Portions Ex 2 + Ex 5

Presentation to National Academy of Sciences

Spent Fuel Studies-

Response of Fuel in Damaged Pool Events

February 13, 2003

Charles G. Tinkler

~~Official Use Only~~

SFP Analysis

- Background
- New SFP analyses
  - Methods
  - Input/boundary conditions
  - Scenarios
  - Conclusions
- Mitigation
- Summary

SFP Analysis Background

- Past NRC studies primarily limited to "early phase" heat-up calculations, no integrated severe accident analysis performed
  - Most codes/calculations only analyzed potential for zirconium fire using "ignition temp" criteria, many did not explicitly model air oxidation
  - No Severe Accident Models – fission product release fractions assumed
  - Historical tools suffered from modeling limitations
    - Damage propagation
    - Oxidant depletion
    - FP release and transport modeling
    - Heat transfer modeling simplifications and conservatisms
    - Flow Mixing

SFP Analysis Background

- Past NRC generic studies often assumed "bounding" configuration for T/H heatup analysis, pool fully racked and full, minimal clearances, fuel of uniform (most limiting) decay power

SFP Analysis Background

- NRC Vulnerability Project
  - Objective is to perform more realistic phenomenological analysis of representative configurations and to evaluate how spent fuel pool can be made more resistant to potential fuel damage events - mitigation
  - Approach
    - Develop methodology based on adapting state of the art integrated reactor code (MELCOR) developed for severe accident analysis
      - Full range of fluid flow, heat transfer, materials, fission product modeling over normal and high temperature regime
      - Integrated analysis guided as needed by separate effects modeling and analysis using specialized (e.g., CFD codes) tools
    - Develop SFP and plant models based on detailed design and operations info (licensee data and dwgs, site visit)

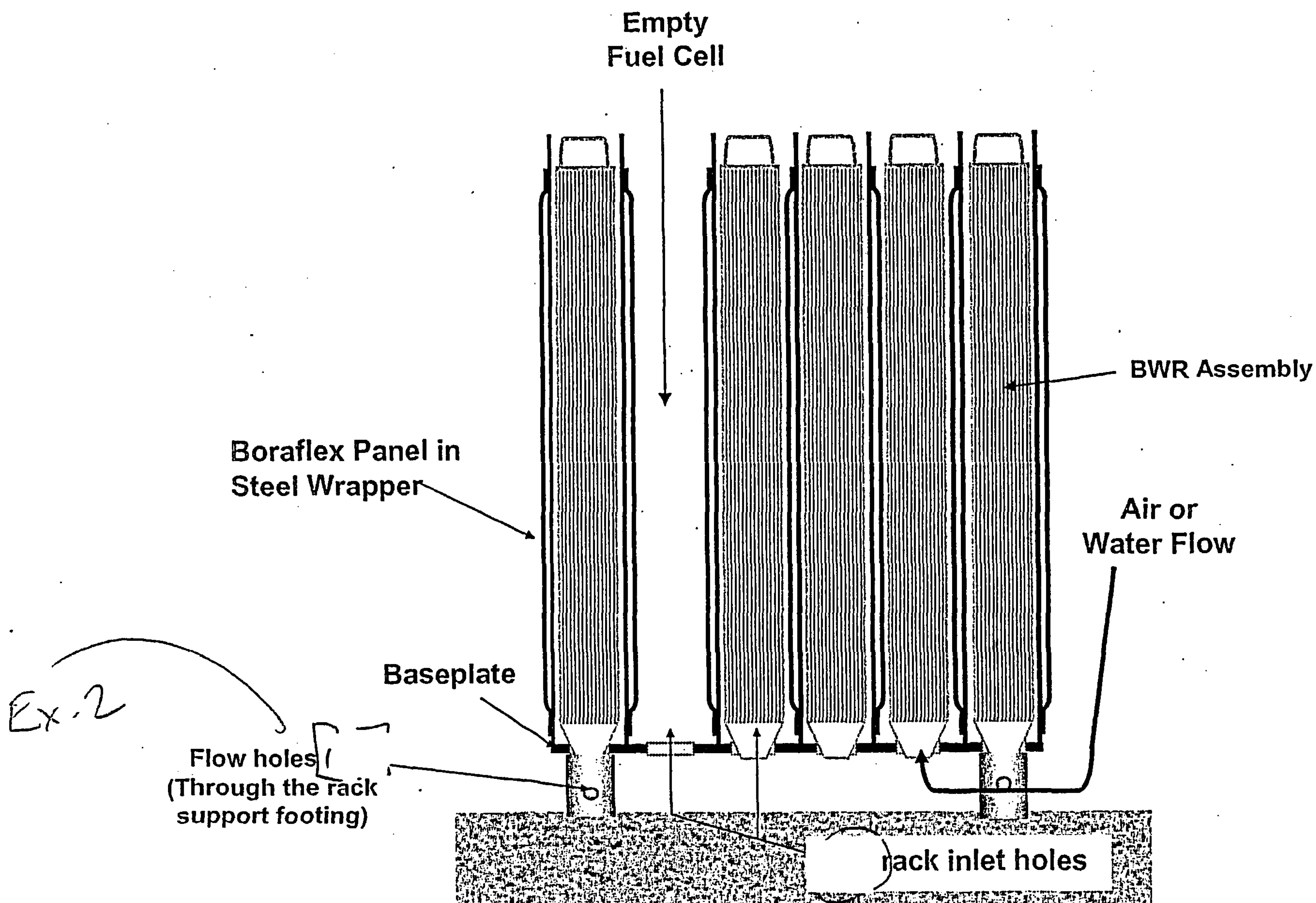
SFP Geometry/Inputs

Reference BWR SFP Pool Description

SFP Pool Characteristics	Description or Dimensions
Dimensions	
Concrete Thickness	
SFP Volume	
Number of Storage Locations	
Number of Locations Used	

Ex. 2

Illustration of Fuel Racks



Spent Fuel Pool Analyses

- Evaluate Response to Initiating Events in Terms of Heatup and Source Term Generation
  - Partial Pool Drainage (Water Boildown)
  - Complete Pool Drainage (Air Natural Circulation)
- CFD Used to Evaluate
  - Details of Single Assembly in Air Circulation and Heat Flows
  - [redacted] Ex 5
  - Flow and Mixing Behavior in Pool and Building
  - Provide Boundary Conditions for MELCOR Analyses
- MELCOR Will Analyze
  - Global Response of Pool and Assemblies,
  - Fuel Damage, Steam and Air Oxidation
  - Fission Product Source Term
  - Mitigation or Recovery Actions

MELCOR Modeling Approach

- 2 Model Approach - Separate Effects and Whole Pool/Reactor Building Models
  - Subdivided into 2 Types of Scenarios
    - Complete Loss-of-Inventory] Ex 5
    - Partial Loss-of Inventory] Ex 5
- Separate Effects Model
  - Developed First to Guide Full SFP Model Development
  - Fast Running + Controlled Boundary Conditions
  -] Ex 5
    - Use Separate Effects Model to Develop Appropriate Modeling Approach
    - Identify Sensitivities and Uncertainties
    - Recommend Code Development
- Full SFP + Building Model
  - Integral Effects
  - Whole SFP Source Term