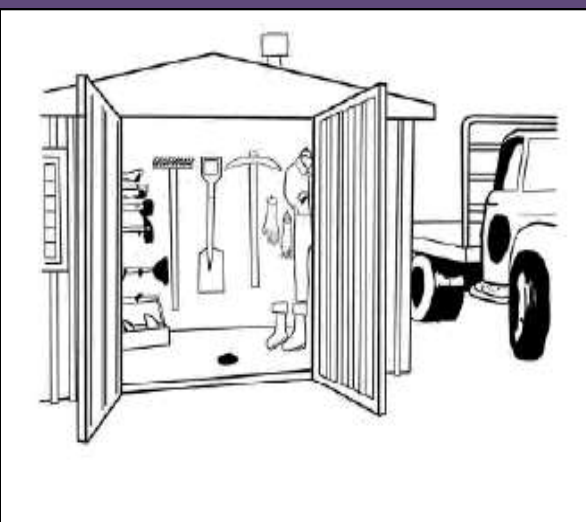




RURAL PIPED SYSTEM WATER SUPPLY OPERATION AND MAINTENANCE MANAGEMENT



Part A: Module D-Session B A Trainer's Manual for Equipment and Tools Management for Water Supply System



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PART - A: TECHNICAL OPERATION & MAINTENANCE MANAGEMENT

MODULE NO.	SESSION	SESSION TITLE	ESTIMATED TIME (Hours)
MODULE – A	Session – A	Facilitator’s Guide for Rural Water Supply Operation & Maintenance Management	4
	Session – B	Introduction to the training: objectives and expectations	2
	Session – C	Introduction of Rural Piped System and Pastoral areas Water Supply Technologies	2
MODULE – B	Session – A	Description of Water Sources for Water Supply	2
MODULE – C	Session - A	Introduction of Rural Piped System Operation and Maintenance	2
	Session - B	O&M Requirements for Water Sources to Water Supply	4
	Session - C	O&M Requirements for Intakes	4
	Session - D	O&M Requirements for Electro-Mechanical Equipment	32
	Session - E	O&M Requirements for Pipelines	8
	Session - F	O&M Requirements for Storage Tanks/Service Reservoir	4
	Session - G	O&M Requirements for Consumer Points	4
Sub Total for this Module			58
MODULE – D	Session -A	Spare Parts Supply and Management	36
	Session - B	Equipment and Tools Management	8
	Session - C	Asset Management	16
MODULE - E	Session – A	Water Audit and Leakage Detection	16
MODULE - F	Session – A	Water Quality Monitoring and Surveillance	24
MODULE - G	Session – A	O&M Requirements for Solar Energy	6
	Session –B	O&M Requirements for Wind Energy	4



MODULE - H	Session – A	O&M Requirements for Sand Dam	6
	Session – B	O&M Requirements for Haffir & Berkads	6
	Session – C	O&M Requirements for Rain Water Harvesting	4
		TOTAL	202



MODULE - D: EQUIPMENT AND TOOLS MANAGEMENT

Table of Contents

List of Annexes	iv
1 SESSION – C: EQUIPMENT AND TOOLS MANAGEMENT	1
1.1. Session Outline	1
1.2. Appropriate Facilitator	1
1.3. Objective	1
1.4. Introduction	1
1.5. Equipment and Tools Administration	2
1.5.1. Keeping Equipment Records	2
1.6. Equipment and Tools utilization/Operation Control System	5
1.6.1. Equipment and Tools Utilization/Operation Records	5
1.6.2. Transportation Pool	6
1.6.3. Fuel and Lubricants Control Procedures	6
1.7. Maintenance Planning, Scheduling and Controlling	6
1.7.1. Maintenance Concepts	7
1.7.2. Maintenance Objectives	7
1.7.3. Preventive (Scheduled) Maintenance	7
1.7.4. Breakdown (unscheduled) Maintenance	7
1.7.5. Equipment Rehabilitation	8
1.8. Inspection and Quality Control	8
1.9. Maintenance Organization Management	8
1.9.1. Shop Organization	8
1.10. Maintenance Planning and Scheduling	8
1.10.1. Preventive Maintenance Scheduling	9
1.10.2. Unscheduled Maintenance	11
1.10.3. Condition Required for PM	11
1.11. Maintenance Control System	11
1.12. Shop Operation	12
1.12.1. Shop Procedures and Control	12
1.13. Maintenance Record	15
1.13.1. Labour Cost	15
1.13.2. Spare part Cost	15
1.13.3. Other Costs	15
1.14. Maintenance Report	16
Annexes	17
List of Annexes	
Annex A: Format 6 – 1: Inspection Report For Newly Acquired Equipment	17
Annex B: Format 6 – 2: Equipment Identification Data Sheet	18
Annex C: Format 6 – 3: Master Equipment Number Register	19

Annex D:	Format 6 – 4: Maintenance/Utilization History File	20
Annex E:	Format 6 - 5A: Transportation Request/Travel Form	21
Annex F:	Format 6 – 5B: Daily Production and Consumption Record	21
Annex G:	Format 6 – 6: Equipment PM Roster	23
Annex H:	Format 6 – 7: PM Record Card	24
Annex I:	Format 6 – 8: Shop Repair Order	25
Annex J:	Format 6 – 9: Shop Repair Order Register	26
Annex K:	Format 6 – 10: Equipment maintenance Request Form	27
Annex L:	Format 6 – 11: External Repair Work Order	28
Annex M:	Format 6 – 12: External Repair Work Order Register	29
Annex N:	Format 6 – 13: Equipment Repair Follow Up Board	30



