Instrumentation, installation, operations and maintenance issues

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Typical station design

<table>
<thead>
<tr>
<th>Component</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logger with display</td>
<td></td>
</tr>
<tr>
<td>Sensors</td>
<td></td>
</tr>
<tr>
<td>Staff gauges (x elements)</td>
<td></td>
</tr>
<tr>
<td>Water level</td>
<td></td>
</tr>
<tr>
<td>Rain Gauge</td>
<td></td>
</tr>
<tr>
<td>Accessories</td>
<td></td>
</tr>
<tr>
<td>Housing (enclosure)</td>
<td></td>
</tr>
<tr>
<td>Power supply (battery,</td>
<td></td>
</tr>
<tr>
<td>solar panel, regulator)</td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td></td>
</tr>
<tr>
<td>Modem GSM/GPRS</td>
<td></td>
</tr>
<tr>
<td>Cable and antenna</td>
<td></td>
</tr>
</tbody>
</table>
Criteria for Site selection

• **A** for Accessibility
• **S** for Sensibility of section
• **S** for Stability of section
• **U** for Use (purpose)
• **M** for Maintenance
• **E** for Equipment (type)
• **S** for Security

And ASSUME your work
Basic equipment:

Staff Gauges:
- Installed along a section of the river
- One gauge starts where the other ends
- They are referenced to a TBM or a survey pillar
- AND AN OBSERVER
Measuring water level: types of sensor

- Float type gauge
- Radar gauge
- Pressure sensor
- Bubble system
# Water level sensors: summary

<table>
<thead>
<tr>
<th></th>
<th>Precision</th>
<th>Influence by fatigue</th>
<th>Robustness</th>
<th>Installation</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shaft encoder with float</strong></td>
<td>A few mm</td>
<td>no</td>
<td>Robust</td>
<td>Tedious and costly (civil engineering works)</td>
<td>~600 €</td>
</tr>
<tr>
<td><strong>Hydrostatic pressure sensors</strong></td>
<td>A few mm</td>
<td>yes</td>
<td>Sensitive to scaling and exposure (ephemeral rivers)</td>
<td>Simple</td>
<td>500 € – 4000 €</td>
</tr>
<tr>
<td><strong>Bubble in sensors</strong></td>
<td>A few mm</td>
<td>yes</td>
<td>Sensitive to scaling</td>
<td>Simple</td>
<td>~1000 €</td>
</tr>
<tr>
<td><strong>Ultra-sonic sensors</strong></td>
<td>A few mm</td>
<td>no</td>
<td></td>
<td>Simple</td>
<td>&gt; 10 000 €</td>
</tr>
<tr>
<td><strong>Radar sensors</strong></td>
<td>A few mm</td>
<td>no</td>
<td></td>
<td></td>
<td>1500 €</td>
</tr>
</tbody>
</table>
Bubble systems: 30 years evolution
Data acquisition and recording

• Data logger:
  – Memory for data storage
  – Programming of sensors:
    • For data recording at predetermined time intervals
    • For data recording as a function of water level

• Number of sensors connected
• Memory: up to several Mb (several months of autonomy)
• Independent of the sensor
• SDI-12 for sensor connection (low power consumption)
Station file and LOG BOOK

It consists of the following elements:

• Description of the station (name, code, coordinates, …)
• Objectives of the station
• Equipment installed at the station
• Topographic survey of the station
  • Longitudinal profile
  • Cross sectional profile
  • Staff gauges attached to a benchmark
• Management of the station
  • Reports of station visits
  • History of repair works
  • Changes in gauge reader, …
• Rating curves and flow measurements carried out
• …
### Description de la station

<table>
<thead>
<tr>
<th>Nom de la station</th>
<th>Gonsé</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code OMM</td>
<td>193520</td>
</tr>
<tr>
<td>Cours d'eau</td>
<td>Massili</td>
</tr>
<tr>
<td>Bassin (Nakambé / Mouhour / Nazinon / Oti)</td>
<td>Nakambé</td>
</tr>
<tr>
<td>Pays</td>
<td>Burkina Faso</td>
</tr>
<tr>
<td>Superficie bassin versant</td>
<td>12°28' N 01°19' W</td>
</tr>
<tr>
<td>Date de mise en service</td>
<td>06-mai-75</td>
</tr>
<tr>
<td>Gestionnaire (Brigade régionale ou nationale)</td>
<td>DGRE (Ouagadougou)</td>
</tr>
<tr>
<td>Accessibilité de la station</td>
<td>Bonne</td>
</tr>
</tbody>
</table>

### Objectif de la station

- Contrôle des débits déversés par les barrages de Lumbila et de Ouagadougou n°3 (qui servent pour l’AEP de Ouagadougou)
- Station exploitée par le réseau OMS - Onchocercose jusqu’en 1992

### Données morphologiques du site

<table>
<thead>
<tr>
<th>Caractéristique</th>
<th>Valeur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largeur du cours d'eau à l'été</td>
<td>3 m</td>
</tr>
<tr>
<td>Largeur du cours d'eau en crue</td>
<td>150 m</td>
</tr>
<tr>
<td>Prof moyenne</td>
<td>2 m</td>
</tr>
<tr>
<td>Prof maximale</td>
<td>4 m</td>
</tr>
</tbody>
</table>

