

Pre-application Meeting BSEP License Amendments Supporting ATRIUM 10XM Fuel

April 7, 2010

Eric Geyer

Bill Murray

John Siphers

Roger Thomas



Agenda

- Introduction and objectives
- ATRIUM 10XM (A10XM) fuel design overview
- Supporting license amendment requests
- Schedule
- Questions, answers, feedback

Introduction and objectives

Background

- AREVA fuel and methods approved for BSEP Mar 2008
- NRC-BSEP MELLLA+/A10XM meeting Aug 2009
 - ◆ BSEP proposed A10XM based MELLLA+ sample problem
 - ◆ NRC feedback: LAR supporting A10XM must be approved prior to MELLLA+ LAR acceptance review
 - ◆ BSEP decision: Implement A10XM prior to MELLLA+
- A10XM COLR limits calculated with two new NRC approved methodologies
 - ◆ BAW-10247PA RODEX4 mechanical methodology (approved Feb 2008)
 - ◆ ANP-10298PA ACE/A10XM CPR correlation (approved Mar 2010)

Introduction and objectives

Background

- BSEP core/cycle characteristics
 - ◆ 24 month cycles
 - ◆ Conventional core loading
 - ◆ BWR/4 D-Lattice
- Spring 2011: B2C20 first Unit 2 A10XM reload
 - ◆ ~226 fresh A10XM
 - ◆ ~238 once burned A10
 - ◆ ~96 twice burned peripheral or near peripheral GE14
- Spring 2012: B1C19 first Unit 1 A10XM reload
 - ◆ Fresh A10XM
 - ◆ Once and twice burned A10
 - ◆ No GE14

Introduction and objectives

Meeting objectives

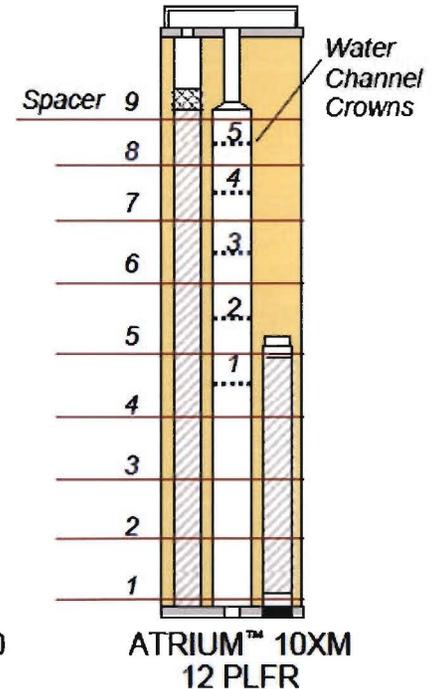
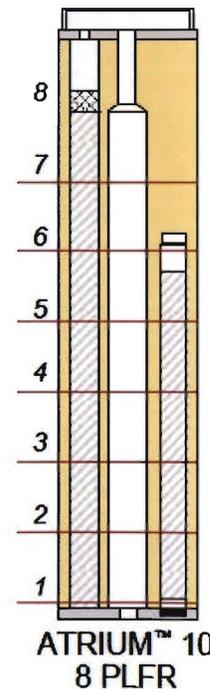
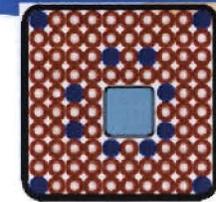
- Provide A10XM fuel design overview
- Summarize AREVA's NRC approved fuel design licensing process for new BWR fuel designs
- Summarize BSEP LAR contents
- Solicit NRC feedback

A10XM fuel design overview

Comparison to ATRIUM 10 (A10)



Parameter		A10	A10XM
Lattice		10x10	10x10
PLFRs	Number	8	12
	Length	Reference	Shorter
Fuel Rod Diameter		Reference	Increased
Clad	Material	CWSR Zr-2	CWSR Zr-2
	Thickness	Reference	Increased Proportionally
Uranium mass		Reference	Increased
Spacers	Number	8 evenly spaced	9 variable spaced
	Type	ULTRAFLOW	ULTRAFLOW
	Material	Zr-4 / X-718 springs	X-718
Water channel		No Crowns	Water Crowns
Fuel channel		Zr-4; thick-thin	Zr-4; thick-thin
Debris Filter		Modified or Improved FUELGUARD	Improved FUELGUARD



A10XM fuel design overview

Operating experience

- A10XM design features validated by operating experience and PIE examinations
 - No new materials introduced relative to current A10 design
 - Lead assemblies since 2002, reload batches since 2005
 - Details in proprietary ANF-89-98 criteria compliance summary
- U.S./LaSalle: 8 A10XM LUA's loaded Spring 2009
 - LUA's testing Chromia doped pellets: not part of standard design
 - Fabricated in AREVA's Richland, WA facility
- B2C20 will be first U.S. reload

A10XM fuel design overview

AREVA new fuel design licensing process

- ANF-89-98(P)(A) Revision 1 and Supplement 1, May 1995, *Generic Mechanical Design Criteria for BWR Fuel Designs*, with NRC accepted letter clarifications (May 2000)
 - “BWR fuel designs which meet these design criteria will not need to be submitted to the NRC for explicit review and approval. Compliance with the design criteria would constitute approval.”
- Generic ANF-89-98(P)(A) fuel design criteria consist of:
 - ◆ Criteria confirmed independent of plant/cycle
 - ◆ Criteria confirmed on a plant/cycle specific basis
- ANF-89-98(P)(A) process applied to both minor design changes and new fuel designs
 - ◆ Minor fuel design examples: spacer strip or clad thickness change
 - ◆ New fuel design examples: spacer with new mixing behavior, change that alters fuel behavior relative to NRC approved models.

