APPENDIX U

INDEX

Figures are on page numbers that are underlined

Adverse Water Conditions, S-18
Afterbay - see Tailwater
American Society of Civil Engineers (ASCE), C-5
Area-Elevation Curve, 4-13, 5-29
Arkansas-White River System, 5-75, 5-96, 5-115, 5-135, 6-34, 6-37, M-16
Automatic Generation Control, 2-42, 6-48, 6-49, 7-28
Auxiliary Equipment, 2-44
Average Annual Energy, 5-2, 5-54, 5-69, 5-89, 5-95, 5-107, 7-61, 9-8
Average Water Conditions, S-18

Backwater, 5-31, 5-38, 6-56, S-1
Base Load, 2-4, 2-5, 6-8, 9-27, S-1
Benefit-Cost Ratio, Q-5
Bibliography, 1-2, Appendix T
Block-Loading, 4-11, 5-30, 6-46, 6-49, 7-28, S-1
Boulder Canyon Project Act, M-35, M-38
Buffer Zone, 5-98
Bureau of Reclamation (USBR)
  Cost Indexes, 8-17, 8-18
  General, 2-1, 4-4, 5-36, C-14, M-43, M-52, M-67
Buswork, 2-42, 2-43, S-1

Capability, S-1 - see also Capacity
Capacity
  Definition of, 2-3, 6-1
  Dependable - see Dependable Capacity
  Equivalent Thermal, 6-25, 6-26, 6-29, O-11, S-2
  Hydraulic, 5-16, 5-32, 5-47, 5-99, 6-3, E-4, S-2
  Installed, 5-31, 5-47, 6-2, 6-29, K-11, S-2
  Intermittent, 6-35, 9-8, O-1, O-3
  Nameplate - see Capacity, Rated
  Overload, 6-2, S-2
  Peaking, 5-55, 5-58, 6-2, 6-33, 6-38, S-2
  Rated, 5-13, 5-21, 6-1, 6-38, 7-24, 7-28, E-3, S-2
  Reserve, 2-12, 5-3, 6-9, S-2
  Sustained Peaking, 6-2, 6-27, 6-31, 6-32, 6-56, N-3
Capacity Benefits, 6-25, 6-26, 7-43, 7-57, 9-8, 9-36, 9-49 thru 9-55, 9-60, 9-63, 9-64, O-2, Appendix Q
Capacity-Duration Curve, 5-55, 5-58, 6-31, D-11, O-5, O-7
Capacity Factor, 6-3
Capacity Value - see Power Values
Capacity Value Adjustments - see Power Values
Cavitation, 5-18, 5-32, 7-38, S-3
Central Arizona Project, M-35
Central Valley Project, 5-135, M-44
Channel Routing, 5-38, 7-46
Circuit Breakers, 2-42, 2-43, S-3
Coal-Fired Plant, 2-6, 2-7, 2-13, 9-27
Colorado River, 5-75, 5-103, 5-135, M-33
Colorado River Compact, M-35, M-40
Columbia River, 5-74, 5-75, 5-97, 5-103, 5-133, 5-135, 6-26, 6-33, M-52
Columbia River Treaty, 5-75, 5-133, M-54
Combined Cycle Plant, 2-10, 2-10, 9-27
Combustion Turbine Plant, 2-9, 2-9, 9-27
Computer Programs
  DURAPLOT, 5-135, 5-136, C-2, C-15, C-17
  HEC-2, 4-9
  HEC-3, C-4
  HEC-4, 4-5, K-8
  HEC-5, 4-7, 5-72, 5-76, 5-77, 5-116, 5-134, 6-55, 7-44, 7-63, C-4, C-5, C-15, Appendix K
  HEC-6, 4-14
  HLDPA, 6-55, C-11
  HYDUR, 5-59, C-2
  HYSSR, 5-35, C-9
  HYSYS, 6-55, C-13
  NAVOP, C-3
  POWRSYM, 6-56, 6-58, 6-59, 7-52 thru 7-57, 7-65, 8-14, 9-34, 9-50, 9-59, O-15, O-16
  RESOP, C-10
  RMA-2, 7-46
  SAM, O-16
  SOCH, C-12
  SSARR, 4-6, 5-28, C-12
  SUPER, 4-7, 5-116, 5-135, C-2. C-4, C-7, C-15
  WHAMO, 2-31
  #723-G1-L333A, 4-14
  #723-G2-L2240, 4-14
  #723-G2-L2250, 4-14
Conservation, 3-18, 9-5, 9-69
Conservation Storage, 5-38, 5-97, 5-98, 5-103, 5-104, 5-106, 5-107, 5-108, Appendix M
Constraints, Operating, 5-37, 5-97, 5-132, 6-4, 6-13, 6-25, 6-46, 6-48, 6-54, Appendix M
Construction Costs, 8-2
Construction Cost Indices, 8-17
Continuity Equation, 5-64, 5-77

Control Equipment, 2-44
Conversion Factors, 5-79, Appendix R
Coordinated Operation, 5-133, Appendix M
Cost Allocation, Q-4, Q-7
Costs
  Annual, 8-7, 8-23, 8-25, 9-45
  Construction, 8-2, 8-6
  Contingencies, 8-4, 8-20
  Engineering and Design (E&D), 8-6, 8-23
  Hydro Plant Outages, 9-69
  Indexing, 8-17
  Inflation During Construction, 8-7, 8-20
  Interest and Amortization (I&A), 8-8, 8-23
  Interest During Construction (IDC), 8-6, 8-23, 9-63, 9-68
  Investment, 8-6
  Operation and Maintenance (O&M), 8-9, 8-10, 8-11, 8-17, 8-23
  Powerhouse, 8-2, 8-3, 8-8
  Pumping, 7-55, 7-66, 8-13
  Replacements, 8-12, 8-19, 8-25
  Sources of Cost Data, 8-4
  Supervision and Administration (S&A), 8-6, 8-23
  Transmission, 6-12, 7-37, 8-15, 9-25
  Types of Cost Estimates, 8-1
  Updating, 8-16
Cranes, 2-32, 2-44, 2-62
Critical Drawdown Period, 5-75, 5-76, 5-77, 5-87, 5-107, 5-121, 6-26, 6-52, F-1, F-1, F-3, J-3, H-3, Appendix M, S-3
Critical Period, 5-2, 5-75, 5-76, 5-121, F-1, F-1, F-3
Critical Rule Curve, 5-90, 5-91, I-4, I-7, Appendix J, M-59
Cumberland River Basin, 5-135, M-2
Cycling, 2-4, 2-7, 2-10, 2-14, 2-21, 6-7, 6-37, 9-27

