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Prairie Island Independent Spent Fuel Storage Installation

Thermal Conductance License Amendment Request Post-Submittal Meeting

Rockville, Maryland

August 15, 2013

Attendees

NSPM

- **Mike Baumann – Director, Nuclear Fuel**
- **Gene Eckholt – Nuclear Projects Licensing Manager**
- **Oley Nelson – Engineer, Spent Nuclear Fuel Projects**

Transnuclear

- **Don Shaw – Director of Regulatory Affairs**
- **Kamran Tavassoli –Thermal Analysis Manager**

Agenda

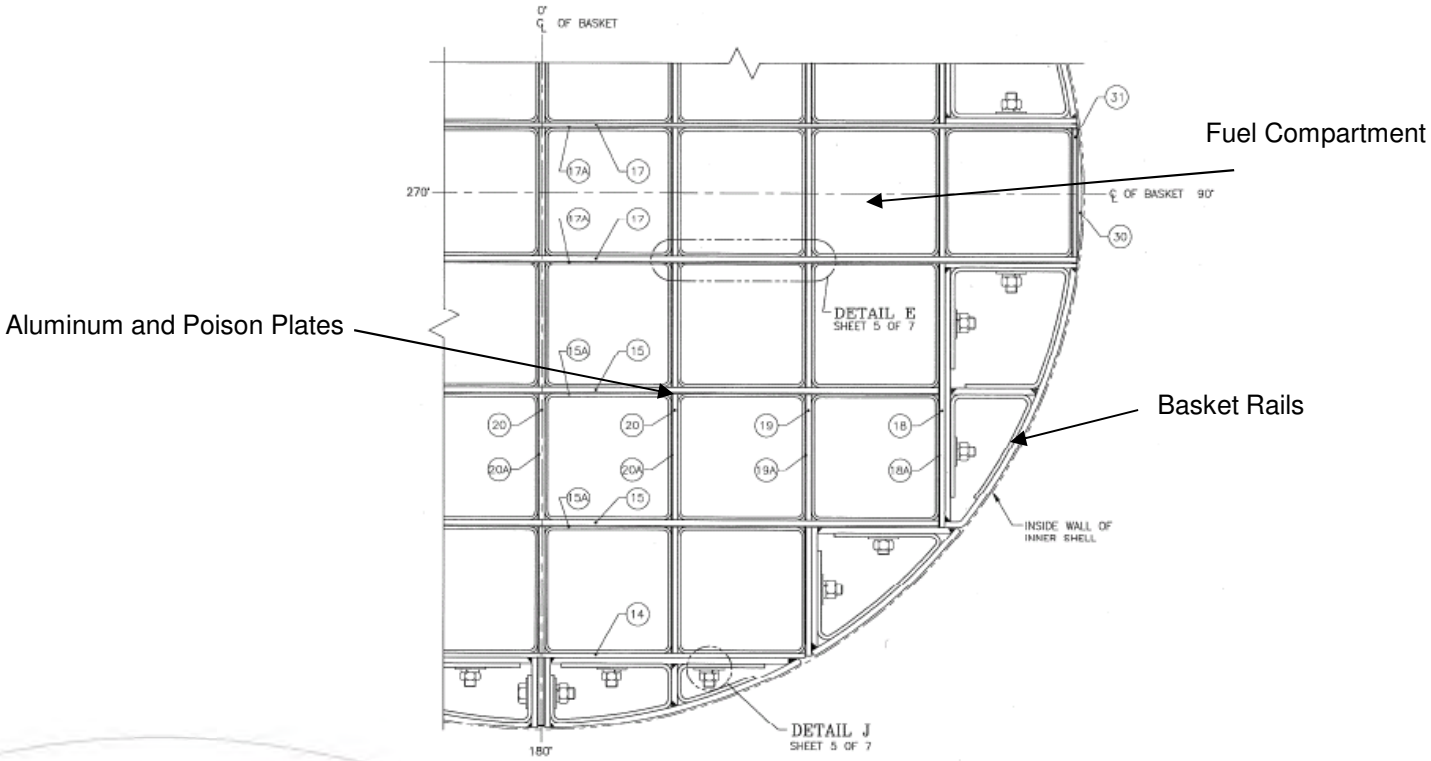
- Introductions
- Purpose of Meeting
- Background
- Proposed Changes
- Reason for Amendment Request
- Thermal Analysis
- Schedule
- Summary / Closing Remarks
- Discussion / Q&A

