CONTENTS

Preface xi
Acknowledgments xv

1 Historical Development 1

2 Tidal Phenomenon 7
   2.1 Introduction 7
   2.2 Ocean Tides 8
   2.3 Types of Tides 9
   2.4 Propagation of Tides in Estuaries 12
   2.5 Coriolis Effect 13
   2.6 Barrage Effects 13

3 Tidal Power Potential and Site Selection 15
   3.1 Hydroelectric Versus Tidal-Electric Developments 15
   3.2 Site Potential Estimation 17
   3.3 Coefficient of the Tide 19
   3.4 Major Factors Influencing Project Economics 20
   3.5 Site Selection 20
4 Management and Organization of Investigations 25
  4.1 Management 25
  4.2 Organization 28
  4.3 Feasibility Studies 29

5 Tidal Power Schemes and Modes of Operation 35
  5.1 Single-Basin Development, Single-Effect Mode of Operation 35
  5.2 Single-Basin Development, Double-Effect Mode of Operation 38
  5.3 Pumping to Augment Tidal-Effect 40
  5.4 Linked-Basin Developments 42
  5.5 Paired-Basin Developments 45
  5.6 Retiming of Tidal Energy 45

6 Basic Data 47
  6.1 Introduction 47
  6.2 General Physiography of the Estuary 48
  6.3 Geology 49
  6.4 Tides 50
  6.5 Waves 54
  6.6 Tidal Currents 54
  6.7 Suspended and Mobile Sediments 55
  6.8 Ecosystem Characteristics 58

7 Hydraulic and Numerical Models in Feasibility Investigations 59
  7.1 Introduction 59
  7.2 Hydraulic Models 60
  7.3 Numerical Models for Estuaries 62
  7.4 Hybrid Models 67
  7.5 Modeling of Barrier Effects 67
  7.6 Mathematical Model for Closure Activities 69
  7.7 Utility System Planning and Simulation 69

8 Civil Works for Tidal Power Development 71
  8.1 Introduction 71
  8.2 Dry Versus Wet Construction 72
  8.3 Design Parameters 77
## CONTENTS

8.4 Caisson Design 80
8.5 Dikes 87
8.6 Construction Schedules 95

### 9 Electromechanical Equipment for a Tidal Plant 97

9.1 Introduction 97
9.2 Specific Requirements for Tidal Generating Equipment 98
9.3 Types of Turbines 99
9.4 Generators 113
9.5 Electrical Equipment 114
9.6 Transmission 115

### 10 Optimization of Plant Output 117

10.1 Principal Variables 117
10.2 Energy Production and Optimization 118
10.3 Simulation of Operation 120
10.4 Development of Models 121
10.5 Plant Optimization 124

### 11 Integration of Output with Electric Utility Systems 129

11.1 Introduction 129
11.2 Absorption of Raw Tidal Energy 132
11.3 Enhancing Raw Tidal Energy Output 137
11.4 System Considerations 141

### 12 Economic Evaluation 149

12.1 Introduction 149
12.2 Economic Cost Parameters 152
12.3 Economic Analysis 153
12.4 Sensitivity Analysis 155
12.5 Risk Assessment 157

### 13 Social and Regional Impacts 159

### 14 Environmental Aspects 165

14.1 Unique Effects 167
14.2 Agricultural Aspects 174
14.3 Floods and Drainage 175
14.4 Birds 176