

PRM-50-93 is a Wake-up Call

April 13, 2010 (4:00pm)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

There are two parts to this comment.

1. NRC has applied Baker-Just in recent actions.
2. Commissioners must wake-up.

1. NRC applied Baker-Just in recent actions.

In its posted denial of PRM-50-76, the NRC states, "The remaining data from Bostrum ("The High Temperature Oxidation of Zircaloy in Water," W. A. Bostrum, WAPD-104 March 1954) and Lemmon ("Studies Relating to the Reaction Between Zirconium and Water at High Temperatures," A. W. Lemmon, Jr., BMI-1154, January 1957), at more relevant zirconium cladding conditions, were used by Baker and Just in the derivation of their equation." However, it is unlikely that the authors of NRC's technical safety analysis, ML041210109, ever looked at either WAPD-104 or BMI-1154. It is more likely that those authors merely lifted the description of those references from the Baker-Just report, ML050550198. Thus the authors of ML041210109 were not aware that Bostrum and Lemmon each used induction heating in their investigations. Furthermore, those authors also were likely unaware of FZKA 5846, the Hofmann and Noack report. Recently NRC has placed reports in ADAMS: WAPD-104 is ML100900446 and BMI-1154 is ML100570218.

NRC reviewers have not been aware that single rod tests with induction heating do not yield conservative values for the temperature at which runaway oxidation proceeds. Thus several nuclear power plant licensees have been allowed to install lead assemblies with alloys such as M-5. One typical example is:

1. (80) San Onofre, Units 2 and 3 - Temporary Exemption from the Requirement of 10 CFR Part 50, Section 50.46 and Appendix K for Lead Fuel Assemblies. ML090860429 2009- 7
12-17

In the above we read:

Metal-water reaction tests performed on M5 alloy material by AREVA NP (as discussed in topical report BAW-10227P-A) demonstrate conservative reaction rates relative to the Baker-Just equation.

Here is the reference to the safety evaluation of topical report BAW-10227P-A:

5. (80) REVISED SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR TOPICAL REPORT BAW-10227P, "EVALUATION OF ADVANCED CLADDING AND STRUCTURAL MATERIAL (M5) IN PWR REACTOR FUEL." ML003681490 2000- 34
02-04

The safety evaluation tells us:

*Evaluation -FCF uses approved LOCA evaluation models along with the Baker-Just correlation, as required by 10 CFR Part 50 Appendix K, for demonstrating compliance with the 2200 OF PCT and 17 percent oxidation criteria for the fuel cladding during a LOCA. FCF has performed high-temperature oxidation tests for M5 cladding (Appendix D of Reference 1) to confirm that the Baker-Just oxidation correlation remains conservative in relation to M5 high-temperature oxidation. **The FCF high temperature oxidation tests were performed in super heated flowing steam where the sample (both M5 and Zr-4) was inductively heated to temperatures of 1050, 1150, and 1250° C for various times.** The measured oxidation rates for the M5 samples were significantly lower than those for the Zr-4 samples at 1050° C; however, at 1150 and 1250° C the oxidation rates were nearly identical. A comparison of M5 measured values to Baker-Just predictions demonstrated that the Baker-Just correlation remained conservative for temperatures typically calculated for LOCA. The staff asked FCF (Reference 4) to provide Arrhenius plots of the high-temperature oxidation data in order to provide a measure of bias and uncertainty in the data. FCF provided these plots (Reference 6) which demonstrated only small uncertainties and essentially no biases in the data. **The FCF data demonstrates that high-temperature oxidation of the M5 alloy is bounded by the Baker-Just correlation and that the Appendix K requirement for the use of Baker-Just remains conservative in relation to the use of M5.***

Oxidation tests where single rod or tubing specimens are inductively heated do not yield conservative data for the temperature at which runaway is initiated. Clearly, the NRC staff's review and approval of topical report BAW-10227P-A, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," dated February 4, 2000 (ADAMS Accession Nos. ML003681479 and ML003681490), has not been based on sound science.