Purpose Of Meeting

- Explain the Reasons for and Benefits of the LAR
- Explain Proposed TS and SAR Changes
- Discuss Supporting Thermal Analysis
- Discuss Schedule
- Answer Staff Questions

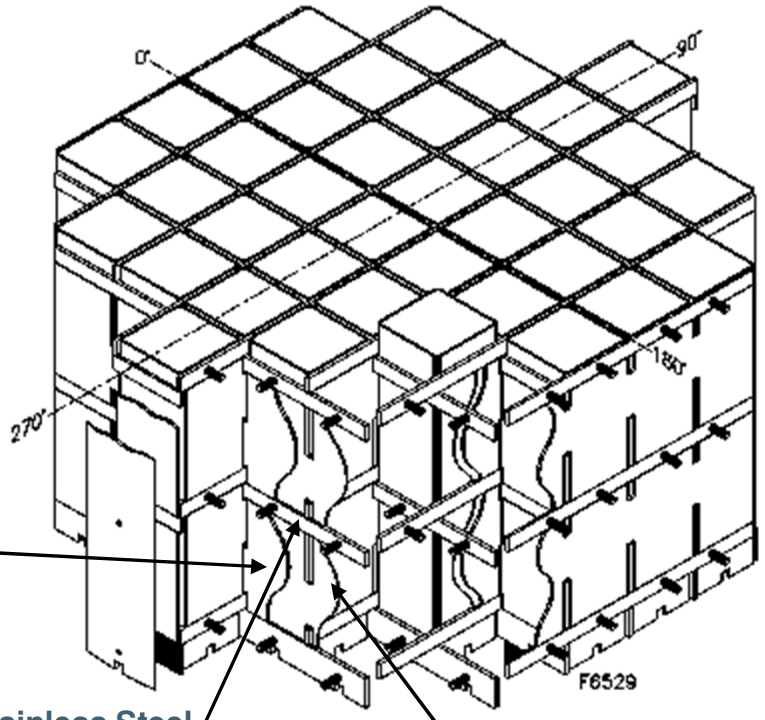
Background

TN-40HT Cask Basket Design



Background

TN-40HT Cask Basket Design



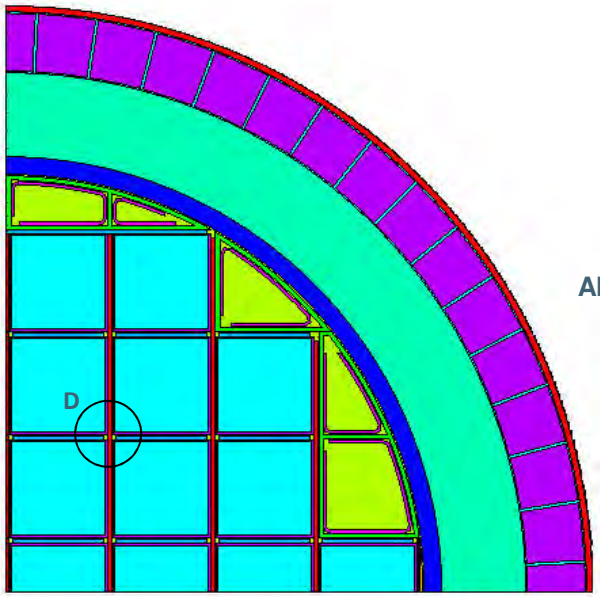
Aluminum Plate

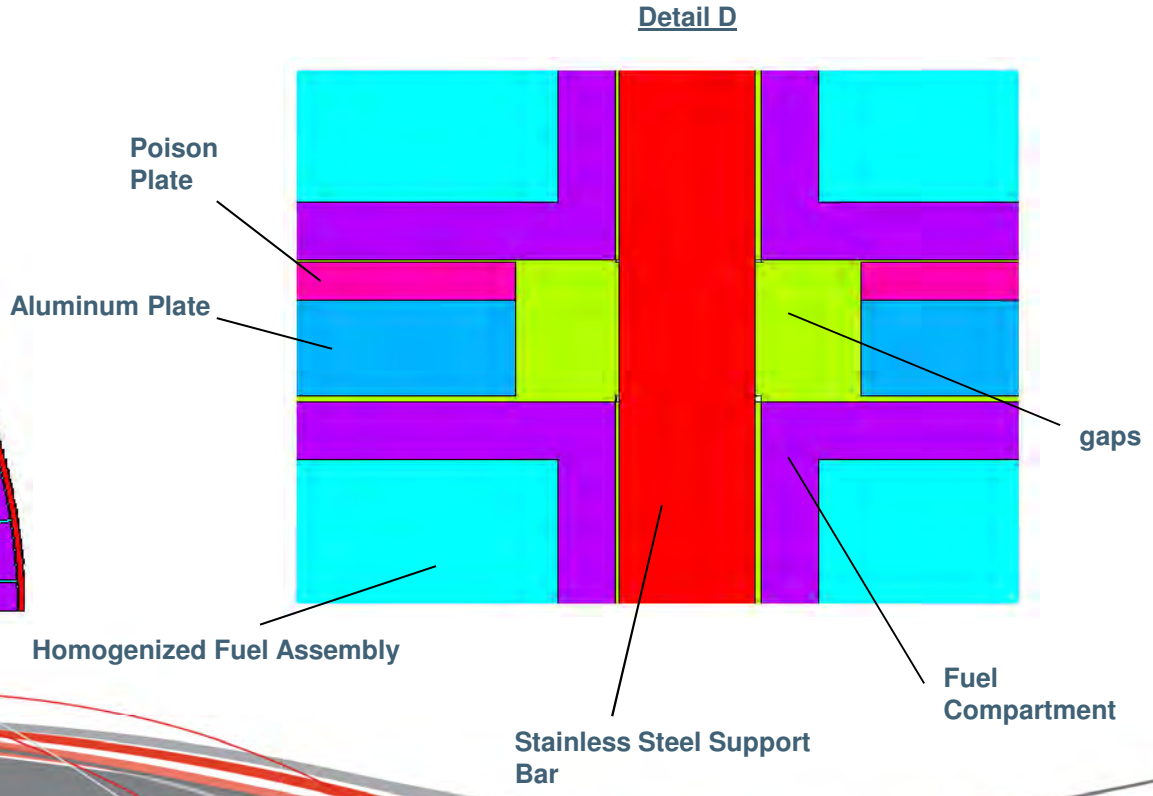
Stainless Steel
Support Bar

Poison Plate

Background

TN-40HT Cask Basket Design





Background

- **TS 4.3.2.b Requires Thermal Conductivity Testing of Neutron Absorbers**
- **Minimum Poison Plate Conductivity is Required to Ensure that Total Conductance (Sum Of Conductivity * Thickness) of Poison and Aluminum Plates is ≥ 3.98 Btu/hr-ºF**

Background

- **Fabrication of First Three TN-40HT Baskets**
  - **Utilized Latitude Provided in Design Drawings**
  - **As-Fabricated Baskets Would Not Meet TS 4.3.2.b**
  - **Baskets Satisfy all Design Bases Functions Except for Compliance with TS 4.3.2.b**

Background

- **NSPM Actions**
  - **Delayed 2012 Cask Loading Until 2013**
  - **Fabricated Baskets That Met the Current TS 4.3.2.b Requirements for the 2013 Loading**
  - **Submitted LAR to Revise TS in June 2012**

Background

- **Post-Submittal, Two Items were Identified that Materially Impacted Analysis Within LAR**
