

## Chapter 6

# General Suggestions about Repairs

MHP plants are usually located in remote mountainous areas where transportation of damaged equipment to a good workshop or a manufacturer can be difficult and may cause delays. Therefore, arrangements should be made to try to carry out as many repairs locally as possible. It is advisable to identify and develop a good relationship with a local or nearby workshop, another plant owner with more expertise, or a good technician. The expert you will try to call for help may be invited to visit the plant before it breaks down so he\* can familiarise himself with the machinery before it breaks down. The aim is that, when a problem arises, this person can be called upon to help assess the damage, identify causes, and help with some repairs. His experience may also be helpful for disassembling any parts of the plant that have to be transported to a proper workshop. In Nepal, many owners of MHP plants have developed expertise in repairing their own plants through trial and error over a long period of time. If possible, such persons may be engaged in the repair of other plants. It is necessary, however, to assess the capability of such people in advance through interaction and discussions as an unqualified or inexperienced technician may do considerable damage to the equipment and/or provide wrong advice.

### 6.1 Maintenance Check List and Schedule

Good and timely preventative maintenance will almost always help to reduce the number of breakdowns and increase the life and productivity of the equipment. Table 6.1 shows a check list and schedule for routine maintenance. Routine maintenance is also discussed in the manual on operation and management. It is helpful if the owner and operators receive good training and visit other plants that are being managed, operated, and maintained properly. In this way, they can learn good operational and management techniques.

In many cases, plants maintained and repaired by the owners and operators themselves are more successful economically and in their operation than those for which technicians for repairs have to come from other far away places. As far as possible, the major maintenance and repair work should be carried out at the site with the help of expert technicians when necessary, since this will save both time and money, including transportation costs. However, there are many components and types of damage that cannot be repaired at the site and have to be transported to a proper workshop facility.

\* Note: Throughout this manual the term 'he' is used to refer to the installer whether male or female.

**Table 6.1: Summary of Preventative Maintenance Checks (Maintenance Must be Carried out Immediately if any Significant Damage is Discovered)**

Item	Daily	Weekly	Monthly	Quarterly	Half yearly	Yearly
<b>Weir/Dam</b>						
Dam for debris			x			
Dam wall for cracks					x	
Dam silting up						x
<b>Intake Mouth</b>						
Free of debris	x					
Flow into intake not too slow or fast	x					
Sluice gate setting correct	x					
Water level at intake is sufficient	x					
Trash rack in good condition		x				
All concrete surfaces free of cracks					x	
No change in stream course causing change in flow						x
<b>Power Canal/Headrace</b>						
Foreign objects in channel	x					
Correct flow level in channel	x					
Leakage from channel	x					
Water diverted for irrigation, etc		x				
Footpath in good condition		x				
No leaks in pipe type headrace			x			
Flushing of pipe			x			
All channel surfaces sound and free of cracks				x		
Surface runoff drains not blocked				x		
Erosion under/around channel			x			
Danger of falling rocks damaging pipes					x	
Headrace not threatened by landslides					x	
<b>Desilting Basin and Forebay</b>						
Correct flow through desilting basin	x					
Forebay trash rack clear of debris	x					
Leakage	x					
Level of silt not above maximum		x				
Cracks in concrete surfaces				x		
Not threatened by landslides				x		
<b>Penstock</b>						
Leakage		x				
Expansion joints leaking/condition		x				
Anchor block movement/subsidence		x				



Table 6.1 Cont.....

Item	Daily	Weekly	Monthly	Quarterly	Half yearly	Yearly
Corrosion			x			
Anchor block cracking			x			
Erosion around anchor blocks			x			
Saddle support cracking			x			
Erosion around saddle supports			x			
Susceptibility to damage from falling objects				x		
Check bolts on all flanged joints				x		
Check retaining bolts on all saddle supports				x		
Check all weld joints for soundness					x	
Paint						x
Penstock route not threatened by landslides					x	
Powerhouse						
Any leaking valves	x					
Powerhouse clean	x					
Turbine bearings for vibration	x					
Turbine speed satisfactory	x					
No unusual noise from turbine	x					
Check coupling for vibration	x					
Generator output voltage satisfactory	x					
Check generator bearings for vibration	x					
Generator bearings not overheating	x					
Generator ventilation unobstructed	x					
Generator not overheating	x					
Generator environment clean and tidy	x					
Load controller functioning correctly	x					
All meters working satisfactorily	x					
Output frequency within limits	x					
Load on system within limits	x					
Phases balanced	x					
No blown fuses	x					
No overheating connectors or conductors	x					
Water flow to and out of ballast heater tank ok	x					
Any valve with operating difficulties	x					
Drive belt tension ok	x					
Drive belt condition ok	x					
Turbine/generator coupling wear ok			x			

Table 6.1 Cont.....