Daily Cycle, 5-39, 5-56, 6-33, 6-37, 6-41, 6-42, 7-3
Daily Operating Pattern, 5-39, 5-56, 6-33, 6-37, 6-41, 6-42, 7-18, 7-44, 7-47
Dam, 2-26
Data Requirements for Power Studies, 5-25, 5-42, 5-67, 5-73, 5-134, 6-46, 7-44
Data Resources Incorporated (DRI), 3-14, 9-25, 9-38, P-7
Demand, 2-3, 3-3, S-4 - see also Loads and Load Forecasts)
Department of Energy, P-7
Dependable Capacity
  General, 5-94, 5-111, 6-2, 6-11, 6-24, 9-8
  Average Availability Method, 5-54, 5-55, 5-59, 6-28
  Critical Month Method, 6-26
  Firm Plant Factor Method, 6-27
  Hydrologic Availability Method - see Average Availability Method
  Measures to Firm Up, 6-37
Dependable Capacity (continued)
  Pumped-Storage Plant, 6-34, 7-57, 7-61, 7-64
  Regulation to Maximize, 5-111, M-22
  Selection of Method, 6-31
  Specified Availability Method, 6-28
  Sustained Peaking Capacity, 6-3, 6-27, 6-31, 6-32, 6-56, N-3
  System Dependable Capacity, 6-27
Design Head, 5-11, 5-50
Discharge
  General Definition, S-4
  Minimum - see Minimum Discharge
  Peaking, 5-56, 6-38, 6-41, 6-42, 6-48
  Power, 5-78, H-9
  Rated, 5-12 thru 5-17, 5-21 thru 5-24, 7-24
Discharge-to-Storage Conversion Factors, 5-79
Disconnects, 2-42, 2-43
Displacement - see Energy Displacement
Diversions - see Losses and Withdrawals
Downstream Flow Requirements - see Minimum Discharge
Draft, S-4
Draft Tube, 2-34
Drawdown, S-4
Dump Power, S-4
DURAPLOT, 5-136, C-1, C-14
Duration Curves
  Capacity-Duration Curve, 5-55, 5-58, D-8, D-11
  Efficiency-Duration Curve, 5-61, 5-62
  Flow-Duration Curve, 4-7, 4-8, 5-5, 5-42, 5-43, 5-48, 5-56, 6-15, 6-16, D-8, D-10
  Flow-Duration Method for Computing Energy, 5-7, 5-42, C-2, Appendix D
  Flow-Duration Models, 5-64, C-2
  Generation-Duration Curve - see Power-Duration Curve
  Head-Duration Curve, 5-11, 5-17, 5-48, 5-50
  Load-Duration Curve, 2-12, 2-13, 5-39, 9-38
  Peaking Flow-Duration Curve, 5-55, 5-57, D-8
  Power-Duration Curve, 5-2, 5-50, 5-51, 5-54, D-1, D-4

Economic Analysis - see Power Benefits
Economic Dispatch, 6-57, 7-17, 7-55
Economy Guide Curves, 5-94, 5-115, M-12
Efficiency
  Cycle (Pumped-Storage), 7-30
  Fixed, 5-18, 5-60, D-4
  Generator, 5-18, 7-31
  Overall, 5-5, 5-18, 5-33, 5-60, 7-24, 7-30, E-4
  Pumping, 7-24, 7-30
  Turbine, 2-47, 5-5, 5-18, 5-25, D-6, D-12

Efficiency (continued)
Versus Head, 5-20, 5-34, E-4
Versus Discharge, 5-20, 5-34, 5-60
Efficiency-Discharge Curve, 5-61
Efficiency-Duration Curve, 5-61, 5-62
Efficiency-Head Curve, 5-20, 5-33, E-4
Elasticities, B-1
Electric Power Research Institute (EPRI), 3-14, 6-37, 7-8, 7-57, O-5, P-7
Electric Power Utilities, 2-1, 3-13
Elevation-Area-Capacity Curve, 4-13, 4-13, 5-29, 5-85
Encroachment, 5-14, 5-30, S-5
Energy
General Definition, 2-2, 5-1
Average Annual, 5-2, 5-4, 5-54, 5-69, 5-89, 5-95, 5-107, 9-8, S-5
Dump, 2-11, S-5
Firm, 5-2, 5-4, 5-70, 5-71, 5-73, 5-87, 5-95, 5-107, 9-8, 9-71, H-5, I-5, M-58, S-5
Nonfirm - see Energy, Secondary
Primary, 5-2, S-5
Secondary, 5-3, 5-4, 5-70, 5-95, 6-11, 9-5, 9-8, 9-71, I-7, M-61, S-5
Usable, 5-40, 5-52, 5-53, D-1
Energy Benefits - see Power Benefits
Energy Displacement, 3-27, 6-10, 6-11, 9-34, 9-38
Energy Information Administration (EIA), 3-12, 9-38, P-1
Energy Potential, Estimating
General, Chapter 5
Flow-Duration Curve Method, 5-7, 5-42, C-2, Appendix D
Hybrid Method, 5-8, 5-134
Selection of Method, 5-8
Sequential Streamflow Method, 5-7, 5-64
Energy Value Adjustment - see Power Values
Energy Values - see Power Values
Engineering News Record, 8-17
Equivalent Thermal Capacity, 6-25, 6-29, O-11
Erection Bay, 2-32
Evaporation Losses, 4-16, 5-29, 5-85, H-4
Export Power, 3-3, 9-5, M-61, S-6

