O&M Management and Monitoring

Swajal
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>App</td>
<td>Application</td>
</tr>
<tr>
<td>DPR</td>
<td>Detail Project Report</td>
</tr>
<tr>
<td>DWSM</td>
<td>District Water and Sanitation Mission</td>
</tr>
<tr>
<td>ESR</td>
<td>Elevated Storage Reservoir</td>
</tr>
<tr>
<td>GI</td>
<td>Galvanized Iron</td>
</tr>
<tr>
<td>GP</td>
<td>Gram Panchayat</td>
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<tr>
<td>GSR</td>
<td>Ground Storage Reservoir</td>
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<tr>
<td>HDPE</td>
<td>High-density polyethylene</td>
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<tr>
<td>HP</td>
<td>Horsepower</td>
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<tr>
<td>HR</td>
<td>Human Resource</td>
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<tr>
<td>IEC</td>
<td>Information Education and Communication</td>
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<tr>
<td>IMIS</td>
<td>Integrated Management Information System</td>
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<tr>
<td>INR</td>
<td>Indian Rupees</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>lit</td>
<td>Liters</td>
</tr>
<tr>
<td>LPCD</td>
<td>Litres per Capita per Day</td>
</tr>
<tr>
<td>M&amp;R</td>
<td>Maintenance and Repairs</td>
</tr>
<tr>
<td>MDWS</td>
<td>Ministry of Drinking Water and Sanitation</td>
</tr>
<tr>
<td>mtr</td>
<td>meters</td>
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<tr>
<td>NRDWP</td>
<td>National Rural Drinking Water Program</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>Operation and Maintenance</td>
</tr>
<tr>
<td>O.T.</td>
<td>Ortho Toluidine</td>
</tr>
<tr>
<td>PHED</td>
<td>Public Health Engineering Department</td>
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<tr>
<td>ppm</td>
<td>parts per million</td>
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<tr>
<td>PVC</td>
<td>Polyvinyl chloride</td>
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<td>PWS</td>
<td>Piped Water Supply</td>
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<tr>
<td>QR code</td>
<td>Quick Response Code</td>
</tr>
<tr>
<td>RCC</td>
<td>Reinforced Cement Concrete</td>
</tr>
<tr>
<td>SO</td>
<td>Support Organisation</td>
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<tr>
<td>SWSM</td>
<td>State Water and Sanitation Mission</td>
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<tr>
<td>VAP</td>
<td>Village Action Plan</td>
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<tr>
<td>VFD</td>
<td>Variable Frequency Drive</td>
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<tr>
<td>VWSC</td>
<td>Village Water and Sanitation Committee</td>
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<tr>
<td>WSS</td>
<td>Water Supply Scheme</td>
</tr>
<tr>
<td>WTP</td>
<td>Water treatment plant</td>
</tr>
<tr>
<td>ZP</td>
<td>Zilla Parishad</td>
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## Index

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5.1.1. Introduction:
Appropriate operation and maintenance management of water supply schemes is essential for designed service delivery of safe water throughout the designed life of the scheme. Lack of proper O&M management quickly leads to deterioration of system. It adversely affects the service delivery and consumer satisfaction. The key adverse impacts of inappropriate O&M are:

- People lose faith in the govt. water supply system.
- Water supply may be irregular, inadequate or of inferior quality.
- People will be reluctant to pay water bills/water cess.
- Tariff recovery will not be as planned.
- Non-availability of adequate funds for O&M leads to deterioration of service delivery, and subsequently results in dysfunctional systems.
- Inadequate service delivery will lead to adverse health impacts and morbidity.
- Women would be compelled to fetch drinking water from distant sources.

One time capital investment is necessary for creating the infrastructure but not adequate to ensure sustainable delivery of safe and adequate water.

One of the main principles of Swajal is management of O&M of a system by VWSC and GP in partnership with the community. This section presents the basic concepts of O&M and its operationalization by VWSC and GP.

5.1.2. Definition of O&M:
As per O&M Manual (MoDWS GoI, 2013);

“Operation refers to timely and daily operation of the components of a Water Supply system such as headwork’s, treatment plant, machinery and equipment, conveying mains, service reservoirs and distribution system etc., effectively by various technical personnel, as a routine function.”

“Maintenance is defined as the act of keeping the structures, plants, machinery and equipment and other facilities in an optimum working order. Maintenance includes preventive/routine maintenance and also breakdown maintenance. However, replacements, correction of defects etc. are considered as actions excluded from preventive maintenance.”

Key Benefits of an efficient O&M system:

- Minimum Breakdowns and good quality and sustainable Water Supply
- Assured design life of the scheme
- Reduction in O&M expenditure

5.1.3. Components of O&M of Water supply facilities:

- Technical management
- Financial management
- Institutional management

All the above three aspects are interlinked and ‘community participation’ is the fulcrum.
5.1.4. Technical Management of Water Supply Facilities:

Technical management of O&M consists of daily operations, regular maintenance and repair, water quality management and liquid waste management.

A. Daily operations:

Daily operation consists of operation of pumps, storage, distribution system including pipelines and valves, tap stands, disinfection and solar panels in case of solar pumps.

i. What needs to be considered during daily operation of the scheme?

Considering the present population, number of stand posts and individual house connections, and rate of water supply (40 lpcd), daily pumping hours should be decided.

Considering that the population to be served in the initial phase of the scheme is less, it is possible to supply more quantity of water in this phase. However, it is not desirable to do so.

Key Tasks in daily operations

- Decide supply timings (morning/evening)
- Pump and store adequate quantity of water in the storage reservoir (GSR/ESR), in morning and evening supply hours.
- By considering availability of electricity supply in the village, the pumping hours should be decided.
- In case of solar pumping sunlight hours need to be considered to ensure storage of daily water requirement.
- Monitor water quality at source and in system on regular basis.
- Regular disinfection of water with the use of TCL powder or online chlorination systems.
- Distribute water in the village by operating various valves at specified time.
Physical verification of water through house connections and public stand posts as planned, with adequate pressure and also for sufficient time.

Ensure that there is no misuse, unaccounted use of water in the village and mitigation of the same if such a case is noticed.

Following table presents the checklist for operation of the water supply scheme

**ii. Operations checklist**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Component</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Source</td>
<td>• Check for water level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for occasional turbidity (in rainy season)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construct the graph of depletion water levels cumulative in the month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>before and after periodic pumping</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for sample testing in laboratory. (Bacteriological-Six Monthly and Chemical Yearly)</td>
</tr>
<tr>
<td>2.</td>
<td>Pump</td>
<td>• Operate pump as per pumping hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check the filling time of tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check visual leakages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check running sound</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check voltage</td>
</tr>
<tr>
<td>3.</td>
<td>Solar Pump</td>
<td>• Check water level in the bore well, supply well</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check condition of cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check water level in the tank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for the dry run sensor</td>
</tr>
<tr>
<td>4.</td>
<td>Solar Panel</td>
<td>• Monitor voltage readings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check panel direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check dust on panel</td>
</tr>
<tr>
<td>5.</td>
<td>Pipe Line</td>
<td>• Check for visual leakages</td>
</tr>
<tr>
<td>6.</td>
<td>Valves</td>
<td>• Operate valves as per schedule</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for smooth working</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check for leakages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Outlet valve to be closed in non- supply hours</td>
</tr>
<tr>
<td>7.</td>
<td>Storage Tank</td>
<td>• Administer chlorine dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check water level sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check outlet valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Check float operations</td>
</tr>
</tbody>
</table>

**iii. Disinfection:**

**a. Importance of disinfection and how to do it**

Though water from the source may appear to be clean, there is every possibility that it may contain microorganisms/pathogens, making it non-potable. Consumption of non-potable water can cause various water borne diseases like Cholera, Dysentery, Typhoid, Gastroenteritis, Jaundice etc. Hence it is of utmost importance that disinfection of the water is done properly and on regular basis.

The simplest and easiest way of disinfection is Chlorination, mainly because chlorine removes almost all pathogens and it is very easy to test residual chlorine in the water.

**b. Methods of Chlorination**

For small/individual rural water supply schemes, it is most convenient to use Bleaching powder (TCL powder) for disinfection. Details about bleaching powder, its dosage and methods of measuring residual chlorine are presented in Annexure 1.

In many places it is found that bleaching powder is not as effective as it is expected for chlorination. It requires very careful manual intervention every day.

