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December 1, 2000

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FROM: Farouk Eltawila, Acting Director **/RA/**
Division of Systems Analysis and Regulatory Effectiveness
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SUBJECT: FINAL REPORT: NUREG-1275, VOLUME 14, "CAUSES AND SIGNIFICANCE OF DESIGN-BASIS ISSUES AT U.S. NUCLEAR POWER PLANTS"

Attached for your information and use is the final report, NUREG-1275, Volume 14, "Causes and Significance of Design-Basis Issues at U.S. Nuclear Power Plants." The study was initially requested by the NRC's Executive Director for Operations in 1997 to better understand design issues being reported at U.S. nuclear power plants. The study provides insights from reported design-basis issues (DBIs) with respect to: (1) their causes, significant patterns within both the power reactor industry and power reactor systems, frequency trends, safety consequences, and risk significance; (2) the lessons that may be useful in assessing regulatory effectiveness of NRC's evolving inspection and plant performance assessment processes and the definition of plant design basis and; (3) regulatory burden implications related to NRC licensee event reporting requirements for DBIs.

This study can assist the NRC and industry ongoing efforts to make NRC's regulatory framework and oversight process more risk informed and performance based, and to reduce unnecessary regulatory burden in reporting of DBIs of little or no risk significance. Specific uses of the report are discussed for each strategic performance goal below.

The study found that from 1985 through 1997, there were increases in the number of reported DBIs which coincided with NRC initiatives such as inspection programs and generic communications having a strong design element. Similarly, using a screening process to determine risk significance of DBIs occurring in 1997, it was found that approximately 78 percent of the DBIs had either minimal risk or no risk significance. For those DBIs that were

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considered potentially risk significant, the report has a number of observations, including (1) none involved a safety demand for a system, structure or component whose function was adversely impacted by the DBI, (2) 87 percent involved potential failures or potential degradations rather than actual failures or actual degradations, (3) 58 percent involved three systems; emergency core cooling, emergency ac/dc power, and containment/containment isolation, (4) plants licensed before 1975 were affected the most, (5) multi-unit sites were more affected than single-unit sites, and (6) BWRs were more likely to have a potentially risk significant DBI than were PWRs.

Over the period from 1990 through 1997, there has been a steady decline in the ratio of the number of accident sequence precursor (ASP) events (conditional core damage probability $\geq 10^{-6}$) with DBIs, to the total number of DBIs reported in licensee event reports (LERs). For example, in 1991, about 8.3 percent of DBIs reported in LERs were determined to be ASP events, and by 1997, this ratio had steadily declined to approximately 0.5 percent. Finally, for the period 1992 through 1997, there were 14 "important" ASP events (conditional core damage probability $\geq 10^{-4}$) from all causes. Only three of the important ASP events during this period involved DBIs, and all occurred at PWRs.

The report is consistent with the NRC strategic performance goals in the areas of maintaining safety; increasing public confidence; making NRC activities and decisions more effective, efficient, and realistic; and reducing unnecessary regulatory burden as follows:

Maintaining safety – The report contributes to the NRC goal of maintaining safety by documenting the observation that the overall risk-significance of DBIs has decreased over the last several years. This would indicate that the impact of design-basis issues on plant performance has decreased and that safety has increased. The report can be used by both licensees and the NRC to better focus design validation and inspection efforts in those areas of greatest benefit in maintaining safety. While the number of DBIs has increased from the mid-1990s to 1997 due to increased agency attention to design issues at nuclear power plants, the overall severity, from a risk perspective, has sharply decreased.

Increasing public confidence – The report reviewed a large sample of DBIs to determine long-term reporting trends, plant characteristics, causes, corrective actions, and potential risk-significance in support of NRC risk-informed initiatives. The report was used to support changes in the NRC design/engineering inspection program, and can be further used during ongoing refinements to that program, while also enhancing the characterization and public understanding of DBIs. The NRC spent considerable inspection effort to assess design issues at Millstone, Crystal River, D. C. Cook, Maine Yankee, Haddam Neck, and other plants during the mid-1990s, the end result being that very few DBIs were determined to be risk-significant. The revised NRC reactor oversight process, including the risk-informed baseline inspection program, the ongoing effort to clarify the interpretation of "design bases" (as discussed in 10 CFR 50.2, "Definitions") through the issuance of proposed Regulatory Guide 1.186, "Guidance and Examples for Identifying 10 CFR 50.2 Design Bases," are also consistent with observations discussed within the report.

Making NRC activities and decisions more effective, efficient, and realistic – The report reviewed (1) NRC inspection initiatives to identify correlations between the amount of design and engineering inspection effort, and the number of DBIs, (2) agency outcomes and trends from increased regulatory oversight, (3) the potential risk significance of reported DBIs based on ASP analyses, and (4) DBIs rankings based on a risk characterization and deterministic significance classification framework. The report observations could be used to better plan and allocate design and engineering inspection effort, and to normalize the resultant findings amongst licensees or groups of licensees.

Reducing unnecessary regulatory burden – The report indicates that the requirements of 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors," and 10 CFR 50.73, "Licensee event report system," have been very conservative, resulting in an necessary burden on licensees. The report observations regarding the risk-significance of many DBIs were used by NRR during recent efforts by the NRC to revise 10 CFR 50.72 and 10 CFR 50.73 to reduce this licensee burden. Elimination of the requirement to report conditions "outside design basis" will become effective in January 2001.

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