Introduction to the book series

HYDROPOWER DEVELOPMENT

by

Professor Ånund Killingtveit, NTNU, Norway
The Norwegian University of Science and Technology (NTNU), Department of Hydraulic and Environmental Engineering, has recently finalized a more than 10-year long project with the objective of covering the total sphere of topics of hydropower development.

The result is a book series consisting of 17 volumes. Both Norwegian and International experience from more than a hundred years of hydropower development is presented here.
Each volume deals with a separate topic.

The necessary theoretical foundation of each topic is set out and followed by a description of how this is applied in practice.

Most of the content in each volume has not been published before. This means that when planning a complete course in hydropower engineering, this series can act as a supplement to conventional textbooks.
A total of close to 50 persons have contributed to the series, all of them with long experience in Hydropower development both in Norway and internationally.

This series represents the most complete and most updated reference to hydropower development today, with contents ranging from important theoretical topics to planning, construction, operation and maintenance of both large and small hydropower projects.

Numerous examples from successful projects are included.
Hydropower in Norway – some facts

1885 – first hydropower plant opened in Skien

1891 – First municipal hydropower plant in Hammerfest

1920 – All towns and 64% of Norway’s population served with electricity

Today

- Electricity consumption is >120 TWh
- Average annual production 118 TWh
- 740 large hydropower plants
- >99% of power produced from hydro

> 100 years of experience in hydropower development
Hydropower in Norway – brief overview

Source: EIA, Annual Energy Review 1997, July 1998, Table 11.15
Hydropower planning, design, operation and maintenance have a history of more than 100 years in Norway, and a vast amount of experience have accumulated at power companies, consultants and at research institutions. Not all of this knowledge have been properly documented before. Around 1990 it was decided to start the documentation work and 17 volumes in all were planned. Today this job is finished, and the complete book series is for the first time presented at this conference.
A brief description of each volume
Contents:

• Introduction – Hydropower in Norway
• The country
• The resource base
• Early development
• Coming of age (1900-1940)
• Recent years (1945-)
• Institutional framework
• Norwegian hydropower engineering
• Status: Hydro power and other energy
• Epilogue: Energy for the future
Contents:

- Characteristics of hydropower plants
- Characteristics of thermal plants
- Demand profiles
- System considerations
- Mathematical modelling of a hydropower system
- Hydro-thermal coordination
- Optimization of system expansion planning
- Production planning
- Pumped storage in a thermal system
- Power exchange across borders
Contents:

• EIA-procedures and their implementation
• The different dimensions of hydropower projects
• Environmental issues and relationships
• Application of environmental considerations on hydropower projects
• Valuation of economic aspects
Contents:

- Watercourses and conservation
- Type of power plants
- Licences
- Landscape architecture
- Building activity
  - Regulation works
  - Buildings
  - Landscaping
- Flora and fauna
- Past - present - future
Contents:

- Investigations
  - Resources
  - Hydropower projects
- Planning
  - The hydropower dev. cycle
  - Reconnaissance studies
  - Prefeasibility studies
  - Feasibility studies
- Implementation
  - Engineering
  - Construction and supply
- Operation
Contents:

- Development objectives
- Costs and benefits
- Economic parameters
- Project appraisal
- Economic analysis
- Valuation of output
- Financial analysis
- Financial strategies
- Performance parameters
- Rehabilitation
- Marginal costing
- Electricity tariffs
- Socio-Economic analysis
- Economic linkages
Contents:

- Streamflow measurements
- Hydrology of snow and ice
- Automatic data acquisition systems
- Data processing, storage and retrieval
- Hydrological models
- Runoff forecasting
- Design floods
- Maximum probable floods
- Operation simulation in hydropower planning
- River system simulator
Contents:

- Hydraulic design in hydropower
- Theory of hydraulic design
- Design strategies for hydraulic structures
- Headworks and intakes
- Spillways and outlets
- Energy dissipation structures
- Penstocks and conduits
- Tunnel and shaft waterways
- Sediment transport
- Sediment handling
- Hydraulic models
Contents:

- Properties of rock and rock masses
- Rock stresses
- Groundwater in rock masses
- Engineering geological investigations
- Rock mass classification
- Design approach of underground openings
- Drill and blast tunnels
- TBM-tunnels
- Support and lining
- Improved and cost saving solutions
Contents:

- Dam site requirements
- Material source requirements
- Properties of compacted materials
- Loads arising from water and wind
- Embankment deformations and displacement
- Design and analysis
- Construction and control procedures
- Instrumentation and performance monitoring
- Summary of experience and views
Contents:

- The constituents of concrete
- Fresh concrete – Criteria for mix design
- Curing
- The hardened concrete - Requirements and properties
- Reinforcement
- Concrete in dams
- Concrete in waterways
- Concrete in powerhouses
- Quality assurance
- Damage and repair
- Seven case histories
Contents:

• Theory of hydraulic turbines
• Selection of turbine types
• Francis turbines
• Pelton turbines
• Kaplan turbines
• Bulb turbines
• Efficiency measurements
• Regulators and load control
• Valves and gates
• Auxiliary equipment
Contents:

- Power frequency electromagnetism
- Hydropower generators
- Transformers in hydropower plants
- Power house arrangements
- High voltage switchgear
- High voltage cables
- Earthing systems
- Control equipment
- Telecommunication systems
- Auxiliary systems
- Documentation, testing, quality assurance
Contents:

- The functions of the powerhouse complex
- The powerhouse complex
- High pressure tunnels and shafts
- Geotechnical investigations and design principles
Contents:

- Construction management overview
  - The project life cycle
  - Organisational concepts
  - Establishing the project framework
- The project parties
  - The owner
  - The engineer
  - The designer
  - The supplier
  - The contractor
- Scheduling and construction follow up
- Contracts
- Disputes and dispute resolution
Contents:

• General aspects
• Transmission and distribution systems planning
  ✓ Planning objectives
  ✓ The planning process
• Design philosophy of overhead lines
  ✓ Brief historical review
  ✓ Standards
• Right of way planning, licence and compensation
• Engineering
• Operation maintenance, overhead line rehabilitation and restructuring
Contents:

- Development trends within the maintenance of power plants
- Visions, goals and strategies
  - Goal oriented maintenance
  - Target values and indicators
- Basic framework considerations for the maintenance function
  - External conditions
  - Internal framework conditions
- Economic impact of the maintenance function
- A model for maintenance
- Planning, organization, management
- Considerations on life cycles
- Decision support systems & methods
SALES AND DISTRIBUTION

- The books are generally sold only in complete sets of 17 volumes.
- The price is USD 700 for each set, plus mailing and distribution.
- Those who have already bought some of the volumes may order individual volumes to complete their sets.
- The price for individual volumes is USD 70 each.

To order please contact:
Norwegian University of Science and Technology (NTNU)
Department of Hydraulic and Environmental Engineering
Attn: Hilbjørg Sandvik
N-7491 Trondheim, Norway

Orders can also be placed by E-mail to: hilbjorg.sandvik@bygg.ntnu.no
FREE COPIES

- Norwegian Agency for Development Cooperation (NORAD) and Norwegian Water Resources and Energy Directorate (NVE) have sponsored the project and a number of sets has been earmarked for free distribution to selected institutions like universities, public libraries, etc in developing countries.

- In order to receive free copies please send an application to the address given, describing the purpose of use and the number of sets needed.

- The selection of institutions qualified for free sets will be decided by representatives from NTNU, NVE and NORAD.