There are simple, easy to use online chlorination systems which do not require every day manual interventions and also do not require power. It is a comparatively new technology. Such systems use solid chlorination agent, and are safe and simple to handle. They do not require daily generation and addition of chlorine solutions.
to water, as in case of bleaching powder. The chemical used in such systems is completely soluble in water and doesn’t have any insoluble residues left after dissolving in water. The systems operate without electricity. Such Chlorination systems can be installed during water distribution, and are capable to generate up to 2 ppm (or even higher if required) of chlorination in running water.

These Systems are online and automatic, and able to operate with minimum intervention. Also, these systems avoid leakage, seepage or degeneration of chlorine solution which is a problem with other types of chlorination systems. The systems work on replaceable chlorine cartridges which are safe to store and easy to replace, even at village levels. Being online, the systems are compact and occupy less footprint. An end of life indicator, which indicates the replacement of cartridge might well be sought to ensure timely replacement and smooth operation of the system.

It is advised to ensure that such chlorination technology is approved for drinking water; the chemical is approved for drinking water and is certified/listed/approved by international authorities like BIS /NSF/ etc. It is also advised to ensure that the replaceable cartridges contain a stable chlorine compound and have sufficient shelf life so that they are stored safely in far flung areas, even for longer periods.

iv. Proper distribution of Water

To ensure timely and adequate water supply at sufficient pressure, following things need to be ensured.

• Let out water from the GSR/ESR, in the distribution network by operating the outlet valve, on time. How much the outlet valve has to be opened needs to be decided by trial and error during initial trials. Once this is decided the outlet valve should be opened at the pre-decided time in morning and evening to suit the water requirement in the village. This procedure needs to be followed daily.

• The person responsible for distribution of water in the village should ensure that water is supplied at adequate pressure throughout the distribution network (through stand posts and house connections). Also the VWSC/GP members from the respective wards/habitations should meet the people in their wards to find out if there is any complaint, and if there is, s/he should bring it to notice of the responsible person for proper redressal of the complaint.

v. Proper use of water

With a view that the scheme runs smoothly it is necessary to see that there is no misuse of drinking water (use of water for irrigation/construction/washing animals/theft etc.). Also it should be ensured that all stand posts have taps in place and the taps remain closed during non-use.

B. Maintenance and repairs:

1. Purpose of Maintenance:

Purpose of maintenance is to see that all civil works (well/stand posts, switch room etc.), machinery and equipment (Pumps, Valves, Switches etc.) are in optimal running condition; and to carry out their timely repairs if some of them fail during operation.

Preventive Maintenance is most important for proper service delivery. These are the works carried out so that all sub works, machinery and equipment’s of the scheme are kept in working condition and their failures are minimized. This covers –

• Taking actions noting indications observed during operation (e.g. Reduction in discharge of a pump, valves not getting operated, leaking valves etc.)

• Periodic maintenance works are taken up as per the specification and protocols. (E.g. changing spare parts like contacts, painting, cleaning tanks, oiling and greasing, washing out pipe lines etc.)
Each equipment and sub component has specifications and manuals for its maintenance.

2. Subcomponent wise indicative checklist for maintenance

i. Maintenance of civil works: Civil works of a typical water supply scheme are well, switch room, GSR/ESR, Stand post etc. Maintenance of these works cover:
   - Cleanliness of their surroundings
   - Regular inspection and repairs especially for leakages
   - Repairs of broken glass panes of windows
   - External (and internal) painting every 2 to 3 years

ii. Maintenance of Pumps and Motors:
   - If pump discharge gets reduced then take out the pump, change necessary parts, refit and reinstall the same (overhauling)
   - Even if there is no change in the discharge of a pump it needs to be taken out and overhauled every year.
   - Maintain history sheet of the machinery, noting pumping hours, details of repairs carried out etc. These history sheets should be checked by VWSC/GP every month.
   - Yield of bore well should be verified prior checking for maintenance of the pump.

iii. Maintenance of Pipelines:
   Regular water supply and no leaks in the system are the indicators of good maintenance and proper running of the system.
   - Regular monitoring of pipe line for leakages
   - Repair of observed leakages
   - If leakages are observed at the same location repeatedly then it is necessary to find out the cause behind it and carry out necessary repairs/replacements.
   - If there are illegal connections take an action and inform village level authorities

iv. Valves on the Pipelines:

   a. Sluice valves are provided on the pipelines to control flow through them.

   - It needs to be noted while operating a valve, whether it can be operated smoothly or otherwise. If there is difficulty in opening/closing of a valve or it does not get closed completely, then it needs to be inspected thoroughly and carry out necessary repairs.
   - Gland packing of a sluice valve needs to be replaced every two months
   - Every sluice valve needs to be inspected thoroughly every six months and repairs carried out, if necessary.

   b. Non-Return Valve
   A non-return valve is installed on a pumping main near the pump. This valve prevents reverse flow of water in the pumping main after the pump is stopped. Maintenance of non-return valve is to be done like a sluice valve.

   c. Air Valve
   Air valves are installed on a pumping main at all peak locations. Air valve allows air to be expelled out of the pumping main when pump is started (pipeline empty condition) and also allows air to enter in the pipeline when the pipeline is getting emptied (Bursting of pipeline).
   - It is necessary to ensure proper functioning of air valve by inspecting the valve every month.
   - Each air valve needs to be critically inspected every six months and repairs/replacement carried out.

The person responsible for water supply in the village should keep date-wise record of all major and minor repairs, replacement of some parts in a register and the same should be presented to the VWSC. Apart from routine maintenance there is also a need for repairs depending upon the situation. There should be preparedness for such scenarios.

Following table presents the indicative checklist for maintenance:
<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Component</th>
<th>Daily</th>
<th>Periodic</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Source well</td>
<td>- Check the cleanliness and sanitary condition</td>
<td></td>
<td>- Pumping test in summer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maintaining the staining wall</td>
<td></td>
<td>- Complete draining and cleaning the existing springs entering into the well</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Maintaining the staining wall</td>
<td></td>
<td>- De-silting &amp; cleaning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Removal of vegetative growth</td>
</tr>
<tr>
<td>2.</td>
<td>Submersible Pump</td>
<td>- Check for dry run</td>
<td>- Check for level sensor</td>
<td>- Take out the pump and carry out overhauling and reinstall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Check phase sequence</td>
<td>- Check for cable connections</td>
<td>- Check for cable conditions, and joints if any</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Check voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Solar Pump</td>
<td>- Check water level in the bore well, supply well</td>
<td>- Check for cable connections—weekly</td>
<td>- Take out pump clean and reinstall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Check the cable condition</td>
<td>- Check for the dry run sensor—Weekly</td>
<td>- Check connections with the panel board</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Get annual inspection done through Authorized service provider</td>
</tr>
<tr>
<td>4.</td>
<td>Solar Panel</td>
<td>- Cleaning by wet cloth</td>
<td>- Clean the cables, cable connections—weekly</td>
<td>- Check nut-bolts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Complete cleaning of panels – Monthly</td>
<td>- Check for shady trees on the panel</td>
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<td></td>
<td></td>
<td></td>
<td>- Set appropriate direction</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Pipe Line</td>
<td>- Check for visual leakage</td>
<td>- Check the on-line chlorination arrangement if exists</td>
<td>- Exposed metal pipes to be painted</td>
</tr>
<tr>
<td>6.</td>
<td>Valves</td>
<td>- Check for smooth working</td>
<td></td>
<td>- Valve dismantling, cleaning and changing of glands/ washers, Remove any deposits</td>
</tr>
<tr>
<td>7.</td>
<td>Storage Tank</td>
<td>- Cleaning weekly</td>
<td>- Check the lid of HDPE tank</td>
<td>- Painting as appropriate</td>
</tr>
<tr>
<td>8.</td>
<td>Tap Stand</td>
<td>- Check for taps in position</td>
<td>- Check platform condition</td>
<td>- Clean the assembly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Check for leakages</td>
<td></td>
<td>- Visible portion to be painted</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Clean soak pit and refill</td>
</tr>
</tbody>
</table>
A specific checklist for trouble shooting of solar systems is attached in Annexure 2.

**vi. Management of Spares/Equipment:**

Timely availability of spares, equipment and machinery, plays an important role in effective maintenance of any scheme. Therefore, it is always necessary to maintain minimum balance of essential and critical spares in stock.

Following needs to be stored for repairs for PVC pipelines of various classes and diameters.

