presented for nuclear materials subject to international nuclear material safeguards. Several other applications are treated or briefly mentioned in the last third of the monograph, including materials accountability in the chemical industry, industrial metals, economics, socialist economies, environmental studies, and arms control.

Avenhaus acknowledges early in the monograph that some may feel that a much more sophisticated formalism has been used than is necessary for treatment of his illustrative applications. A presentation of the principles of materials accountability that is more readily understood would be interesting and helpful to most readers with responsibilities in the field of nuclear materials accounting. The 1975 American Nuclear Society monograph, *Nuclear Materials: Accountability, Management, Safeguards*, by James E. Lovett gives such information. The 1973 U.S. Atomic Energy Commission publication, *Statistical Methods in Nuclear Material Control*, by John L. Jaech gives comprehensive information on applications of statistics to nuclear material control.

Avenhaus analyzes the safeguards application where materials accounting is applied to nuclear materials inventories and flows measurable and verifiable by a measurement technique. The plant operator measures all material and the inspection team verifies the plant operator's data by independent measurements of materials chosen on a random sampling basis. The material balance principle is applied to detect data falsification for the purpose of diverting material and evading detection. The contest between the inspection team and a would-be diverter is expressed in terms of zero-sum games, with payoffs to diverters and inspectors expressed in terms of probabilities of detection. The technique is then used to address the question of determining the optimal strategy for an inspection team. Examples considered include inventories containing different numbers of batches, materials, and measurement variances. Although the plant operator and inspector team are not required to use the same measurement technique, each is assumed to use only one measurement technique on any specific material to be measured.

The treatment in this monograph does not give sufficient attention to the common practice of an inspectorate that makes better use of the modern inspection tools at its disposal. Current practice includes the use of more than one verification technique by inspectors. Simple and quick measurements, as by nondestructive assay, are now made to detect any gross diversion from a large part of an inventory, while painstaking measurements to weigh, sample, and analyze materials are made on a far smaller part of an inventory to detect systematic bias. The ability of an inspection team to detect diversion has been greatly increased in this and other ways, including tamper-indicating monitors now in use to provide credible information on operations during the absence of inspectors.

The aspect of this game theory treatment that I found most difficult to accept is the degree of emphasis on a specific, preestablished limit to the amount of inspection effort allowed, even after an abnormality or discrepancy appears to have been found. According to Avenhaus, a second action level would follow such a discovery, but it would be limited to recalibration of instruments and a check for transcription errors and, if the difference persists, a report to the "international authority." Avenhaus does not look favorably, for instance, on making additional measurements and does not consider any other immediate action to clarify the situation. He feels there is a need to avoid disturbing the operation of a plant that must be protected against "overambitious" inspector teams. In my opinion, the possibility of further action should not be set aside so quickly because the immediate resolution of an identified, significant abnormality will be in the interest of the plant operator, his national government, and their presumed goal of international credibility.

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Boiling Liquid-Metal Heat Transfer

Author	O. E. Dwyer
Publisher	American Nuclear Society (1976)
Pages	446
Price	$37.95
Reviewer	Adrian M. Tentner

One of the American Nuclear Society monograph series, this book provides an overview of the technical status of boiling liquid-metal heat transfer. Written for researchers, design engineers, and graduate students in nuclear, mechanical, and chemical engineering, the book contains detailed explanations of the theoretical aspects of liquid-metal boiling. The author refers to numerous papers and reports on original research in presenting a large amount of experimental data and various liquid-metal pool boiling heat transfer correlations.

Much of the information in the book, such as the calculated and experimental results, is based on sodium, thus rendering the book particularly useful to those involved in liquid-metal fast breeder reactor development and safety analysis. However, considerable information on potassium, mercury, rubidium, and cesium is also included.

Major sections of the book deal with incipient boiling superheats and growth of spherical bubbles in superheated liquid, the ebullition process in nucleate boiling, nucleate and film boiling heat transfer in pool boiling of liquid metals, and critical heat flux in nucleate pool boiling of liquid metals.

The book is well written, and the treatment of theoretical aspects of liquid-metal boiling is sufficiently basic so that useful application of them can be made to the analysis of a variety of situations. Furthermore, the drawing together of comprehensive information from numerous published papers as well as the extensive reference lists will be highly useful to those having an interest in the field.

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