Acknowledgements



Acronyms and Abbreviations

PM Preventive Maintenance



1 SESSION – C: EQUIPMENT AND TOOLS MANAGEMENT

MODULE - D	TEHNIICAL OPERATION AND MAINTENANCE REQUIREMENTS
1.1. Session Outline	This session covers the following core topics: <ul style="list-style-type: none"> ▪ Introduction to Equipment and Tool Management ▪ Equipment and tools Administration ▪ Equipment and tools utilization/operation and control system ▪ Maintenance planning and scheduling and controlling ▪ Inspection and Quality Control ▪ Maintenance Control Systems ▪ Shop organization and operation ▪ Maintenance of records and reports
1.2. Appropriate Facilitator	Supply administrator, electromechanical engineer or technician with experience on Equipment and tool administration.
1.3. Objective	At the end of the session, the participants will able to: <ul style="list-style-type: none"> ▪ Participants will be able to understand equipment and tool management system for Rural Piped System. ▪ Participants will describe the administrative and technical procedures that should be followed in registering, numbering and identifying equipment, and the methods of recording equipment performance and utilization.
Output	<ul style="list-style-type: none"> ▪ Identified and Classified Equipment and tools ▪ Plan and scheduling maintenance ▪ Maintenance record and report
Timing	Approximately 8 hours
Methodology	<ul style="list-style-type: none"> ▪ Presentation, discussion and group exercises. ▪ Demonstrate different recording and reporting formats for Equipment and tools management system.
Materials	Flip charts, markers, pens, even overhead projector.
Session Guide and Content	
1.4. Introduction	Introduce Equipment and tool management system for Rural Piped System that is basic technical information and procedures for equipment and tools registration, utilization and control, maintenance planning and scheduling, shop operation and control and maintenance of records and reports. Facilities Services managers and supervisors are responsible for establishing systems for adequate accountability for Water Supply Services tools and equipment, and for establishing and communicating

	<p>standards for employees' use, care and safekeeping of the tools and equipment. Each administrative unit is expected to establish procedures for inventory control of tools and equipment to ensure compliance with requirements, and to track the distribution and return of tools and equipment issued to individual employees. Each individual employee is responsible for appropriate use and care of tools and equipment issued to him or her, and for accounting for and returning all tools and equipment in accordance with supervisory instructions and the unit's procedures. Employees are expected to immediately report lost, stolen, or damaged tools or equipment.</p> <p>Equipment is to be tagged, inventoried, and disposed of in accordance with the water administration office's policies and procedures.</p> <p>Water Administration Office-owned equipment and tools may only be used in the performance of the office duties and may not be used for employee personal use. Salvaged, broken, or junked equipment and tools are office's/utility's property, are not for employee personal use, and may not be removed from the organization. Unauthorized use or removal may result in disciplinary action or termination.</p>
<p>1.5. Equipment and Tools Administration</p>	<p>Explain the needs of equipment and tools administration through the following basic technical information and procedures:</p> <p>1.5.1. Keeping Equipment Records</p> <p>When a unit of equipment is purchased or owned, it should be assigned a suitable identification, such as a number, to be used throughout its life.</p> <p>The water service should have a definite plan for keeping a record of the cost of each major unit of equipment. The record may be kept on suitable equipment cards or in ledgers. The information obtained from such records will determine the complete financial history of any unit of equipment.</p> <p>The information will assist in determining the economic life of the equipment.</p> <p>The record should show:</p> <ul style="list-style-type: none">▪ the original cost,▪ the schedule of depreciation,▪ the time it has been used, and▪ The cost of repairs and maintenance. <p>It may also be useful to keep a record of the amount of fuel and lubricating oil consumed.</p> <p>1.12.1.1. Equipment and Tools Data Recording Forms</p> <p>The training facilitator should refer annexes at the end when explaining this section.</p> <ul style="list-style-type: none">✓ <i>Inspection Report Form</i> (Form 6-1) presented in Annex-A that Form used for recording the technical data and condition of the newly received equipment/vehicles when inspection is carried out by the qualified mechanic/inspector.✓ <i>Equipment Identification Data Sheet</i> (Form 6-2), Annex-B is

designed to contain essential information of equipment for identification and cost accounting. The form will be retained in an active file until the equipment is disposed off; after such time, the form will be placed in an inactive file.

- ✓ *Master Equipment Number Register* (Form 6-3), Form in Annex-C is designed to have all the technical information of the equipment/vehicles available in the water service. It is prepared for each class of equipment/vehicles and helps in assigning number in the sequential number of equipment/vehicle for its identification.
- ✓ *Maintenance & utilization History File* (Form 6-4), Annex-D serves as a file for all documents pertaining to the maintenance and repair of the equipment/vehicle and reports of daily operation & utilization of equipment. The file is maintained in the maintenance office.
- ✓ *Transport Request & Travel Form* (Form 6-5), Annex-E is used when requesting transportation services & during travel in accordance with pool regulations.
- ✓ *Equipment Utilization/Operation Records Form* (Form 2-6) is designed for Daily reporting of the actual status of each equipment assigned to an organization unit in terms of hours actually worked, hours available for use but not worked, and hours out of service due to repairs. It also used for recording the actual amount of electricity, fuel, lubricants & other inputs consumed by the equipment and the output of equipment (KM travelled, m³ of water produced, KWH produced etc).

1.12.1.2. Equipment and Tools Registrations

The vehicles and equipment available in the water supply service must be registered and given an identification number.

The registration and identification of equipment serves to identify the item, to collect the utilization and repair costs, and to compile them in the operational and maintenance history file on an individual item basis.