1. Pipes – 2 No. each of each class/dia
2. Couplers – 2 no. each of each class/dia
3. Bends – 1 no of each type and dia
4. Tee – 1 no. of each type and dia
5. PVC Saddles – 10 Nos.
6. Rubber Packing – 10 Kg
7. Solvent cement of standard company – 1 Kg
8. 12 mm dia Brass Ferules – 10 nos.
9. Spindles of sluice valves – 1 no of each dia

**vii. Tools and Tackles:**

Following tools and tackles should be available for O&M team: Pliers, spanner set, Pipe wrench, screw driver, hammer, hack saw, hack saw blades, file, hand drill, pickaxe, shovel, Ghamele, bucket, chisel, rope, sibble (digging bar), drill bits, wooden mallet.

**viii. Miscellaneous:**

Sand Paper, Habak, Nut bolts, Gland Packing etc.

It is necessary that VWSC/GP is aware of pump/motor repair facilities available at block and district place. Also they should be aware of availability of various spares for pumps, motors, switches etc. at Block/District place, so that it can be decided which spares need to be purchased in advance and stored at village level.

It is also necessary to pre-decide as to which type of repair/maintenance work is to be managed at local level and which repair/maintenance work is to be carried out through a servicing agency.

All tools and tackles are to be kept in possession of the Secretary and he should keep a daily record of inflow and outflow of the same. This record should be scrutinized by VWSC/GP during its monthly meeting.

**C. Water Quality Management:**

It is the responsibility of the VWSC/GP to provide safe and disinfected water to the villagers. To know more about water quality, let us first look at the sources of water pollution.

**I. Pollution at source:**

As regards bore well/percolation well as source, it can get polluted due to following:

- Washing utensils, bathing or washing of livestock, near well.
- Waste water getting infiltrated in the source.
- Locating public toilets and cattle shed in the vicinity of source.
- Swimming in the source well.
- Percolation tank/Gaotali on the upstream of well getting polluted.
- Unhygienic condition in the vicinity of source well.
- Use of dirty rope/ bucket for fetching water from source well.

**II. Improper Disinfection:**

Reasons for improper disinfection could be
i) Non availability of bleaching powder
ii) Improper dosing and
iii) Non availability of chlorine in the desired proportion, in the bleaching powder.

**III. Infiltration of polluted water into distribution network:**

As there is intermittent water supply in the village, at the end of every water supply cycle, the pipelines become empty. If there are leakages in pipes, valves or house connections, surrounding polluted water finds way into the distribution network at such locations causing pollution of water.
IV. Pollution at GSR/ESR

- Due to lack of periodic cleaning of the GSR/ESR.
- If the lid remains open, then dry leaves, birds etc. may enter the tank causing pollution.
- Due to use of dirty rope or bucket
- Intentional pollution by human beings.

Mitigation measures:

1. Protection of source

It is important that the construction of the source is done properly and its surroundings are kept clean.

a) It should be seen that the waste water does not percolate in the source.

b) Washing of clothes and utensils, bathing around the source should be banned/prevented.
c) Construction of toilets—private or public, cattle farms, soak pits should be banned within a radius of 15 m (50 ft.) from the source well.

d) Care should be taken to see that percolation tanks and/or village tank located in the vicinity of the source, or on upstream side of well, do not get polluted.

e) Growth of bushes, formation of algae, should be avoided and if present, should be cleaned immediately.

f) Source maintenance should be carried out before and after monsoon.

2. To achieve proper disinfection:

a) Maintain adequate stock of bleaching powder.

b) As the bleaching powder becomes old, it loses its potency. Hence a stock of bleaching powder for more than two to three months should not be kept.

c) If O.T. test indicates lesser residual chlorine, it means that the bleaching powder used has less than 30 % chlorine. In such a case the dose of bleaching powder needs to be increased. Hence bleaching powder sample should be sent to laboratory for knowing the available chlorine in the sample. Based on the laboratory report the bleaching powder dose should be increased, it should also be ensured that bleaching powder samples are being sent to a laboratory on regular basis and a record of the test reports should be maintained.

d) Consider using online chlorination systems

3. Measures to be taken to avoid infiltration of polluted water in the distribution network

a) Carry out leak repairs on pipe lines/valves immediately.

b) Ensure that the distribution pipe lines do not pass through gutters/nalla/slushy areas etc.

c) In most of the cases, P.V.C. pipes are used for connections. This is probably because P.V.C. pipes are cheaper. These pipes are likely to crack, causing pollution. Hence for house connections or connections for stand posts, only G.I. pipes should be used.

d) Entire distribution network should be washed out at an interval of six months. After washing, the network should be disinfected by using water with higher dose of chlorine.

4. Measures to avoid pollution at G.S.R/ E.S.R

a) Always keep the manhole cover in place.

b) GSR/ESR should have proper fencing

c) Entry of children or villagers should be restricted in the GSR/ESR premises.

d) GSR/ESR should be thoroughly cleaned every month.

e) If cracks are noticed in the GSR/ESR, it should get inspected by a qualified engineer and repairs carried out as advised by the engineer.

How to clean GSR/ESR:

1. Drain the water from the GSR/ESR by opening the outlet valve.

2. Close the valve when there is about 15 cm depth of water in the tank.

3. Clean the inside surface of the tank with the help of a wire brush and then wash the inside surfaces with a water jet.

4. Add about 20 to 25 gms of bleaching powder per square meter area of the tank and then stir the contents. The inside surface should be thoroughly cleaned with this water.

5. Completely drain water in the tank. Fill some quantity of clean water in the tank and wash the inner surfaces. Drain after cleaning/washing and put the GSR/ESR in use.

VWSC/GP should take following steps for maintaining quality of water.

VWSC/GP should carry out village cleanliness survey (sanitary surveillance) regularly. During this survey all members of the VWSC/GP, including ward representative and the person(s) responsible for water supply in the village, should be present. This survey is expected to pin point the possible reasons for pollution of the source and source protection measures. Once the reasons for pollution are known, mitigation measures should be taken.
What should be observed during the survey?

a) At the source
   • Cleanliness around the source
   • Things likely to pollute the percolation tank/ Gaontali on the upstream side
   • Toilets, accumulated water around the source.

b) In the village
   • Accumulated water
   • Pipelines passing through gutters
   • Defective connections
   • Location of inadequate water pressure
   • Surrounding of stand post(s)
   • Water storage habits of villagers
   • Habits of villagers for use of water
   • Any other relevant issues

O.T. Test of water sample

The number of water samples required to be tested has been discussed in earlier section.

Normally carrying out O.T. test is responsibility of the person in charge of water supply. However, since O.T. test is a very simple and easy test, it should be carried out periodically by the President and Secretary of VWSC/GP. And most importantly, the tests to be carried out by the President/Secretary of VWSC/GP should be done through a surprise visit. O.T. test record should be reviewed every week by the Secretary or a designated representative.

If negative O.T. test is observed then the concerned person should bring this to the notice of VWSC/GP. They should find out the reason for negative O.T. test and take remedial measures.

If negative O.T. test is observed repeatedly, then this should be brought to the notice of Health Department and their advice should be sought. Simultaneously, water sample should be sent to the District Health Laboratory/PHED/RWS lab for bacteriological test. For this, it is necessary to train the person concerned for collecting the water sample for bacteriological test. Also it is necessary to have sample bottles with VWSC/GP. Then action should be taken as advised by the Health Department.

Bacteriological test

Bacteriological test of water samples should be carried out, once in six months, by the District Health Laboratory/PHED/RWS lab. If sample is observed to be unfit for human consumption, then cause of pollution should be found out and corrective measures should be taken. If necessary, advice of Health Department should be sought.

During epidemic

• Frequency of O.T. test should be increased
• Bleaching powder dose should be increased
• Cleanliness survey should be conducted
• Health Department should be informed about the epidemic

Chemical test

Chemical tests of water sample should be done every year based on the parameters prescribed by NRDWP guideline.

The results of both bacteriological and chemical contamination should be shared with all community members through public display of results and also through corner meetings, etc.

D. Liquid Waste Management:

Waste water management is an important part of technical management of water supply system. It is a risk for water quality and at the same time it indicates sub optimal maintenance of the scheme.

Routine scenario in villages:

• No taps on stand posts/ house connections, continuously flowing water through house connections and public stand posts, choked surface drains, stagnated water on roads.
• Slushy areas near the public stand posts, making it difficult to even approach the stand post.
• Water accumulation in low lying areas of village, resulting in mosquito breeding and foul smell.
Why Waste Water Management?

