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HOW TO START MANUFACTURING OF
EQUIPMENT FOR SMALL HYDRO POWER PLANTS
IN DEVELOPING COUNTRIES*

by

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# TABLE OF CONTENTS

1. **INTRODUCTION**
   1.1 Water resources development needs
   1.2 Hydroelectric machines and equipment for small (and mini-) hydro power plants
   1.3 Local supply capabilities

2. **LOGISTICS OF DECISION-MAKING**
   2.1 Analysis of local manufacturing capacities and techniques
   2.2 Design analyses
   2.3 Main steps of decision-making

3. **PRODUCT DEVELOPMENT AND PRODUCTION PLANNING**
   3.1 Adaptation of designs to local needs
   3.2 Experimental models, prototypes, production planning
   3.3 Start-up of manufacturing

4. **ROLE OF GOVERNMENT AGENCIES**

5. **PROGRAMMING OF DEVELOPMENT WORK**

---

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION</td>
<td>2</td>
</tr>
<tr>
<td>1.1 Water resources development needs</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Hydroelectric machines and equipment for small (and mini-) hydro power plants</td>
<td>2</td>
</tr>
<tr>
<td>1.3 Local supply capabilities</td>
<td>3</td>
</tr>
<tr>
<td>2. LOGISTICS OF DECISION-MAKING</td>
<td>4</td>
</tr>
<tr>
<td>2.1 Analysis of local manufacturing capacities and techniques</td>
<td>4</td>
</tr>
<tr>
<td>2.2 Design analyses</td>
<td>4</td>
</tr>
<tr>
<td>2.3 Main steps of decision-making</td>
<td>5</td>
</tr>
<tr>
<td>3. PRODUCT DEVELOPMENT AND PRODUCTION PLANNING</td>
<td>5</td>
</tr>
<tr>
<td>3.1 Adaptation of designs to local needs</td>
<td>5</td>
</tr>
<tr>
<td>3.2 Experimental models, prototypes, production planning</td>
<td>6</td>
</tr>
<tr>
<td>3.3 Start-up of manufacturing</td>
<td>6</td>
</tr>
<tr>
<td>4. ROLE OF GOVERNMENT AGENCIES</td>
<td>7</td>
</tr>
<tr>
<td>5. PROGRAMMING OF DEVELOPMENT WORK</td>
<td>7</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

1.1 WATER RESOURCES DEVELOPMENT NEEDS

The development and utilization of water resources is central to the health and well-being of all people. Successful development of a nation's water resources also can contribute to the availability of low cost energy and improve the living conditions of the rural population far away from urban centres.

As a small country, Austria offers an interesting example: hydropower actually supplies 70 per cent of its electricity consumption. About 1,306 small hydropower plants (capacity of less than 5 MW) are operated in Austria with a capacity of 370 MW. This corresponds to an energy production of about 2000 GWh/a.

The hydropower potential of 44 domestic river systems is summarized in the Austrian Hydropower Register (Wasserkraftkataster). As of December 31, 1978, the exploitable potential is assessed to be 49,246 GWh/a for a standard year. By 1995, the facilities already in operation and those still under construction or in design will use 85 p.c. of the exploitable hydropower potential.

In Austria present research concentrates on three main areas: small-scale hydroenergy potential assessment, improvements to existing plants, development of hydropower technology.

1.2 HYDROELECTRIC MACHINES AND EQUIPMENT FOR SMALL (AND MINI-) HYDROPPOWER PLANTS

The correct assessment of water resources and the proper planning of their utilization largely determine the economic benefits to be expected. As regards hydropower, the appropriate selection of the turbines, generators and related equipment is of crucial importance: the level of energy generation depends on their performance, reliability, durability, the easiness of repair and maintenance.
The long-term nature of hydro-power plants and projects, the growing attention paid to the better use of small hydroenergy potential, the care to make the most appropriate choice of well adapted designs of machinery and equipment lead to the logical question asked by some countries: should they buy such equipment also in the future from outside or should they develop their own capabilities for design and manufacturing?

1.3 Local supply capabilities

The question of creating local supply capabilities might be raised at the national level by government agencies, ministries in charge of water resource development programmes. Master development plans may indicate small hydropower potentials and their exploitation up to 1990-95. Joint planning and implementation efforts by several countries may create demand for water management technologies that could encourage appropriate developments on the supply side as well.

The initiative may also come from the manufacturing industry itself. Design and engineering institutions, manufacturing companies may wish to assess the market potential of small hydropower equipment.

The question posed needs careful examination by both sides - particularly in view of the fact that they are

Potential partners in manufacturing equipment for small hydropower plants as

HYDROPOWER DEVELOPERS
in need of equipment with good performance characteristics at reasonable investment costs.

MANUFACTURERS
looking for product lines with appropriate development potential: ensuring the economic use of their manpower and investment potential.
One can and should anticipate some learning (trial and error) period necessary on both sides. Appropriate preparatory work and planning may limit, however, the losses and help avoid failures.

2. LOGISTICS OF DECISION-MAKING

2.1 ANALYSIS OF LOCAL MANUFACTURING CAPACITIES AND TECHNIQUES

A selected team of local engineers and manufacturing staff assisted by foreign experts studies the local workshops, foundries etc. with regard to technical characteristics and performance.

The analysis will be complemented by a report on manufacturing processes and facilities required for the fabrication of hydropower equipment.

