GENERAL CONCEPTS FOR EXPERIMENTAL VALIDATION OF ASCI CODE APPLICATIONS

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Computer codes developed as part of the Accelerated Strategic Computing Initiative (ASCI) will be applied to high-consequence nuclear stockpile problems. In some cases, a premium will be placed on the credibility of the *predictive* application of these codes. The credibility of a code for use on a high-consequence problem is strongly dependent upon the success of a set of scientifically defensible and consequential verification and validation tasks. For computational science and engineering codes of the type being developed by ASCI, validation requires experimental activities that can serve as substantive benchmarks for assessing the fidelity of implemented physics and engineering models.

This presentation defines and analyzes a process methodology [1] that can be used in planning, executing, and assessing experimental validation projects. The perspective in this presentation has been to provide a specific view of what useful experimental outcomes should be and how they can be achieved in experimental validation projects. The process methodology consists of eight key elements that embody important concepts distinguishing experimental validation. These elements will be discussed with examples of how they are being applied by the ASCI V&V program at Sandia National Laboratories.

Element 1 Defense Programs (DP) Application: Validation activities must assess confidence in the use of the code for a specified DP application.

Element 2 Planning: Validation activities must be formally planned.

Element 3A Code Verification: A nominal level of code verification should be established as a requirement to conduct a validation activity.

Element 3B Calculation Verification: Calculation verification seeks assessment of the accuracy of calculations performed during the course of the validation activity.

Element 4 Experimental Design, Execution, and Analysis: Validation experiments should provide data that are accurate enough to fulfill the validation requirements defined by the underlying DP application.

Element 5 Metrics: Comparisons of code predictions with measurements must be quantitative, should encompass uncertainty in both the experimental data and the code calculations, and must be assessed.

Element 6 Assessment: Assessment is the methodological element that determines the increase or decrease in confidence in the code that results from the validation activity.

Element 7 Prediction and Credibility: The original DP application and its requirements ultimately require code usage that may be predictive i.e., extrapolation from the associated validation knowledge base.

Element 8 Documentation: Documentation should be sufficient to provide traceable, repeatable, and credible information about the conduct, results, and conclusions of the experimental validation activity.

References

[1] Trucano, Pilch, and Oberkampf, “General Concepts for Experimental validation of ASCI Code Applications, Sandia National Laboratories, SAND2002-0341, Mar2002.