nuclear fuel management, waste management and environmental impacts, and analysis of alternate energy sources. He advises the Japan Atomic Energy Commission on these matters. Professor Kiyose is a member of the Executive Committee of the Japan Section of the American Nuclear Society (ANS) and of the Institute of Nuclear Materials Management. He is also a member of the ANS Standards Committee.

EMP Radiation and Protective Techniques. By L. W. Rickets, J. E. Bridges, and J. Miletta. John Wiley and Sons, Inc., New York (1976).

This book presents a good introduction to the nature of electromagnetic pulse (EMP) produced by a nuclear detonation. A book on this subject is long overdue. It was written for the design engineer, project officer, or program manager who needs to know how EMP is generated, its effects on electronic equipment, and EMP protective methods. The text is well illustrated with figures, tables, and a few photographs, and the mathematical level is relatively simple. Some specific EMP problem-solutions are included, although most of the text deals with the more general and fundamental aspects of EMP.

The first chapter covers the EMP environments produced by detonations at altitudes ranging from near the surface to high altitudes well above 40 km. The EMP source regions, areas of coverage, and time histories are discussed for low- and high-altitude bursts. This chapter provides the reader with some useful information concerning the various EMP environments. The importance of high-altitude EMP to both military and civilian systems because of its large area of coverage is explained. Also, internal EMP, which is the EMP produced by the direct interaction of gamma radiation with a structure, is discussed.

The second chapter covers EMP coupling. Electrical conductors exposed to the electromagnetic fields perform as antennas and receive EMP energy. The quasi-static approach to calculating the electrical transients induced in electrically small conductors is defined. The rigorous approaches to calculating EMP-induced transients in larger structures are also discussed, and some example calculations are included. Three classes of problems are discussed: the overhead power line, the monopole antenna, and the buried shielded cable. This chapter contains some simple approximate formulas for the buried shielded cable that are most useful if the reader would like to perform his own calculations. Unfortunately, such simple formulas are not included for power line and antenna problems. Also, the authors completely overlooked the Singularity Expansion Method for solving EMP interaction problems.[1]

The third chapter covers failures for such components as transistors, diodes, resistors, and capacitors. Techniques for predicting the pulse power threshold levels that will likely result in damage to semiconductor components are presented. Simple formulas are used to compute the damage threshold levels from the components' parameters. Tables show failure levels of resistors and capacitors.

EMP protective techniques are discussed in the fourth chapter. The techniques covered are electromagnetically shielded enclosures, cable shields, filters, and EMP surge arresters. Some very useful test results on many EMP surge protective devices are included, as is a table listing over a dozen suppliers of surge protective devices. This chapter should be very helpful to those interested in transient protection and EMP hardening.

The remaining chapters cover laboratory test techniques and EMP hardening at the system level. The system hardening chapters will be of interest to manufacturers that have to meet EMP specifications for miliatry and civil defense hardware. The various EMP simulation facilities are discussed in an appendix. These simulators are used to test for EMP vulnerabilities, adequacy of EMP protection, and verification of theoretical calculations.

In summary, this book does accomplish its purpose, which is to present EMP information for the project officer, design engineer, or the program manager. It presents very good insight to the nature of EMP and how to protect against it. Those involved in EMP analysis of complicated systems will probably find that the EMP coupling techniques discussed in this book are not adequate except for a very few simple structures. However, even the EMP analyst will find that this book is a useful reference.

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About the Reviewer: P. R. Barnes has been involved in EMP studies since 1968. He spent the first four years working on EMP simulation and interaction problems at the Air Force Weapons Laboratory. Since 1972, he has analyzed the effects of EMP on power and communications systems as a research associate at the Oak Ridge National Laboratory. His academic training was at the University of Kentucky and the University of New Mexico, where he earned his Masters in Electrical Engineering. His research interests are in the fields of EMP and energy.

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[1] CARL E. BAUM, *Proc. IEEE*, **64**, *11*, 1598 (Nov. 1976).