Having in mind a given demand for equipment, the studies will help in answering the general questions like

"What can be manufactured locally?"

"How should local production capacities be improved and expanded?"

2.2 DESIGN ANALYSES

The selected equipment should be adapted to the specific operational conditions of the anticipated sites as well as to the production facilities of the manufacturing company. Some of the questions to be examined during the review and development of the equipment design:

"What operational conditions are to be considered?"

"How sturdy the equipment must be designed to remain in good operating conditions in view of existing and expected maintenance capacities?"

"How good are the maintenance capacities?"

"How to adapt the equipment design to local conditions?"
2.3 MAIN STEPS OF DECISION-MAKING

The studies and analyses indicated above may lead to the specification of the following measures:
- Selection of equipment for local design and manufacturing
- Tentative assessment of the demand in view of types of machinery and the quantities required in a period of about 10 years
- Alterations on the design of all items to be manufactured locally to meet
  a) manufacturing capacities
  b) operation and maintenance capacities
- Training of personnel
  a) for manufacturing
  b) for operation and maintenance
- Upgrading of workshops and foundries
- Economic considerations

3. PRODUCT DEVELOPMENT AND PRODUCTION PLANNING

3.1 ADAPTATION OF DESIGNS TO LOCAL NEEDS

After the decision is made about the equipment to be manufactured locally, a complete set of shopdrawings and related design computations needs to be purchased. For each mechanical item a detail review will be made in order to facilitate manufacturing, ensure durability and easy maintenance.

The discussions should also lead to the transfer of know-how, to the better understanding of the various technical solutions based on experience as well as on theoretical considerations.

Some of the questions to be discussed:
"Why is this item designed this way?"
"How can it be better adjusted to our purpose?"
"Can it be made simpler without losing critical margins of efficiency?"
The efforts should result in a rather uncomplicated piece of equipment which can be produced with a minimum of problems. At the beginning, the efficiency of the equipment might be comparatively low. Improvements can be certainly achieved by continuous research.

3.2 EXPERIMENTAL MODELS, PROTOTYPES, PRODUCTION PLANNING

The model development will be carried out simultaneously with its adaptation to local manufacturing conditions. Any step in design will be complemented and supported by adequate choice of material, preparation of special tools, manufacturing of one-on-one scale models for proper interpretation of difficulties occurring during the production. Exact research will result in proper instructions and local manufacturing specifications.

After assembly of all items, the equipment will be tested for proper functioning in the workshop and during operation under full load.

Continuous improvements on the equipment will finally guarantee satisfying results.

3.3 START-UP OF MANUFACTURING

The fabrication can start only after the completion of design adaptations and the up-grading of the production facilities. Since some difficulties can still be expected, both the design engineers and the research team will directly control the manufacturing process in the initial period.

During this stage the qualification of personnel will be improved by intensive training and the final adjustments on the production machinery will be carried out.
The criteria for quality control are to be determined by the team of
engineers and research specialists. The system should be firmly estab-
lished in production and assembly.

4. ROLE OF GOVERNMENT AGENCIES

The development of hydropower and of related manufacturing industries
have a special role to play in the economy of any country. The logistical
planning, controlling and financial support on the part of the responsi-
sible government agencies seems to be necessary to achieve the results
along the lines indicated above.

5. PROGRAMMING OF DEVELOPMENT WORK

5.1 SELECTION AND DEFINITION OF PARTS AND PRODUCTS:

Stoplogs
Trashracks
Screens
Gates
Steel Liner
Turbines
Others....

5.2 PROGRESSIVE STAGES OF DEVELOPMENT

<table>
<thead>
<tr>
<th></th>
<th>Definition of goals:</th>
<th>1st DECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1st DECISION</td>
<td></td>
</tr>
<tr>
<td>0 - 1</td>
<td>Studying local manufacturing capacities</td>
<td></td>
</tr>
<tr>
<td>0 - 2</td>
<td>Defining the required manufacturing techniques</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Selection of parts and products for local production: 2nd DECISION</td>
<td></td>
</tr>
</tbody>
</table>
Development of local design
Research on product
Training of personnel for manufacturing
Upgrading of existing manufacturing capacities
Specifications and detail design for local manufacturing
Start-up of local manufacturing: 3rd DECISION

These stages are presented in Figure 1.
### A. OBJECTIVES FOR COUNTRY/REGION

1. **GENERAL**
   - Water Resources Development:
     - needs
     - reconnaissance
     - programme
     - studies
     - feasibility
     - detail design
     - procurement of equipment
     - implementation of works
     - management of plant and system

2. **PROCUREMENT**
   - Equipment for small hydro-power plants:

   2.1 Assessment of the demand

   2.2 Initiatives to create local supply facilities

### B. PROGRESSIVE STAGES OF DEVELOPMENT

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Policy considerations</td>
<td>Techno-economic decision making</td>
<td>Product and design development and production planning</td>
<td>Economic considerations</td>
</tr>
<tr>
<td></td>
<td>Definition of goals</td>
<td></td>
<td></td>
<td>Start-up of manufacturing</td>
</tr>
</tbody>
</table>

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**FIGURE 1**

EQUIPMENT FOR SMALL HYDRO POWER PLANTS:
THE LOGISTICS OF CREATING LOCAL SUPPLY FACILITIES