For each new vehicle and equipment delivered by the region a qualified mechanic or inspector should inspect and prepare:

- An Inspection Report Form (Form 6-1)
- An Equipment Identification Data Sheet (Form 6-2)

The item should be assigned a class and sub-class designator based on the registration numbering system to be discussed in the next chapter. The next sequential serial number is taken from the appropriate “class” master equipment number register form (Form 6-3) presented in this section and the technical data of the equipment is recorded on the master equipment register.

The complete equipment registration number should be recorded on:

- The Equipment Identification Data Sheet
- The Equipment utilization and Maintenance file

The equipment utilization & Maintenance file together with the copy of the Equipment Identification Data Sheet should be:

- Sent to the maintenance shop for filing in all operation & maintenance records
- Returned to the section concerned for appropriate action when the item is disposed of.

1.12.1.3. Equipment and Tools Classification

Equipment and vehicles are classified into classes and each class is assigned with a certain number of sub-classes. The criteria for each of the classes are based primarily on the configuration of the unit and on their common purpose.

The conceptual framework used in forming each of the sub-classes and classes is as follows:

Class A: Bicycles, motorcycles

This class includes all bicycles and motor cycles.

Sub-class: 01 – Bicycle
02 – Motorcycle

Class B: Automobiles, vans, mini-buses and other passenger vehicles

This class includes all automobiles including sedans, passenger vans, mini-buses and others.

Sub class: 01 - Automobile sedan
02 - Automobile station wagon
03 - Van, passenger
04 - Mini – bus, passenger
05 - Bus, passenger

Class C: Trucks

This class includes two basic groups: general purpose trucks and special purpose trucks.

Sub class: 01 – Truck, pick-up
02 – Truck, van, cargo

03 – Truck, pick-up, mobile workshop, etc.
(Special purpose)
04 – Truck, cargo
05 – Truck, dump truck
06 – Truck, fuel water servicing
07 – Truck, special purpose (mounted with crane, Compressor fork lift, mobile workshop, etc.)
08 – Truck, crane mounted

Class D: Stationary equipment

This class includes equipment, which does not provide their own propulsion. The units may be equipped with engines and motors that provide power for the operation of the machine. It encompasses various portable skid mounted or trailer mounted units; un-mounted units, integral wheeled equipment, etc.

- Sub class: 01 – Pump
 02 – Generator
 03 – Compressor
 04 – Arc welder
 05 – Concrete mixer

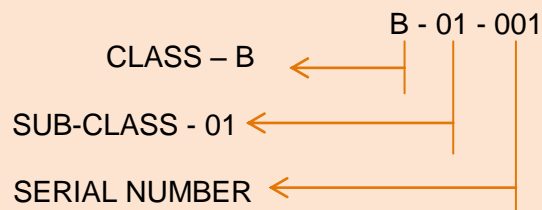
Class E to Z: Reserved for future use

1.12.1.4. Equipment and Tools identification

All equipment must be a given number which should be displayed. The recognized emblem of the organization also needs to be displayed, especially for self-propelled equipment.

The equipment numbering system provides for the assignment of a unique identifying serial number for each item of equipment in a particular class, by maintaining a separate master equipment number register described earlier in this manual. These serial numbers are assigned in sequential order within each class without regard to the sub-class.

The numbering of equipment and vehicles for identification to a specific unit is as follows:



In the example above

CLASS B - Indicates that it is automobile
 SUB – CLASS-01 – Indicates that it is automobile

sedan

001-Indicates the serial (registration) number of the equipment that is given in the master equipment number register.

1.6. Equipment and Tools utilization/Operation Control System

Explain that equipment and tools utilization data are required for a number of planning, scheduling, cost determination function related to equipment.

1.6.1. Equipment and Tools Utilization/Operation Records

Equipment assigned for some purpose may be in use only for a short period of time due to break down, idle time, etc. This information and inputs to and outputs from the equipment during operation must be recorded and reported because they provide a basis for determining whether assigned equipment is being properly utilized and to analyze operating costs.

The *Equipment Utilization/operation Record Form* (Form 6-5) is designed

for daily reporting, using a single form for each separate unit. Each form will serve for one month of operation.

The utilization record provides for the reporting of:

- The total available working hours
- Actual time operated
- Idle time
- Down time spent for repairs
- Inputs to the equipment (fuel, oil, electricity etc.)
- Outputs from the equipment (km travelled, m³/h pumped, kwh etc.)

The following definitions should be used in determining how the hours are to record on the utilization reports.

- a) **Available hours:** includes working hours during which time the vehicles or equipment is assigned to a cost centre, including travel time to or from the assigned area, less down time hours.
- b) **Down time Hours:** includes all hours equipment is down for maintenance or repair which area normal working hours.
- c) **Idle hours:** includes only those hours of “Available Hours” When the equipment was not operated.
- d) **Operating Hours:** includes only those hours of “available hours” that the vehicle or equipment was operating.
- e) Example
- f) Available Hours + Down – time = Working Hours
- g) Operating Hours + Idle Hours = Available Hours
- h) Utilization Rate = $\frac{\text{Operating Hours}}{\text{Available Hours}} = \frac{\text{OH}}{\text{OH} + \text{IH}}$

After the review by the concerned body, the utilization records should be filed in the maintenance/utilization record file.

1.6.2. Transportation Pool

Transportation Support for all services, sections etc. requiring personnel or freight services will be arranged by the administrative section.

- a) Transportation Request/travel form

The Transport Request/Travel Form must be properly filled, signed, approved and submitted to the transportation pool administration, which will assign transportation using the same form.

