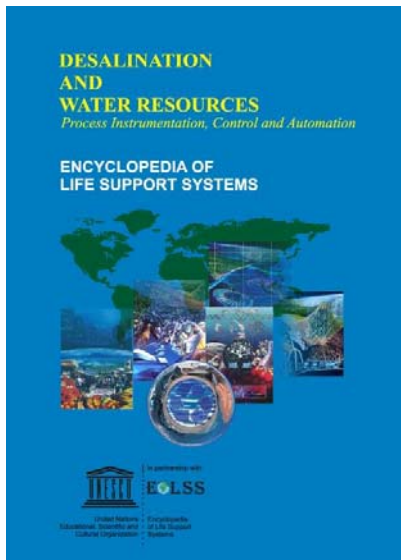


CONTENTS

DESALINATION AND WATER RESOURCES PROCESS INSTRUMENTATION, CONTROL AND AUTOMATION



**Process Instrumentation, Control and
Automation - Volume 1**

No. of Pages: 394

ISBN: 978-1-84826-436-6 (eBook)

ISBN: 978-1-84826-886-9 (Print Volume)

For more information of e-book and Print
Volume(s) order, please [click here](#)

Or contact : eolssunesco@gmail.com

DESALINATION AND WATER RESOURCES (DESWARE)

International Editorial Board

Editor-in-Chief: Al-Gobaisi, D. M.K.

Members

Al Awadhi, A. Ali	Hammond, R. P.	Morris, R.
Al Radif, Adil	Hanbury, W. T.	Nada, N.
Al-Mutaz, I. S.	Harris, A.	Ohya, H.
Al-Sofi M.	Harrison, D.	Peluffo, P.
Andrienne, J.	Hassan, A. M.	Rao, G. P.
Awerbuch, L.	Hodgekiess, T.	Rautenbach, R.
Balaban, M.	Husain, A.	Reddy, K. V.
Beraud-Sudreau, D.	Ismat, K.	Saal, D.
Birkett, James D.	Karabelas, A.J.	Sadhukhan, H.K.
Blanco, J.	Kesou, A.	Sage, A.P.
Bodendieck, F.	Krause, H. P.	Sarkodie-Gyan,
Borsani , R.	Kubota, S.	Thompson
Bushnak, A. A.	Kumar, A.	Sommariva, C.
Capilla, A. V.	Kurdali, A.	Strathmann, H.
Catanzaro, E.	Laborie, J.	Temperley, T.
Damak, S.	Leitner, G. F.	Tleimat B.
Darwish, M. Ali	Lennox, F. H.	Todd, B.
Delyannis, E.u E.	Lior, N.	Tony F.
Dempsey J.	Ludwig, H.	Tusel, G.
El-Din, S.	Lukin, G.	Belessiotis, V.
El-Mahgary, Y.	Magara, Y.	Veza, J. M.
El-Nashar, A. M.	Makkawi B.	Vigneswaran, S.
El-Sayed, Y. M.	Malato, S.	Wade, N. M.
Finan, M. A.	Mandil , M.A.	Wang, S.
Furukawa, D.	Marquardt, W.	Wangnick, K.
Genthner, K.	McArthur,N.	Woldai A.
Germana, A.	Meller, F. H.	Watson, I. C.
Ghiazza, E.	Mewes, V.	Wessling, M.
Glade, H.	Michels, T.	Winters, H.
Goto, T.	Miyatake, O.	
Grabow, W. O.K.	Morin, O. J.	

CONTENTS

Availability Analysis of MSF Distillers Using Fault Tree Logic **1** R. Rautenbach and S. Schäfer, *Institut für Verfahrenstechnik Turmstrae 46, D-52056 Aachen, Germany*

1. Introduction
2. Theoretical Approach to Availability of Process and Plant Equipment
 - 2.1. Availability of Single Components
 - 2.2. Availability of Components with Redundant Stand by Equipment
 - 2.3. Systems or Subsystems of Single Components
 - 2.4. Redundant Systems and Subsystems with Planned and Unplanned Outages
3. Example of Water Shortage Scenario
4. Example of an Availability Study for Two MSF Distillers Using Fault Tree Logic
5. Data Collection of Failure Frequencies
6. Availability of Abu Dhabi Distillers
 - 6.1. Overhaul Maintenance
7. Fault Tree Analysis for Sub-systems of Existing MSF Distillers and Considerations for Future Design
 - 7.1. Fault Tree Analysis for a Typical MSF Distiller
 - 7.1.1. Selection of Investigated Subsystems
 - 7.1.2. Brine Re-circulation System
 - 7.1.3. Considerations for Future Plants
 - 7.1.4. Brine Heater Subsystem
 - 7.1.5. Considerations for Future Plants
 - 7.1.6. Blow Down Sub-System
 - 7.1.7. Considerations for Future Plants
 - 7.1.7.1. Operational aspects
 - 7.1.7.2. Monetary aspects