If waste water is not managed properly then it results in:

- Mosquito breeding which may cause diseases like Malaria, Elephantiasis, and Encephalitis.
- Waste water may find way into the distribution network causing pollution of water.
- Water accumulated on roads, low lying areas causes inconvenience to the villagers.

Key actions for Waste Water Management (Grey Water/Sullage):

- Ensure proper drainage arrangements at public stand posts and house connections either in kitchen gardens or soak pits
- Arranging public awareness programme for developing backyard gardens and use of soak pits.
- Ensure that there are taps on the stand posts and house connections and also that these taps remain closed when not used.
- Ensure that there is proper drainage and disposal arrangement at house before sanctioning a house connection.
- Measures like guidance from experts in the field, arranging trainings, demonstrations, workshops for building public awareness and their participation.
- Connecting waste water to main gutters / surface drains and carrying out regular cleaning of surface drains.
- IEC for avoiding misuse of water.
- Carrying out maintenance and repair work of existing surface drains and construction of new surface drains through various public schemes.

Community participation and proper IEC can play important role in management of waste water.

5.1.5. Financial Management of WS Scheme

For sustainability of the scheme its economic viability is non-negotiable.

VWSC and GP along with the community have to prepare the budget for their water supply scheme. It is a simple documentation of expenditure items and sources of revenue mainly through community and GP contribution. First the expenditure is calculated, following which the GP contribution is decided. The balance amount can be derived from the user charges or water tariff.

Following is the reference template to calculate water tariff -

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Details</th>
<th>Expenditure Details</th>
<th>Estimated Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Operations Expenditure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Water Staff Expenditure</td>
<td>No. of staff × Monthly salary × 12 months</td>
<td>Rs. ____________</td>
</tr>
<tr>
<td></td>
<td>Note: Depending upon scope and size of water services, area to be served, the number of staff should be worked out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Electricity bill</td>
<td>a. Annual Fixed Expenditure depending upon pump HP = Pump HP × (Rate/ Hp/Month) × 12 months</td>
<td>Rs. ____________</td>
</tr>
<tr>
<td></td>
<td>Units used × Pumping Hrs. × 0.75</td>
<td>b. Annual Expenditure depending upon unit consumption = unit consumption × (Rate/Unit)</td>
<td>Rs. ____________</td>
</tr>
<tr>
<td>Sr. No.</td>
<td>Details</td>
<td>Expenditure Details</td>
<td>Estimated Expenditure</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>2(a+b)= Total</td>
<td></td>
<td>Rs. ____________</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Chemicals: TCL Powder</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> - Depending on daily water use, calculate based on: 5g of TCL powder for 1000 Liter water. Total expenditure of TCL should be calculated based on regular dosing, usage in tank cleaning, water channels, WTP structures and other cleaning.</td>
<td>Annual Expenditure on TCL = Total required quantity of powder × Rate/Kg</td>
<td>Rs. ____________</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Water Sample Testing Charges</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Sample conveyance charges | a. Bacteriological tests = No. of samples per year × rate/sample 
b. Chemical tests = No of sample/year × rate/sample | Rs. ____________ | |
| 5. | Water Committee Office (stationary, log books, misc.) | Monthly expenditure × 12 months | Rs. ____________ | |
| Total of A | Operation cost (1+2+3+4+5) | | |
| 6. | Routine M&R | M&R = capital cost of water supply scheme × 1.5 % | Rs. ____________ | |
| (for pipe line leakage repairing, valve repairing, pump motor repairing, tap repairing, colouring, miscellaneous expenditure) | In case of multiple schemes. | | |
| 7. | M&R expenditure for Water Sources | a. Hand pump M&R expenditure = No. of hand pumps × annul maintenance cost 
b. bore well M&R expenditure = No of bore wells × annul maintenance cost 
c. Open well M&R expenditure = No of wells × annul maintenance cost | Rs. ____________ | |
| Note: - According to DSR/ government rates: expenditure for source maintenance is- 
Rs. 1000/- for hand pump, Rs. 5000/- for bore well and Rs. 1000/- for open wells 
However, factor the rates as per actual rates in respective locations/ villages. | | | |
| 7(a+b+c)= total | | Rs. ____________ | |
| 8. | Reserve fund for any major repairs | Reserve fund = 20 % of Sum of (1 to 7) | Rs. ____________ |
### Sr. No. | Details | Expenditure Details | Estimated Expenditure
--- | --- | --- | ---
Total of B | Total M&R expenditures | Sum of (6 to 8) | Rs. ___________
9. | Total Operation and M&R Expenditure | (A+B) | Rs. ___________
C. | Income | | Estimated Income
10 | GP contribution | To be decided by GP | Rs. ___________
11 | Contribution to be collected from users | Total expenditure (row 9) – GP contribution (row 10) | Rs. ___________
12. | Assuming, 90% as billing efficiency And 80% recovery of water tariff from the billed amount | Water tariff collection = (Community contribution as per row 11) × (1/0.9) × (1/0.8) | Rs. ___________
13. | Water tariff rate: | Total water tariff collection as per row-12 / number of consumers | Rs. ___________

**Note:**
For metered connections, volumetric measurement should be used for billing. Special tariff rates should be considered for metered schemes.

### 5.1.6. Institutional Management of Water Supply Facilities:

For efficient O&M and implementation of the scheme, the capacity of VWSC/GP and Village Water person should be strengthened. Their roles and responsibilities are delineated below.

**a. Distribution of Work and Responsibilities:**

It will be the prime responsibility of VWSC/GP to get all water supply O&M works done through the person(s) appointed for this job.

VWSC/GP will be responsible to keep watch on day-to-day activities. VWSC/GP/GP can always seek guidance from experienced, enthusiastic and learned people from the village while performing day-to-day activities. VWSC/GP can always share this responsibility with due and clear understanding.

A number of issues may get raised in the meetings of VWSC/GP; it will be the responsibility of the President of VWSC/GP to study and address these issues.

President VWSC/GP will be responsible for overall running of the scheme.

**Village water person: roles and responsibilities:**

1. Operate the pump at the specified time and for specified hours for pumping water in the GSR/ESR.
2. Monitor quality of water on regular basis.
3. Proper disinfection of the water.
4. Distribute water in the village by operating various valves, at the specified time.
5. To verify whether water is being distributed through house connections and public stand posts, with adequate pressure and also for sufficient time.
6. To ensure that there is no misuse, unaccounted use of water (theft) in the village and mitigation of the same if such a case is noticed.
7. To do periodic testing of water samples and
keeping record of the same should be vested with the person responsible for distribution of water.

8. The person responsible for distribution of water in the village should ensure that water is supplied at adequate pressure throughout the distribution network (stand post and house connections). Also the VWSC/GP members from the respective wards should meet the people in their ward to find out if there is any complaint he should bring this to the notice of the responsible person for proper redressal of the complaint.

Village water and sanitation committee: roles and responsibilities:

**Roles of GP/ VWSC**
- Ensuring safe, regular and adequate water to all villagers
- Operation of water supply schemes and its techno-financial management
- Appropriate maintenance and repairs of the scheme, identification of water contaminants and application of mitigation measures
- Provide contribution of GP for O&M
- Collection of fixed monthly charges and water rates from the community
- Developing a system for water disinfection
- Regular testing of water samples from source to distribution and water quality control
- Immediate intimation and guidance by BDO/ Jr. Engineer and health department in case of water quality issues
- Awareness among community regarding proper care during epidemics
- Ensuring proper water handling and storage practices at household level

If a water supply scheme is operated and maintained properly then the customers are satisfied and happy. In such situation there are minimum complaints from the customers and it is easier to collect water cess from them.

b. **Complaint redressal:**

**What is meant by complaint redressal?**

**Basically why there are complaints?** The customers always accept desired water supply at desired pressure and of desired quality. However, due to improper operation and untimely maintenance, the water supply gets disturbed. Such conditions generate complaints.

**Sequence of Complaint Redressal:**
- Receipt of complaint and its recording.
- Finding out reasons for the complaint
- Attending the reason of the complaint or arranging for rectification/ repairs.
- Confirming that water supply is restored and there is no complaint.
- Informing the Complainant

**Complaint Redressal:**

Complaint can be handled in two ways. Establishing the Customer Care Center (CCC) or redressal at local level. An example of CCC is shared in Monitoring Framework.

On receipt of complaint, it should be immediately noted in the complaint register, then the cause of the complaint should be found and arrangements should be made for redressal of the same.

