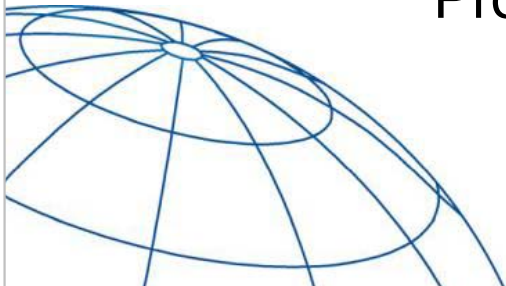


**Consulting Services for the
“Programme for the Promotion of Renewable Energies:
German-Armenian Renewable Energy Fund (GAF-RE)
Phase III”, BMZ ID 2012.7029.7**

**Small Hydropower Projects (SHPP)
Operation & Maintenance Organization,
Processes, Procedures, Manuals**

Yerevan, 28.06.2017



BMZ



Federal Ministry
for Economic Cooperation
and Development



CENTRAL BANK OF ARMENIA

KFW



CONSULTING & IT

ENERGY

ENVIRONMENT

WATER & INFRASTRUCTURE

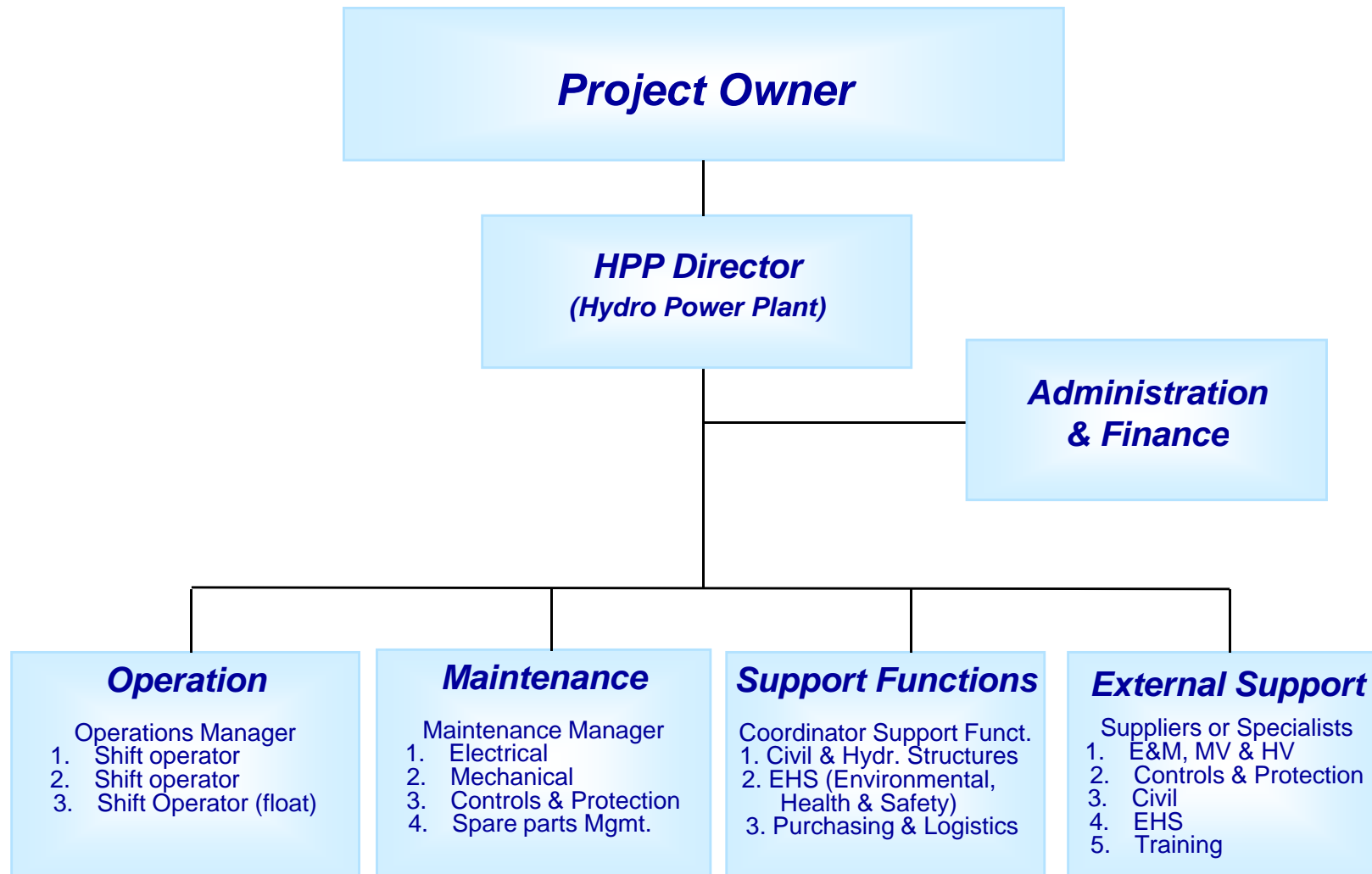
Operation & Maintenance Organization, Processes, Procedures, Manuals

