

Table of Contents

1	Introduction	7
1.1	Background.....	7
1.2	Purpose.....	7
1.3	Scope.....	8
1.4	Benefits.....	8
1.5	Objectives	9
1.6	Key Concepts.....	9
1.7	Structure of the Guide.....	9
2	Key Principles and Relationships.....	11
2.1	Introduction	11
2.2	Philosophy	11
2.3	Maintenance Practices.....	11
2.4	Maintenance Program.....	12
2.5	Spare Parts and Materials	17
2.6	Training	17
2.7	Culture	18
2.8	Maintenance Key Relationships.....	18
3	Maintenance Good Practices and Maintenance Best Practices.....	21
3.1	Introduction	21
3.2	Overview	21
3.3	Maintenance Good Practices.....	22
3.4	Maintenance Best Practices	23
4	Maintenance Program.....	29
4.1	Overview	29
4.2	Examples of Maintenance Program (Outline), Maintenance Strategy, and Maintenance Plan	29
4.3	System Maintenance Strategy.....	32
4.4	Maintenance Plan	36
4.5	Types of Maintenance.....	39
5	Maintenance Management.....	43
5.1	Records for Facilities, Systems, and Equipment	43
5.2	Labor Resources.....	44
5.3	Planned Maintenance	45
5.4	Spare Parts.....	46
5.5	Paper-Based Maintenance Management Systems.....	49
5.6	Computerized Maintenance Management Systems	50
5.7	Maintenance Documentation	52
6	Work Execution	53
6.1	Work Order Management	53
6.2	Self-Inspection and Continual Improvement.....	64
6.3	Contract Management and Outsourcing.....	67
6.4	Change Management	69
7	Roles, Responsibilities, and Interfaces	73
7.1	Introduction	73
7.2	Roles and Responsibilities.....	73
7.3	Production and Maintenance	73
7.4	Project Engineering and Maintenance.....	74

7.5	Health, Safety, and Environment and Maintenance.....	75
7.6	Quality and Maintenance	75
7.7	Organizational Structure	76
8	Training	77
8.1	Purpose.....	77
8.2	Knowledge and Skills for Maintenance Personnel.....	77
8.3	Training Scope and Curricula Management	77
8.4	Training Methods and Trainers	79
8.5	Training for Vendors, Contractors, and Consultants	80
8.6	Training Effectiveness.....	81
8.7	Training Record Keeping and Regulatory Requirements	82
9	Appendix 1 – Regulatory Citations	83
10	Appendix 2 – Health, Safety, and Environment in the Maintenance Environment	87
10.1	Introduction	87
10.2	HSE Program Management for the Maintenance Unit.....	88
10.3	Hazards and Risk in the Maintenance Environment	91
10.4	Control of Hazards and Risks in Maintenance Work Areas	92
10.5	Permit to Work System	96
10.6	Control of Hazardous Energies, Lockout/Tagout	98
10.7	Confined Spaces and Restricted Spaces	99
10.8	Hot Work	101
10.9	Flammable and Explosive Atmospheres.....	102
10.10	Working at Heights.....	102
10.11	Working with Compressed Gases.....	103
10.12	Mandatory Maintenance Practices.....	103
10.13	Facility Design for Maintenance Safety.....	104
10.14	Environmental.....	106
11	Appendix 3 – Science-Based Quality Risk Management.....	111
11.1	Purpose.....	111
11.2	Risk Management.....	111
11.3	ICH Q9 Quality Risk Management Approach.....	111
11.4	Overview of the Quality Risk Management Process.....	112
11.5	Initiating Quality Risk Management	113
11.6	Risk Assessment.....	114
11.7	Risk Control	115
11.8	Risk Communication	116
11.9	Risk Review	116
11.10	Quality Risk Management Tools	116
12	Appendix 4 – Templates and Examples.....	117
12.1	Example Scenarios	117
12.2	Maintenance Strategy Template	118
12.3	Example Maintenance Plan	119
12.4	Example Maintenance Plan Checklist.....	121
12.5	Example Change Control Request/Approval Form.....	122
13	Appendix 5 – References	123
14	Appendix 6 – Glossary.....	125
14.1	Acronyms and Abbreviations	125
14.2	Definitions	126