If the nature of the complaint is such that it cannot be handled by the water person at his level (e.g. irregular power supply resulting in less pumping and further consequence thereof) or if materials required for the repairs are not available, then he should inform the issue to the GP and in such a situation the GP should take necessary action. Once this is managed, necessary noting should be made in the complaint Register; with signature of the Secretary.
**Review of Complaint Register:**

The VWSC/GP should review various entries in the complaint register, at least once in a week. Since complaint register is a good tool indicating proper working of the scheme, it should invariably be reviewed by the President of VWSC/GP, once in a month.

Role of VWSC/GP about Complaints: VWSC/GP should take a broad view on any complaint. They should consider the complaint as mirror of the overall functioning of the scheme. To ensure that all complaints from the customers are attended properly, the ward representatives should follow up.

Timely leak repairs, watch on unauthorized connections, avoiding misuse of water and wastage of water, play important role in successful O&M of a water supply scheme.

**Complaint Register:**

VWSC/GP should maintain a complaint register, recording there in, date wise details of the complaint. This register should be seen daily. If there is a specific complaint, then VWSC/GP should bring this to the notice of the water person for timely redressal. If there is any oral complaint the same should also be recorded in the complaint register.

**Typical complaint Register (Sample):**

<table>
<thead>
<tr>
<th>Complaint Date / Time</th>
<th>Complainer and Location</th>
<th>Details of complaint</th>
<th>Entry by the water person</th>
<th>Details of complaint redressal (date time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>27/01/18 13:00 Hrs</td>
<td>Gopal Deshmukh near Maruti Mandir</td>
<td>Less water supply since 3 days</td>
<td>Sd xxx Signature 28/01/18</td>
<td>Attended house of Shri Gopal Deshmukh. Found line chocked. Line washed, flushed and water supply restored. No complaint now Sd:- Date: 28/01/18</td>
</tr>
</tbody>
</table>
Annexure 1: How to do disinfection with Bleaching Powder:

- Contact period of minimum half an hour is required for the chlorine to act on the pathogens and kill them. Hence, it is necessary to do the chlorination, minimum one hour before the supply hours.
- The quantity of Bleaching power required for disinfection depends on the quantity of water in the GSR/ESR. It can be found out with the help of following formula.

**Details about Bleaching Powder**

- Bleaching powder is also referred to as T.C.L. powder
- Bleaching powder is nothing but a compound of Lime and Chlorine
- In fresh Bleaching powder, normally chlorine content is 33% or more
- Bleaching powder is unstable in nature and as the time passes the chlorine content reduces.
- To avoid loss of chlorine, it is necessary to store Bleaching powder in dry condition and away from direct sun light. If the Bleaching powder is in a bag, after use, the bag should be properly closed.

The percentage of chlorine, in the Bleaching power can be found out in a laboratory test. Such chlorine Tests are carried out in District Public Health Laboratories.

**Formula for Circular Tanks:**

\[
\text{Quantity of water in the tank (in liters)} = 785 \times (\text{Tank Diameter in meter})^2 \times (\text{Height of water column}) \quad \text{– All measurement in Meters.}
\]

**Formula for Square/Rectangular Tanks**

\[
\text{Quantity of water in the tank (in lit)} = \text{length of tank (in m)} \times \text{width of tank (in m)} \times \text{height of water in the tank (in m)} \times 1000
\]

**Quantity of bleaching power required:**

If the Bleaching powder contains 30% or more chlorine, then 5 gm Bleaching powder is required for proper disinfection of 1000 lits of water.

Let us understand this by an example.

**Example**

If a square tank of size 4 m x 4 m (inner dimension) has 2.5 m depth of water in it then –

\[
\text{Volume of water in the tank} = 4 \times 4 \times 2.5 \times 1000 = 40,000 \text{ lit}
\]

Hence quantity of Bleaching Powder required for disinfection of this water = \(40,000 \times \frac{5}{1000} = 200\) gms

However, if the chlorine content of the bleaching powder is less than 30%, the quantity of bleaching powder for disinfection of the same quantity of water (40,000 lits) will have to be increased in the ratio of the theoretical content of chlorine and the actual content of chlorine.

**Chlorination:**

Quantity of Bleaching Powder required for disinfection as per above formula should be taken in a plastic bucket and adding small quantity of water, a thick paste should be
prepared. Then the bucket should be filled up to 50% to 75% by water and the paste should be thoroughly stirred with a wooden stick. This solution should be allowed to stand for some time and then the supernatant should be poured in another bucket.

Then with the help of a rope, this bucket should be lowered in the GSR/ESR up to a depth of 0.3 to 0.5 m and let the chlorine solution get properly mixed in the water in the tank by stirring. Do not mix/use the remnants of the first bucket in the tank water. It should be kept separately and disposed of properly.

Method for determination of presence of Chlorine in water

- Disinfected water has residual chlorine. Presence of residual chlorine is an indicator of proper disinfection. This residual chlorine also helps disinfection of likely pollution of water in the distribution network.
- How much residual chlorine is there in the disinfected water can be determined by a very simple test. This test is called “Ortho Toluidine Test” or simply “O.T. Test”. O.T Test should indicate residual chlorine in following proportion:
  1. 1 hr after disinfection of water in the tank – minimum 1 ppm.
  2. In the water from tail end of the distribution system and water sample from a public stand post – 0.2 to 0.5 ppm.

How to carry out O.T. Test

- A kit which is called “Chloroscope” is used for this O.T. Test.
- Take water sample in a Test Tube. The tube should be filled up to 3/4 height of the tube.
• Put 1–2 drops of O.T. solution in the test tube and shake it well.
• If there is residual chlorine in the water, the colour of water changes from colourless to yellow.
• Compare colour of the water in the test tube with colour disk in the chloroscope. The matched colour disk indicates the residual chlorine in the sample.
• No change in colour of water in the test tube indicates that the ‘Test is Negative’ meaning there is no residual chlorine in the sample tested.

**The OT test reports need to be shared with the community through public displays, discussions during Gram Sabhas and village meetings, reviews during VWSC/GP monthly meetings, etc.**

### Periodic Testing of Water Samples:

The work of periodic testing of water sample and keeping record of the same should be vested with the person responsible for distribution of water.

The person concerned should carry out the testing as given below –

1. Water Sample from the GSR/ESR – Once a day, 1 hr after adding bleaching powder
2. From Distribution System –
   - For a village having population up to 1000 – Daily one sample from the distribution system / stand post.
   - During Epidemics – daily 5-6 samples

**Use of Bleaching Powder in excess of the required quantity:**

There is a possibility of the source getting polluted at the start of monsoon and during heavy rains. This may result into epidemics. Hence it is very important to take utmost care in disinfection during such periods. In such situations use of Bleaching Powder, in excess of required quantity, is recommended. The extra dose of bleaching powder should be adjusted in such a way that the residual chlorine is more than 1 ppm. Adequate O.T. Test should ensure this.
Annex 2: Troubleshooting of Solar submersible pump system

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A rapid decline in pump performance.</td>
<td>Wear and tear due to sand/silt penetrating into well</td>
<td>Detect the problematic wells, seal off the problematic section of the well or reduce pump performance to less than half of the problematic capacity.</td>
</tr>
<tr>
<td>Contactors fail too often, and motors consume excessive kWh per CuM pumped.</td>
<td>High starting frequency</td>
<td>Reduce pump capacity, install a VFD or larger tank capacity.</td>
</tr>
<tr>
<td>Motor temperature increases overtime; pump performance falls.</td>
<td>Deposits (Calcium, Iron, etc.) on motor surface and in hydraulic parts of pump.</td>
<td>Pull the pump and motor for cleaning; clean the piping, well filter and install a cooling sleeve on motor.</td>
</tr>
<tr>
<td>Pump performance falls off</td>
<td>Aggressive water (Corrosion of pump and pipes)</td>
<td>Pressure test piping from ground level. If leakages occur, pull and replace the pump and pipes with a higher corrosion class.</td>
</tr>
<tr>
<td>Water disappears down the piping when the pump is stopped</td>
<td>Rising mains pipe corrosion</td>
<td>Pull the pump and replace the piping material with a higher corrosion class.</td>
</tr>
<tr>
<td>The water level in the well is constantly becoming lower.</td>
<td>Well over pumping</td>
<td>Reduce pump capacity until the water level remains constant over the course of a year. Drill more wells at other aquifers.</td>
</tr>
<tr>
<td>Motor On / Off Auto Switch not functioning</td>
<td>Float switch system setting disturbed.</td>
<td>Check the level of float and reset</td>
</tr>
<tr>
<td>Low discharge of pump</td>
<td>Shadow on the solar panel.</td>
<td>Check the growth of trees near the solar panels and trim and cut it regularly.</td>
</tr>
<tr>
<td></td>
<td>Dust on Solar panels.</td>
<td>Clean the solar panels</td>
</tr>
<tr>
<td></td>
<td>Leaks in the HDPE Riser pipes joints in the bore well</td>
<td>Remove the pump and check the joints of HDPE Riser pipe at the outlet of pump nipple and special water chamber nipple. Seal properly HDPE pipe on both the nipples by heating it oil and pressing and tightening of nut bolts.</td>
</tr>
<tr>
<td></td>
<td>Leaks in the rising main</td>
<td>Check the leakages in the joints of rising main up to tank and tighten and seal it properly.</td>
</tr>
</tbody>
</table>
| Float switch not giving signal to pump in normally OFF condition (water flow over the tank) | Improper installation of float switch                                | 1) Float switch position should not be under pumped water in tank  
2) Min 1 meter  
Distance should be maintained between float switch & dead weight                                                                 |
| Float switch not giving signal to pump in normally ON/OFF condition | Improper installation of float switch                                | As above                                                                                                                                |
5.2 Trial run and Exit