  - **An Error in Vacuum Drying Analysis**
  - **Unrelated Cask Design Change Required New Thermal Analysis**
- **LAR was Withdrawn in January 2013**

Background

- Resubmittal of LAR
  - Thermal Analysis was Performed Correcting Error and Incorporating Design Change
  - RSIs from Initial Submittal were Incorporated
    - Added Sketch of Basket Assembly
    - Added Tables Comparing Design Basis and Lower Conductance Models
    - Input Separate Effective Parallel and Perpendicular Conductivities

Proposed Changes

- New SAR Section
  - Adds Lower Conductance Thermal Evaluation
  - Demonstrates All Temperature Limits are Met and Bounded by Previous Thermal Analysis
- TS 4.3.2.b: Revise Minimum Thermal Conductance of Poison and Aluminum Plates from 3.98 to 3.55 Btu/hr-ºF

Proposed Changes

- **TS 4.3.2.b: Revise Minimum Nominal Thickness of Aluminum Plate at Which Thermal Conductivity Testing of Poison Plate is Not Required From 0.359 to 0.320 inches**

- **TS Table 4.3-3: Revise Conductivity and Conductance Values, Based on Change to TS Section 4.3.2.b**

Reasons for Amendment Request

- **Provides Flexibility for Future Manufacturing**
  - **Will Not Require Special Order Aluminum Plates**
  - **Reduces Potential Fabrication Challenges**
  - **Increases the Number of Poison Plate Suppliers**
- **Allows Use of Three Fabricated Baskets**