Control Schemes of Cogenerating Power Plants For Desalination **45** J. Dastyh, Pickhardt and H. Unbehauen, *Ruhr Universität Bochum, Germany*

1. Introduction to Combined Cycle Power Plants
 - 1.1. Gas Turbines in Power Plants
 - 1.2. Steam Turbines
 - 1.3. Main Control Loops
2. Operation Modes for Steam Turbines
 - 2.1. Condensing and Extraction Steam Turbine
 - 2.2. Back Pressure Steam Turbine
3. The Use of Cogeneration Power Plants for Desalination
4. Connecting of Power Plants and Desalination Plants

Fault Diagnosis Using Artificial Intelligence in Thermal Desalination Systems **66** N.J. Scenna and E.E. Tarifa, *UTN-FRR Zeballos 1621-2000- Rosario, Argentina and UNJu, Gorriti 237-4600- San Salvador de Jujuy, Argentina*

1. Introduction
2. Model Based Approaches. Qualitative vs Quantitative Approaches
3. Process Modeling using Signed Directed Graphs (SDGs)
4. Diagnosis using SDGs
 - 4.1. The Compilation of the SDG
 - 4.2. Fault Diagnosis using Qualitative Simulation
 - 4.3. The Use of Fuzzy Logic for Qualitative State Determination
5. The Computational Implementation
 - 5.1. Fuzzy Logic for Rule Evaluation
 - 5.2. The Expert System

6. A Diagnosis System for a MSF System
 - 6.1. DEDYSI. A Dynamic Simulator of MSF Desalination Systems
 - 6.1.1. The ODEs System
 - 6.1.2. Algebraic Equations System
 - 6.2. Qualitative Simulation of the MSF System
7. The Diagnosis System Performance
8. Conclusions
9. Further Study

Fault Diagnosis In Chemical Processes, Its Relation To Thermal Desalination Systems 91

E. Tarifa and N.J. Scenna, *UNJu, Gorriti 237-4600- San Salvador de Jujuy, Argentina and UTN-FRR, Zeballos 1621-2000- Rosario, Argentina*

1. Introduction
2. Characteristics of a Diagnosis System
 - 2.1. The Nature of the Diagnosis Problem
3. Different Approaches for Fault Diagnosis
 - 3.1. Model Based vs. Empirical Approaches
 - 3.1.1. Expert System Based Approaches
 - 3.1.2. Neural Network Based Approaches
 - 3.2. Model Based Approaches
 - 3.2.1. Quantitative Models
 - 3.2.2. Qualitative Models
 - 3.2.3. Qualitative Simulation
 - 3.2.3.1. Signed Directed Graph Based Approaches
 - 3.3. Fault Diagnosis Using Fuzzy Logic
 - 3.3.1. Fuzzy Logic and Signed Direct Graph Based Methods
4. Some Examples of Diagnosis Systems in Industry and in Desalination Processes
 - 4.1. Desalination Processes
5. Conclusions
6. Further Study

Introduction to Process Control

129

Andreas Bunzemeier and Herbert Krause, *ABB Utility Automation GmbH, Minden, Germany*

1. Theoretical Background
2. Control Theory in Practice
3. Future Development

Fundamentals of Control Theory

140

Andreas Bunzemeier, *ABB Utility Automation GmbH, Minden, Germany*

Lothar Litz, *Institute for Process Automation, University of Kaiserslautern, Germany*

1. Introduction – Kinds of Control
2. Basic Requirements on Control Quality
 - 2.1. Specifications of Continuous Control Systems
 - 2.2. Specifications of Binary Control Systems
3. Process Modeling
 - 3.1. General Process Characteristics
 - 3.2. Classification of Process Models
 - 3.3. Theoretical Modeling and Experimental Identification
 - 3.3.1. Theoretical Modeling
 - 3.3.2. Experimental Identification
 - 3.4. Models Based on Artificial Intelligence
 - 3.4.1. Fuzzy-Logic-Based Modeling