Factors
Availability (Mechanical), 6-25, 6-29, 7-32, O-5, S-6
Capacity, 6-3, S-6 - see also Plant Factor
Load, 2-3, S-6
Plant, 5-116, 6-3, 6-10, 6-27, 7-28, 9-28, S-6
Power, 6-10, 6-36, S-6
Falling Water Charges, 9-66
Federal Energy Regulatory Commission
General, 1-5, 3-12, 9-35
Loads, 3-12, 6-6, 6-33, 6-52

Federal Energy Regulatory Commission (continued)
Regions, 3-12, 3-13
Power Values, 6-6, 6-26, 6-31, 6-36, 8-14, 9-14, 9-20, 9-25, 9-35, O-10, P-2
Federal Hydropower Projects, 2-1
Federal Power Act, 3-7, 9-66
Financial Feasibility, 9-56
Financing, Nonfederal, 9-70
Firm Power - see Energy, Firm
Firm Yield, 5-75, F-1, F-3, I-5
Firm Yield Curve, F-4
Firming up Peaking Capacity, 6-37
Flashboards, S-6
Flexibility, 6-25, 6-36, 7-57, O-11, S-6
Flexibility Adjustments, 6-25, 6-36, 7-57, O-11
Flood Control, 5-37, 5-66, 5-85, 5-90, 5-94, 5-97, 5-98, 5-99, 5-103, 5-106, Appendix M
Flood Control Act of 1944, 2-1, 3-27, 9-56
Flood Routing, 5-39
Flow-Duration Curve, 4-7, 4-8, 5-5, 5-42, 5-43, 5-48, 5-56, 6-15, 6-16, D-8, D-10
Flow-Duration Method, 5-7, 5-42, C-2, Appendix D
Forced Outages, 7-32, O-5, S-6
Forebay, S-6
Fossil Fuel Power Plants - see Thermal Power Plants
Fuel Cost Escalation, 7-51, 9-23, 9-37, P-6
Fuel Costs, 7-51, 9-18, 9-37, P-1
Fuel Displacement - see Energy Displacement
Full-Gate Discharge, 5-12, 7-24, D-4, S-7
Future Power Installations, 9-58
Generating Unit, S-7 - see also Turbines and Generator
Generation Requirements, 5-39, 5-77, 5-79, 6-46, 7-17, H-5
Generator, 2-36, 2-38, 2-39, 5-12, 5-18, 5-21, S-7
Glossary, Appendix S
Governor, 2-39, 2-40, 2-41, S-7

Hand Routings, 5-72, 5-88, 6-55, Appendixes E, H, I, J, and N
Head
Average, 5-11, 5-67, H-5
Critical, 5-17, S-7
Design, 5-11, 5-50, S-7
Gross, 5-5, S-7
Maximum, 5-10, 5-33, 5-48, 5-67
Minimum, 5-10, 5-33, 5-48, 5-67, 7-22
Net, 5-6, 5-45, 5-69, S-7
Rated, 2-47, 5-11, 5-21, 5-47, 5-111, 7-24, S-8
Head-Discharge Curve, 4-10, 4-11, 5-45, 5-46, 5-48
Head Losses
General, 5-6, 5-35, 5-45, E-1, G-1, N-1
Intake, 5-37

Head Losses (continued)
  Penstock, 5-36, 7-31, 7-36
  Trashrack, 5-36
Head Range, 5-10, 5-13, 5-29, 5-32,5-33, 5-33, 5-71, 7-22, 7-24, 7-68, E-2
Headwater Benefits, 9-63, Appendix Q, S-8
HEC-5 - see Computer Programs
Historical Streamflow Record - see Period of Record
Hourly Loads, 5-39, 6-52, 7-18, 7-44, 7-47
Hourly Operation Studies, 4-13, 6-37, 6-41, 6-44, 7-44, 7-62, Appendix N
Hybrid Method for Estimating Energy, 5-8, 5-27, 5-134, C-14
Hydraulic Capacity, 5-16, 5-32, 5-47, 5-99, 6-3, E-4
Hydroelectric Design Centers
  Cost Estimating, 8-4, 8-5
  General, 1-2
  Turbine Selection, 2-31, 2-61, 5-20, 7-23, 7-38, 7-41
Hydroelectric Plants - see Hydropower Plants
Hydrograph, S-8
Hydrologic Availability, 6-28, O-3, S-8
Hydrologic Data Requirements, Chapter 4
Hydrologic Engineering Center (HEC), 5-134, K-1 - see also HYDUR, HEC and #723 series programs under Computer Programs
Hydropower Plants
  Benefits - see Power Benefits
  Characteristics of, 2-10, 2-19
  Components of, 2-26, 2-26
  Estimating Energy Potential, Chapter 5
  Expansion of Existing Plants, 6-46, 9-52, 9-59
  Peaking Projects, 2-14, 2-21, 2-23, 4-10, 5-9, 5-11, 5-55, 5-66, 6-2, 6-8, 6-18, 6-33, 6-37, 6-40, 6-41, 6-44, 9-29, 9-52, Appendix N
  Pondage Plants, 2-21, 2-21, 5-9, 5-11, 5-14, 5-17, 5-55, 6-13, 6-18, 6-37, 6-46, 6-52, 6-56, D-11, N-1
  Pumped-Storage Plants - see Pumped-Storage Projects, Off-Stream
  Pump-Back Plants - see Pump-Back Projects
  Reregulating, 2-25, 2-25, 6-14, 6-43, 6-41, 6-41, 6-46, 6-54, 6-56, 6-59, N-6
  Run-of-River Plants, 2-20, 2-20, 5-8, 5-41, 5-66, 6-16, 9-50
  Scoping, 9-43
  Sizing of - see Plant Sizing
  Small Hydro - see Small Hydro Projects
  Staging of, 3-3, 6-19, 9-63
  Storage, 2-22, 2-22, 5-9, 5-138, 6-16, 9-48 - see also Storage
  Systems - see System Analysis
  Use of Hydropower in Power Systems, 2-14, 6-44, 6-56

