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ANP-2796(NP)
Revision 0

# Zircaloy-BWR Lead Use Channel Program at LaSalle County Generating Station

January 2009

AREVA

AREVA NP Inc.

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## Nature of Changes

| Item | Section(s) or Page(s) | Description and Justification |
|---|---|---|
| 1. | All | Original Release. |

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## Nomenclature

| Acronym | Definition |
|---|---|
| AREVA NP | AREVA NP Inc. |
| [ | ] |
| LUC | Lead Use Channel |
| MCPR | Minimum Critical Power Ratio |
| NRC | U.S. Nuclear Regulatory Commission |
| PIE | Post-irradiation Examination |
| SE | Safety Evaluation |

## 1.0 Introduction and Summary

The Zircaloy-BWR Lead Use Channel (LUC) Program was the subject of a conference call among the U.S. Nuclear Regulatory Commission (NRC), EXELON Nuclear, and AREVA NP Inc. (AREVA NP) on October 27, 2008. During this conference call, AREVA NP explained the technical background and licensing assessments for the LUC Program. The intent of this letter is to provide a written description of the technical issues discussed in the conference call and to document that all licensing requirements for the LUC have been satisfied.

AREVA NP's LUC program addresses the recent industry-wide problem of excessive control blade friction forces due to fuel channel bow. AREVA NP has developed a lead fuel channel program to implement a new material that may demonstrate an improved resistance to bow under current and future reactor operating conditions. The LUCs are made from Zircaloy-BWR material and placed on ATRIUM-10™* fuel assemblies. [

].

## 2.0 Technical Background

Zircaloy-BWR represents the culmination of AREVA NP's extensive research and experience with Zircaloy-2 and Zircaloy-4 alloys. While Zircaloy-BWR is closely related to Zircaloy-4, some of the alloying elements are purposely set outside the ASTM-specified range to achieve the desired performance. [

].

Over the past 15 years, components made from Zircaloy-BWR have been included in leads programs and shown excellent in-reactor material performance for demanding conditions reaching assembly burnups [ ] MWd/kgU. Post irradiation examination (PIE) campaigns have demonstrated that Zircaloy-BWR [

].

The LaSalle LUCs will be the first implementation of Zircaloy-BWR for fuel channels, with a second lead program planned to start irradiation [ ]. Based on the existing irradiation experience

* ATRIUM is a trademark of AREVA NP Inc.

stated above, [ ]
reduce the amount of fuel channel bow.

The LUC program also includes the irradiation and examination of Zircaloy-BWR channels with [

].

## 3.0 Licensing Assessment

The AREVA NP fuel channel design report (Reference 1) has been approved by the NRC with the restriction of using either Zircaloy-2 or Zircaloy-4. Therefore, the Zircaloy-BWR fuel channels will be treated as LUCs in accordance with AREVA NP's approved methodology (Reference 3) for introducing new products. Under this methodology, AREVA NP has demonstrated that all performance criteria are met by the LUCs and that a comprehensive examination program will confirm the satisfactory performance of the fuel while under irradiation. Exelon will insert the LUCs according to the provisions of 10CFR50.59 on the basis of reload licensing documentation that has been provided by AREVA NP.

The Zircaloy-BWR LUCs are within AREVA's approved process for introducing new products, which includes the demonstration that all licensing criteria are met. The LUCs will not affect any neutronic, thermal-hydraulic, or safety analyses. Fuel channel performance can indirectly affect Minimum Critical Power Ratio (MCPR) safety limits if the channel bow is above predictions. However, the magnitude of channel bow will be monitored, among other planned in-service inspections, as a precautionary measure to prevent bow beyond the amount assumed in the safety analyses.

Regarding mechanical performance, the Safety Evaluation (SE) for Reference 1 restricts AREVA NP to using channel material with strength greater than or equal to the values specified in Reference 1. There is no change in the minimum specified unirradiated material strength for Zircaloy-BWR. [

]. Therefore, the strength analyses performed for the reload fuel channels are applicable to the LUC.

The chemical composition of Zircaloy-BWR, [

].

The Zircaloy-4 fuel channel corrosion analyses performed for the reload fuel channels are conservative for the LUC.

The growth model for AREVA NP fuel channels based on the experience with Zircaloy-2 and Zircaloy-4 has been documented and approved by the NRC in Reference 2. The switch to Zircaloy-BWR will not increase the upper limit on fuel channel growth. [

]. For demonstrating compliance with the design criteria, the fuel channel maximum growth correlation documented in Reference 2 is conservatively used to analyze the LUCs. However, the minimum growth is [ ] to conservatively bound [ ].

Regarding fuel channel deformation (such as bulge and bow), Zircaloy-BWR's material properties [

] are not significantly different from Zircaloy-4. Therefore, the calculated channel bulge for Zircaloy-4 reload fuel channels is applicable to the LUCs. Channel bow is not as well understood as bulge. [

] it is reasonable to expect that fuel channels made of Zircaloy-BWR will not have greater bow than Zircaloy-4 fuel channels. [

].

A key objective of the LUC program at LaSalle is to obtain performance data for these fuel channels. The scope of the recommended PIE includes [

]. The PIE

data is needed to monitor the performance of the fuel channels and to validate the licensing methods prior to reload application.

## 4.0 References

1. EMF-93-177(P)(A) Revision 1, *Mechanical Design for BWR Fuel Channels*, Framatome ANP, Inc., August 2005.

2. EMF-85-74(P) Revision 0 Supplement 1(P)(A) and Supplement 2(P)(A), *RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Models*, Siemens Power Corporation - Nuclear Division, February 1998.

3. ANF-89-98(P)(A) Revision 1 and Supplement 1, *Generic Mechanical Design Criteria for BWR Fuel Designs*, Advanced Nuclear Fuels Corporation, May 1995.