Thermal Analysis

Objectives

- Re-analyze All Thermal Conditions
- Maintain the Current SAR Analysis as Bounding
- Limit the Effect of Reduction of the Poison Plate Conductivity to Thermal Design Functions

Thermal Analysis

Re-Analyzed Conditions

- Normal and Off-Normal
- Accident Conditions
  - Fire
  - Buried Cask
- Vacuum Drying

Thermal Analysis

Thermal Model Used

- **Models Used in Current SAR Thermal Analysis**
  - **Full Length Model Used to Evaluate Normal/Off-Normal Storage Conditions**
  - **Cross-Section Model Used for Accident and Vacuum Drying Conditions (Saved Computer Memory and Computation Time)**
- **Models Used in Lower Conductance Analysis**
  - **Full Length Model Used for All Conditions**

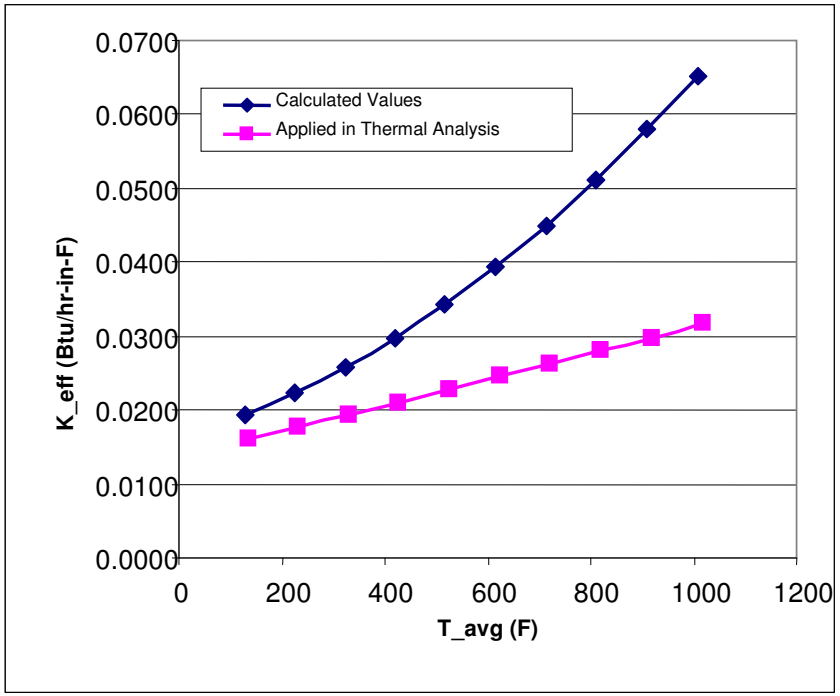
Thermal Analysis

Thermal Inputs

- Inputs for Aluminum and Poison Plates Based on Poison Plate Conductivity of 0.68 Btu/hr-in-ºF
  - Equates to Thermal Conductance of 3.55 Btu/hr-ºF (At 70 ºF)
  - Used Separate Equivalent Conductivities for Parallel Resistance and Serial Resistance
- Transverse Fuel Conductivities (in Helium) were Changed to the Values in SAR Table A3.3-9
- All Other Material Properties Remain the Same as Current SAR Thermal Analysis

Thermal Analysis

Thermal Inputs



Calculated Values	SAR Table A3.3-9
Applied in Thermal Analysis	SAR Table A3.3-8

SAR Figure A3.3-19
Comparison of Transverse Effective Conductivities

Thermal Analysis

Normal / Off-Normal Condition

	Normal/Off-Normal Condition	
	"Design Basis" Model	**"Lower Conductivity" Model**
Neutron Absorber Plate Conductivity	4.14 Btu/hr-in-°F at 100°F 3.70 Btu/hr-in-°F at 500°F (SAR, Table A3.3-8, Page 6 of 7)	0.68 Btu/hr-in-°F for all temperatures
Transverse Effective Fuel Conductivity in Helium	SAR, Table A3.3-8, Page 1 of 7	SAR, Table A3.3-9
Model Shape	Full-Length (SAR, Section A3.3.2.2.1.1.1)	Full-Length (SAR, Section A3.3.2.2.1.1.1)
Axial Heat Profile	SAR, Section A3.3.2.2.1.3	SAR, Section A3.3.2.2.1.3
Boundary Conditions	-	No Change
Max Cladding Temp	694°F	672°F
Other Component Temp	-	No change or Bounded by Design Basis Model