Item	Daily	Weekly	Monthly	Quarterly	Half yearly	Yearly
Inspect runner for damage				x		
Inspect runner for damage				x		
Coupling rubber and bolts ok			x			
Tightness of pulleys on shafts ok		x				
Inspect turbine shaft for straightness				x		
Inspect and grease turbine bearings				x		
Inspect turbine bearing seals			x			
Inspect and grease generator bearings				x		
Inspect generator bearing seals					x	
Check all casing and runner bolts for looseness				x		
Inspect tapered locking sleeves for bearings			x			
Inspect tapered adapter sleeves on shafts			x			
Check bolts on coupling to shaft sleeve					x	
Earthing satisfactory						x
Powerhouse not threatened by landslides						x
Tailrace						
Leaks from tailrace	x					
Foreign objects in channel	x					
All tailrace surfaces sound and free of cracks				x		
Check for erosion under/around tailrace					x	
Danger of falling rocks damaging tailrace					x	
Transmission & Distribution						
Insulators not damaged		x				
Overhead conductor tension ok			x			
Overhead conductor spacing ok			x			
Fencing around high voltage transformer ok			x			
Distribution switches, fuses, etc. ok				x		
No trees/bushes encroaching on conductors				x		
Poles in good condition				x		
Pole stay wire tension satisfactory				x		
Lightning arresters in good condition					x	
All earth plates and connections in good condition					x	

**Table 6.1 Cont.....**

Item	Daily	Weekly	Monthly	Quarterly	Half yearly	Yearly
No loose connections or hot joints					x	
Transformer casing clean					x	
Transformer silica gel ok					x	
Transformer switch gear clean					x	
Transmission line not threatened by landslides						x
Transformer oil level satisfactory						x
Transformer insulators clean and intact						x
20% of meters and cut outs checked and calibrated						x
Customer connections sound						x
Illegal connections checked wherever possible						x
General						
Spare parts available				x		
Tools in correct place and in good condition		x				
Meeting with consumers					x	

When components have to be replaced, the replacements should be of the same size and rating as the original and manufactured by a genuine factory. Less expensive or non-genuine components may not only break down more quickly, they may also cause damage to other more expensive parts.

It is always good practice to keep in stock some smaller items and items that need to be replaced more frequently such as bearings, belts, rectifiers, important panel meters, fuse wires/fuses, an MCB, bushes for the generator, nuts and bolts, packing and seals, conductors and cables, and insulators and lightning arresters. Adequate quantities of normal consumables, such as grease and kerosene, should also be kept in stock so that delays are avoided in procuring them when they are needed. A more comprehensive list of items to keep in stock is provided in the manual on management and operation.

Sometimes, equipment of various sizes needs to be transported to a workshop usually by porters. In such cases, care should be exercised when starting and stopping the journey and during transportation so that the items are not dropped, damaged, or lost. They should also be packed properly and covered to prevent damage by rain or other elements. Some ideas on ways of packing and transporting equipment are provided in the manual on installation.



Proper tools should be used for a given job; for example, pliers should not be used as a spanner or a hammer. Such practices can damage the tools and may cause serious damage to the equipment that is being repaired.

## 6.2 Suggested List of Tools to be Stocked at an MHP Plant

The following is a list of the tools that should be kept in stock to enable maintenance of an MHP scheme.

- Electrical
- Combination pliers
  - Needle nose pliers
  - Wire cutter
  - Flat head screwdriver set
  - Phillips head screwdriver set
  - Soldering iron and solder
  - Line tester and/or multimeter
  - Safety belt
  - Knife
  - Wire puller (for large electrification plants)

- Mechanical
- Hammer
  - Hacksaw
  - File set (flat, half round)
  - Open and ring spanner sets
  - Slide wrench (200 mm or 300 mm)
  - Pipe wrench (600 mm)
  - Steel rule
  - Grease gun
  - Metric Allen key set
  - Vice grip pliers
  - Bench vice
  - Bearing puller
  - Measuring tape
  - Blow lamp
  - Paint brush
  - Oil can
  - Spirit level
  - Wire brush
  - Emery paper

- Civil
- Pick
  - Spade

- Shovel
- Crow bar (lever)
- Trash rack cleaner
- Other tools related to civil works

Note: A torch or portable lamp is essential for working in the dark, both in the powerhouse and outside.

### 6.3 Maintenance of Tools

Good quality and reliable tools are essential in order to keep an MHP plant well maintained. The following rules will help keep tools in a good useable condition.

- Clean tools after use and return to storage area
- Apply lubrication if necessary
- Keep a record of tools
- Do not throw tools, handle with care
- Use tools as they are meant to be used
- Check condition of tools and do not use damaged tools
- Purchase new tools or repair old ones if tools are damaged
- Store hand tools on a board or in a cupboard
- Store measuring instruments (multimeter, vernier, etc) in a cupboard or a drawer to protect them from dust and impact