#### Profil en travers et en large

- Contrôle des débits diversifiés par les barrages de Lumbila et de Ouagadougou n°3 (qui servent pour l’AEP de Ouagadougou)
- Station exploitée par le réseau OMS - Onchocercose jusqu’en 1992

### Capteur limnique

- Existant | Oui |
- Type | OTT X |
- State | OK |
- Capteur limnique | OK |
- Gaine | OK |
- Date d’installation | 06/05/1975 |
- Autre type de capteur limnique | Non |

### Observateur

- Présence d’un observateur | Oui |
- Nom | Village |
- Téléphone | 

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**Ex : Gonsé station file (Massili, White Volta Basin - Burkina Faso)**
Design of installation

Mekong River at Vientiane Km 4

Works to be planed:

- Stairs to be build with new staff gauge,
- Housing to build at the location of the former raingauge, bottom at 1,5 meters,
- Sensor (concrete for the outlet), pipe (35 m)
- Install rain gauge on the roof of the housing,
- Install solar panel and GSM antenna on the roof,
- Benchmark destroyed, make a new one
- Electrical ground connection
Commissioning of installation

To ensure that the completed installation is inspected, ‘set to work’, tested, adjusted and configured, and equipment is working in accordance with the design specification and provide the conditions intended by the project.

It will also demonstrate that the installed equipment complies with the design intent, as outlined in the design specification.
Operating the station

➢ To have a station working properly, it is important to respect some basic rules:

- Concern cleaning (solar panel, inside, etc.);
- Concern equipment;
- Concern logbook;
- Observer involved.
Operating the station

- Use Standard (or Simplified) Operational Procedures (SOP)

- To avoid mistakes and misuses by local observers and technicians (lessons learned from projects);

- To ensure a good survey and monitoring of the station and the equipment;

- To prevent degradation and reduce operational costs.
Operating the station

- **2 kinds of SOP according to the users:**
  - Observer of the station,
  - Technician staffs of Line Agencies.

- **Limited number of SOPs:**
  - At the moment, 10 SOPs are available;
  - 2 or 3 pages per SOP, with photos;
  - In national language.
## Annual running costs

<table>
<thead>
<tr>
<th>Topic</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observer</td>
<td>300 - 500</td>
</tr>
<tr>
<td>Transmission (GPRS)</td>
<td>150 - 300</td>
</tr>
<tr>
<td>Visits (4/Year), including salaries, per diem, gasoline...</td>
<td>1000 - 1300</td>
</tr>
<tr>
<td>Spare parts (% of investment)</td>
<td>500 - 700</td>
</tr>
<tr>
<td>Total</td>
<td>2000 - 2800</td>
</tr>
</tbody>
</table>
**Maintenance**

The primary goal of maintenance is to avoid or mitigate the consequences of failure of equipment.

Two types of maintenance:
- Corrective maintenance, or "repair," is conducted to get equipment working again.
- Preventive maintenance is conducted to keep equipment working and/or extend the life of the equipment.

**PLAN YOUR REGULAR VISIT**
Maintaining the station

A global cleaning is necessary around the station (housing especially) to give a secure and good access to the house and the staff gauges.
Maintaining the station

• Clean the solar panel once a week;
• Inside the house, clean regularly (remove dust, insects...);
• Clean rain gauge, staff gauges...
Maintaining the station

- Clean the staff gauges once a month to remove algae and mud;
- Open a logbook to note any intervention within the station (visit, setup modification, adjustment of initial values…).
- Logbook is very often missing !!!
Cleaning !!!!

Kwando River at Kongola,
SADC HYCOS

Niger River at Ke Macina,
NIGER HYCOS
Some interesting problems!!!
**Maintenance**

Preventive maintenance activities include partial or complete overhauls at specified periods.

The ideal preventive maintenance program would prevent all equipment failure before it occurs.

This requires adequate training, both technical and organizational, and a commitment to a sustainable operation.

Costing calculations are in almost all cases necessary.
Issue

• According to project’s managers, the main concerns are related to the operation and maintenance of the stations.

• It should be noted that very often the countries sometimes wrongly perceived them as the property of the Basin Organization.

• DON’T USE BUDGETS PER PROJECT, THINK GLOBAL
Some elements of NMHSs O&M on the national level

Harmonization of equipment:
• Reduce the costs of spare parts;
• Facilitate the maintenance
• Training is easier

Develop a plan for replacement
Way to standardization
Operation and Maintenance

Operation and maintenance activities rarely encompass only technical issues: managerial, social, financial, and institutional issues also play roles in advancing infrastructure sustainability.

- Plan your visits;
- Respect the SOPs;
- Train the observers;
- Common sense
CAPACITY BUILDING

• Invest in training of station observers and technicians: They are the backbone of the entire system!

• Provide incentives (other than salaries) for technicians and station observers to motivate them to deliver first-class services
THANK YOU