- 3.4.2. Artificial Neural Network Based Modeling
- 4. Types of Continuous Controllers
 - 4.1. Standard Controllers
 - 4.2. State Controllers
 - 4.3. Advanced Control Concepts
- 5. Stability of Continuous Control Systems
 - 5.1. Example 1: Stability of a position control system)
- 6. Concepts of Control Design
 - 6.1. Parameter Optimization
 - 6.2. Setting Rules for Standard Controllers
 - 6.2.1. Classical Tuning Procedure
- 7. Concepts of Binary Control Design
 - 7.1. Logical Control
 - 7.1.1. Example 2: On-Off Control of an AC Motor
 - 7.2. Sequential Control

Process Control Systems

187

Andreas Bunzemeier, *ABB Utility Automation GmbH, Minden, Germany*

Lothar Litz, *Institute for Process Automation, University of Kaiserslautern, Germany*

- 1. Historical Development
- 2. Functional Aspects
 - 2.1. Hierarchy of Functional Levels
 - 2.2. Field Level
 - 2.2.1. Sensors
 - 2.2.2. Actuators
 - 2.2.3. Signals and Standards
 - 2.3. Process Interface
 - 2.3.1. Measured Value Processing
 - 2.3.2. Actuator Interface
 - 2.4. Process Control Level
 - 2.4.1. Automation Degree
 - 2.4.2. Decentralized and Hierarchical Control
 - 2.4.3. Implementation of Control Algorithms
 - 2.5. Operation and Observation
 - 2.5.1. Operation Concepts
 - 2.5.1.1. Standard Displays
 - 2.5.1.2. User Defined Displays
 - 2.5.2. Control Room Concepts
 - 2.6. Process Scheduling and Supervisory Level
 - 2.6.1. Process Optimization
 - 2.6.2. Recipe management
 - 2.6.3. Maintenance support systems
- 3. Structural Aspects
 - 3.1. Hierarchical Structure of Hardware
 - 3.2. Bus Network
 - 3.3. Open Communication
 - 3.3.1. ISO/OSI Model
 - 3.3.2. Fieldbus
 - 3.3.3. Smart Technique
 - 3.4. Reliability
 - 3.4.1. Availability
 - 3.4.2. Self Diagnosis
 - 3.4.3. Redundancies
 - 3.4.4. Fault tolerant systems
 - 3.4.5. Fail-safe Systems
 - 3.5. Hardware Structure of Installation

- 3.5.1. System Topologies
- 3.5.2. Power Supply Concepts
- 4. Environmental Conditions
 - 4.1. Electromagnetic Compatibility (EMC)
 - 4.2. Temperature
 - 4.3. Humidity
 - 4.4. Lightning Protection
 - 4.5. Hazardous Areas
- 5. Engineering and Documentation
- 6. Installation, Commissioning and Maintenance
- 7. Quality Assurance and Performance Tests
- 8. Economic Aspects of Automation
- 9. Future Trends in the Field of Process Control

Control Valves Actuators

243

P. Muroi, *Parcol, Genova, Italy*
 R. Borsani, *Fisia Italimpianti, Genova, Italy*

- 1. Introduction
- 2. Pneumatic Actuators
 - 2.1. Diaphragm Actuators
 - 2.1.1. Operation
 - 2.1.2. Manufacturing Features
 - 2.1.3. Advantages and Disadvantages
 - 2.2. Rolling Diaphragm Actuators
 - 2.3. Multi-Spring Diaphragm Actuator
 - 2.4. Pneumatic Cylinder Actuator
 - 2.5. Operational Layouts
- 3. Oleodynamic (Electrohydraulic) Actuators
- 4. Electric Actuators
 - 4.1. Main Components of Electric Actuators
 - 4.2. Control Units
 - 4.3. Advantages and Limitations
- 5. Selection of Control Actuator
 - 5.1. Operating Environment

Control Valves Positioners

261

P. Muroi, *Parcol, Genova, Italy*
 R. Borsani, *Fisia Italimpianti, Genova, Italy*

- 1. Introduction
- 2. Pneumatic Positioner Operation
- 3. Electropneumatic Positioner
 - 3.1. Floating Coil Type
 - 3.2. Torque Motor
- 4. Selection of Positioner
 - 4.1. Signal Source: Pneumatic or Electric
 - 4.2. Supply and Signal Values
 - 4.3. Air Consumption
 - 4.4. Speed of Response
 - 4.5. Response to External Disturbances
 - 4.6. Static Gain
 - 4.7. Linearity, Hysteresis, Dead-Band, Repeatability
 - 4.8. Dynamic Response
 - 4.9. Protection and Installation
 - 4.10. Interchangeability