Sarweystraße 3 70191 Stuttgart
P.O.Box 10 14 54 70013 Stuttgart
Phone: + 49 711 8995-0
Fax: + 49 711 8995-459
www.fichtner.de

Please contact: Fabian Knapp / Urs Gantenbein
Extension: 1575 / 769
E-mail: Fabian.Knapp@Fichtner.de /
 Urs.Gantenbein@Fichtner.de

Rev No.	Rev-date	Contents / amendments	Prepared / revised	Checked / released
0	28.06.2017	Final	Urs Gantenbein	Fabian Knapp
1				
2				

Operation & Maintenance Organisation (Typical)



Operation & Maintenance Management

The level / # of required operators and maintenance staff is heavily dependent on the degree and features of automation and (remote-) monitoring of the HPP, as well as of the quality and reliability of the installed systems and equipment

The # of required Management / Area-Responsibility positions / functions is heavily dependent on size, # of units and complexity of the HPP

The Owner / HPP Manager is responsible to plan, define and implement:

- Operations & Maintenance structure, organization, staffing level
- Selecting, hiring, training of the resources for the positions and tasks/activities as planned in the O&M organization chart ,as per planned operating regime
- Prepare and implement O&M plans, schedules, procedures, instructions, etc. for the specific systems and equipment in the HPP, on the basis of the O&M manuals from the Contractor / Manufacturer
- Staffing plan, including back up for vacation, sick periods, etc.

Operation Management – detail planning

The Operations Manager is responsible to plan, define and implement:

- Operators tasks and activities, including instructions procedures and reporting templates, etc. for normal operation & failure conditions

hourly, at each start/ stop / load change, daily, weekly, etc.

- definition of operational limits; normal exceptional; out of range, etc.
- processes and procedures for failure, break down and emergency situations
- reporting responsibility and priority in case of events / abnormal conditions, etc.

Maintenance Management – detail planning

The Maintenance Manager shall review with the Engineer and the EHS Manager the maintenance procedures supplied by the Contractor / Manufacturer, as well as the required plant specific lock-out procedures:

- in view of safety for staff and systems
- completeness and applicability of the procedure within the integrated HPP
- request additional details from the Contractor / E&M Supplier
- prepare, complete & correct instructions, procedures, templates, etc. as needed, with design, reference, bench mark values, e.g. from commissioning reports, etc.
- Note: System or E&M suppliers do many times not have sufficient experience or understanding of the HPP environment, maintenance conditions & requirements
-

The Maintenance Manager is responsible to plan, define and implement:

- periodic / routine Maintenance tasks and activities, including instructions, procedures and reporting templates, etc.;
daily, weekly, monthly, yearly, etc.
- processes and procedures for failure, break down and emergency situations

Operation & Maintenance Management – detail planning

The O&M Managers shall define and coordinate between themselves which readings, measurements, and checks the operators shall perform and report periodically in support of the maintenance tasks

The Maintenance Manager shall coordinate with the Coordinator of Support functions – Purchasing (approval by HPP Manager)

The ordering of materials, parts, and equipment, etc.


Replacement of spare parts that have been used, and replacement for parts which have been identified as being faulty / defective, etc.

