

COMSOL Multiphysics® Software Activities Within the Research Reactors Division of Oak Ridge National Laboratory

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Abstract

INTRODUCTION

Our group at ORNL started using COMSOL Multiphysics® software shortly after version 3.0 was released in the Spring of 2004. After 11 years and several releases, the application usage has grown along with number of licenses we are responsible for. This paper will broaden the scope and take a look at our past and present applications, and evaluate where we are headed with COMSOL software in the future. In doing so, we reveal some lessons learned along our pathway, provide some insight on how best to use COMSOL in a group setting, and perhaps help both users and developers to improve how the code is utilized.

WHY WE ARE USING COMSOL

A discussion is made for why we have chosen COMSOL software as our modern engineering analysis tool. While the impressive graphical user interface (GUI) features are a positive influence on continued use, and expansion of the user base, these are not the fundamental reason for our initial and continued renewal of the software.

SOME SUCCESS STORIES

In this section, I provide some overview of two of our most successful uses of COMSOL software in the past. I also provide references where the reader may find some details on specifics.

OUR CURRENT APPLICATIONS

Our most active usage for COMSOL software at the present time is associated with the conversion of the High-Flux Isotope Reactor (HFIR) of ORNL from high-enriched uranium (HEU) to low-enriched uranium (LEU) fuel. I will update the reader on where we are on this long-term project. Figure 1 provides a summary.

An update will be included here on the role of COMSOL on other previously-presented projects including the irradiation and production of Pu-238 for a power source for NASA deep space flights.

ANTICIPATED EXPANSION OF OUR APPLICATIONS

Several areas of research are ongoing whereby COMSOL software modeling is expanding into our current base models. Separate-effects COMSOL models have already been developed for fluid-structure interaction and hot-spot analysis via fuel segregation, and non-bonding. These separate-effects models are to be integrated into our current set of LEU fuel plate models.

New areas of research are presently being investigated for incorporation into our existing COMSOL models: (1) fuel swelling due to irradiation, (2) equation-based modeling of nuclear reactor physics, and (3) multiple-plate models.

Using these new developments, anticipated model development might include: (1) full fuel element models, (2) entire core models, (3) flow blockage models, and (4) other severe accident simulations.

BEST PRACTICES

As we increase our COMSOL software usage and users, it presents problems of a different sort that are more managerial and logistic than software related. This section will provide some details on the following activities taking place at our facility that may be of interest to the readers of this paper: (1) software, license, and documentation management, (2) local COMSOL user group, (3) local tips and tricks library, and (4) software quality assurance.

SUGGESTIONS AND CONCLUSIONS

REFERENCES

Figures used in the abstract

HFIR COMSOL Best-Estimate Model Typical Results

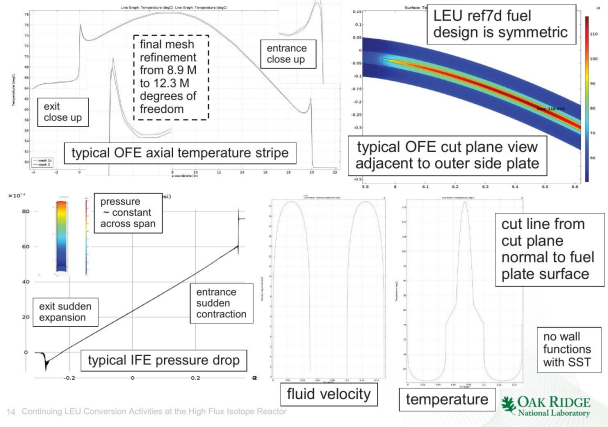


Figure 1: Typical Results from the COMSOL Best-Estimate Model of a Proposed Design of a HFIR LEU Fuel Plate