1.6.3. Fuel and Lubricants Control Procedures

Quantity of fuel and oil dispensed to vehicles and equipment is controlled by the use of the utilization operation record form.

The technical section clerk will compute the average kilo meters per litter or hours per litter for each item of equipment. Periodic review of the data will assist in determining apparent fuel loss.

1.7. Maintenance

Explain Maintenance Concepts and Maintenance Objectives also

**Planning,
Scheduling and
Controlling**

discuss the two maintenance classification:

1.7.1. Maintenance Concepts

The maintenance concept for vehicles and equipment available in the water service is that the maintenance section will perform:

- i) Scheduled maintenance,
- ii) unscheduled maintenance and
- iii) Other repairs within its capacity.

Major repairs and other types of repairs beyond its capacity will be outsourced to commercial workshops.

The basic aim of the maintenance concept is that it should provide a minimum down time for maintenance on vehicles and equipment, provided the repair parts supply system is properly stocked and responsive to requirements.

The productive efficiency of equipment is based not only on the improvement of technology and materials, but also on the effectiveness of the maintenance effort.

Effective and economic maintenance services require systemic scheduling programme that will make equipment available for mechanical inspections, lubrication, adjustments, and necessary repairs at predetermined intervals.

Thus, down time and resultant costly disruptions of equipment operations work schedules due to equipment failures are minimized.

1.7.2. Maintenance Objectives

One of the main tasks and responsibilities of the maintenance section is to establish maintenance standard and maintain equipment of the region at the lowest possible maintenance cost, and by so doing, serve safe and serviceable equipment at all time and minimize down time and maximize service life of the equipment with adverse effect of reducing the capital investment and capital replacement cost.

To achieve these main objectives, basic management principles must be developed and management elements such as planning, organizing, controlling, evaluating reports, etc. must be adopted.

To prolong the life of vehicles and equipment, maintenance work must be performed in time.

Two types of maintenance:

1.7.3. Preventive (Scheduled) Maintenance

The purpose of preventive maintenance is to keep vehicles and equipment in safe and serviceable condition at all times at minimum cost and to detect and correct minor deficiencies before they result in costly and major repairs. Equipment is considered in safe and serviceable condition when operation will not cause damage to the equipment or create a safety hazard.

1.7.4. Breakdown (unscheduled) Maintenance

Unscheduled maintenance is the correction of deficiencies that occur

	<p>between scheduled maintenance services. It is generally limited to the correction of specific items reported as needing maintenance by a driver or equipment operator and confirmed by the shop inspector.</p> <p>After a long period of service, most of the components for any vehicle or equipment deteriorate. In effect, the maintenance section must schedule major repair work for such equipment vehicles.</p> <p>1.7.5. Equipment Rehabilitation</p> <p>Rehabilitation is any one time major or group of major repair specifically planned and scheduled over a limited period of time. It has the effect of extending the service life of the equipment to two or more years. Approval of such repair is usually limited to the chief of the technical section.</p>
<p>1.8. Inspection and Quality Control</p>	<p>Inspection is the act of conducting a systematic diagnostic determination of the repairs needed to return and equipment to a safe and serviceable condition. Inspection includes the preparation of a shop repair order in standard nomenclature and the estimating of the cost (labour and material) of the listed repairs. The technical inspection will help minimize the maintenance time for repair by identifying and indicating the exact point of failure on the equipment.</p> <p>Quality control is a system used to check and test the correctness of the maintenance work accomplished by the workshop using testing instruments and carrying out road tests, if necessary.</p>
<p>1.9. Maintenance Organization Management</p>	<p>Maintenance and repair are essential for continuous efficient operation of any stationary and automotive equipment.</p> <p>The maintenance of all equipment should conform to the standards and methods outlined on this manual.</p> <p>The technical section of the water service is responsible for organizing a preventive maintenance schedule, conduction preventive maintenance work at the scheduled time, performing unscheduled repairs & other repairs within its own capacity.</p> <p>The technical section shall outsource major repairs and repair types beyond its capacity. It shall follow up and control the repair status, quality of workmanship and cost of outsourced repairs.</p> <p>1.9.1. Shop Organization</p> <p>The maintenance section should know the status of the work load at all times in order to effectively maintain a full work load.</p> <p>Equipment, which cannot be repaired due to lack of spare parts, must be moved to an area outside the shop, in order to effectively utilize the repair area and maintenance personnel. In order for the technical section to be aware of the back log of equipment awaiting repair, it is recommended that a control board be maintained for those items.</p>
<p>1.10. Maintenance Planning and Scheduling</p>	<p>Planning and scheduling plays an important role in equipment maintenance system by providing up to date information of the equipment maintained within the organization region or sites assessment of manpower and spare parts requirement.</p>

Effective planning and scheduling will ensure that the work load is uniform and balance, thereby minimizing the required workforce and maximizing the application of the workforce to productive effort. It should be recognized that there is an economical point at which random failures of equipment can be reduced by scheduled maintenance.

The following is a list of forms used in the equipment management program. Details on the use of each form are presented at the appropriate place in the manual.

Equipment PM Roster (Form 6-6), in Annex-G provides a basis for scheduling PM services on a monthly basis, for one working year and provides a simple method of ensuring a relatively constant shop work load.

PM Record Card (Form 6-7) in Annex-H serves as a record of PM servicing, and is a record of utilization (kilometres or hours) of the item. It also assists in establishing the average annual usage.