Hydro-Thermal Power System Operation - see Power System Operation

Imports (of power), 2-11, S-8
Inflation, 8-7, 8-20, 9-12
Inflow, S-8
Institute of Electical and Electronic Engineers (IEEE), C-5
Intake Structure, 2-27, 2-28
Interchangable Runners, 5-10
Interconnection (Intertie), S-8
Interest During Construction (IDC), 8-6, 8-23, 9-63, 9-68
Interest Rate, 8-6, 8-8, 9-12, 9-69
Intermediate Load, 2-4, 2-5, 6-8, 9-27
Intermittent Capacity, 6-35, 9-8, O-1, O-3
Interruptible Power, 2-12, S-13

Kilowatt, 2-2, S-8
Kilowatt-Hour, 2-2, S-8
KW/cfs Factors, 5-20, 5-32, 5-85, Appendix G, H-8, H-11

Leakage, 4-16, 4-17, 5-29, 5-77
Little Rock District, C-2, M-22
Load
  Base, 2-4, 2-5, 6-7, 6-8
  Intermediate, 2-4, 2-5, 6-7, 6-8
  Interruptible, 2-12, S-9
  Peaking, 2-4, 2-5, 6-7, 6-8, 9-27
Load Center, 9-25, S-9
Load Curve - see Load Shapes and Load-Duration Curves
Load-Duration Curves, 2-12, 2-13, 5-39, 9-38
Load Factor, 2-3, S-6
Load Forecasts
  Accuracy of, 3-17, B-5
  Econometric, 3-15, 3-17, B-3
  End-Use, 3-15, B-2
  Requirements, 3-15, 3-19
  Sources, 3-7, 3-16
  Treatment of Conservation, 3-18
  Trend Analysis, 3-15, B-2
  Use of, 3-3, 3-15
Loads (Power)
  General, 2-3
  Base, 2-4, 2-5, 6-8, 9-27
  Intermediate, 2-4, 2-5, 6-8, 9-27
  Interruptible, 2-12
  Peaking, 2-4, 2-5, 6-8, 9-27
Load-Resource Analysis
  General, 2-12, 3-1, 9-4, S-9
  Definition of System, 3-2, 7-46
  Energy Displacement Projects, 3-1, 3-2, 3-27, 9-4
  Energy-Load Analysis, 3-3, 3-21, 5-2
  Estimating Demand, 3-3
  Examples, 3-4, 3-22, 3-24
  Major Steps, 3-2, 3-20
  Peak-Load Analysis, 3-3, 3-21, 5-3

Load-Resource Analysis (continued)
Pumped-Storage Project, 7-42, 7-47
Responsibility of Corps, 3-6, 3-27, 9-4
Small Hydro, 3-2, 3-28
Load Shapes - see Also Operating Patterns
Daily, 2-2, 2-3, 5-39, 6-52, 7-18, 7-44, 7-47
Seasonal, 2-4, 5-4, 5-39, 6-11
Weekly, 2-3, 5-39, 6-7
Long-Run Incremental Cost (LRIC), 3-19, 9-2
Losses
General (streamflow) 4-15, 5-23, 5-44
Consumptive, 4-16, 5-29, H-4, S-9
Evaporation, 4-16, 5-29, 5-85, H-4, K-8
Example Summary, 4-19
Fish Passage Facilities, 4-17, 5-29
Gate Leakage, 4-17, 5-29
Head - see Head Losses
Leakage and Seepage, 4-16, 5-29, 5-78, 7-16
Navigation Lock Requirements, 4-17, 5-29
Nonconsumptive, 4-16, 5-29, 5-44, 5-67, 5-78, H-3, H-8
Transmission - see Transmission Losses
Turbine Leakage, 4-17, 5-29
Withdrawals, 4-16, 5-29, 5-78, H-3, H-7

Marketability, 3-27, 6-6, 9-57
Mass Curve, 5-76, Appendix F, F-2, S-10
Matching Generator to Turbine, 5-21, 7-24
Maximum Power Pool Elevation, 5-71, M-6, M-7, M-20
Mechanical Availability, 6-25, 6-29, 7-32, O-5
Minimum Discharge
For Non-Power Purposes, 4-14, 5-37, 5-56, 5-84, 5-104, 6-13, 6-33, 6-41, 6-46, 6-50, N-1, N-5
Turbine Minimum Discharge, 5-18, 5-32, 5-47, 5-48, 6-22
Minimum Head, 5-10, 5-33, 5-48. 5-67, 7-22
Minimum Power Pool Elevation, 5-71, M-6, M-7, M-13, M-15, M-20
Minimum Provisions for Power, 9-58
Missouri River, 5-75, 5-118, 5-135, M-23
Missouri River Division, 1-2, M-33
Mobile District, 1-2
Multiple-Purpose Operation, 5-97, 5-132, 5-134, 7-70, Appendix M

Nashville District, M-8
National Economic Development Plan, 9-56, 9-71
National Hydropower Study, 3-13, 4-3, 5-60, 7-71, 9-2, 9-7, T-5
Navigation Lock Water Losses, 4-17, 5-29
Need for Power Analysis, Chapter 3, 7-42, 9-4
Non-Federally Financed Projects, 9-70
Non-Power Operating Constraints, 5-37, 5-97, 5-132, 6-13, 6-25, 6-46, 6-48, 6-54
Nonstructural Alternatives, 3-19, 9-5
North American Electric Reliability Council (NERC), 3-7, 3-8, 3-13, O-5, O-9
North Pacific Division, 1-2, 5-134, 6-58, 7-65, C-10, C-12, C-16, M-67
Northwest Power Planning Council, 9-7
Nuclear Power Plant, 2-8, 2-8, 2-13, 9-27