5.2.1 Introduction:
After the water supply scheme construction is complete, the contractor is responsible to operate and maintain the scheme for fixed duration as specified in the contract. This period is called trial run period. Purpose of trial run is to ensure effective implementation and optimal performance of the scheme and to build capacities of the village level functionaries and water person for scheme Operation and Maintenance.

The contractor exits from the scheme after the trial run period and the scheme O&M is handed over to the VWSC/ GP. A protocol for exit of contractor from the scheme is available which includes detailed methodology and steps for exit.

This section elaborates the concept and methodology for trial run and describes the steps of exit protocol.

5.2.2 Trial Run:
The trial run is intended to test operation of the scheme as per its design and to manage the risks faced during implementation. It enables the GP and community to test daily operations, storage capacity, supply pressure, distribution of water, etc. against the design norms. Additionally, it also entails team briefing, on the job training and skills building of the GP level functionaries (existing or newly appointed water person, VWSC members, GP members, etc.) to take up O&M of the scheme in future.

During the trial run, the contractor is responsible for technical operations of the scheme, its financial management, administrative concerns and social considerations. The trial run period can validate setting of appropriate tariff rates to ensure financial viability and self-sufficiency of the scheme.

Apart from daily operations, periodic maintenance of scheme components and repairs if required during the trial run period is also the responsibility of the contractor.

5.2.3 Exit protocol:
Entire scheme from source to tap stand is to be transferred to the respective Gram Panchayat after the trial run period is over. Before handing over the scheme to the GP, few steps are to be followed which are termed as the exit protocol.

During this process, every component of the water supply scheme is assessed by the community, GP functionaries and PHED officials through scheme transect. The relevant documents including quality certificates, specifications, drawings, test reports, etc. are to be handed over to the GP. A completion certificate is issued by the GP followed by transfer of documents and assets by the contractor. These steps are described below in detail-

5.2.3.1 Joint scheme transect:
Before handing over the system, a walk through including the members of the Gram Panchayat and VWSC, user group and officials of PHED/ZP Department will be made. During the walk, the officials and villagers will ensure that all scheme components are as per design and agreement and the works are technically appropriate and qualitative. Following are the key pointers for assessment of each component –
The proceedings of the walk through, including the comments of all the participants be recorded and this record shall be maintained in the office of A.E. and E.E./Gram Panchayat.

An inventory of all the components indicating their status of working should be made and jointly signed by the representative of the Gram Panchayat and the department and a copy of the same should be handed over to the Gram Panchayat and one copy should be retained in the office of the A.E. as well as E.E.

5.2.3.2 Village meeting for handing over

The contractor is expected to organize a village meeting to inform the villagers about handing over and to transfer the relevant documents to the GP. All GP level functionaries, members of youth groups, SHGs, CBOs and villagers will participate in the meeting. The contractor will declare his exit from the scheme and will describe the scheme components, technical specifications, financial viability and other information in detail. All relevant documents will be handed over to the GP. The GP will ensure transfer of the following documents during the meeting-

<table>
<thead>
<tr>
<th>Component</th>
<th>What to assess</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source well/Bore well/Tube well/Spring</td>
<td>Exact depth and diameter as per certificate of geologists, quality of construction and material, etc.</td>
</tr>
<tr>
<td>Pump house</td>
<td>Quality of construction, board displaying details of pumping machinery, notice board, etc.</td>
</tr>
<tr>
<td>Pump machinery</td>
<td>Quality of pump and pumping material as per the budget. In case of solar pumps; quality and specifications of panels</td>
</tr>
<tr>
<td>Rising main</td>
<td>Work completion as per budget, air valves at appropriate distance, leakages, etc.</td>
</tr>
<tr>
<td>Water storage tank</td>
<td>Quality of construction, quality of material used, leakages, etc.</td>
</tr>
<tr>
<td>Distribution system</td>
<td>Uniform pressure in all habitations, leakages, installing taps to the community stand post and individual connection, etc.</td>
</tr>
</tbody>
</table>

The above complaints should be transferred to the asset register of GP.

5.2.3.3 Organization of Gram Sabha

A Gram Sabha will be organized where details of handing over will be presented to the villagers. Scheme details, technical information, future requirements and plan, various reports and certificates, etc. will be discussed during the Gram Sabha. The Gram Sabha will give approval to handing over of the scheme in the end.
5.2.3.4 Transfer of documents and preparation of handing over report

A key plan and details of the scheme indicating the functional strength of each component should be prepared. The details of each component such as the type of head work, the size and length of each pipe line, type, make and capacity of pumping machinery and its allied accessories, type, size and location of control valves, which should be jointly signed by the PRIs representative and the PHED/ZP department officers and should be kept in the records of Gram Panchayat as well as in the department.

The electric connection of Pump Houses and other installations shall be transferred on the name of the G.P.

In the end, the GP is expected to issue a completion certificate for completion of all tasks under the contract. Following is the list of reports and documents which need to be attached along with the completion certificate / handing over report-

- Letter by the VWSC for completion of the scheme and relevant capacity building activities
- Report of the scheme trial run
- Asset register
- O&M budget and tariff calculations
- Water quality reports
- Property card of land used for construction
- Scheme design and map
- Social audit report
- Agreement Copies
- Original and modified WSS project DPR (Sanctioned)
- Gram Sabha (general and women Gram Sabha) resolution

5.2.3.5 Submission of the report

The handing over report /completion certificate will be submitted to the block and district officials. A copy of the report will be maintained in the GP Office.
5.3 Monitoring Framework

5.3.1 What is Monitoring?

Monitoring is a continuous and systematic process of collection of data on specific indicators to provide information on the progress of the programme.

Alternatively, it can also be defined as the systematic and continuous process of collecting and using information throughout the project cycle for the purpose of management and decision-making.

It is the tracking of the desirable changes in program performance over time. Change will occur as a result of activities conducted after planning and resource allocation for the same.

So monitoring is the tracking of (i) resource allocation as per plan (ii) planned activities (iii) the desirable change. Therefore, in the monitoring process, data is collected throughout the life cycle of the programme.

Monitoring authenticates the PROGRESS of the programme; it measures the inputs, activities and outputs. It answers the questions what has been done so far? Where? When? and how effectively has it been done? It also provides a basis for programme evaluation.

Swajal program aims to provide sustainable access to drinking water to people in rural areas under the National Rural Drinking Water Programme (NRDWP) taking a demand driven and community-centred approach. It is expected that the community designs, implements, maintains and safely manages a piped water supply scheme in their habitation/hamlet/village. This approach empowers them to take decisions to regulate and manage water supply on a sustainable basis.

5.3.2 Objectives of Monitoring

The objectives of a monitoring system are:-

- Providing a platform for quick disposal of problems in operations and maintenance of community-led piped water supply scheme.
- Provide policy makers with a continuous update of physical and financial progress indicators on real-time basis.
- To enable users in analyzing and aggregating data generated at various levels to track progress, process quality, fund utilization, training and capacity building and sustainability of the efforts.
- Developing capacity of users and stakeholders to enable them to use the system and monitor process and outcomes.

5.3.3 Project Cycle of Swajal scheme:

The Swajal scheme cycle is divided into 4 phases i.e. Pre-Planning, Planning, Implementation and O&M. The activities planned in phase wise manner during the project cycle are stated in session 1.2.

