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Book Reviews

Reactor Noise. By Joseph A. Thie. ANS Monograph. 262 pp. $6.95, hardbound, $4.45, paperback.

Reactor Noise is the first of a series of monographs developed through the joint efforts of the American Nuclear Society and the Division of Technical Information of the U. S. Atomic Energy Commission. The book's objective is to present a concise and authoritative treatise on the theoretical and experimental processing of random fluctuations which are usually superimposed on the measurable variables of nuclear systems. The purpose of processing these fluctuations is either to extract useful information concerning the dynamic characteristics of the reactor system or to reduce their effects on the accuracy of desirable measurements.

The monograph is organized in eleven chapters. The first five chapters discuss the terminology necessary for the description of noise-like signals and the statistical theory pertinent to random fluctuations with statistical regularity. Probabilities, distribution functions, correlations and power spectral densities are discussed in chapters 2 and 3. Cross-correlation and autocorrelation functions and their spectral densities are given in detail in chapters 4 and 5 respectively.

Chapters 6 and 7 are devoted to a summary of experimental results using noise analysis by a number of investigators working with low-power subcritical reactors or assemblies.

The next three chapters are concerned with the special analog or digital equipment that has been used by different laboratories for the recording and analysis of noisy data. Finally, chapter 11 is an account of the results of a number of experimenters who used noise techniques to investigate the dynamic behavior of reactors operating at full power.

The monograph is written in very simple language and is practically free of typographical errors. It is addressed to both practicing engineers and scientists and newcomers in the field of linear reactor dynamics. The author makes a continuous effort to illustrate the various concepts by means of simple and suggestive examples and experiments. He summarizes the available experimental data very faithfully and he tries to reproduce objectively the different points of view that a variety of experimenters have developed. He also discusses throughout the monograph the meaning and importance of the experimental results with regard to their improving the understanding of linear reactor dynamics.

All these attributes reflect the author's fluent knowledge of the field and make the monograph a practical introduction to the basic notions of noise analysis, a purposeful collection of experimental results and useful description of the electronic gear required for reactor-noise studies.

It is possible that limitations of space and the desire of the author to address the monograph to readers of varied backgrounds have introduced in the text some comments and omissions that may disturb the "rigor hungry" or misguide the novice. Some samples are: the illustrative example of ergodicity (p. 14), the definition of gaussian, white noise (p. 31), the introduction of spectral powers for aperiodic functions (p. 35), the formulas for the Fourier representation of white noise (p. 40), the lack of discussion of the implications of considering T = finite for statistical events whose statistics are defined over an infinite time (pp. 49-52) (see for example, Feller, *An Introduction to Probability Theory and its Applications*, Vol. 1, pp. 65-87, Wiley, New York (1957) and Davenport and Root, *Random Signals and Noise*, p. 107, McGraw-Hill, New York (1958)), the implicit or explicit suggestion throughout the text that power spectral densities contain more information than the corresponding correlation functions, etc. Also, $\phi_{xz}(0)$ (p. 64) is the average power and not the total power.

In chapters 6 and 7 a variety of "Theories" or methods are derived from scratch and then compared with experiments. The reader is left with the impression that at least five or six "theories" are necessary to understand the dynamic behavior of subcritical reactors or subcritical assemblies. This reviewer wonders whether it would have been more appropriate to derive one formula for both chapters and then adapt it to short or long times, to large or small frequencies, or to critical or subcritical reactors. In this connection, it is not

clear why Cohn's "theory" (p. 123) is applicable to critical reactors when its equivalent in the time domain (p. 103) is not.

Finally there is an important question which has not received a satisfactory answer in chapter 11: "how does one decide whether a resonance in the power spectral density of the fluctuations of a reactor variable constitutes an instability hazard, a warning of a minor malfunction or an unimportant indication?"

The data on EBWR (p. 227) suggest that the resonance indicates a deterioration of stability. The data on Dresden (p. 235) suggest that the resonance is associated with an unimportant pulsation in the risers. The data on N. S. Savannah (p. 238) suggest that the random reactor reactivity input does not have a flat spectrum, a result that is just as acceptable as a flat spectrum, etc. This variety of results means that analysis of the noise inherent in reactors cannot be uniquely interpreted unless other measurements (such as oscillation tests) are available. But if other measurements are available, why noise analysis?

Obviously the feelings of this reviewer about *Reactor Noise* are scattered throughout the "sample space." Their probability density distribution covers both positive and negative events. Even though the number of samples is limited, it is reasonable to state that the distribution is "normal" with a positive definite mean.

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Treatment and Storage of High-Level Radioactive Wastes. Proceedings of a Symposium in Vienna in October 1962; International Atomic Energy Agency, Vienna, 1963, 666 pages, $13.00. (Available from International Publications, Inc., 317 East 34th Street, New York 16, New York.)

The purpose of the Symposium and a general idea of the nature of the contents of the book are contained in the following excerpt from the Forward:

"The highly radioactive 'wastes' arising from the reprocessing of irradiated fuel pose long-range problems, and methods for the ultimate disposal of these wastes must be developed and evaluated. Such development and evaluation can be materially assisted by providing the scientists doing the work with an opportunity of exchanging ideas and information on their experience. Therefore, the IAEA, as part of its programme of promoting nuclear technology, convened in Vienna from 8-12 October 1962 the Symposium on the Treatment and Storage of High-Level Radioactive Wastes.

"The Symposium was attended by 130 scientists from 19 countries and two international organizations. Thirty-three papers were presented and discussed in full and formed a background for a panel discussion of chairmen near the end of the Symposium. The papers and a record of the discussions are published in this single volume."

The contents include: a review of current waste management practice in the United States (tank storage) plus a summary of the United States' research program; seven papers, under the general heading of concentration and storage, which cover a hodgepodge of current waste-treatment practices at specific installations, projected future programs, and research programs on various phases of treatment and disposal; seven papers (all from the United States) on solidification and fixation of liquids by calcination; eleven papers on vitrification; four papers on miscellaneous methods of solidification and fixation; a paper describing a French pilot plant for packaging solid wastes of various types; and a paper on shipment of gross quantities of radiostrontium.

Fourteen of the papers concern practices and research in the United States. All of the papers have English abstracts, but six of the texts are in French and five are in Russian. All discussions are in English.

As one might conclude from the above, the volume is a handy reference for persons who are directly involved in some aspect of high-level waste treatment and disposal. It brings together rather detailed information on both current practices and current research in most of the world. The discussions following each paper and the general discussion at the end of the symposium bring out some of the differences in opinion and in philosophy of waste management between countries, as well as between different establishments within countries.

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