Off-Stream Pumped-Storage - see Pumped-Storage Projects (Offstream)
Office of Power Marketing Coordination (OPMC), 3-10, 9-58
Ohio River Division, C-2, C-4, C-11
Omaha District, 1-2
Operating Constraints (Limits), 5-37, 5-97, 5-132, 6-25, 6-46, 6-48, 6-54, Appendix M
Operating Cycles - see Operating Patterns
Operating Patterns
Daily, 5-39, 5-56, 6-33, 6-37, 6-41, 6-42, 7-3
Weekly, 5-39, 6-33, 6-38, 6-41, 6-52, 7-3
Seasonal, 5-39, 6-11, Appendix M
Operating Strategies - see Reservoir Regulation Strategies
Operation and Maintenance (O&M) Costs, 8-9, 8-23
Outages
Cost of, 9-69
Forced, 7-32, O-9, S-10
Maintenance, 7-33, O-9, S-10
Scheduled, O-10, S-10

Peak Demand Period (Months), 2-4, 2-5, 3-20, 5-113, 6-26, 6-28, 6-30, 7-18, M-28, M-58, S-11
Peak Load, 2-4, 2-5, 6-7, 9-2/
Peaking Capacity, 5-55, 5-58, 6-2, 6-33, 6-38
Peaking Operation, 2-4, 2-9, 2-11, 2-14, 2-21, 2-23, 4-10, 5-9, 5-11, 5-55, 5-66, 6-7, 6-37, 6-38, 6-41, 6-44, 6-46, 7-2, 7-58, 9-27, 9-52, 9-60, Appendix N
Penstock, 2-27, 2-29, 7-15, S-11
Percent Gate, 5-18
Performance Curves, 2-46, 2-50 thru 2-56, 5-18, 5-19, 5-21, 5-22, 7-25, D-4, D-5
Period of Analysis, 6-55, 8-9, 9-8, 9-13
Period of Record, 4-4, 4-5, 5-27, 5-72, 5-75, 5-89, 5-95, 6-48, 7-61, 7-63, S-11
Pick-Sloan Plan, M-24
Planning Guidance Notebook, 3-1, 6-4, 6-5, 7-39, 9-1
Plant Factor, 5-116, 6-3, 6-10, 6-27, 7-28, 9-28
Plant Sizing
General, 5-1, 5-45, 5-67, Chapter 6, 9-46
Environmental Constraints, 6-13
General Procedure, 5-1, 6-3, 9-46

Plant Sizing (continued)
Marketability Considerations, 6-6
Non-Power Operating Constraints, 6-13
Physical Constraints, 6-12
Range of Alternatives, 6-1, 6-4, 6-5, 6-16, 7-43
Size and Number of Units, 5-18, 6-20, 6-21, 7-33
Pondage, 2-21, 2-21, 5-9, 5-11, 5-14, 5-17, 5-55, 6-13, 6-18, 6-37, 6-46, 6-52, 6-56, D-10, N-1
Power, 2-2, S-12
Power Benefits
Actual or Simulated Market Price, 9-2
Capacity Benefits, 6-28, 7-43, 7-57, 7-67, 9-8, 9-36, 9-49 thru 9-55, 9-60, 9-62, 9-63, O-2, Appendix Q
Combinations of Alternatives, 9-34
Comparability Criterion, 9-11
Conceptual Basis, 9-1
Cost of Most Likely Alternative, 9-4, 9-14
Economic Analysis - see Power Benefits
Energy Benefits, 7-43, 7-55, 7-66, 9-8, 9-18, 9-36, 9-49 thru 55, 9-62, 9-63, 9-71, Appendix Q
Energy Displacement Method, 3-27, 6-10, 6-11, 9-34, 9-38
Examples of Benefit Analysis, 9-48, Appendix Q
Falling Water Charges, 9-66
Fuel Cost Escalation, 7-51, 9-23, 9-37, P-6
Inflation, Treatment of, 9-12
Interest Rate, 9-12, 9-69
Marginal Costs (LRIC), 3-19, 9-2
Need for Power vs. Power Benefits, 7-42, 9-4, 9-70
Nonstructural Alternatives, 3-19, 9-5
Overall Approach, 9-7
Period of Analysis, 6-55, 8-9, 9-8, 9-13
Power Values - see Power Values
Scoping, 9-46
Screening Curves, 9-28, 9-30, 9-31
Selection of the Most Likely Alternative, 9-27
Special Problems, 9-58
System Benefits, 9-63, Appendix Q
Willingness to Pay, 9-1
With- and Without-Project Conditions, 3-3, 7-42, 7-43, 7-46, 7-52, 7-65, 9-9
Power Benefits for Specific Types of Projects or Studies
Cost of Delays to On-line Dates, 9-68
Cost of Hydro Plant Outages, 9-69
Design Analysis, 9-66
Minimum Provisions for Power, 9-58
Non-Federally Financed Projects, 9-70
Powerplant Expansion, 9-52, 9-59
Pumped-Storage Projects, 7-43, 7-55, 7-66, 9-54, 9-62
Power Benefits for Specific Types of Projects or Studies (continued)
Reallocation of Storage, 9-65
Run-of-River Projects, 9-50
Small Hydro Projects, 9-38, 9-50, 9-70
Staged Construction of Hydropower Projects, 9-63
Storage Projects, 9-48, 9-63, 9-65, Appendix Q
Systems of Projects, 9-63, Appendix Q
Power Demand, 2-3, 3-3, S-4 - see also Loads and Load Forecasts
Power Discharge, 5-77, H-9
Power-Duration Curve, 5-2, 5-50, 5-51, 5-54, D-3, D-7, D-8, D-9
Power Factor, 6-10, 7-36, S-13
Powerhouse
Components, 2-34, 2-35, 2-36
Costs, Chapter 8
Types, 2-31
Power Imports, 2-11
Power Marketing Administrations (PMA's)
General, 1-5, 2-1, 3-10
Addresses, 3-11
Load-Resource Analysis, 3-10, 3-16
Load Shapes, 5-40, 6-18, 6-31, 6-48, 7-17
Marketability Studies, 3-27, 6-6, 6-28, 6-32, 9-56
Generation Requirements, 5-40, 6-6, 6-28, 6-33, 6-38, 7-17, 7-22, 7-59
Examples of Operation, Appendix M
Transmission Costs, 8-16
Power Operation
Base Load, 2-4, 2-6, 2-8, 2-13, 2-14, 2-21, 6-8, 9-27
Cycling (Intermediate), 2-4, 2-6, 2-10, 2-13, 2-14, 2-21, 6-7, 6-37, 9-27
Peaking, 2-4, 2-9, 2-11, 2-13, 2-14, 2-21, 2-23, 4-10, 5-9, 5-11, 5-55, 5-66, 6-7, 6-37, 6-38, 6-41, 6-44, 6-46, 7-2, 7-58, 9-27, 9-52, 9-60, Appendix N
Reserve, 2-9, 2-12, 6-9
Powerplant and Industrial Fuel Use Act of 1978, 6-8
Powerplant Expansion, 6-46, 9-52, 9-59
Powerplants - see Hydropower Plants and Thermal Plants
Power Pool, S-13
Power Studies
Checklist, Appendix A
Organization of, 1-2
Power System Operation, 2-1, 2-12, 6-46, 6-57, 9-18
Power Values
At-Load Center, 9-25, S-13
At-Market, 9-25, S-13
Capacity Value, 6-25, 9-8, 9-15, S-13
Capacity Value Adjustment, 6-26, 6-36, 7-57, 9-15, O-2

