

## MEMORANDUM

TO: J. T. Larkins  
R. P. Savio  
FROM: J. N. Sorensen *JNS*  
DATE: October 2, 1998  
SUBJECT: Defense in Depth Paper

Attached for your review is a summary of a proposed paper on defense in depth to be submitted to the PSA'99 conference. Drs. Kress, Powers and Apostolakis have reviewed this summary and approved it. Dr. Powers had minor comments which have been incorporated.

The summary is due to the conference organizers of PSA'99 by October 15, 1998. I would appreciate your approval to submit this summary in time to mail it by October 8, 1998. If that is not possible, I believe it could be submitted electronically as late as October 15, but that would be using all available margin.

*Sorensen*

# The Role of Defense in Depth in Risk Informed Regulation

## Summary Submitted for Consideration by PSA'99

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### Introduction

The nascent implementation of risk informed regulation in the United States suggests a need for reexamination of the Nuclear Regulatory Commission's (NRC) defense in depth philosophy and its impact on the design, operation and regulation of nuclear power plants. The reexamination is motivated by two opposing concerns: (1) that the benefits of risk informed regulation might be diminished by arbitrary appeals to defense in depth, and (2) that the implementation of risk informed regulation could undermine the defense in depth philosophy. From either perspective, three questions are suggested: (1) How is defense in depth defined? (2) How should the implementation of risk informed regulation alter our view of defense in depth? (3) How can it be determined that specific design or regulatory requirements are necessary or sufficient to achieve a satisfactory degree of defense in depth?

### Current Regulatory Practice

Defense in depth is a nuclear industry safety strategy that began to develop in the 1950s. Currently the term is commonly used in two senses, both related to safety philosophy. The first is to denote the philosophy of high level lines of defense, such as prevent accident initiators from occurring, terminate accident sequences quickly, and mitigate accidents that are not successfully terminated. The second is to denote the multiple physical barriers to the release of radioactivity, usually exemplified by fuel cladding, primary coolant system, and containment. In

probabilistic methods to establish that the acceptance criteria are met, and (3) evaluate the uncertainties in the analysis and determine what steps should be taken to compensate for those uncertainties. In this view, defense in depth serves to increase the degree of confidence in the results of the PRA or other analyses supporting the conclusion that adequate safety has been achieved.

The underlying philosophy here is that the probability of accidents must be acceptably low. Everything done to achieve sufficiently low accident probabilities is defense in depth.

#### Proceeding with Risk Informed Regulation

There appear to be two viable options:

- (1) Reaffirm the high level, structural view of defense in depth.
- (2) Recommend defense-in-depth as a supplement to risk analysis.

Option (1) represents the status quo. The articulation and implementation of defense in depth to date is consistent with the structural model. The role of defense in depth is that defined in the PRA policy statement. Option (2) holds promise for the most regulatory burden reduction, but requires a change in the regulatory structure. The role of defense in depth becomes subordinate to PRA.

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\* The views expressed in this paper are the authors', and do not necessarily represent the views of the Advisory Committee on Reactor Safeguards.