Therefore, with specific reference to Swajal, the objectives are aligned with 4 phases.
5.3.4 Parameters to be monitored:

Looking at the vision of the project the parameters to be monitored are:

- Manner and extent of participation and involvement of relevant key stakeholders in the selection, design, implementation, operation and maintenance of the project.

- Quantity: 40 LPCD of water with all HH covered
- Quality: Water Quality with desired standards,

- Roles and Responsibilities
- Facilities created
- Tariff collection
- Mechanism to resolve the complaints

A detailed list of indicative key performance indicators to be monitored is given below.

5.3.5 Indicative Key Performance Indicators to be monitored as per Project Cycle

<table>
<thead>
<tr>
<th>#</th>
<th>Key Performance Activity</th>
<th>Who</th>
<th>Means of Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No. of Habitation selected</td>
<td>DSPT/DWSM</td>
<td>GP Selection process</td>
</tr>
<tr>
<td>2</td>
<td>No. of House Holds covered</td>
<td>DSPT/DWSM</td>
<td>GP Selection</td>
</tr>
<tr>
<td>3</td>
<td>Population covered</td>
<td>DSPT/DWSM</td>
<td>General Information</td>
</tr>
<tr>
<td>4</td>
<td>No. of participants oriented</td>
<td>DSPT/DWSM</td>
<td>Training report</td>
</tr>
<tr>
<td>5</td>
<td>No. of Habitation level Training proposed</td>
<td>DSPT/DWSM</td>
<td>Action Plan</td>
</tr>
<tr>
<td>6</td>
<td>No. of Habitation level Trainings conducted</td>
<td>DSPT/DWSM</td>
<td>Training Report</td>
</tr>
<tr>
<td>7</td>
<td>No. of Participants Trained (Habitation)</td>
<td>DSPT/DWSM</td>
<td>Training Report</td>
</tr>
<tr>
<td>8</td>
<td>No. of Habitation in which planning process completed</td>
<td>DSPT/DWSM</td>
<td>Village Action Plan Report</td>
</tr>
<tr>
<td>9</td>
<td>No. of Habitation in which Village Action Plan (VAP) prepared</td>
<td>DSPT/DWSM</td>
<td>Village Action Plan Report</td>
</tr>
<tr>
<td>10</td>
<td>No. of Habitation in with Gram Sabha resolution</td>
<td>DSPT/DWSM</td>
<td>GP Resolution copy</td>
</tr>
<tr>
<td>11</td>
<td>No. of Habitation in which DPR prepared</td>
<td>DSPT/DWSM</td>
<td>DPR Copy</td>
</tr>
<tr>
<td>12</td>
<td>No. of DPR approved (Technical &amp; Admin)</td>
<td>DSPT/DWSM</td>
<td>Copy of Tech &amp; Admin approval</td>
</tr>
<tr>
<td>13</td>
<td>No. of IEC activities proposed</td>
<td>DSPT/DWSM</td>
<td>List of Activities</td>
</tr>
<tr>
<td>14</td>
<td>No. of IEC activities conducted</td>
<td>DSPT/DWSM</td>
<td>Report of Activities</td>
</tr>
<tr>
<td>15</td>
<td>No. of Contractor proposed</td>
<td>DSPT/DWSM</td>
<td></td>
</tr>
</tbody>
</table>
### O&M Management and Monitoring

<table>
<thead>
<tr>
<th>#</th>
<th>Key Performance Activity</th>
<th>Who</th>
<th>Means of Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>No. of Contractor appointed</td>
<td>DSPT/DWSM</td>
<td>Copy of Work Order</td>
</tr>
<tr>
<td>17</td>
<td>No. of GPs with account opened</td>
<td>DSPT/DWSM</td>
<td>Account Number</td>
</tr>
<tr>
<td>18</td>
<td>No. of Habitations started Civil work</td>
<td>DSPT/DWSM</td>
<td>MBR</td>
</tr>
<tr>
<td>19</td>
<td>No. of Habitation Strengthening of Existing Source</td>
<td>DSPT/DWSM</td>
<td>MBR</td>
</tr>
<tr>
<td>20</td>
<td>No. of Habitation which have created New Source</td>
<td>DSPT/DWSM</td>
<td>MBR</td>
</tr>
<tr>
<td>21</td>
<td>No. of Habitation with drinking water facilities</td>
<td>DSPT/DWSM</td>
<td>MBR</td>
</tr>
<tr>
<td>22</td>
<td>No of habitation were work is completed</td>
<td>DSPT/DWSM</td>
<td>MBR</td>
</tr>
<tr>
<td>23</td>
<td>Operation And Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>No. of Habitation where Scheme Commissioned</td>
<td>DSPT/DWSM</td>
<td>Progress report</td>
</tr>
<tr>
<td>25</td>
<td>Period for O&amp;M by contractor</td>
<td>DSPT/DWSM</td>
<td>Progress report</td>
</tr>
<tr>
<td>26</td>
<td>Average proposed O&amp;M cost for individual connection of GP</td>
<td>DSPT/DWSM</td>
<td>Work Order</td>
</tr>
<tr>
<td>27</td>
<td>Average proposed O&amp;M cost for stand post of Habitation</td>
<td>DSPT/DWSM</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>% of Tariff Collection</td>
<td>GP</td>
<td>GP Book of Accounts</td>
</tr>
<tr>
<td>29</td>
<td>No. of GPs deposited 10% of capital cost</td>
<td>DSPT/DWSM</td>
<td>Account Statement</td>
</tr>
<tr>
<td>30</td>
<td>No. of GPs deposited community contribution in O&amp;M</td>
<td>DSPT/DWSM</td>
<td>Account Statement</td>
</tr>
<tr>
<td>31</td>
<td>No. of GPs contribution in O&amp;M (50% or more)</td>
<td>DSPT/DWSM</td>
<td>Account Statement</td>
</tr>
<tr>
<td>32</td>
<td>EXIT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>No. of GPs Exit by submitted works completion Report</td>
<td>DSPT/DWSM</td>
<td>Exit report</td>
</tr>
<tr>
<td>34</td>
<td>No. of GPs WS facility running smoothly, for three years after commissioning</td>
<td>DSPT/DWSM</td>
<td>Exit report</td>
</tr>
</tbody>
</table>

#### 5.3.6 IoT in Swajal

Dedicated dashboards linked to the IMIS of Ministry of Drinking Water and Sanitation will be set up for monitoring at National level. The dashboards will be used to monitor the scheme use IoT to feed the dashboards. The IoT is used for –

1. **Community Empowerment:** Mobile or SMS for sharing information with community. Information on water supply facilities, its operation & maintenance and complaint redressal.

2. **Overflow Management:** The overflow of the water tank in daily operation managed by float control/level control sensors to regulate the on/off of the pump.

3. **Measure the Water Table:** The sensors located in the source provide the static ground water level of the source. This will monitor the water level of the source.
4. Water Quality monitoring: The mobile app to update and share the water quality parameters to the consumer group will advocate on the quality of water.

5.3.7 Participatory community monitoring for effective implementation of the action plan

5.3.8 Methods of participatory community monitoring

The methods of participatory community monitoring are listed in the table below and also referred to checklist of community monitoring presented in construction supervision section.

<table>
<thead>
<tr>
<th>#</th>
<th>Methods</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>To display the action plan with updated status of implementation at public places</td>
<td>Display Board</td>
</tr>
<tr>
<td>2</td>
<td>Water Quality Monitoring (Application of TCL and OT Test)</td>
<td>TCL stock Register at GP</td>
</tr>
<tr>
<td>3</td>
<td>To prepare classified table for families due for water tariff payment</td>
<td>List of defaulters in public place</td>
</tr>
<tr>
<td>4</td>
<td>Review meeting/ workshop</td>
<td>Meeting register, Minutes of meeting</td>
</tr>
<tr>
<td>5</td>
<td>Comparative study of photographs (then and now)</td>
<td>Photograph</td>
</tr>
<tr>
<td>6</td>
<td>Preparing, reading and discussion monthly reports</td>
<td>Monthly Report register and meeting record register</td>
</tr>
<tr>
<td>7</td>
<td>Review, assessment and FGD about the on-going works/ processes</td>
<td>Minutes of meeting</td>
</tr>
<tr>
<td>8</td>
<td>Focused Group Discussions</td>
<td></td>
</tr>
</tbody>
</table>
5.3.9 Data collection and data entry methods and tools:

Quantitative Method:

In Quantitative method data has a numerical value and can be collected through data collection instruments with the different approaches.