Power Values (continued)
Energy Value, 9-8, 9-18, 9-38, 9-71, S-13
Energy Value Adjustment, 9-18, O-14
Generalized, 9-28
Indexing, 9-38
Sources of, 9-35
POWRSYM, 6-56, 6-58, 6-59, 7-52 thru 7-57, 7-65, 8-14, 9-34, 9-50, 9-59, O-15, O-16
Preliminary Firm Energy Estimate, 5-71, 5-77, 5-121, H-1
Price Indexing, 8-17, 9-38
Principles and Guidelines
Fuel Cost Escalation, 9-22, P-1, P-2, P-6
Inflation, 9-12, 9-23
Intermittent Capacity, 6-35, O-2
Load-Resource Analysis, 3-1, 3-2, 3-11, 3-15, 3-28, 7-42
Nonstructural Alternative, 9-5
Period of Analysis, 9-8
Power Benefits, 9-1, O-1, P-12, Q-3
Small Hydro, 9-70
System Energy Benefits, O-12
Production Cost Avoidance (PCA) Method, C-8
Production Cost Models, 6-56, 6-58, 7-48, 7-52 thru 7-57, 7-65, 8-14, 9-4, 9-20, 9-37, 9-50, 9-52, 9-54, 9-62, O-14
Public Utilities Regulatory Policy Act (PURPA), 9-2
Pump-Back Projects
Dependable Capacity, 7-61, 7-64, 7-67
Economic Analysis, 7-64
Head Range, 7-23
Objective, 2-24, 6-44, 7-1, 7-4, 7-58
Operating Cycle, 7-62
Sequential Routing Studies, 7-61, 7-62, 7-67, K-18
Steps in Analysis, 7-60
Pumped-Storage
Daily/Weekly Cycle, 7-1, 7-3, 7-17
Economic Dispatch, 6-57, 7-17, 7-55
Environmental Problems, 7-70
General Concept, 2-11, 2-23, 7-2
Must-Run, 6-57, 7-17
Off-Stream - see Pumped-Storage Projects (Off-Stream)
Pump-Back - see Pump-Back Projects
Pumping Energy, 7-3, 7-18, 7-56
Pump-Turbines - see Pump-Turbines
Screening Studies, 7-68
Seasonal, 7-1, 7-6, 7-69, M-51
Types of Projects - see Pumped-Storage Projects (Off-Stream)
Pumped-Storage Projects (Off-Stream)
Charge/Discharge Ratio, 7-19, 7-32
Cycle Efficiency, 7-30
Dependable Capacity, 6-34, 7-57
Economic Analysis, 7-42, 7-46, 9-54, 9-62
Examples, 7-5, 7-10
Head Range, 7-22, 7-24
Load-Following, 7-28
Pumped-Storage Projects (Off-Stream) (continued)
Lower Reservoirs, 7-16, 7-35, 7-37, 7-40, 7-45
Plant Factor, 7-33
Plant Size, 7-22, 7-33
Production Cost Studies, 6-56, 7-48, 7-52 thru 7-57
Operating Cycle, 7-3, 7-17, 7-39
Reliability, 7-32
Sequential Routing Studies, 5-9, 6-46, 7-41, 7-44, K-18, N-6
Site Characteristics, 7-14, 7-39
Steps in Analysis, 7-38
Storage Requirements, 7-15, 7-19, 7-20, 7-39, 7-40, 7-42, 7-45
Transmission Costs and Losses, 7-37
Upper Reservoirs, 7-16, 7-37, 7-40
Pumped-Storage Projects (Pump-Back) - see Pump-Back Projects
Pumped-Storage Projects (Types)
Daily/Weekly Cycle, 7-5
Diversion Type, 7-7
Existing, 7-8, 7-9
Multiple-Purpose, 7-5, 7-6, 7-7, 7-69, 7-70
Off-Stream, 2-23, 2-24, 7-1, 7-5, 7-10
Pump-Back, 2-24, 2-24, 7-1, 7-6, 7-12, 7-58
Seasonal, 7-1, 7-6, 7-69
Underground, 7-1, 7-69
Pumping Energy
Estimating Amount Required, 7-18, 7-55, 7-66
Cost of, 7-55, 7-66, 8-13, 9-36, 9-62
Pump-Turbines
Charge/Discharge Ratio, 7-19, 7-32
Pump-Turbines (continued)
Efficiency, 7-30
Head Range, 7-22, 7-24, 7-68
Performance, 7-24
Pumping Capacity, 7-24, 7-28, 7-44
Rated Output, 7-24, 7-28
Starting/Stopping Times, 7-28
Types, 7-22

