ARH-600 and CritView – A Brief History

Introduction

During the beginning of the nuclear era, computers and material cross sections were almost unheard of. Thus, the nuclear material process developers primarily relied upon critical experiments. The results of the experiments were frequently used to directly support process operations. The use of hand calculation methods such as geometric transformations using neutronic bucking relationships were applied to allow the experimental results to be applied to disparate configurations.

As computers came into the picture the CS practitioners developed codes to assist with the process evaluations. However, these computers were slow, and computer time was expensive, cross-section libraries were limited, thus basic parametric analyses were performed and documented to facilitate comparison with, and extension of, the experimental results. The documentation of these results allowed the use of this information by other practitioners.

ARH-600

The ARH-600 parametric evaluation compendium was developed at the DOE Hanford site in Washington state in the early to later 1960’s. At the time computers and their codes were obviously not as powerful and advanced as today. It is of note, then, that even though the calculations were performed using simple geometries (1 or 2 dimensions), few group cross sections (1 to 3 groups), the uncertainties were large (sometimes more than 10%), and the curves in ARH-600 were drawn using a French curve, with the goal to incorporate as many of the 3-6 points available, the results are reasonably close to what we find today using modern codes and cross sections.

Other sites also developed their own compendiums, and these have been published in documents such as LA-10860 (LANL) and TID-7016 (ORNL).

CritView

The CritView code was developed at Hanford, starting in the early 2000’s. Over the years this effort has been funded by the DOE NCSP. The original scope for CritView was to be a modern replacement for ARH-600 using the current available codes and cross sections. The results would include significantly more validation and peer review than was documented for ARH-600.

The ARH-600 code was developed as an electronic equivalent of a nuclear criticality handbook (e.g., ARH-600). The code takes an electronic data library and allows the user to plot data as needed. This approach has two distinct advantages over a paper handbook. First, the database can be easily expanded to include additional configurations or modeling techniques. Secondly, the code provides flexibility by allowing the user to easily change the units, parameters, and formats of the plots.

CritView provides the ability to quickly and easily change the axis dimensions and units of data plots. For example, a plot showing the relationship between critical radius and concentration can be converted to show the relationship between critical mass and concentration. Similarly, if the plot shows concentration in units of g/cc (for example) it can be changed to g/L. Other major functionality includes the ability to compare curves, to list out the data points in a curve, and to export the plot to a graphics file for use in a document.

The CritView code is intended to evaluate the behavior of various fissile configurations (e.g., minimum critical mass, minimum critical diameter, etc.). The data included in the associated database (like the data in ARH-600 itself) is typically a best estimate of critical (e.g., keff = 1.0) and does not include accommodation for uncertainty or bias. As such it can be somewhat non-conservative and should not be considered as providing subcritical limits. The code is primarily intended as a scoping tool for estimating minimum critical configurations, and for determining potential areas of interest in a criticality safety parametric study. It is not intended to supplant analysis of specific configurations. In general, it is recommended that the code not be used to directly set limits or controls for criticality safety.

CritView is distributed through the NCSP’s web site (ncsp.llnl.gov). It is currently being maintained by SRNS under contract to the NCSP.