

Preface

The history of mining may be traced back to the ancient Egyptians, who operated malachite mines. Today a large number of people are employed in the mining industry throughout the world. For example, in the USA alone around 675,000 people work in the natural resources and mining sector. Today, the mining industry uses various types of complex and sophisticated equipment whose reliability, maintainability, and safety have become an important issue.

Although over the years a large number of journal and conference proceedings articles on mining equipment reliability, maintainability, and safety have appeared, to the best of author's knowledge, there is no book that covers all three of these topics within its framework. This causes a great deal of difficulty for information seekers on the subjects because they must consult many different and diverse sources.

Thus, the main objective of this book is to combine all three of these topics into a single volume, to eliminate the need to consult many different and diverse sources in obtaining desired information. The sources of most of the material presented are given in the reference section at the end of each chapter. This will be useful to readers if they desire to delve deeper into a particular area. The book contains a chapter on mathematical concepts and another chapter on introductory material on reliability, maintainability, and safety considered essential to understand contents of subsequent chapters.

The topics covered in the volume are treated in such a manner that the reader will require no previous knowledge to understand the contents. At appropriate places, the book contains examples along with their solutions, and at the end of each chapter there are numerous problems to test reader comprehension.

An extensive list of references on mining equipment reliability, maintainability, and safety is provided at the end of the book to give readers a view of developments in the area over the years.

The book is composed of 11 chapters. Chapter 1 presents the need for improving mining equipment reliability, maintainability, and safety; mining-equipment-related facts and figures, important terms and definitions, and useful information on mining equipment reliability, maintainability, and safety classified under six distinct categories. Chapter 2 is devoted to mathematical concepts considered useful for per-

forming mining equipment reliability, maintainability, and safety analysis. It covers topics such as Boolean algebra laws, probability properties, useful mathematical definitions, and probability distributions.

Chapter 3 presents various introductory aspects of reliability, maintainability, and safety including reliability networks, commonly used methods in reliability analysis, maintainability functions, maintainability analysis tools, safety analysis methods, and safety indexes. Chapter 4 is devoted to mining equipment reliability and covers topics such as reasons for improving mining equipment reliability, open-pit system reliability analysis, programmable electronic mining system failures, fault tree analysis of shovel machine, and dump-truck tire reliability and factors affecting their reliability. Various aspects of human factors and error in mining are covered in Chap. 5. Some of the topics covered in the chapter are the need for human-factor application in mining, human sensory capacities, human-factor formulas, useful general human-factor guidelines for application in mining equipment design, classifications and causes of human errors leading to fatal accidents in mines, typical mining equipment maintenance errors, useful design improvements to reduce mining equipment maintenance errors, and human error analysis methods for application in the area of mining.

Chapters 6 and 7 are devoted to mining equipment maintainability and mining equipment reliability and maintainability testing, respectively. Chapter 6 covers topics such as reliability test classifications, success testing, accelerated testing, confidence interval estimates for mining equipment mean time between failures, test methods to obtain maintainability-related test data for mining equipment, test methods for demonstrating diverse maintainability parameters, and useful guidelines for avoiding pitfalls in maintainability testing of mining equipment. Some of the topics covered in Chap. 7 are the meanings of the mining equipment maintainability and design-induced maintainability problems of mining equipment, advantages of the improved mining equipment maintainability design, mining equipment maintainability design characteristics, maintainability measures for mining equipment, and common maintainability design errors and useful maintainability design guideline for mining equipment.

Chapter 8 presents various important aspects of mining equipment maintenance including maintenance-related facts and figures, factors contributing to equipment maintenance cost in mines, maintenance of explosion-protected switchgear in mines, useful maintenance measures for mines, and mathematical models for performing mining equipment maintenance. Various important aspects of mining equipment costing are covered in Chap. 9. Some of the topics covered include reasons for mining equipment costing, methods for making mining equipment investment decisions, cost estimation models for mining equipment, life cycle costing concept, and life cycle cost estimation models for mining equipment.

Chapter 10 is devoted to the introductory aspects of mining equipment safety and covers topics such as facts and figures, quarry accidents, causes of mining equipment accidents and major sources of mining equipment fires, methods for performing mining equipment safety analysis, human-factor-related tips for safer mining equipment, strategies to reduce mining equipment fires and injuries, and general ar-

eas for safety improvements in mines. Finally, Chap. 11 presents various important aspects of programmable electronic mining system safety including programmable-electronic-related mishaps, methods for performing hazard and risk analysis of programmable electronic mining systems, lessons learned in addressing the safety of programmable electronic mining systems, and sources for obtaining programmable electronic mining system safety-related information.

This book will be useful to many individuals including engineering professionals working in the mining industry, mining administrators, mining engineering undergraduate and graduate students, mining engineering researchers and instructors, reliability, maintainability, maintenance, human factors, and safety professionals, and design engineers and associated professionals concerned with mining equipment.

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