



Technology Training that Works!

Practical Boiler Plant Operation and Management for Engineers and Technicians

Contents

Preface		iii
1	Introduction	1
1.1	Fundamentals	2
1.2	Types of package boilers and their applications	3
1.3	Boiler components	16
1.4	Common boiler related terminologies and definitions	21
2	Fuel Combustion and Steam Generation Process	27
2.1	Overview of the boiler heating and steam generation process	28
2.2	Steam generation fundamentals	29
2.3	Influence of the type of fuel on boiler design	32
2.4	Firing appliances	33
2.5	Theory of combustion	46
2.6	Boiler efficiency	50
2.7	Fireside deposits and corrosion	52
3	Boiler Auxiliary Plant	57
3.1	Water treatment plant	58
3.2	Dosing	61
3.3	Feedwater pumps	63
3.4	Valves	65
3.5	Steam Traps	69
3.6	Piping	77
3.7	Fans	80
3.8	Heat recovery equipment	83
3.9	Flue gas cleaning and dust removal	88



Technology Training that Works

4	Operation and Controls	97
4.1	Boiler instruments and their purpose	98
4.2	P and I diagrams	107
4.3	Control systems and operating philosophy	111
4.4	Operational sequences and procedures	121
4.5	Safety equipment and interlocks	124
4.6	Safety procedures and emergencies	129
4.7	Operating records and logs	131
5	Pressure Containing Components	133
5.1	Basics of code calculation theory and assumptions	134
5.2	Overview of design parameters	136
5.3	Importance of pressure part inspection	139
6	Planning and Managing Boiler Maintenance	141
6.1	Maintenance policies and programs	142
6.2	Setting up an inspection program	142
6.3	Types of boiler inspections	144
6.4	Involvement of the authorized inspection authority (AIA)	146
6.5	Maintenance information and procedures	147
6.6	Developing a preventive maintenance program	148
6.7	In-house vs. contractor repair maintenance	149
7	Managing Boiler Repairs and Modifications	151
7.1	When does boiler repair become boiler modification?	152
7.2	Importance of historical records	152
7.3	Understanding legislative requirements	152
7.4	Steps to be taken upon identification of defect	153
7.5	Responsibilities of the boiler owner and repair contractor	154
7.6	AIA and inspection points	155
8	Cold Storage of Boiler	157
8.1	Establishing the storage period	158
8.2	Storage period and critical preservation steps	159
8.3	Consequences of a no storage plan	160



Technology Training that Works!!!

9	Control Principles and Design Concepts	165
9.1	Water level indicators and measuring devices	166
9.2	Draft and its function in the combustion process, draft types and measurement	169
9.3	Protection against implosion	171
10	Emission Controls and Environmental Constraints	173
10.1	Types of emissions for different fuels	174
10.2	Impact of nitrogen and sulphur oxide pollutants	175
10.3	Emission controlling methods	176
10.4	Methods used to control sulphur-dioxide	177
10.5	Methods used to control nitrogen oxides	178
10.6	Particulate control	179
10.7	Overview of various cleaning equipment and their Effectiveness	179
10.8	Specified emission levels	186
11	Boilers and Power Generation	189
11.1	Introduction	190
11.2	Power generation plant types	190
11.3	Typical layouts of power generation types	195
11.4	Boilers in power generation plants	200
11.5	Selecting the right boiler for power plant application	201
12	Waste-to-Energy Plants and Waste Heat Recovery	209
12.1	Introduction	210
12.2	Technologies used in energy recovery	210
12.3	Design and construction of waste-to-energy plants	212
12.4	Mass fuel burning	212
12.5	Refused-derived fuel burning	213
12.6	Operation and maintenance of refuse boilers	216
12.7	Waste heat recovery methods	217
12.8	Waste heat boilers	224
13	Troubleshooting Boiler problems	229
13.1	Normal and abnormal operation	230
13.2	Evaluating the condition of the boiler	232
13.3	Typical operational problems and causes	233



Technology Training that Works

13.4	Recognizing trouble indications	236
13.5	Signs of boiler trouble	240
13.6	Troubleshooting common boiler problems	247
<hr/> Appendix A: Exercises		253
<hr/> Appendix B: Answers to Exercises		269
<hr/> Appendix C: Practical Problems		273
<hr/> Appendix D: Answers to Practical Problems		277