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SANDIA REPORT

Revision 0

Evaluation of Spent Fuel Pool Accident Response to a Complete Loss-of-Coolant Inventory Using MELCOR 1.8.5

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Table of Contents

List of Tables

List of Figures

Evaluation of Spent Fuel Pool Accident Response to a Complete Loss-of-Coolant Inventory Using MELCOR 1.8.5

1. INTRODUCTION

In 2001, NRC staff performed an evaluation of the potential accident risk in a spent fuel pool at decommissioning plants in the United States [Ref. 1]. The study was prepared to provide a technical basis for decommissioning rulemaking for permanently shutdown nuclear power plants. The study described a modeling approach of a typical decommissioning plant with design assumptions and industry commitments; the thermal-hydraulic analyses performed to evaluate spent fuel stored in the spent fuel pool at decommissioning plants; the risk assessment of spent fuel pool accidents; the consequence calculations; and the sensitivity study and implications for decommissioning regulatory requirements. It was known that some of the assumptions in the accident progression in Reference [1] were necessarily conservative, especially the estimation of the fuel damage. The present study continues on this work by using the best-estimate severe accident code MELCOR [Ref. 5] to predict a postulated severe accident progression following complete loss-of-coolant inventory in the spent fuel pool of a representative operating reactor nuclear power plant.

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1.3 Background and Scope

The NRC recently performed a computational fluid dynamics (CFD) analysis of a complete loss-of-coolant accident using the Fluent computer code. The study was intended to improve the state-of-art of in the analysis of the SFP accidents and address limitations found in other specialized SFP models (e.g., SHARP, SFUEL, and COBRA-SFS). In particular, the specialty SFP codes included simplifications concerning the fluid mixing above, around, and below the racks, limitations in the range of burn-up of the fuel, and limitations in the bulk building response. The NRC CFD study included a relatively comprehensive analysis of many modeling uncertainties including decay heat, outer wall heat transfer, ventilation rate, flow resistance, material conductivity, the hottest fuel location, etc. Among other findings, the study identified the minimum amount of time since the discharge of fuel, such that the fuel could be cooled by natural circulation and not engage in rapid exothermic oxidation reactions. In particular, best-estimate simulations suggest that the peak fuel temperature was less than 800 K with 26 months of decay time. However, the study assumed BWR fuel in a completely full (i.e., 4200 assemblies and no open spaces), high-density rack system. The scope of the analysis did not include partial water conditions or any severe accident degradation.

Ex. 5

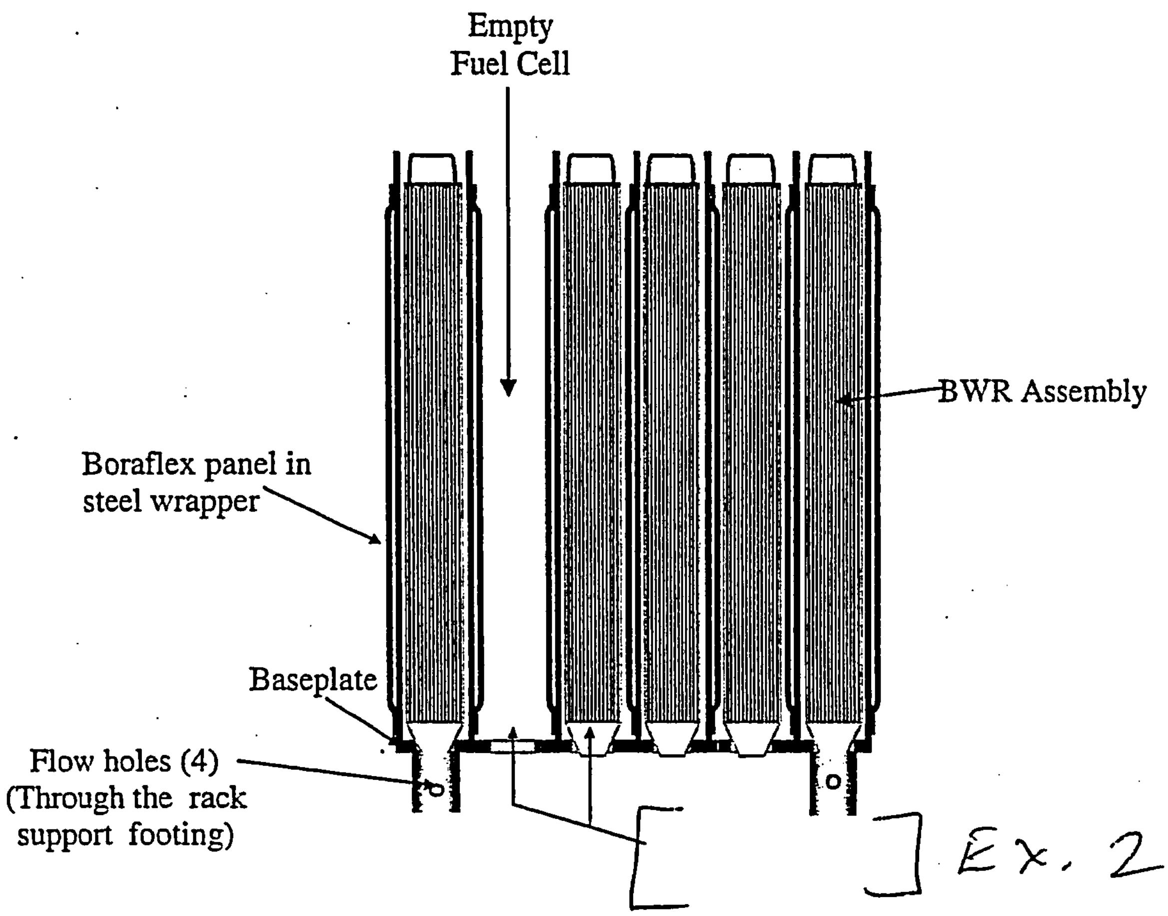

Figure 2.2 Typical Spent Fuel Pool Rack Cross-section.

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