Shop repair order (Form 6-8), in Annex-I provides a record of the maintenance labour time, labour cost, spare parts and material cost, external repair cost and other expenses. It also provides a basis for the development of time standards for PM servicing.

Note – No Repairs are authorized to be conducted unless a shop Repair Order is filled.

Shop Repair Order Register (Form 6-9) in Annex-J: Shop repair orders are registered on the shop repair order register and assigned a sequential number.

1.10.1. Preventive Maintenance Scheduling

Preventive maintenance (PM) is accomplished through a careful operation and timely serving of equipment systematic inspection, detection, and correction of potential equipment failure before major defects develop.

The purpose is to keep equipment and devices in satisfactory operating conditions at all times.

Preventive maintenance consists of the following:

- Operator (daily) preventive maintenance
- Scheduled Preventive maintenance

a) Operator (daily) PM

Operators are the “first-line defence” against equipment wear, failure, and damage. Equipment must be systematically inspected by operators or authorized persons daily, before and after operation, using a PM checklist.

The PM checklist form for each type of equipment is listed in the operation & maintenance manual. Defects discovered during these inspections or during the operation of the equipment should be noted on the operator’s check list. If a deficiency observed could cause a serious damage, it should be brought to the attention of the maintenance section for immediate repair.

b) Scheduled (Preventive) Maintenance

It is important to schedule PM inspections and service using the manufacturer's recommendation as to the maximum distance or time interval between inspections. Practically, as the speedometers or motor hours of vehicles or equipment are usually inoperative and not simple to repair, it is better to apply the maximum time interval for the recommend maximum distance interval by the manufacturers. Maximum time interval for carrying out PM for equipment is estimated to ensure proper maintenance service.

As a starting point for the implementation of a scheduled preventive maintenance system, Monthly (M), Quarterly (Q), Semi-annual (S) and Annual (A) inspection and servicing is generally acceptable. These are discussed below.

M- Monthly Inspection and Service – all safety items and those services recommended by the manufacturer to be performed by the manufacturer

Q- Quarterly Inspection and service – all elements included in the M inspection and service and those services recommended by the manufacturer to be performed every 3 months of 15,000 kms.

S- Semi-annual inspection and service all elements included in the M & Q inspection and service and those services recommended by the manufacturer to be performed every 6 months of 30,000 kms.

A - Annual Inspection and Service – all elements included in M.Q and S inspection and service, and those services recommended by the manufacturer to be performed.

Service Checklist, Interval & time standards

The recommended service checklist and interval for all equipment is recorded on the operation & maintenance manual.

Explain the factors that affects the repair time standards as:

- the type of equipment to be repaired,
- workshop equipment,
- available hand tools & special tools,
- experience of the technical personnel &
- Many other factors.

It is impractical to estimate beforehand the repair time standards where no previous data on repairs is available. Therefore repair time standards will be set out and continue to be set out as repair data accumulate. The technical section head will be responsible for setting out and revising repair time standards based on accumulated repair data.

PM Roster

Ensuring that equipment is available for scheduled maintenance and that there is a balance workload in the shop is often difficult. As the PM Service is based on a monthly schedule, the roster implemented is a monthly roster form for one working year (**Form 6-6**).

The PM roster should be prepared in the following manner:

- Utilize a separate roster for each category of equipment

- Select the month in which you plan to begin the program.
- Indicate the category/class of equipment and the year in the space provided on the roster.
- The numbers across the top of the form represent the weeks of the months.
- For each equipment write M, Q, S, A Underneath the week and month where monthly, quarterly semiannual and annual preventive maintenances are scheduled to be carried out.
- Take care to spread out the M, Q, S & A schedules for equipment so as to have a balanced workload each week and each month.
- Note- a Shop Repair Order should be opened while conducting M, Q, S & A preventive maintenance.

1.10.2. **Unscheduled Maintenance**

Controlling unscheduled repair work into the shop cannot follow the same procedures as preventive maintenance scheduling.

When a piece of equipment is required to have unscheduled repairs, an inspector should inspect the equipment and record appropriate information on the shop repair order (**Form 6-8**).

The shop repair order should be recorded on the Shop Repair Order Register Form (**Form 6-9**).

In order for the shop office to be aware of the backlog of equipment awaiting repair, it is recommended that an “Equipment Awaiting for Repair” control board (**Form 6-10**) be maintained.

1.10.3. **Condition Required for PM**

An effective and efficient PM program requires the establishment of a PM scheduling system for all equipment served by the maintenance shop. For the program to succeed, several management responsibilities are required, including:

- A complete inventory of equipment with systematically assigned equipment identification numbers, affixed to each piece of equipment.
- Purchasing the special tools and equipment required to service, repair and overhaul the equipment.
- Providing adequate training for operators and maintenance personals.
- Determination and establishment of repair time standards and service interval for each type of equipment to be serviced.

1.11. **Maintenance Control System**

Explain the following control systems and procedures that need to be maintaining equipment:

- System of equipment operating cost and uses records, including a numbering and identification system for all equipment.
- Adequate budget allotments for equipment maintenance and repair based on actual cost experience and anticipated needs.
- A priority system and schedule for repairs, overhaul, and replacements.

