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GENERIC SAFETY INSIGHTS FOR INSPECTION OF BOILING WATER REACTORS*

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1. INTRODUCTION

As the number of operating nuclear power plants (NPP) increases, safety inspection has increased in importance. However, precisely what is important, and what is not important? What should one focus inspection efforts on. Over the last two years Probabilistic Risk Assessment (PRA) techniques have been developed to aid in the inspection process.

Broad interest in generic PRA-based methods has arisen in the past year, since only about 25% of the U.S. nuclear power plants have completed PRAs, and also, inspectors want PRA-based tools for these plants. This paper describes the BNL program to develop generic BWR PRA-based inspection insights or inspection guidance designed to be applied to plants without PRAs.

2. DESCRIPTION

The generic BWR PRA-based insights, were developed by a review and analysis of all available BWR PRAs[2], individual PRA reviews, and the various already completed PRA review and oversight documents[1,3]. As an example, each BWR PRA was reviewed to extract and list the dominant contributors to risk. Those items which appeared significant for the majority of plants were considered generic and included in the generic insights list. Those items which were dominant to risk at one or two plants were not considered generic, but were

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included in a second list which includes the remainder of the BWR risk-significant items. Table 1 illustrates the contribution of the dominant sequences in the 9 PRAs which were reviewed. Already completed PRA review documents were then studied to gain additional insights and confirm those from the first task. Upon completion of these various reviews, a draft insight document was consolidated.

The next step in the development was to evaluate the usefulness of the insight document to its desired final purpose, namely, to provide inspection guidance for nuclear plants without a plant-specific PRA. Therefore, it was provided to the USNRC to develop and perform inspections at nuclear plants without PRA's. The lessons learned from these trial applications will be incorporated to improve the guidance document.

3. RESULTS

At the beginning of this project, it was not obvious how many significant generic insights would be obtained, since it is well known that many aspects of plant risk are plant unique due to the diversity of nuclear system designs. The results of the study, however, identified a significant number of items which were common dominant risk contributors at many BWRs. A sample listing of items from the BWR generic PRA-based insight document, and related inspection areas, is included in of Table 1. In applying these items to a BWR without a PRA, one must realize that for the plant in question: (1) there may be dominant risk items not on the list, and (2) there may be items on the list which are not dominant for this plant. Nonetheless, based on comparisons between completed PRAs and the generic list, it is judged that about 75% of the dominant risk items at any given plant will be included. Since this will

be used merely to supplement and focus other inspection techniques the lack of 100% completeness is not a major concern. The document provides an excellent means to focus limited resources into key risk significant areas and hence, contribute to overall nuclear safety.

The BWR generic insights were originally intended to be used primarily for NRC inspection purposes, but they could also be used for general insight by management and for various review purposes by either NRC or utility personnel. Some sample methods of use are described below.

1. Inspectors can familiarize themselves with the generic insights and be sensitized to what is generally important at BWRs according to PRA studies.
2. A special generic PRA-based review could be conducted at a BWR without a PRA to verify that appropriate steps had been taken to minimize the occurrence of the identified dominant failures.
3. During routine inspections performed by the NRC or QA personnel, the generic insights could be used to partially replace random selection for choosing areas, systems and components to review.
4. The dominant human errors could aid in the review of emergency procedures, operator training, and operator licensing.
5. Important component failures give guidance into areas to review during in-plant walk-throughs and in review of surveillance test results.

4. REFERENCES

1. NUREG 1050, Probabilistic Risk Assessment (PRA) Reference Document.
2. Actual PRAs for the following nuclear power plants: Big Rock Point, Browns Ferry, Grand Gulf, Limerick, Millstone-1, Oyster Creek, Peach Bottom (ASEP), Shoreham, and Susquehanna.

3. "PRA Insights," BNL, R. Fitzpatrick, et al., NUREG/CR-4405, December 1985.

4. "Prevention and Mitigation of Severe Accidents in a BWR-4 With a Mark I Containment," BNL, T. Pratt, et al., Draft Report, April 1986.

5. "Generic PRA-Based BWR Insights," BNL Technical Report A-3453-9-86, J. Higgins, 1986.

TABLE 1 - SAMPLE BWR GENERIC INSIGHTS

The items listed in Column 1 are considered to be generic dominant contributions to risk. The areas listed in Column 2 are sample areas to be inspected to minimize the risk from the Column 1 items.

COLUMN 1	COLUMN 2
I. Initiators: 1. Loss of offsite power. 2. Major transients in the power conversion system.	I. Procedures for operation of switchyards, main steam and feedwater systems.
II. Sequences: 1. Station Blackout 6 of 9 PRAs for an average of 49% CMF 2. ATWS 7 of 9 PRAs for an average of 27% CMF	II. Operator training and procedures for blackout and ATWS.
III. Failure of Systems: AC/DC Power RPS Suppression Pool Service Water HPCI/RCIC ADS RHR	III. Selection of surveillance tests, maintenance items, operating procedures to be reviewed. System walkdowns.
IV. Common Cause Items: 1. Diesel Generator Failure 2. DC System Failure 3. Service Water Failure	IV. Special reviews for commalities in maintenance, calibrations, and support systems.

V. Human Errors:

1. Failure to manually initiate ADS or SLC.

VI. Component Level Items:

HPCI - Turbine and Governor Failure
SW - components in maintenance
RHR - Injection valve permissive circuitry

V. Emergency procedures and operating training.

VI. Equipment and maintenance training.

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