Ramping, 6-46, S-14
Rated Output, 5-13, 5-21, 6-1, 7-24, 7-28, E-3
Reallocation of Storage, 9-65
Recommended Plan, 9-56
Recreation, I-10, K-3
Regional Reliability Councils, 3-7, 3-8
Regulation of Reservoirs, 5-71, 5-74, 5-77, 5-91, 5-93, 5-97, 5-107, 5-111, 5-118, Appendixes H, I, and M (see also Reservoir Regulation Stategies)
Reports
Definite Project (DPR), 8-2
Design Memoranda (DM), 8-2

Reports (continued)
Feasibility, 8-1
Feature DM, 8-2
Reconnaissance, 8-1
Reregulating Reservoir, 2-19, 2-25, 2-25, 6-4, 6-41, 6-41, 6-43, 6-46, 6-54, 6-56, 6-59, N-6, 8-14
Reserves (of Power), 2-12, 5-3, 5-116, 6-7, S-14
Reservoir
Regulation - see Regulation of Reservoirs
Operation Strategies - see Reservoir Regulation Strategies
Types of Storage, 5-97 - see also Storage Characteristics, 4-13, 5-29, 5-71
Reservoir Regulation Strategies
Economy Guide Curves (TVA), 5-94, 5-115, M-12
Joint-Use Storage, 5-99, 5-103, I-5, Appendix M
Maintain Maximum Head, 5-94, 5-95, 5-107
Maximize Average Annual Energy, 5-107, I-10
Maximize Dependable Capacity, 5-111, I-12, M-22
Maximize Energy Benefits, 5-109, I-11
Maximize Firm Energy, 5-71, 5-91, 5-112, 5-120, Appendix H, I-2, I-4, K-21, M-58
Maximum Allowable Storage Use, 5-94, 5-95
Multiple-Purpose Operation, 5-66, 5-91, 5-97, Appendix M
Power Guide Curves (PCA), 5-94, 5-96, 5-115
Pump-Back, 7-58
Pumped-Storage (Off-Stream) - see headings on Pumped-Storage Projects (Off-stream)
Secondary Energy, 5-89, 5-93, 5-95, M-61
System Power Reserve, 5-118
Systems of Reservoirs, 5-118, Appendix M
Zoned Power Storage, 5-95, 5-118
Resources, Power, 2-3, 2-4, 3-3
Reversible Units - see Pump-Turbines
Routing Interval, 5-26, 6-44
Rule Curves
General, 5-91, S-16
Economy Guide Curves, 5-94, 5-115, M-12
Examples, Appendix M
Flood Control, 5-37, 5-98, 5-99, 5-103, E-2, I-4, M-12, M-28, M-49, M-59, M-66
Multiple-Purpose, 5-37, 5-97, 5-118, Appendix E, I-4, I-10, Appendix M
Multi-Year, J-3, M-3, M-59, M-63
Power, 5-91, 5-109, 5-110, 5-112, 5-114, I-4, Appendix J, M-58
Power Guide Curves, 5-94, 5-96, 5-115
Single-Year, J-1, J-2
System, 5-125, M-30, M-63
Variable Draft, 5-103, 5-114, M-60
Water Quality, J-1, J-2
Runners - see Turbines
Run-of-River Projects, 2-20, 5-8, 5-41, 5-42, 5-54, 5-66, 6-16, 9-50

Sacramento River, 5-103, M-44
Scoping, 9-46
Screening Curves, 9-28, 9-30, 9-31
Seasonality
Operating Constraints, 6-14
Power Demand - see Load Shapes, Seasonal
Seasonal Storage, 2-22 - see also Reservoir and Storage headings
Sedimentation Studies, 4-14
Selection of Plant Size - see Plant Sizing
Selection of Recommended Plan, 9-56
Sequential Streamflow Routing (SSR)
General, 5-7, 5-64
Data Requirements, 5-67, 5-73, 6-46, 7-49
Hand Routings, 5-72, 5-79, 5-88, 6-55, Appendixes E, H, I, J and N
Hourly Operation Studies, 5-9, 5-39, 6-37, 6-44, Appendix N
Models, 5-88, 5-131, 5-134, 6-55, C-4
Pump-Back, 7-61, 7-62, 7-67
Pumped-Storage, 5-9, 7-41, 7-44
Regulation of Multiple-Purpose Storage, 5-97, 5-132, K-3, M-59
Regulation of Power Storage, 5-9, 5-71, 5-91, 5-97, 5-107, 5-118, Appendixes H and I
Regulation of Projects without Power Storage, 5-66, Appendix E
Regulation of Reservoir Systems, 5-118, Appendix L, M-59
Worksheet, 5-79, 5-80, 5-82
Size and Number of Units - see Plant Sizing
Small Hydro Projects
General, 1-4
Benefit Analysis, 9-38, 9-50, 9-70
Need for Power, 3-2, 3-28
South Atlantic Division, 1-2
Southwestern Division, 5-134, C-2, C-8
Spill, 5-48, 5-70, 5-79, S-16
Spinning Reserve, 2-12, 2-13, 6-9, S-14
Spiral Case, 2-36, 2-37, S-16
SSARR, 4-6, 5-28, C-12
SSR - see Sequential Streamflow Routing Analysis
Staged Development of Hydropower Plants, 3-3, 9-63
Stanford Research Institute (SRI), P-7
Steam Plants - see Thermal Plants
Storage
Carry-Over, 5-118, M-25, M-38, M-49
Conservation, 5-97, 5-98, 5-99, 5-103, 5-118, Appendix M
Daily/Weekly - see Pondage
Dead, 5-97
Flood Control, 5-66, 5-85, 5-90, 5-94, 5-97, 5-98, 5-99, 5-103, 5-106, Appendix M