	<ul style="list-style-type: none"> ▪ A system of planned component replacement and preventive maintenance systems at all levels. ▪ To provide costs and quantities of parts, supplies, labor and overhead expenses on each job and on each piece of equipment, equipment servicing and repair forms must be designed. ▪ Prompt supply of spare parts and all other equipment needs. Requisitioning procedures should provide adequate “ready issue” stock at the point of use as determined by analysis as past needs and in accordance with planned repair and overhaul programs. ▪ Regular submission of equipment operating reports and workshop activity summaries for accounting purposes.
<p>1.12. Shop Operation</p>	<p>1.12.1. Shop Procedures and Control</p> <p>Of all the basic elements of the equipment maintenance management program, those dealing with control are probably the most important. In the broad sense, control encompasses all functions of management and comprises those specific functions which enable management to effectively direct the effort of the organization toward the accomplishment of planned objectives.</p> <p>When applied to the equipment maintenance management program, specific functions which monitor and control work input include:</p> <ul style="list-style-type: none"> ▪ productivity, ▪ overhead, material expenditures ▪ equipment downtime, and ▪ Quality of workmanship. <p>Simplified procedures are required to control and expedite repair, maintenance, and rebuilding work. These procedures must provide for a maximum of control by the technical section head.</p> <p>Equipment maintenance request form (Form 6-10) in Annex-K provides a means of transmitting specific information regarding deficiencies in equipment detected by the operator/driver. Explain Form 6-10 in Annex-K.</p> <p>External repair work order (Form 6-11) in Annex-L provides a standard method for formally ordering the maintenance work to be carried out by the external workshops. External repair order register (Form 6-11) is used for recording the maintenance works to be carried out by external workshops using “external repair order” and for numbering it.</p> <p>Equipment repair follow-up board (Form 6-13), in Annex-N is designed to provide repair backlog. Increase in backlog or decrease in repair output should be investigated immediately.</p> <p>1.12.1.1. Repair Request Procedures</p> <p>The purpose is to provide a standard method for requesting maintenance or repair service to specific equipment, and to advise maintenance personnel of known or observed deficiencies.</p> <p>a) Scheduled Maintenance Request</p> <p>The user of the equipment or as the case may be the technical section</p>



shall initiate the pm request.

- The maintenance clerk should prepare a shop repair order form (**form 6-8**) described in part c, indicating the type of pm servicing to be performed by pm work sheet.

b) Unscheduled maintenance request procedures

In the event the operator/driver notes a deficiency requires maintenance,

- He should notify the supervisor to whom the equipment is assigned of the equipment's deficiency.
- The supervisor contacting the maintenance shop should establish a schedule for the repair of the unit and send the equipment to the workshop with a repair request form.
- The maintenance clerk should prepare a shop repair order indicating the type of repair to be performed, and hand this over to an inspector for further check-up.

c) External repair request procedures

Repair work should be:

- Registered on the external work order register form (form 6-12)
- Approved by the technical head & the water supply head
- Sent to external workshop with the external workshop order form (form 6-11)

If the items are:

- Beyond the capacity of the technical section.
- For damaged equipment under insurance coverage.

For new equipment within the warranty period, repairs will be performed by the dealers.

1.12.1.2. Inspection Procedures

Before performing the scheduled maintenance and unscheduled maintenance for the equipment, technical inspection must be carried out.

a) Preventive Maintenance Inspection

Before starting scheduled preventive maintenance:

- The assigned technician needs to inspect many things by sight, sound, feel and must pay attention to certain related items during inspection. He also needs to check the equipment for oil and fuel line leaks, leaking gaskets and seals, etc.
- After visual inspection during operation of equipment, the equipment should be cleaned. After cleaning the technician will proceed thoroughly with the inspection, using the preventive maintenance service worksheet.
- When the technician, during the course of the inspection determines that unscheduled repairs are required, he should complete and equipment maintenance request form and submit it to the technical section.

b) Unscheduled maintenance inspection

After the driver or operator delivers the equipment for unscheduled

maintenance with the maintenance request form to the workshop,

- The inspector should start checking the repair requested by transferring the equipment into the inspection bay.
- If, during the inspection, the inspector determines serious problems, he must check it by a road test, if necessary.
- If the inspector has found additional deficiencies during inspection, he should write this on the shop repair order and submit it to the maintenance shop for repair.

1.12.1.3. Maintenance Priority

If the workshop has a full workload, it is necessary to have a priority system established to determine which item should be given priority for repair.

The following system for assigning maintenance priorities will allow the shop foreman to utilize all maintenance resources on jobs with the greatest repair need. With this system, repairs are classified by their effect on the level of equipment serviceability and by the shop foreman's ability to schedule or control them.

Priority-1 is assigned to any equipment having a breakdown or discrepancy detected during PM those results in the unit being unsafe to operate or function in its primary mission.

Priority - 2 is assigned to any repair that may be postponed for short period of time, but should be done in the near future, or this may result in certain break down or unsafe operating conditions.

Priority- 3 is assigned to any repair that, if not performed, would affect the long-term serviceability of the item, but would not result in an operating condition.

Job repair types listed on the shop repair orders will be the basis for determining the priority of the repair.

1.12.1.4. Spare part supply Concept

a) spare part supply inventory

The primary reason for maintaining repair parts stocks is to provide an adequate level of service to equipment maintenance function. This level of service can be determined by the frequency and quantity parts are supplied to the shop.

Maintaining certain levels of repairs parts stocks allows mechanics more access to parts when they are needed , particularly when:

- Shops are located away from urban centers and the support of local supply houses is lacking and
- Part stocks are prohibitively expensive, either because they are required only for few specialized equipment units or the demand for the parts is generally unpredictable and they are not stocked.

