SYMPOSIUM ON THEORETICAL MODELS FOR PREDICTING IN-REACTOR PERFORMANCE OF FUEL AND CLADDING MATERIAL

INTRODUCTION

FUELS III–SPECIAL SESSION ON INTEGRAL FUEL ELEMENT PERFORMANCE MODELS

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The following seven papers constitute the proceedings of Session III on Integrated Fuel Element Performance Models for the Symposium on Theoretical Models for Predicting In-Reactor Performance of Fuel and Cladding Materials. This session represents the first time that people from a number of organizations have met to discuss the development of analytical methods for the design and prediction, with high confidence, of the performance of fuel elements in LMFBR's. The progress described in these papers is a significant and an early step "Towards the Engineering Design of Reactor Fuel" as cited by E. E. Kintner, assistant director for Reactor Engineering, RDT, at the International Conference on Fast Reactor Irradiation Testing, held in Thurso, Scotland, last April. In this context, this session and this symposium both reflect the priority that RDT has placed on developing the required capability and the response of the laboratory and industrial organizations participating in LMFBR Fuel Element Development.

Fortunately, the progress to date in the modeling of light-water reactor fuel elements provides a starting base for the development of an analytical approach to fast reactor fuel element modeling, reducing the time and magnitude of the effort yet required to include the even more complex engineering aspects of fast reactor fuel design such as cladding swelling, high thermal gradients, enhanced cladding creep, transient behavior, and ability to accomodate normal operating transients without significant degradation in quality or ability to be operated to very high fuel burnup.

The "state of the art" reflected in the papers of this session consists of the development of integral models, some based on extensive (macroscopic) properties and behavior, and others based on intrinsic (microscopic) properties and behavior. Both approaches are necessary and of value at this early stage. As yet, it has not been possible to fully evaluate and incorporate the models of fuel and cladding behavior as subroutines into the integral models.

Considering progress yet to be made, one looks forward in the near term to the further incorporation of differential models into integral models, interaction between prediction of fuel element performance and new experimental data, increased utilization of models as a basis for sensitivity analyses and design of future irradiation tests, interpolation between designs, increased emphasis on transient behavior, and first postulates of performance limits. In the long term, it should be possible to make reliable performance predictions confirmed by test and incorporating reliability analysis into prediction of behavior of all of the fuel in a fast reactor.