Storage (continued)
Joint Use, 5-99, 5-103, I-5, M-12, M-25, M-38, M-49, M-58, M-66
Non-Power Conservation, 5-66, 5-104
Power, 2-22, 5-71, 5-79, 5-97
Reallocation of, 9-65
Seasonal, 2-22, 5-71, 5-91, 5-97, 5-107, 5-118, Appendix M
Secondary Conservation, I-8
Sequence of Drafting, 5-119, M-30, M-40, M-63
Surcharge, K-4, M-6
Storage Effectiveness, 5-119, 5-122, Appendix L
Storage-Elevation Curves, 4-12, 5-29, E-3, L-2
Storage Project, 2-22, 2-22, 5-9, 5-138, 6-16, 9-48, S-16
Storage Requirements, 5-37, 5-71, 5-75, F-3
Storage Zones, 5-97
Streamflow
Average, S-17
Depleted, 4-6, S-17
Losses - see Losses
Maximum, S-17
Median, S-17
Minimum - see Minimum Discharge
Modified, 4-4
Natural, 4-4, S-17
Regulated, S-17
Streamflow Data
General, 4-1, 5-27
Accuracy and Reliability, 4-3
Adjustment of, 4-4
Extension of Data, 4-5
Sources of, 4-1
Types of, 4-6
Streamflow Records - see Streamflow Data
Submergence, 7-38
Surge Tanks, 2-30, 2-30
Sustained Peaking Capacity, 6-2, 6-27, 6-31, 6-32, 6-56, N-3
Switchyard, 2-43, 2-44, S-17
System Analysis
Power System Operation, 2-1, 2-12, 6-46, 6-57, 7-42, 9-18
Reservoir System Analysis, 5-10, 5-77, 5-118, K-16, Appendixes L and M
System Power Benefits, 5-77, 7-42, 9-63, Appendix Q

Tailrace, 2-34, S-17
Tailwater Characteristics
General, 2-34, 4-7, 5-5, 5-30, H-4
Block-Loading, 4-11, 5-30, 6-48
Encroachment, 5-14, 5-30, S-5
Lag, 4-13
Rating Curve, 4-7, 4-10, E-7, H-2, N-2
Tennessee River Basin, 5-75, 5-135, M-9
Tennessee Valley Authority, 2-1, 3-10, 4-4, 5-94, 5-115, 6-56, M-11, M-16
Thermal Power Plants
Coal-Fired Steam, 2-6, 2-7, 2-13, 9-15, 9-27
Combined Cycle, 2-7, 2-10, 2-10, 9-27
Combustion Turbine, 2-9, 2-10, 2-13, 9-15, 9-27
Cycling Plants, 2-6, 9-27
Fossil-Fuel Steam, 2-6, 2-7, 9-27, P-1
Nuclear, 2-8, 2-8, 2-13, 9-27
Oil-Fired Steam, 2-6
Transformers, 2-44, 2-45, S-18
Transmission
Costs, 6-12, 7-37, 8-15, 9-25
Losses, 6-12, 7-37, 9-25
Tulsa District, 5-96, 5-115, 6-34. C-8. M-22
Turbines, Hydraulic
Application Ranges, 2-46, 2-46, 7-22
Design Head, 5-11, 5-50
Efficiency, 2-47, 5-5, 5-18, 7-30, D-6, D-12
General Description, 2-36
Head Range, 5-10, 5-11, 5-32, 5-33, 5-71, 7-22, E-2
Interchangable Runners, 5-10
Matching Generators to Turbines, 5-21, 7-24
Minimum Discharge, 5-18, 5-32, 5-47, 5-48, 6-22
Performance Curves, 2-47, 2-50 thru 2-56, 5-18, 5-19, 5-21, 5-22, 7-24, D-4
Rated Head, 5-11, 5-21, 5-47, 5-111, 7-24, 7-28
Reversible Units - see Pump-Turbines
Selection of, 2-61, 5-10, 5-20, 6-24, 7-24
Submergence, 7-38
Turbine Types
Bulb Turbine, 2-58, 2-59
Crossflow Turbine, 2-49, 2-50
Fixed Blade Propeller, 2-52, 2-53, 2-62, 5-18, 5-19
Francis Turbine, 2-50, 2-51, 5-19, E-2
Impulse, 2-48
Kaplan Turbine, 2-54, 2-55, D-4
Pelton Turbine, 2-48, 2-48
Pit Turbine, 2-58
Pumps as Turbines, 2-60
Reaction, 2-50
Rim Turbine, 2-58, 2-60
Submersible Turbine-Generator, 2-58
Tubular Turbine, 2-56, 2-57
Turgo Turbine, 2-50

Underground Powerhouses, 2-31, 2-33, 7-1
United States Bureau of Reclamation (USBR), 2-1, 2-50, 5-36, 8-17, M-43, M-52, M-67
United States Geological Survey (USGS), 4-1, 4-2, 4-4, 5-135, C-16
Usable Energy - see Usable Generation

Usable Generation, 5-40, 5-52, 5-53, D-1
USGS - see United States Geological Survey
Utilities, 2-1, 3-13

Water Conditions
  Adverse, S-18
  Average, S-18
  Critical, S-18
  Median, S-18
Water Hammer, 2-30, S-18
Water Power Equation, 5-3, 5-69, 5-84, 7-21, 7-24, 7-36
Water Quality Studies, 4-14
Water Surface Fluctuations, 4-15, 5-38, 6-13, 6-46, 7-37, 7-70
WATSTORE, 4-2, 4-3, 4-7, K-8
Weekly Cycle, 5-39, 6-33, 6-38, 6-41, 6-52, 7-3
WHAMO, 2-31
Wheeling, S-18
Wicket Gates, 2-36, 2-37, 5-12, S-18
Withdrawals, 4-16, 4-18, 5-29, 5-78, H-3, H-7
With- and Without-Project Conditions, 3-3, 7-42, 7-43, 7-46, 7-52, 7-65, 9-9, Q-13

*U.S. GOVERNMENT PRINTING OFFICE: 1990--517-483/20837