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BOOK REVIEW

Thermal Analysis of Pressurized Water Reactors, L. S. Tong and J. Weisman, 2nd Edn.

The second edition of this book presents a generally well-done updating of the first edition with PWR thermal/hydraulic material published over the last decade. The authors have retained the original basic format and added, deleted and reordered materials as new developments have dictated. The areas of computed-based design techniques and safety analysis have been considerably expanded. Specific information on the pressurized heavy water (CANDU) and even the light water breeder reactor (LWBR) has been added allowing the contents to reflect more appropriately their title. A useful summary has been added at the end of each major section and it appears that equation errors in the first edition have been corrected. However, not all topics or correlations which needed rework were addressed and in several cases the supplementary information itself needs clarification. Such deficiencies occur predominantly in Chapters 3 and 4.

The contents are organized into five chapters, which might more aptly be called sections. under each of which is a wide range of relevant topics. Chapter 1 deals with Power Generation. Here the significant additions deal with recognition of the recent steam generator problems, CANDU and LWBR characteristics, methods for rapid estimate of core power distribution, and power distribution following a load change. The later topic is particularly useful as the vehicle for introducing the means of control of axial peaking due to xenon transients. Here, however, the terms and formula presented refer solely to the Westinghouse approach. Additionally the comparable approach for BWRs should indicate that the goal is to maintain the axial power over a cycle not over the in-core fuel life.

Chapter 2, Fuel Elements, represents an extensive revision and a well-integrated presentation of the thermal, metallurgical and structural factors involved in fuel element design and performance. Useful additions or supplementary discussion here include the topics of alternate fuels as U_3Si and metallic thorium, zirconium corrosion, clad behavior in transients and thermal performance of annular fuel shapes. The most significant addition is the comprehensive discussion of Behavior of UO_2 Fuel Elements which includes recent experience regarding densification, swelling and mechanical behavior of the clad. The chapter concludes with an expanded discussion of multi-region calculational procedures which have been proposed and specific identification of the more sophisticated behavior codes available now. There is not much new in the presentation of thermal analytic techniques for fuel elements because the first edition covered this area well.

In Chapters 3 and 4 which deal with Hydrodynamics and Heat Transfer and Transport respectively the characteristic strengths and weaknesses of the text are most apparent. As in the previous chapters significant additions have been made to reflect recent additions to the literature. For example, sections on pressure drop across area changes, flooding, subchannel analysis and the boiling crisis have been added or supplemented. Additionally, materials have been reordered to yield a more coherent sequence. The coverage is generally that of a literature survey with sufficient equations to enable a calculation to be made. However, the authors did not take the opportunity to provide a consistent depth of coverage of the topics covered. Furthermore, some additions are in error or confusing. For example the Owens friction factor is evaluated at a liquid Reynolds number based on the total flow as liquid so that a two-phase viscosity is not needed for this type of homogeneous approach. The discussion of pressure loss across an insert involving contraction and expansion would be considerably clearer regarding selection of computational formula if the criteria for estimating the location of the vena contracta relative to the restriction had been given. The discussion of the Zuber–Findlay model is not cast

clearly in terms of global and local slip and thereby the opportunity to contrast it to the previously presented void fraction models is cast away. The topic of flow redistribution is not covered by showing the various formulations as progressive simplifications of the general transverse momentum equation while on the other hand the basic thermohydrodynamic equations for flow stability analysis are rather fully presented. Nusselt numbers for rod bundles are presented only in terms of early correlations of Weisman whereas the more recent and broader correlation of Markoczy as not mentioned.

The text concludes with Chapter 5 which covers Thermal and Hydraulic Performance of a Reactor Core. Here the Design Basis is presented along with information on design procedures which utilize the fundamental information presented in previous chapters. Further specific attention is focused on transient performance and current means for PWR transient analysis.

This book meets its goal of providing an updated overview for students and a reference for practicing engineers concerning thermal and hydraulic analysis of pressurized water reactors. Considerable information is provided regarding the interface areas of power distribution, fuel metallurgical performance and structural analysis to acquaint the reader with these factors which relate and influence the thermal/hydraulic design procedure. However, the reader must come to this book with an understanding of engineering fundamentals. Here he will find an identification of procedures, empirical data and engineering properties but generally not a clear indication of their origin or complete reduction from the relevant conservation equations. However the book is fully referenced thereby allowing the interested reader to acquire the depth of understanding he feels appropriate. Considerable effort has been spent in updating the coverage as evidenced by two footnote additions covering the very recently published WRB-1 critical heat flux correlation and the one-pass core analysis method using the COBRA/IIICMIT Code. This book rightfully stands as the authoritative text on the current practice of thermal/hydraulic analysis of Pressurized Water Reactors.

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