24.536 Reactor Experiments and 407.403 Advanced Nuclear Lab

HW #5: Subcritical Multiplication and "Approach to Critical" Post-lab Exercises

Introduction

The purpose of Reactor Experiment #1 is to predict the critical height of a control blade within the UMass-Lowell Research Reactor (UMLRR) using the inverse subcritical multiplication factor method (i.e. the 1/M method) and, in the process, to get a better understanding of subcritical source-driven systems. A rough prediction of the critical blade height will be done during the actual experiment and the development and understanding of the basic methodology should come from your pre-lab analysis (i.e. HW#4). Thus, for the post-lab phase of this experiment, you only need to confirm/refine the results obtained during the lab, and to briefly summarize your in-lab and post-lab data and results from the experiment, along with some discussion of your methodology and any important observations from your work.

The specific tasks and deliverables for this post-lab assignment are described below:

Task 1: Summarize Results from Reactor Experiment #1: Approach to Critical Lab

Perform each of the following tasks and include your responses, analyses, and discussions, as needed, as part of your complete package for HW#5.

Problem 1: Access the full set of measured data from the day of the experiment from the Dropbox share folder for this course and post-process these data accordingly. In particular, using the ***umlrr_data*** Matlab GUI you can easily highlight the time intervals of interest, perform suitable averaging over these intervals, and confirm/update the approximate average count rate data for each step of the full approach to critical experiment. Be sure to include summary plots of the measured blade position vs time and the measured startup counter (SUC) count rate vs. time and refer to these as part of your discussion. Based on your new post-lab analysis, were any of your original data from the day of the lab modified significantly after a more critical review? Did the estimate of the final predicted critical height change by much? Did everything behave as expected? Explain any interesting observations from your in-lab and post-lab comparisons.

Problem 2: Make a summary table of your final data for the experiment and generate a final 1/M plot that shows the complete approach to critical procedure in graphical form. Describe the procedure used to obtain this curve and interpret for the reader what is happening here.

Problem 3: Discuss how well the critical height was predicted in this experimnet. In particular, at the end of the lab, the reactor staff will take the reactor critical via movement of the RegBlade. Based on the difference between the final and the fixed position of the RegBlade during the experiment -- along with some knowledge of the blade worth curves -- you can determine how close to critical the final position of the control blade under study actually was. Discuss this subject in some detail -- that is, be sure to quantify and discuss how well the class did in predicting the actual critical height in this particular UMLRR configuration…

Problem 4: Finally, discuss your overall experience from this lab -- that is, did it help you understand the behavior of subcritical systems, the term "relative subcritical multiplication factor, M_r", what is meant by a "1/M curve", and how this is used to predict when a system will actually go critical (by varying some parameter in the system)? Also please comment on any changes that could be made in future experiments of this type to improve the overall learning experience for the class…

Documentation and Submission of HWs

In general, I expect a professional, well-written, semi-formal report for each HW assignment in this course. Please refer to HW#1 regarding the format for each HW assignment in this course -- **they should all be done and submitted in a similar fashion!!!**

For this HW, you need to post-process the measured data from the experiment and to discuss these data and the resultant predicted critical height obtained from your work, and how this compares to the actual critical position observed in the experiment. As done previously, please put everything together, including all your Matlab m-files or Excel files to do the 1/M plots, in a single zip file -- **only one zip file per HW please** -- and **email this to me before 4 pm (UML time) on the Sunday** before our next class.

Good luck…