The primary aim of stocking repair parts is to minimize equipment downtime in shops. Unavailability of parts is the main cause of in –shop equipment downtime .The premium on equipment down time does not necessarily dictate a party management policy that requires a large inventory of repair parts at numerous stocking points throughout the

	<p>regional office. It should instead dictate the adaptation of a balanced approach to parts management, an approach involving both stocking repair parts at all maintenance section and establishing flexible supply line from contract or commercial sources.</p> <p>Effective control over parts inventories in parts supply sections of the maintenance activities depends on the accurate knowledge of the quantity on hand and the specific location of the item. The ability to know the availability of the item quickly is essential and minimizes the repair time of the equipment.</p> <p>b) storage of used and replaced parts</p> <p>Many items issued from parts stock should be repaired items which have been recovered when they were replaced.</p> <p>Failure to require that the replaced items be returned prior to the issue of a replacement can be costly. Many of these items can be repaired and returned to stock, others may be disposed of as scrap.</p>
<p>1.13. Maintenance Record</p>	<p>Explain the importance of maintenance record as:</p> <p>A record system is importance to the success of a maintenance system. A properly maintained record system will provide the basis for a sound and accurate maintenance cost data, and will also provide a basis for the comparison of maintenance effort and life history of the equipment.</p> <p>1.13.1. Labour Cost</p> <p>Labour cost must be recorded and filed in the maintenance/utilization file. It may be calculated by using a monthly salary of the maintenance personnel and rating it hourly and multiplying it by the time consumed for repair.</p> <p>The shop repair order must be used by all maintenance activities to accurately record repairs required and completed, and to report the cost of maintenance performed on individual unit so equipment.</p> <p>1.13.2. Spare part Cost</p> <p>All spare parts used for repairing the equipment with their unit price must be recorded and filed in the maintenance /utilization file.</p> <p>1.13.3. Other Costs</p> <p>Indirect costs, electrical and water consumption costs, etc are not included in the total maintenance cost. An overhead maintenance cost must be added to the total maintenance cost spent on repair the amount which to be decided by the water supply head after collection and analysis of relevant data. For the time being a 20% overhead cost is assumed.</p> <p>The technical section must collect the maintenance cost data described above from each shop repair order as these data are useful in determining the following information:</p> <ul style="list-style-type: none">▪ Time spent for different types of repair▪ The cost of parts for various type of servicing or repair▪ The cost of labor for repairing an item <p>These data are also useful to determine several types of planning data</p>

	<p>such as the ones below which are valuable to the management.</p> <ul style="list-style-type: none">▪ The average number of man-hours required to perform the specific type of repair.▪ The average cost of parts to perform such a repair.
1.14. Maintenance Report	<p>Explain the types of maintenance report requires as:</p> <ol style="list-style-type: none">1. Labour cost2. Spare part and other material cost3. External maintenance cost4. Maintenance backlog and maintenance load <p>This report will be compiled and forwarded to the water supply head</p>



Annexes

Annex A: Format 6 – 1: Inspection Report For Newly Acquired Equipment

_____ Rural Piped System Service

Inspection Report for newly acquired Equipment

Date _____ Report No. _____
 Procurement Ref. No. _____ Invoice No. _____
 Equipment: Description _____

Type _____ Make year _____ Make _____ Model _____

 Manufacturer _____ Serial No _____
 Engine _____ Type _____ Make _____ Model _____ Serial no _____
 Electric Motor/Generator _____ Type _____ Make _____ Model _____ Serial no _____
 Other _____ Type _____ Make _____ Model _____ Serial no _____

Parts: Damaged, missing, malfunctioning

Item	Description	Condition

Accessories:

Technical Literatures:

Inspected by _____ Approved by _____
 Title _____ Title _____
 Sign _____ Sign _____
 Date _____ Date _____

Distribution: Original - Maintenance Section
 Copy - Transport Pool



Annex B: Format 6 – 2: Equipment Identification Data Sheet

_____ Rural Piped System Service Equipment Identification Data Sheet			
<hr/> <hr/>			
Make _____	Model _____	Model year _____	Passenger Capacity _____
Description _____		Chassis No. _____	
Engine: Make _____	Model _____	Serial No. _____	No. Cylinders _____
Drive Train: 4 x 2 _____	4 x 4 _____	6 x 2 _____	6 x 4 _____ 6 x 6 _____ Tracked _____
Towed: Trailer 2 heel _____ 4 wheel _____ Semi – trailer _____ Wheel _____			
Tires: Front _____ x _____ - _____ Ply Tread Type _____			
Rear _____ x _____ - _____ Ply Tread Type _____			
Gross vehicle weight _____ Kilos/ton Payload Capacity _____ Kilos/ton			
Battery (ies): Voltage _____ Ampere hour's _____ Quantity _____ Length _____ width _____ Height _____			
<hr/> <hr/> <u>Mounted Equipment</u>			
Engine: Type _____ Make _____ Model _____ Serial No. _____ No. Cylinders _____			
Electric Motor/Generator: Type _____ Make _____ Model _____ Serial No _____			
Other: Type _____ Make _____ Model _____ Serial no _____ (other information) _____ _____ _____ _____			
<hr/> <hr/> <u>Accessories or Attachments Furnished with Equipment</u>			
_____ _____ _____			
		Inspector _____	
		Name	Signature
		Date	
Purchase Price _____ Birr		Vendor _____ Source _____	
P.O. No. _____ Date _____		Receiving Report No. _____ License Plate No. _____	
Assigned Equipment Number _____			



Annex C: Format 6 – 3: Master Equipment Number Register

_____ Rural Piped System Service Master Equipment Number Register											
Equipment: Class _____											
Sub Class	Serial No	Model Year	Equipment Description	Model /Type	Engine No/ Motor No.	Chassis No. Serial No.	Source	Cost Price	Date Purchase	Disposal Action	Date