2. Commissioners must wake-up.

The Commissioners should not blindly follow the staff recommendations and findings as they did in the case of PRM-50-76. The Commissioners must have an awareness of what is going on as the review proceeds instead of casually reviewing a completed set of recommendations. Furthermore, the Commissioners should not tolerate undue delays in the review.

For example, the Commissioners did not do their homework in their unanimous approval of the staff recommendation to deny PRM-50-76. They had no awareness of the staff activities as the staff review proceeded from the date of docketing, May 8, 2002, until they received the following on June 29, 2005; a duration of almost 38 months.

**RULEMAKING ISSUE
NOTATION VOTE**

SECY-05-0113

June 29, 2005

FOR: The Commissioners
FROM: Luis A. Reyes
Executive Director for Operations
SUBJECT: DENIAL OF A PETITION FOR RULEMAKING TO REVISE APPENDIX K TO 10 CFR PART 50
AND ASSOCIATED GUIDANCE DOCUMENTS (PRM-50-76)

The proposed federal register document was Attachment 1 to the above.

Authorized Fed Register Attachment to above Attachment 1

[7590-01-P]
NUCLEAR REGULATORY COMMISSION
10 CFR Part 50
[Docket No. PRM-50-76]
Robert H. Leye; Denial of Petition for Rulemaking
AGENCY: Nuclear Regulatory Commission
ACTION: Petition for Rulemaking; Denial

This proposed federal register document included a list of references including the two keystone references, WAPD-104 and BMI-1154 that are cited in Baker –Just;

“The High Temperature Oxidation of Zircaloy in Water,” W. A. Bostrum, WAPD-104 (March 1954)

“Studies Relating to the Reaction Between Zirconium and Water at High Temperatures,”
A. W. Lemmon, Jr., BMI-1154, (January 1957)

The document that appeared in the Federal Register on September 6, 2005, **ACTION:**
Petition for rulemaking; denial, had a list of references; however the vital reports,
WAPD-104 and BMI-1154 were not listed.

On August 5, 2005, the voting record was released:

UNITED STATES NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001
August 5, 2005
SECRETARY
COMMISSION VOTING RECORD
DECISION ITEM: SECY-05-0113
TITLE: DENIAL OF A PETITION FOR RULEMAKING TO REVISE
APPENDIX K TO 10 CFR PART 50 AND ASSOCIATED
GUIDANCE DOCUMENTS (PRM-50-76)

The voting record includes a signed note from each of the four Commissioners. In each case the opening sentence is: “I approve ...”

Commissioner Lyons wrote:

I approve the staffs recommendation to deny the petition for rulemaking and concur with the comments of Commissioner Merrifield. The staff needs to address the following comments in both the Federal Register Notice and the denial letter to the petitioner:

1. The following sentence contained on page 2, lines 4 and 5 of the letter to the petitioner and page 21, lines 8 and 9 of the Federal Register Notice needs to be modified to clarify how these experiments relate to the denial of the petition. 'The NRC funded more than 50 Zircaloy clad bundle reflood experiments at the National Research Universal (NRU) reactor.'

2. The following sentence contained on page 2, lines 5 through 10 of the letter to the petitioner and page 21, lines 10 through 13 of the Federal Register Notice needs to be modified to clarify how these programs relate to the denial of the petition. 'The NRC is currently conducting and evaluating experimental and analytical programs on fuel cladding behavior to evaluate the adequacy of current 50.46 oxidation-related criteria and models.'

3. The following paragraph on page 2 of the letter to the petitioner and page 22 of the Federal Register Notice needs to be modified to clarify how this information relates to the denial of the petition.

"The NRC applied the Cathcart-Pawel oxygen uptake and ZRO2 thickness equations to the four FLECT Zircaloy experiments [start new paragraph] The NRC applied the Cathcart-Pawel oxide thickness equation to 15 of their transient temperature experiments This result is consistent with the application of the Cathcart-Pawel equations, which are intended for use in best-estimate LOCA calculations in accordance with RG 1.157."

However, the denial was effected and published in the Federal Register on September 6, 2005, and the requirements listed by Commissioner Lyons were never met. Those requirements are met among the well documented teachings of PRM-50-93.

