on the proper functioning of instrumentation in alum coagulation, chlorination. However it is not always possible to find and employ personnel with specialized skills for the maintenance of flow meters, other instrumentation in water treatment plants and pumping installations, chlorination plants and alum dosers. Instead of trying to recruit additional staff for repairs and maintenance of these specialized equipment, it is always a better alternative to obtain on contract, the specialized services for maintenance of the above mentioned equipment. Such a practice may ensure proper functioning of the equipment with least cost.

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