A10XM fuel design overview

AREVA new fuel design licensing process

- ANF-89-98(P)(A) process for minor design changes
 - ◆ Criteria confirmation available at AREVA for inspection by NRC
 - ◆ Minor design change confirmation not provided to NRC for information
- ANF-89-98(P)(A) process for new fuel designs
 - ◆ Plant/cycle independent criteria compliance summary provided to NRC by AREVA for information
 - ◆ Plant/cycle specific criteria evaluations performed for licensees would need to be provided by the licensees; available at AREVA for inspection by NRC
- A10XM criteria confirmation summaries to be provided for information
 - ◆ AREVA to provide A10XM plant/cycle independent criteria compliance summary-April 2010
 - ◆ BSEP to provide plant/cycle specific criteria compliance summaries - as completed during the reload licensing process

A10XM fuel design overview

AREVA new fuel design licensing process

- Plant/cycle specific criteria confirmations performed by normal reload licensing process
- Reports to be provided for information:
 - ◆ Thermal Hydraulic Design Report (Unit 2 and Unit 1)
 - TH compatibility (plant criteria)
 - ◆ Fuel Cycle Design Report (Unit 2 only)
 - ◆ Mechanical Design Report (Unit 2 only)
 - Fuel lift (plant criteria applies to both Units)
 - Structural deformation (plant criteria applies to both Units)
 - ◆ LOCA Report (applies to both Units)
 - LOCA performance criteria (plant criteria)
 - ◆ Reload Safety Analysis Report (Unit 2 and Unit 1)

Supporting license amendment requests

- BSEP will request two license amendments to calculate COLR limits for A10XM fuel
 - Add ACE/A10XM CPR correlation LTR to list of methods
 - Add RODEX4 mechanical methodology LTR to list of methods
- Remaining COLR references are currently approved for application to BSEP and are fuel design independent
- SPCB CPR correlation and RODEX2 will continue to be used for remaining fuel designs
- BSEP amendment requests will reference and describe execution of the ANF-89-98(P)(A) process

Supporting license amendment requests

ACE/A10XM CPR correlation

- ANP-10298PA, Revision 0, ACE/ATRIUM 10XM Critical Power Correlation
 - NRC approved March 2010
 - Used to calculate SLMCPR and OLMCPR for A10XM fuel
- SLMCPR methodology implementation
 - NRC approved power distribution uncertainties previously demonstrated applicable to BSEP for AREVA fuel transition
 - ANP-10298PA incorporates same conservative channel bow treatment for SLMCPR used by ANP-10249PA, ACE/A10 CPR correlation

Supporting license amendment requests

ACE/A10XM CPR correlation

- Separate SLMCPR submittal expected
 - Conservative channel bow treatment increases SLMCPR
 - Current TS SLMCPR not expected to bound cycle specific result

SER Restriction	Compliance
Not approved for AREVA fuel designs other than A10XM	Will be applied to A10XM fuel
Must be applied within correlations approved range of applicability as specified in Table 2-1 of ANP-10298P	Correlation range of applicability enforced by software; same controls applied to current SPCB correlation

Supporting license amendment requests

RODEX4

- BAW-10247PA, Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors (RODEX4)
 - NRC approved February 2008
 - Used to calculate LHGR limits for A10XM fuel
- Methodology implementation
 - LAR will demonstrate applicability of NRC approved power distribution uncertainties used by RODEX4 to BSEP
 - Abnormal channel bow not expected
 - ◆ All AREVA fuel channeled with shadow bow resistant Zr-4 channels
 - ◆ Reload design process incorporates channel bow prevention and management

Supporting license amendment requests

RODEX4

SER Restriction/Condition	Compliance
Analytical fuel pellet grain size shall not exceed 20 microns if actual grain size is larger than 20 microns	Analyses will conform with this analytical limit
Shall not be used to model fuel above incipient fuel melting temperatures	RODEX4 will not be applied to this condition
Hydrogen pickup model not approved for use	Model will not be used
Approved values of equation constants and tuning parameters shall not be changed without NRC review	Approved values will be used

Supporting license amendment requests

RODEX4

SER Restriction/Condition	Compliance
Calculations must account for a design basis crud thickness. Level of crud should be based on an upper bound of expected crud. Specific analyses required if abnormal crud or corrosion layer is observed.	Analyses bound measurement data base. BSEP fuel inspections have demonstrated low crud levels.
Peak rod average burnup limit of 62 GWd/MTU	Will not be applied above 62 GWd/MTU
UO ₂ fuel with less than 10 w/o Gd	Will not be applied to other than UO ₂ fuel less than 10 w/o Gd
CWSR Zr-2 fuel clad material	Will not be applied to other than CWSR Zr-2 clad

Schedule

Milestone

Date

AREVA 89-98 A10XM Compliance Report *	Apr 2010
BSEP ACE/A10XM and RODEX4 LAR	Apr 2010
Fuel Cycle Design Report **	Aug 2010
Thermal Hydraulic Design Report **	Aug 2010
LOCA Report **	Aug 2010
BSEP SLMCPR LAR	Sep 2010
Mechanical Design Report **	Nov 2010
Reload Safety Analysis Report **	Nov 2010
BSEP ACE, RODEX4, SLMCPR approval	Mar 2011 (3/4/11)
B2C20 Outage	Mar 2011 (3/4/11)

* Provided For Information by AREVA

** Provided For Information by BSEP

Questions, Answers, Feedback

Questions?