**TABLE OF CONTENTS**

9 Pre-Boiler and Post-Boiler Treatment Processes

9.1 Overview of Common External Treatment 303
Process Technologies 306
9.2 Basic Pretreatment Processes 307
9.3 Pre-Boiler Purification Technologies 341
9.4 Post-Boiler Condensate Conditioning 376
9.5 Novel Pretreatment Oxygen Removal Technologies 382

10 Internal Treatment Programs 385

10.1 Outline of Internal Treatment Control and Programs 386
10.2 Anodic Inhibitor Chemistries 394
10.3 Tannin Programs 403
10.4 Coagulation and Precipitation Program Chemistries 411
10.5 Chelant Program Chemistries 430
10.6 All-Polymer/All-Organic Programs 437
10.7 Chelant-, Phosphate-, or Polymer-Based, Combination Programs 461
10.8 Coordinated Phosphate and Program Derivations 464
10.9 All-Volatile Treatment Program Chemistries 474
10.10 Mixed Treatment and Zero Solids Treatment 476
10.11 An Outline of Water Treatment for Nuclear Powered Steam Generators 477

11 Adjuncts and Conjuctional Treatments 479

11.1 Oxygen Scavenger Chemistries 479
11.2 Oxygenated Treatment (OT) 506
11.3 Ammonia and Amine Adjuncts 510
11.4 Alkalinity Boost Chemistries 545
11.5 Antifoam and Defoamer Chemistries 548
11.6 Multiblend Formulations 555

12 Control of Boiler Water Chemistry 559

12.1 Water Treatment Recommendation Perspectives 560
12.2 Tables and Supporting Notes 566

13 Operational Control of Waterside Surfaces 599
13.1 Sampling and Testing Steam and Condensate 599
13.2 Managing Standby and Idle Boilers 606
13.3 Boiler Inspections 612
13.4 Boiler Cleaning 623
13.5 Some Troubleshooting Notes 657

14 Control of Fireside Conditions and Surfaces 669
14.1 Basic Fireside Problems 670
14.2 Fuel Treatments/Additives 678
14.3 Fuel Treatment Formulations 687
14.4 Combustion Gas Analysis 689

Appendix I Useful Data 695
Appendix II Glossary 711
Bibliography 763
Index II