Annex D: Format 6 – 4: Maintenance/Utilization History File

_____ Rural Piped System Service

Maintenance/Utilization History File

CLASS _____
SUB CLASS _____
SERIAL NO. _____
Consists of the Following Records/ information
Inspection Report Form/Copy
Equipment Identification Data Sheet/Copy
Maintenance Request Forms
Job Repair Orders
Utilization/Operation report forms

Month	OH	HI	RH	TH	% U	Utilization Cost	Maintenance Cost	Operating Cost

Operating Cost = Utilization Cost + Maintenance Cost

HO - Operated Hour IH - Idle Hour RH – Repair Hour
 TH - Total Hour % U = Percentage Utilization
 = Operating Hours
 = Available hours
 = $\frac{OH}{(OH+IH)} \times 100$



Annex E: Format 6 - 5A: Transportation Request/Travel Form

_____ Rural Piped System Service

Transportation Request/Travel Form

Equipment _____ No. _____

Site Identification No Location _____ From ___/___/___

To ___/___/___

Date	Start	Stop	Start	Stop	Start	Stop	Start	stop	Start	Stop	Total Hours	Operation				Utilization			
												v	a	p	n	OH	JH	RH	TH
1/																			
2/																			
3/																			
30																			
30																			
Total																			

V = Volt; a = amperes ; P = Pressure (bar) ; N = Speed (rpm)

OH = Operated hour ; IH = idle hour ; Rh = repair hour ; Th = total hour

Operator: _____ Signature _____
 Technical section head _____ Signature _____

For Production & Consumption Data See for 6 – 5B

Annex F: Format 6 – 5B: Daily Production and Consumption Record



_____ Rural Piped System Service
Daily Production and Consumption Record

	Production									Consumption												
	WM R Start	WM R End	WM R DIFF	KM Star t	KM En d	KM Diff	HR Star t	HR En d	HR Diff	KW H Prod	Kwh(a) Start	Kwh(a) end	Kwh(a) Diff.	Kwh ® Star t	Kw h ® end	Kwh(r) Diff.	P Cos t	Fue l Ltr.	Fue l cos t	Oi l ltr	Oil Cos t	
Total																						

WMR Start - water meter reading at start of day
 WMR End – Water meter reading at end of day
 WMR Diff – water meter reading difference for the day



Annex G: Format 6 – 6: Equipment PM Roster

_____ Rural Piped System Service

Equipment PM Roster

Class _____ Year _____

Serial Number	Jan				Feb				Mar				Apr				May				Jun				July				Aug				Sep				Oct				Nov				Dec			
	1	2	3	4																																												



Annex H: Format 6 – 7: PM Record Card

_____ Rural Piped System Service								
PM Record Card								
Equipment No. _____			Description _____			Location _____		
Date	Pm type	Kilometres or hours	date	Pm type	Kilometres or hours	date	Pm type	Kilometres or hours



Annex I: Format 6 – 8: Shop Repair Order

_____ Rural Piped System Service Shop Repair Order						
Equipment No. _____ Description _____						
Code No	Type of Repair	Work Done	Mech.' Name	Hour	Costs	
					Repair Hour	
					Garage Hour	
					Labour Cost	
					Material Cost	
					External Repair Cost	
					Other Costs	
					Over Head (20%)	
Code No	Type of External Repair	Order No			This Shop Order	
					Brought Forward	
					Grand Total	
Checked & Completed By Workshop Clerk _____ Date _____ Approved By Technical Head _____ Date _____						



Annex J: Format 6 – 9: Shop Repair Order Register

_____ Rural Piped System Service Shop Repair Order Register										
Shop Repair Order		Equipment Serial No.	Description of Work	Date		Cost of				Total Cost
Number	Date			In	Out	Labour	Part And Materials	External Repair	Others	



Annex K: Format 6 – 10: Equipment maintenance Request Form

_____ Rural Piped System Service

Equipment maintenance Request Form

No. _____
Date: _____

To: _____

1. Equipment/Vehicle: Type _____ Location _____
Side No. _____

2. Correction for the following deficiencies is requested: _____

3. Driver/Operator: Name _____
Approved by : Name _____

To be filled by Maintenance Section

3.1. Date in _____

3.2. Inspector Comments: _____

3.3. Inspector's Name _____ Signature _____

4. Shop Repair Order No. _____
(For reference)

Distribution: Original - To maintenance shop (to be filed in maintenance file)
Copy - To requester



Annex L: Format 6 – 11: External Repair Work Order

_____ Rural Piped System Service

External Repair Work Order

Date: _____
No: _____

To: _____

Please send a quotation for the following repairs

1. Equipment/Component

Type _____	Plate No. _____
Eng. No. _____	Serial No. _____
Side No. _____	
Shop Repair Order No. _____	

2. Description of work/job _____

3. Requested by _____ Sig. _____ Date _____

Approved by _____ Sign _____ Date _____

Stamp

External body

4. Received by _____ Sig _____ Date _____

Stamp



Annex M: Format 6 – 12: External Repair Work Order Register

_____ Rural Piped System Service

External Work Order Register

Ext. Work Order		Equipment/Component			Description of Work	Delivery Date	Cost				Remark
Number	Date	Type	Engine / Serial No.	Side No.			Labour	Spare Part/ Material	Other	Total	



Annex N: Format 6 – 13: Equipment Repair Follow Up Board

_____ Rural Piped System Service Equipment Repair Follow Up Board							
Item No	Equipment		Date In	Repair Type	Repair Shop		Remarks
	Side No.	Description			Type	Delivery Date	

