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Verification and Validation: Measured Credibility, on Demand, for Stockpile (Medical) Applications

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Abstract
High consequence decisions, based largely or wholly on modeling and simulation, must balance equally the assessment results with the credibility of the simulations that generated the assessment results. This is referred to as risk-informed decision making. What special knowledge should we demand if we are to assert that modeling and simulation results are worthy of confidence? We will define six processes areas that frame the discussion of credible simulation results: (1) representation or geometric fidelity, (2) physics and material model fidelity, (3) code verification, (4) solution verification, (5) validation, and (6) uncertainty quantification. Best practices (25 in total) spanning these process areas will be presented. The motivation for each process and practice will be discussed, tutorials for some key concepts presented, and examples from many disciplines will illustrate the value and challenges in applying key practices. Sandia has termed this framework of processes and practices the Predictive Capability Maturity Model (PCMM) with the intent that the PCMM can be used to measure and to communicate the credibility of simulation results in the context of a specific application.

Biographical Information
Martin Pilch earned his BS in Mechanical Engineering from the Newark College of Engineering 1974. He went on to earn his MS in Nuclear Engineering (1976) and his PhD in Nuclear Engineering (1981) from the University of Virginia. Pilch currently is deputy program manager for the Advanced Simulation and Computing (ASC) Program at Sandia National Laboratories. He plays a key coordinating role for the laboratory for the development, demonstration, and deployment of methodologies for Quantifying Margins and Uncertainties (QMU) that support risk-informed decisions affecting the stockpile of US nuclear weapons. Pilch spent the first nineteen years of his career developing and validating models for severe accident issues associated with the operation of nuclear power plants. During this time he participated in and led major activities using a *risk-informed* approach, which integrated modeling and experiments in a probabilistic framework, for addressing and resolving safety issues that arose as a consequence of the accident at Three Mile Island. Prior to becoming the ASC Deputy Program Manager, Pilch managed the V&V program as part of the ASC Program at Sandia and was a line manager of the Validation and Uncertainty Quantification Department in the Engineering Sciences Center. As the V&V Program Manager, Pilch managed an R&D and applications portfolio with a goal of establishing credibility and quantifying uncertainties in the use of high-end modeling and simulation for nuclear weapon issues.

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