# AN INTRODUCTION TO THE BASICS OF RELIABILITY AND RISK ANALYSIS

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*To my life team members: Giorgia, Aurora, Cecilia and Matteo*
*To my work team members: my students and collaborators*

*Milano, 21 December 2006*

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## *About the Book*

This book introduces the principal concepts and issues related to the safety of modern industrial activities and presents the classical techniques for reliability analysis and risk assessment used in the current practice. It is aimed at providing an organic view of the subject.

The contents of the book comprise: *i)* a basic illustration of some methods of system analysis commonly used in practice for the identification of the hazards associated to industrial plants and processes; *ii)* a review of the basics of probability theory, tailored to its application to reliability analysis and risk assessment; *iii)* an overview of the basics of reliability, availability and maintainability applied to standard system configurations, such as series, parallel, stand-by and others; *iv)* a presentation of the fault tree and event tree analysis methods, which constitute powerful tools widely used in practice for the reliability and risk assessment of complex systems; *v)* a review of the statistical methods for the estimation of failure rates; *vi)* a sketch of some modelling techniques of reliability growth and prediction.

The book can serve as any senior undergraduate or post-graduate university course on the subject or as reference for the initiation of young researchers to the field. In this view, several numerical examples are provided when appropriate, as guide for the comprehension.

## *About the Author*

Enrico Zio (BS in nuclear engineering., Politecnico di Milano, 1991; MSc in mechanical engineering., UCLA, 1995; PhD, in nuclear engineering., Politecnico di Milano, 1995; PhD, in nuclear engineering., MIT, 1998) is a full professor of Nuclear Engineering and Dean of the Graduate School of the Politecnico di Milano, Italy. He holds a course on *Computational methods for safety and risk analysis* at the Politecnico di Milano and has served as lecturer at various Master and PhD programs in Italy and abroad.

He has served as Vice-Chairman of the European Safety and Reliability Association, ESRA and as Editor-in-Chief of the International journal Risk, Decision and Policy. He is member of the editorial boards of two recognized international scientific journals and has been involved in the organization of various international conferences, in the field of Safety and Reliability.

His research interests are: analysis of the reliability, safety and security of complex systems under stationary and dynamic operation, particularly by Monte Carlo simulation methods and cellular automata; development of soft computing techniques (neural networks, fuzzy logic, genetic algorithms) for safety and reliability applications, system monitoring, fault diagnosis and optimal design. He is co-author of one international book on Monte Carlo simulation applied to reliability and risk analysis and of more than 100 papers on international journals.

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