Examples of Maintenance Instructions

SISIAN	0608/MVE/AM/0215
Maintenance plan (for details please refer to the manual)	

	Activity	Consumable	Amount	Interval
Turbine	Bearings lubrication	NLGI 2	2x30 g	720 h
	Check of corrosion protection			4 300 h
	Removing the old grease from bearing housing			8 700 h
	Protection of unpainted metal parts	Resistin ML	As required	720 h
Hydraulic system	Oil change	Hydraulic mineral oil ISO VG 32	40 litres	17 500 h
	Oil filter change	Filter element	1 piece	17500 h
	Periodic check of oil filter			720 h
	Visual check of leakages			2000 h
Gearbox	First oil change	PaO ISO VG-320	420 litres	400 h
	Subsequent oil change			20 000 h
	Periodic check of oil filter			720 h
Valve actuator	Bearing lubrication	NLGI 2	3 g	8 700 h
Generator	Refiling lubrication unit	NLGI 3	500 g	7 200 h
Complete hydroelectric generating set	Inspection			24 h
Complete electric equipment	Check of temperature conditions			2 160 h
	Check of cable connections			4 300 h
	General checking			4 300 h

Examples of Maintenance Instructions continued

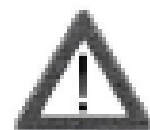
	DOC. No.: IDM 1		Internal Job No.: GENERAL DOCUMENT	
	Rev.: 00	Date: APRIL 2008.	Page: 11 / 16	
	Document type: STANDARD IDM – V3-06			



WARNING!

The valve must be approximately at ambient temperature before commencing maintenance, otherwise there is a danger of injury upon contact.

7.2 Seal Replacement



WARNING!

Before commencing work on pressurised valve components, complete occupational safety must be guaranteed. The valve must be removed from the pipe.



WARNING!

The valve must be approximately at ambient temperature before commencing maintenance, otherwise there is a danger of injury upon contact.

Examples of Maintenance Instructions continued

Where this replacement becomes necessary for a valve, the valve must be removed from the pipe and cleaned thoroughly. Move the disc (2000) into the fully open position to create optimum working space.

The grub screws (4050) can now be loosened removed from the joints of the retaining ring (4000) to remove the retaining ring (4000)

The seal (4010) can then be removed. Clean the sealing area of the valve body (1000) and disc(2000), and the retaining ring (4000)

For assembly, position the disc into medium position and place the valve on a suitable surface to avoid damaging the sealing face of the valve body flange.

Insert the seal (4010) as per the original configuration. Screw the bolts (4030) into the segments of the retaining ring (4000) and place them into the groove intended for this purpose. We recommend aligning the small part of the retaining ring so that it comes to rest at the bottom. The grub screws (4050) are then to be slightly pre-tightened evenly. After visual checking of the sealing area the grub screws (4050) are to be tightened evenly from opposing sides.

The valve can now be opened slightly and re-closed. After completion of these tasks the visual setting is to be checked using a seat pressure check. After successful checking, the grub screws (4050) are tightened and secured by the centre punch to secure the retaining ring in the chosen position.

Examples of Maintenance Instructions continued

3.1.1 Periodic maintenance

CAUTION: The control system of the dispenser is composed of moving parts. Therefore it is dangerous to do any kind of maintenance while the group is operating.

Object	Check	Action
Metal structures	Periodic check of the painting of the components	Provide any adjustments. (see technical specification par. 1.3)
	Periodic check of the tightness of the bolts	
Self-lubricating bushes	Periodic check of clearance between the pin and bushing	Periodic lubrication. Replacement in case of excessive wear
Hydraulic cylinder	Periodic check of internal leakage	Replace the seals if it's necessary

Object	Check	Action
Hydraulic piping	See the chapter about the hydraulic power pack	
Clearance between the guide vanes and head + bottom cover	Annual verification of clearance between the guide vanes and head + bottom cover	Restore the clearance
Clearance between guide vanes	Annual verification of clearance between the guide vanes	Disassembly the distributor and the remake the clearances
Draft tube diffuser	check any cavitations damage	Filling material by welding, may provide air injection

HPP Portfolio

- 31 (+9) Turbines at 11 (+2) SHPPs funded through the GAF-RE Programme
- 6 Turbine types (Pelton, Francis, Turgo, Crossflow, S-Turbine, Propeller)
- Armenian, Russian and European Turbine Manufacturers
- Visible range in difference of quality



HPP Portfolio – Francis

Francis Turbines



Francis Turbine : Local Production



Francis Turbine: European Production

HPP Portfolio – Pelton

Pelton / Turgo Turbines



Turgo Turbine : Local Production



Pelton Turbine: European Production

Thank you for your Attention!



Examples of Maintenance Instructions