5. Use of Positioner
 - 5.1. For Accurate Valve Plug Positioning
 - 5.2. To Improve Actuator Performance
 - 5.3. To Increase Pneumatic Actuator Speed of Response
 - 5.4. To Operate Double-Acting Actuators
 - 5.5. For Split-Range Operations
 - 5.6. To Change Control Valve Flow Characteristics

Automation and Control of Thermal Processes

272

Reinhard Leithner, *Technische Universität Braunschweig, Germany*

1. Introduction
2. Thermal Processes
 - 2.1. Plants
 - 2.2. Main Plant Components
 - 2.3. Measuring Instruments
 - 2.4. Simulation and Optimization
3. Structures and Technologies of Automation and Control Systems
 - 3.1. Structures
 - 3.2. Technologies
 - 3.3. Actuators
 - 3.4. Duties and Functions
4. Future Developments

Automation and Control of Electric Power Generation and Distribution Systems: Steam Turbines

292

Bennauer M., Egenger E.-G., Schlehuber R., Werthes H. and Zimmer G, *Siemens AG, PG, Mülheim, Germany*

1. Introduction
2. Functional Specifications
 - 2.1. Fundamentals of a Steam Turbine
 - 2.1.1. Sectioning and Reheating
 - 2.1.2. Steam Bypass
 - 2.1.3. Combined Heat and Power Generation
 - 2.2. Conversion from Mechanical Power into Electrical Power (Generator)
 - 2.3. Connecting Units
 - 2.3.1. Steam Generator
 - 2.3.2. Consumer Net
 - 2.4. Operating Conditions and Load Dispatching
 - 2.4.1. Base-Load Plant
 - 2.4.2. Peak-Load Plant
3. Turbine Controller Design
 - 3.1. Steam Turbine Controller (Turbine Governor)
 - 3.1.1. Operating Modes
 - 3.1.2. Transition Between Different Operation Modes
 - 3.1.3. Set-Up of the Turbine Controller
 - 3.2. Bypass Controller
 - 3.3. Heat Extraction/Pressure Control
4. Future Developments

Combined Cycle and Combined Heat and Power Processes

314

Andrzej W. Ordys and Michael J. Grimbale, *University of Strathclyde, Glasgow, UK*
 İlhan Kocaarslan, *Kirikkale University, Kirikkale, Turkey*

1. Introduction

- 1.1. Economic Justification for CC/CHP Power Plants
- 1.2. Environmental Justification for CC/CHP Power Plants
2. Elements of Combined Cycle / Combined Heat and Power Processes
 - 2.1. Gas Turbine
 - 2.1.1. Classification
 - 2.1.2. Properties of Gas Turbines
 - 2.2. Boiler
 - 2.3. Steam Turbine
 - 2.4. Condenser
 - 2.5. De-aerator and Feed-water System
3. Typical CC/CHP Configurations
 - 3.1. Combined Heat and Power (CHP) Plant
 - 3.2. Combined Cycle Power Plant
4. Operation of CC/CHP Plants
 - 4.1. Start-up and Shut Down
 - 4.2. Steady-state Operation
 - 4.3. Dynamic Operation
5. Automatic Control in CC/CHP Plants
 - 5.1. The Tasks of Control System
 - 5.2. Gas Turbine Control
 - 5.3. Boiler Control
 - 5.4. Steam Turbine Control
 - 5.5. Coordinated Boiler and Steam Turbine Control
 - 5.6. Feedwater Control
 - 5.7. Auxiliary Controls
6. Control Philosophy in Future Combined Cycle Power Plants
 - 6.1. System-wide Communication
 - 6.2. Plant Management
7. Conclusions

Fault Detection and Diagnostics of Failures

343

V.V. Klyuev and V.N. Filinov, *Moscow Scientific Industrial Association "Spectrum", Moscow, Russia*

1. Basic Concepts
2. Relationship between Diagnostics and Reliability
3. Diagnostics aspects at the Design Stage
4. Diagnostics at the Manufacturing Stage
5. Diagnostics at the Operation Stage
6. Diagnostics at the Repair and Storage Stages

Index

371

About DESWARE

377