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Development of Smart Component Based Framework for Dynamic Reliability Analysis of Nuclear Safety Systems

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Dynamic reliability methodologies account for the safety system's time dependent characteristics while estimating the reliability. Time dependence can arise due to interaction of process variables with the hardware and hardware failure on process conditions. Though static reliability models often capture the average behavior and try to make conservative estimates, it is inadequate from a number of perspectives. First, this requires that the analyst needs to establish that the model is conservative. Second, such modeling requires more expertise and experience in the appropriate domain of the problem, rather than in the reliability methods. Third, approximate methods may be inadequate to establish reliability enhancements or degradations due to subtle alterations in the system design. In spite of the significant effort in the reliability community to establish dynamic reliability analysis methods, there are no general purpose tools similar to that available for fault tree event tree modeling. A methodology based on 'Smart Components' is being developed for dynamic reliability evaluation of safety systems involving digital IC systems interacting with process and hardware. Smart Component based dynamic method uses elements of object oriented and relational data base architecture and is suitable for being developed into a general purpose tool. The paper demonstrates the capability of the method to evaluate reliability of systems having various types of time dependence, interaction between hardware failure and process evolution and complexity by means of few case studies. The method is found to be promising for accurate modeling of dynamic as well as static scenarios.

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