The set of paper-based formats with indicators for different phases of project cycle will be created at state and district level. These reports will be collected and reviewed on monthly basis. The formats will capture the physical and financial information of the scheme.

Tools:

• Monthly Progress Reports: Paper-based formats to monitor Physical and Financial progress during implementation.
• Monthly review meeting: State/District authorities will conduct review meeting at regular frequency to interact and discuss with implementation team.

Qualitative Method:

Qualitative method is based on the appreciation that data generated is always within a context. Quantitative methods assume context neutrality, whereas qualitative methods factor in the “context” of the study. Qualitative methods are important to evaluate themes, which are based on subjective perceptions and narratives of experience, for example, when you wish to know about the people’s experience of a programme or issues like empowerment.

Swajal program will use qualitative method also. Apart from quantitative method the actual field investigation during the construction phase will be carried out intensively by district and block project teams. The state officials will also monitor with frequent visits to site. Review at block and district level will be done by the responsible authorities of project team.

Tools:

• Personal interview with beneficiary on field: Authorities on field visit discuss with individual beneficiary / HH to review the implementation process during civil works.
• Focus group discussion: Community level discussion on community level monitoring indicators during the field investigation.
• Observation on field: Physically verify the subworks proposed, quality monitoring along with community members.

Data Entry Method:

The designated monitoring expert or representative at district level will be responsible for collection of monthly progress reports, reviewing the component-wise information and feeding it into the IMIS (Integrated Management Information System). A computer with internet connectivity will be made available for data entry and reports generation for Swajal at district level.

Information flow:

The information of data will route from district to Central level. The paper based reports at District will be collected and feed into IMIS system. The information filled in the IMIS will be authenticated by the State officials. After the approval the information will be uploaded and used for further data analysis and reports.

Transmission and analysis:

The IMIS will be a web based system. The data recorded by district will go through systematic authentication at district and state level. The authenticated data will be uploaded to IMIS. The IMIS with backend database support generate the required physical and financial reports. Data analysis will be determined by the project/
programme objectives and indicators and ultimately the audience and their information needs. Therefore, data analysis should be appropriate to the objectives that are being analysed, as set out in the project/programme log frame and Monitoring plan.

For example:
- Analysis of output indicators is typically used for project/programme monitoring to determine whether activities are occurring according to schedule and budget. Therefore, analysis should occur on a regular basis (e.g. weekly, monthly and quarterly) to identify any variances or deviations from targets. This will allow project/programme team to look for alternative solutions, address any delays or challenges, reallocate resources, etc.
- Analysis of outcome indicators is typically used to determine intermediate and long-term impacts or changes – e.g. in people’s knowledge, attitudes and practices (behaviours).

Types of reports:
Two types of reports will be generated - physical and financial. The physical progress report will depict the scheme level progress of Swajal and its implementation. It will cover the Planning, Implementation level information as well as Water Quality reports. The financial reports will depict the disbursement/release and utilisation of funds, contribution by state, GoI and GP information. The physical and financial reports will be in the following form –
- Monthly Progress Report – Monthly reporting will allow for a more regular overview of activities which can be useful, particularly in a fast-changing context.
- Quarterly Report – Quarterly reports allow for more time between reports, with less focus on activities and more on change in the form of outputs and even outcomes.

5.3.10 Proposed potential monitoring structure:
The progress indicators of the Swajal scheme during Pre-Planning, Planning, Implementation and O&M phases will be monitored under the proposed structure. For post implementation of Swajal a separate mobile application for community and local authorities is proposed and work on the same is in progress. This app will help community to ensure effective and efficient services.

The IMIS will be based in MDWS at central level. It will be backed by the database server to manage the data and generate the required reports. At state level this IMIS will be accessed through internet. Every state can access the information using the user identification number and password provided by MDWS. The state can have the control over the district data and information and will have the rights to read, write and modify the data. The authentication of data will be done at state level. After the approval and authentication from state office, the data can be uploaded in IMIS. This can be further be used for reports and analysis.

For the management of mobile based application for managing scheme information, state can use the app developed at central level by MDWS or can create platform according to the local need.
5.3.11 IMIS of SWAJAL and Information flow management:

The monitoring of SWAJAL program will be done on Physical and Financial aspects in at three levels as presented below –

- MDWS (National)
- SWSM (State)
- DWSM (District)
- GP

The information flow from District to National level IMIS system will monitor the performance of SWAJAL program. The IMIS system will capture the program level information at district level for village selected in Swajal scheme. The monitoring team at district level will capture the data from planning phase, implementation phase and O&M phase and update the IMIS during the project period. The phase wise proposed physical and financial performance indicators are presented above. The indicators are aligned to the activities performed during planning, implementation and O&M phase of the project cycle.

The IMIS will monitor the following –

i. General Information of GP/Village/Habitation
   The General Information will consist of basic information of selected GP/Village/Habitation with number of HH and population.

ii. Financial Progress
    Financial Progress will consist of Central/State Allocation of funds, Release and Expenditure information. The component wise financial progress for state and district level will be available through the reports generated by IMIS.

iii. Physical Progress
    Physical progress will show actual physical progress of the scheme.
    - Target Vs Achievement
    - Scheme Details
    - Details of Recharge structures
    - Community Involvement
    - Scheme Handover to community
    - Financial report for O&M expenditure
    - WQ status and coverage
    - Support Activities (Admin, HR, IEC etc)
Mechanism for complaint redressal

- The user can flag a complaint via toll free number.
- Complaint is first tackled by O&M agency at first level and data goes to the MIS and timeline for repairs will be generated.
- If the complaint is redressed, the ticket will be closed and conveyed to the user via Mobile App/ SMS
- If the complaint is not resolved within stipulated time, the complaint will be escalated to PHED.
- Corresponding colour coded indicators in MIS dashboard

An example of a potential feedback mechanism can be found under Annexure attached.
Annexure : Examples of feedback mechanism

Customer Relationship Management System and Customer Relationship Centre Project of OREDA, Odisha – A Case Study

| Department of Science and Technology, Government of Odisha | Odisha Renewable Energy Development Agency | Parameter Softwares (P) Ltd. Project Managers | RESolve IT Platform |

Synopsis:
How bringing community to the centre of state intervention and introduction of technology (CRMS) and putting up a facilitation centre (CRC) brought about a sea change in the way various solar powered drinking water systems improved their performance in a short span of time. The impact was not just seen at the community level, but the overall efficiency of the other stakeholders showed a marked improvement.

Background:
OREDA over the years had established thousands of public utility facilities which used renewable energy. They are mostly established at the remotest of locations to serve the disadvantaged, unreached and unserved communities of the state. As per the MNRE guidelines such systems are under a service warranty for period of 5 years. OREDA left the custodian of the installation and the supplier of the installation to communicate with each other for service request after some breakdown. It was seen that due to deteriorating service by the suppliers the installation were dying down well before completing its economic life. This resulted in public dissatisfaction and also created lots of negative perception towards RE as a viable alternative source of energy.

Intervention:
PSPS designed and developed a CRMS which will have comprehensive data about the location, assets, people and their requests for R&M and coordinate with the stakeholders to get the service effectively executed. And also established a CRC to provide the human interface to the people to get their grievances redressed. PSPL started giving service from October 2015.

Features of the Project:
- The centre operates 7 am to 7 pm on all 7 days (7-7 X 7)
- Its manned by people who represents typicality of the language of that region of the state
- It has a Toll-Free Number, Cell Phones, Land Lines and WhatsApp and Email as communication channels.
- All transactions are journaled manually apart from the IT way of doing it.
- A cloud hosted CRMS is customised for the requirement of OREDA which has analytical features to analyse performance of stakeholders.
- The project heavily depends on human communication along with electronic channels to ensure smooth work flow.
- The project from Aug 2018 has brought all installations under mandatory preventive maintenance regime
How it works:
Anyone can call the CRC telephone lines and identify himself with the installation about which he wants to discuss. The CRC after establishing the genuinity of the caller and after identifying the installation ID raises a ticket which contains the nature of breakdown. The CRMS upon being altered fires series of Emails and SMS to the concerned people for responding to the request. The tickets are followed up both electronically and manually and closed. The supplier upon resolving the ticket informs the CRC about the resolution and CRC double checks with the designated stakeholders and closes the ticket. Analytics creates various reports which help in understanding the components of the project.

Periodic (Weekly) review of the performance is done by the top management of the organization which is vital to sustaining the initiative.