Portions Ex 2 and Ex 5

Ex 2 only

G
8/18

Presentation to ACRS

Spent Fuel Pool Studies

July 9, 2003

Charles G. Tinkler

STAFF

SFP Analysis

- **SFP Background**
  - Geometry
  - Plant Specific Inputs
- **CFD Results**
- **MELCOR Results**
  - Separate Effects Model
  - Whole Pool Model
- **Modeling Issues/Uncertainties**

SFP Analysis Background

- **NRC Vulnerability Project**
  - **Past work primarily limited to "early phase" heat-up calculations, no integrated severe accident analysis performed**
  - **Most codes only analyzed potential for zirconium fire using "ignition temp" criteria**

    - **No Severe Accident Models**
    - **Historical Tools Also Criticized for Modeling Limitations**
      - **Damage propagation**
      - **Oxidant depletion**
      - **FP release and transport modeling**
      - **Heat transfer modeling**
      - **Flow Mixing**

SFP Analysis Background

- NRC, Vendors, and Utilities Recently Applied Computational Fluid Dynamics (CFD) to Low Temperature Analyses
  - Mixing assessment

- Desire to better model and understand integrated spent fuel pool heatup and fuel damage progression
  - Apply MELCOR +
  - Coolability limits
  - Extent of damage
  - Timing

SFP Analysis Background

- NRC Vulnerability Project
  - Scoping Study Performed Using Data From PWR High-Density Racking Submittal
    - Separate Effect MELCOR Calculations
      - Partial Loss-of-Coolant Inventory
      - Complete Loss-of-Coolant Inventory
    - Separate Effect CFD, Heat Conduction, and Radiation Calculations
  - Developed Methodology to Apply MELCOR for SFP Geometry

SFP Analysis Background

- NRC Vulnerability Project (current)
  - Reference BWR Selected
    - Data Collection
    - Site Visit
  - Model Development Work Scope
    - Separate Effect MELCOR Calculations
    - Whole Pool MELCOR Calculations
    - CFD Calculations
  - Applications
    - SFP Vulnerability Scenarios

SFP Geometry/Inputs

- Data Obtained from Utility
  - Submittal for Conversion to High Density Racking [ ] Ex. 2
    - Rack Vendor Report
  - [ ] Ex. 2
  - SFP Decay Heat Code
    - Individual Assembly Decay Heat
    - Whole Pool Decay Heat
  - Drawings and Other Fuel Data
  - SFP Inventory
    - Assembly Number Versus SFP Position

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

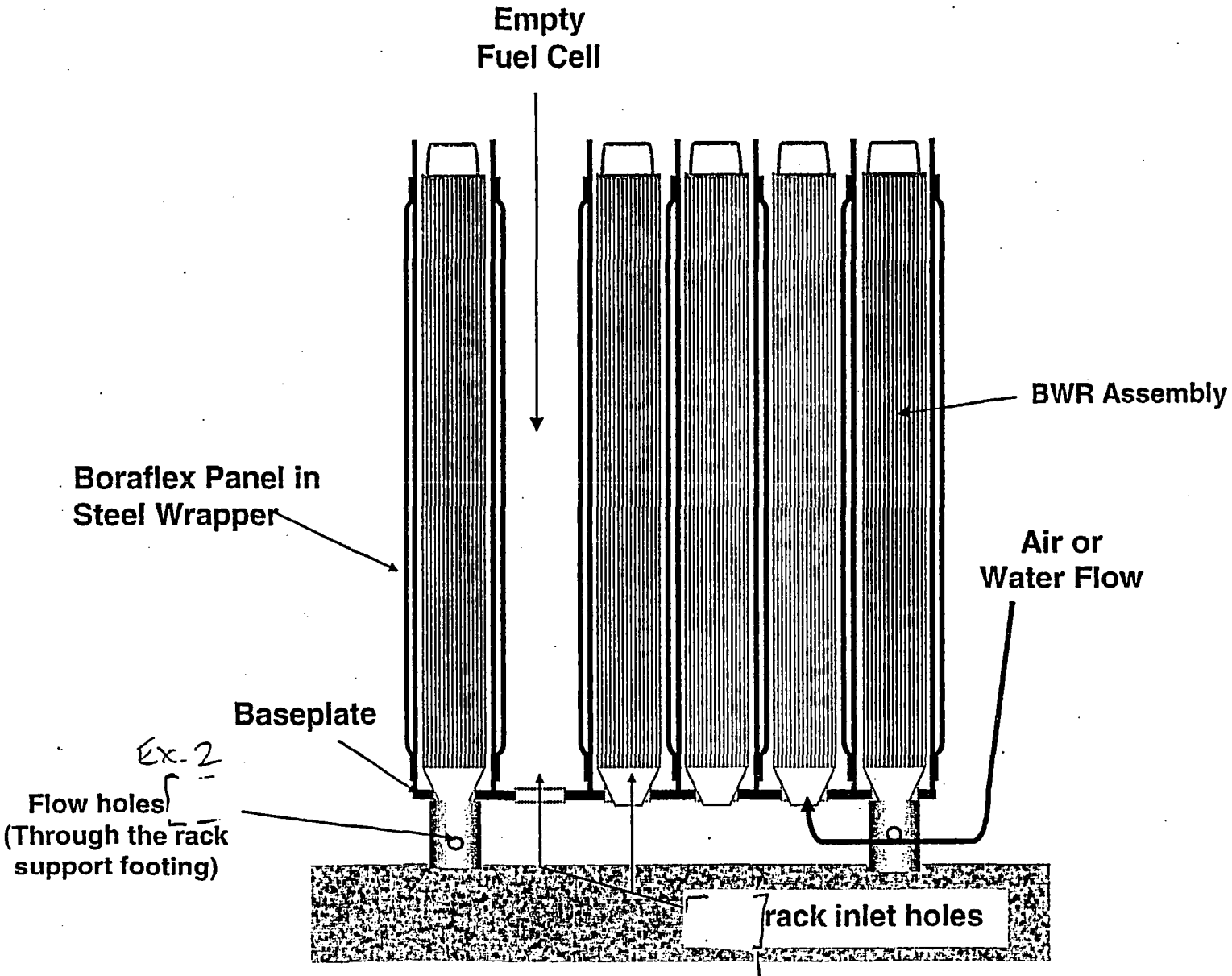
SFP Geometry/Inputs

Reference BWR SFP Rack Description

SFP Rack Characteristics	Description or Dimensions
Rack Height Above the Base Plate	
Baseplate Thickness	
Support Leg Height	
Poison Material	
Poison Length	
Cell Pitch	
Cell Construction	

Ex. 2

Illustration of Fuel Racks



~~Official Use Only~~ Ex. 2

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)
  - Combination of Above
  - [redacted] Ex. 5
- 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

SFP Vulnerability Factors That Are Understood from NPP Research

- Fuel Rod Heatup and Failure Dynamics
  - Convection, Conduction, Radiation
  - Steam Oxidation
  - Fuel Melting and Relocation
  - Assembly Decay Heat
- Building Response
  - Ventilation, Natural Circulation Heat Transfer
  - Fission Product Transport, Deposition