Westinghouse

A BNFL Group company

Next Generation Fuel
Pre-Submittal Meeting

NRC Meeting
One White Flint
_____ __, 2005

Agenda

Objective

Brief Overview of Assembly Design

- NGF Assembly Design Features
- NGF Fuel Rod Features
- NGF Design Margins
- Mid-grid/IFM Design
- Wear Resistance
- CFD Illustration
- Mass Evaporation
- Operability Benefits
- Guide Thimble Design Comparison
- Structural Capability Enhancement
- Integral Nozzle

Licensing Submittal

- NGF Topical Report
- What is the basis for the Topical Report?
- What analyses/evaluations are required?
- Models and Methodology?
- Plant Application?

Schedule

Objectives

- Discuss the submittal of the NGF topical report to the NRC for review and approval
- To provide a brief overview of the design and associated features
- Discuss the licensing approach and what will be addressed
- Discuss the proposed schedule for submission, review and approval

Brief Overview of Assembly Design

NGF Assembly Design Features

NGF Fuel Rod Features

a, c

NGF Design Margins

a, c

Mid-grid/IFM Design

a, c

Mid-grid/IFM Design

a, c

Operability Benefits

- NGF features provide added thermal margin while minimizing susceptibility to CIPS (aka AOA)
- The added margin and decreased CIPS susceptibility can be :
  - Held in reserve to address potential future needs, e.g., steam generator tube plugging, or
  - Used to operate the fuel at higher fuel duties, or
  - A combination of the above
- Higher fuel duties can then be used to:
  - Reduce fuel cycle costs without uprating by developing LPs with fewer feed assemblies but higher peaking factors, or
  - Increase revenues by uprating the plant and operating at a higher kW/ft, or
  - A combination of the above
- Further, thermal margin may be added by applying advanced analytical techniques, [ ]^{a,c}
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Guide Thimble Design Comparison

a, c

Structural Capability Enhanced

a, c

Integral Nozzle

a, c

Licensing Submittal

NGF Topical Report

- What is the basis for the topical report?
- What analyses/evaluations are required?
- Models and Methodology?
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What is the basis for the topical report?

17x17 Next Generation Fuel (NGF) Topical Report Requirements

SRP 4.2, II. Acceptance Criteria:

- Specific criteria necessary to meet the requirements of 10 CFR Part 50, 50.46; General Design Criteria 10, 27, and 35; Appendix K to 10 CFR Part 50; and 10 CFR Part 100 identified in subsection I of this SRP.

- "To meet the requirements of General Design Criterion 10 as it relates to Specified Acceptable Fuel Design Limits for normal operation, including anticipated operational occurrences, fuel system damage criteria should be given for all known damage mechanisms. Fuel system damage includes fuel rod failure, which is discussed below in subsection II.A.2. In addition to precluding fuel rod failure, fuel damage criteria should assure that fuel system dimensions remain within operational tolerances and that functional capabilities are not reduced below those assumed in the safety analysis. Such damage criteria should address the following to be complete."

What is the basis for the topical report?

	SRP Subsection	Topical Report Section
Design Basis Fuel System Damage	II.A.1.(a) - Stress, Strain or Loading Limits on grids, GT, fuel rods, control rods & other fuel system structural members	2.2.1.3, 2.2.1.4, 2.2.1.5, 2.3.1, 2.3.2, 2.3.4, 2.3.5, 2.4.2
	II.A.1.(b) - Strain Fatigue	2.2.1.3, 2.4.6
	II.A.1.(c) - Fretting Wear	2.2.1.3, 2.4.5
	II.A.1.(d) - Oxidation, Hydriding and Crud	2.2.1.3, 2.3.1, 2.3.2, 2.3.4, 2.3.5, 2.4.3
	II.A.1.(e) - Dimensional Growth, Rod Bow, Irradiation Growth	2.2.1.1, 2.3.3, 2.3.4, 2.4.8
	II.A.1.(f) - Rod/BA Internal Gas Pressure	2.4.1, 2.4.9, 2.4.10
	II.A.1.(g) - Holddown Forces	2.2.1.2, 2.3.3
	II.A.1.(h) - Control Rod Reactivity	N/A
Design Basis Fuel Rod Failure	II.A.2.(a) - Hydriding	2.4.3
	II.A.2.(b) - Cladding Collapse	2.4.7
	II.A.2.(c) - Fretting	2.4.5
	II.A.2.(d) - Clad Overheating	2.4.3, 2.4.4
	II.A.2.(e) - Pellet Overheating	2.4.4, 2.4.9, 2.4.10
	II.A.2.(f) - Excessive Fuel Enthalpy	2.4.4, 3.0, 5.1
	II.A.2.(g) - PCI	2.4.2
	II.A.2.(h) - Burst	2.4.3, 2.4.4, 2.4.9, 5.2
	II.A.2.(i) - Mechanical Fracturing	2.4.1, 2.4.2, 2.4.3

What is the basis for the topical report?

	SRP Subsection	Topical Report Section
Design Basis Fuel Coolability	II.A.3.(a) - Cladding Embrittlement	2.4.1, 2.4.3, 5.2
	II.A.3.(b) - Violent Expulsion of Fuel	2.4.4, 3.0, 5.1
	II.A.3.(c) - Clad Melting	2.4.4, 5.2
	II.A.3.(d) - Fuel Rod Ballooning	2.4.1, 2.4.4, 5.2
	II.A.3.(e) - Structural Deformation (Seismic/LOCA)	2.2, 2.3
Description & Design	II.B	2.1
Design Evaluation	II.C.1 - Operating Experience	2.3.6
	II.C.2 - Prototype (LTA) Experience	2.3.6
	II.C.3 - Analytical Predictions	3.0 thru 7.0
Testing, Inspection & Surveillance Plans	II.D - Test, Inspections, Surveillance	

What analyses/evaluations are required?

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Models and Methodology? / Plant Application?

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- The reference core report will show what analyses need to be completed to demonstrate acceptability of the fuel design for implementation by a licensee
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Schedule

Schedule

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