Thermal Analysis

Fire Accident Condition

	Fire Accident Conditions	
	"Design Basis" Model	**"Lower Conductivity" Model**
Neutron Absorber Plate Conductivity	4.14 Btu/hr-in-°F at 100°F 3.70 Btu/hr-in-°F at 500°F (SAR, Table A3.3-8, Page 6 of 7)	0.68 Btu/hr-in-°F for all temperatures
Transverse Effective Fuel Conductivity in Helium	SAR, Table A3.3-8, Page 1 of 7	SAR, Table A3.3-9
Model Shape	Cross-Section (SAR, Section A3.3.2.2.1.2)	Full-Length (SAR, Section A3.3.2.2.1.1.1)
Axial Heat Profile	Uniform Peaking Factor of 1.1 (SAR Section A3.3.2.2.5.1)	SAR, Section A3.3.2.2.1.3
Boundary Conditions	-	No Change
Max Cladding Temp	788°F	693°F
Other Component Temp	-	Bounded by Design Basis Model

Thermal Analysis

Buried Accident Condition

	Buried Cask Accident Conditions	
	"Design Basis" Model	**"Lower Conductivity" Model**
Neutron Absorber Plate Conductivity	4.14 Btu/hr-in-°F at 100°F 3.70 Btu/hr-in-°F at 500°F (SAR, Table A3.3-8, Page 6 of 7)	0.68 Btu/hr-in-°F for all temperatures
Transverse Effective Fuel Conductivity in Helium	SAR, Table A3.3-8, Page 1 of 7	SAR, Table A3.3-9
Model Shape	Cross-Section (SAR, Section A3.3.2.2.1.2)	Full-Length (SAR, Section A3.3.2.2.1.1.1)
Axial Heat Profile	Uniform Peaking Factor of 1.1 (SAR Section A3.3.2.2.5.1)	SAR, Section A3.3.2.2.1.3
Boundary Conditions	-	No Change
Max Cladding Temp	1058°F (at 93 hrs)	911°F (at 93 hrs)
Other Component Temp	-	Bounded by Design Basis Model

Thermal Analysis

Vacuum Drying Condition

	Vacuum Drying Conditions	
	"Design Basis" Model	**"Lower Conductivity" Model**
Neutron Absorber Plate Conductivity	4.14 Btu/hr-in-°F at 100°F 3.70 Btu/hr-in-°F at 500°F (SAR, Table A3.3-8, Page 6 of 7)	0.68 Btu/hr-in-°F for all temperatures
Transverse Effective Fuel Conductivity in Vacuum (Air)	SAR, Table A3.3-8, Page 1 of 7	SAR, Table A3.3-8, Page 1 of 7
Model Shape	Cross-Section (SAR, Section A3.3.2.2.1.2)	Full-Length (SAR, Section A3.3.2.2.1.1.1)
Axial Heat Profile	Uniform Peaking Factor of 1.1 (SAR Section A3.3.2.2.1.2.1)	SAR, Section A3.3.2.2.1.3
Boundary Conditions	-	No Change
Max Cladding Temp	731°F	718°F
Other Component Temp	-	Bounded by Design Basis Model

Thermal Analysis

Analysis Summary

- **Maximum Fuel Cladding Temperatures Remain Bounded by the Current SAR Evaluations**
  - **Using Lowered Conductivity of Poison Plates (0.68 Btu/hr-in-ºF)**
  - **Using More Accurate Transverse Effective Fuel Assembly Conductivity**
  - **Using Full Length Model Instead of Cross-Section Model for Transient Runs**

Thermal Analysis

Analysis Summary Continued….

- New SAR Section Describes Lower Conductance Analysis
- New SAR Section Concludes that Current SAR Results Remain Conservatively Bounding or Unaffected
- Lower Conductance Temperature Results Do Not Replace Existing SAR Temperature Results
- No Impact on the Other Analyses that Use the Thermal Analysis Results as Input

Schedule

- Requested Approval Date of January 31, 2014
  - Supports Loading Campaign Scheduled for Spring of 2014
    - Plans Call for Use of the Three Already Fabricated Baskets

Summary

- Analysis Used Previously Reviewed Thermal Model and Effective Fuel Conductivity
- Results of Current SAR Analysis Remain Conservatively Bounding or Unaffected
- LAR Provides Flexibility that Will Reduce Future Manufacturing Challenges
- Request Approval in Time to Support 2014 Loading Campaign
- Proposed Changes Do Not Impact the Health and Safety of the Public

Discussion

Discussion

Q&A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