Comment submitted by

Robert H. Leyse*
Chemical Engineer and Nuclear Engineer
P. O. Box 2850
Sun Valley, ID 83353

***Experience:**

Career to date: Commenter's ongoing career spans several decades: General Electric at Hanford Works (1950), Argonne, DuPont Savannah River Plant, General Electric Vallecitos, Westinghouse Pittsburgh, Scandpower Norway, Consulting with Westinghouse at TMI-2, EPRI Nuclear Safety Analysis Center, EPRI Exploratory Research, and now self employed (2010).

Selected Experience pertinent to this comment on PRM-50-93:

PWR FLECHT: Test design, discoveries and reporting as referenced in PRM-50-93.

Presentation at 2003 RELAP5 International Users Seminar, West Yellowstone, Montana
Unmet Challenges for SCDAP/RELAP5-3D. Analysis of Severe Accidents for Light Water Nuclear Reactors with Heavily Fouled Cores. Robert H. Leyse,
www.inl.gov/relap5/rius/yellowstone/leyse.pdf

Comment NEI PETITION FOR RULEMAKING: PRM-50-78 (Cladding Materials) September 9, 2002
The petition should be denied because the evaluations of cladding materials do not account for the realities of plant operation under so-called normal conditions as well as the LOCA environment.

PETITION FOR RULEMAKING: PRM-50-76 May 8, 2002
Petitioner is aware of deficiencies in Appendix K. 1. A. 5. The Baker-Just equation does not include any consideration of the complex thermal hydraulic conditions during LOCA including the potential for very high fluid temperatures. Likewise, petitioner is aware of deficiencies in Regulatory Guide 1.157, BESTESTIMATE CALCULATIONS OF ECCS PERFORMANCE, Paragraph 3.2.5.1. The report NUREG-17 does not include any consideration of the complex thermal hydraulic conditions during LOCA including the potential for very high fluid temperatures.

PETITION FOR RULEMAKING: PRM-50-73 September 04, 2001
The specific issue is that 50.46 and Appendix K do not address the impact of crud on coolability during a fast moving (large break) LOCA.

PETITION FOR RULEMAKING: PRM-50-78 September 9, 2002
Regulations are needed to address the impact of fouling on the performance of heat transfer surfaces throughout licensed nuclear power plants.

Current field is microscale heat transfer to pressurized water at ultra-high heat fluxes.

Microscale Heat Transfer to Subcooled Water
LEYSE: MICROSCALE HEAT TRANSFER
doi.wiley.com/10.1111/j.1749-6632.2002.tb05912.x
Or go to: <http://www3.interscience.wiley.com/journal/118947467/abstract>

MICROSCALE PHASE CHANGE HEAT TRANSFER AT HIGH HEAT FLUX. Robert H. Leyse. Inz, Inc.
Phani K. Meduri, Gopinath R. Warriar and Vijay K. Dhir ...
boiling.seas.ucla.edu/Publications/Conf_LMWD2003

Rulemaking Comments

From: NRCREP Resource
Sent: Tuesday, April 13, 2010 12:32 PM
To: Rulemaking Comments
Subject: Comment on PRM-50-93
Attachments: NRC-2009-0554-DRAFT-0014.1[1].doc

Van,

Attached for docketing is a comment from Robert H. Leyse on PRM-50-93 that I received via the regulations.gov website on April 12, 2010.

Thanks,
Carol

Received: from HQCLSTR02.nrc.gov ([148.184.44.80]) by TWMS01.nrc.gov
([148.184.200.145]) with mapi; Tue, 13 Apr 2010 12:32:05 -0400
Content-Type: application/ms-tnef; name="winmail.dat"
Content-Transfer-Encoding: binary
From: NRCREP Resource <NRCREP.Resource@nrc.gov>
To: Rulemaking Comments <Rulemaking.Comments@nrc.gov>
Date: Tue, 13 Apr 2010 12:32:06 -0400
Subject: Comment on PRM-50-93
Thread-Topic: Comment on PRM-50-93
Thread-Index: AcrbJlfU7OSoqrULTyGwihUBjdTDpg==
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X-MS-TNEF-Correlator:
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