

Contents

Preface						
Acl	Acknowledgments					
Fig	Figure Citations xvi					
Ab	out th	ne Author	xix			
1.	Ove	rview	1			
	1.1 1.2	The Power Delivery Chain in a Vertically Integrated Utility The Power Delivery Chain in a Market Environment 3				
2.	Ene	rgy, Load, and Generation Technologies	7			
	2.1 2.2 2.3	Energy, Power, and their Measurements 7 Load 14 Generation Technologies 21				
3.	The	Grid	49			
	3.1 3.2 3.3 3.4 3.5 3.6	Fundamentals: Load, Generation, and Alternating Current Grid Equipment 56 Grid Reliability and Contingency Requirements 64 Grid Configuration 67 Grid Operations 72 Blackout August 14, 2003 76				
4.	Shor	rt-Term Utility Planning	81			
	4.1	Planning and Execution of Dispatch: Day-Ahead Planning Through Real-Time Delivery 81				
	4.2	Day-Ahead Demand Forecasting: Load and Ancillary Service Requirements 84				
	4.3	Least-Cost Dispatch in a Single Control Area: A Simple Model 89				
	4.4 4.5	A Solution Using Profit Maximization 95 Least-Cost Dispatch in a Single Control Area with Operating Constraints 99				

	4.6	Least-Cost Dispatch in a Single Node with Spinning Reserve and	
	4.7	Regulation 111 Least-Cost Dispatch in a Network 113	
	4.8	Real Time 120	
5	Long	-Term Utility Planning	122
٥.	_		122
	5.1	Project Development 122	
	5.2	The Planning Process 127	
	5.3	Long-Term Load Forecasting 129	
	5.4	A Simplified Look at Generation Capacity Additions 131	
	5.5	Generation Additions and Retirements Within a Single	
	5.6	Control Area 143	
	3.0	Generation Additions and Retirements with Transmission to a Single	3
	5.7	Control Area 147 Generation Additions and Retirements and Transmission Additions	
	3.7	Within a Network 148	
	5.8		
	5.0	Reserve Reugirements 151	
6.	Midte	erm Utility Planning	152
	6.1	Informational Requirements 152	
	6.2	Formulation of the Optimization Problem 156	
7.	A Ma	arket Environment	161
	7.1	Principles and Architecture 161	
	7.1	Principles and Architecture 161 Short Torm Morket Designs Day Ahead Schoduling Thomash	
	1.2	Short-Term Market Design: Day-Ahead Scheduling Through Real-Time Delivery 164	
	7.3	Long-Term Market Design: No Clear Solutions 170	
	7.4	Midterm Market Design 173	
	7. 1	Withtern Market Design 173	
8.	Asset	Management in Short-Term Markets	180
	8.1	Retailers 180	
	8.2	Power Producers 183	
	8.3	Integrated Energy Companies 189	
9.	Inves	tment Analysis: Long-Term Planning in a Market	
	Envir	ronment	192
	9.1	Investment Setting in Utility and Market Environments 192	
	9.2	Project Analysis for a Merchant Plant 193	
	9.3	Power Purchase Agreements (Long-Term Contracts) 202	
	-	202	
10.	Risk	Management in the Midterm Markets	211
	10.1	Retailer Risk 211	
		Power Producer Risk 214	

1	0.3	A Quick Risk Primer in Statistics for Risk Management 215			
1	0.4	Risk Management in Midterm Markets: Retailers 229			
1	0.5	Risk Management in Midterm Markets: Power Producers 252			
1	0.6	Risk Management in Midterm Markets: Integrated Electricity			
		Suppliers 274			
11. 7	The (California Experience	278		
1	1.1	Market Fundamentals 279			
1	1.2	Short-Term Market Structure: The CALPX, CAISO, and			
		Other Market Participants 281			
1	11.3	Fatboy, Get Shorty, Ricochet, and Death Star 286			
1	11.4	Market Contrast: PJM and California 288			
Ribli	agra	nhv	201		
DIUII	Bibliography 2				

Index

Contents ix

294