November 5, 1996

LICENSEE: Consumers Power Company

FACILITY: Palisades Nuclear Plant

SUBJECT: PALISADES UPDATED REACTOR VESSEL FLUENCE ANALYSIS

A meeting was held at NRC Headquarters on August 14, 1996, between Consumers Power Company and the NRC to discuss the updated reactor vessel fluence values and their effect on the 10 CFR 50.61 analysis for the Palisades plant. A list of attendees is provided as Attachment 1. Attachment 2 is a list of questions discussed during the meeting and provided to the licensee for its response.

In late March, Consumers informed the staff that it had revised the fluence values and docketed the updated reactor vessel fluence values in an April 4, 1996, submittal. Using the information in that submittal, Consumers concluded that the axial weld containing heat #W5214 would remain the limiting vessel material; however, the revised PTS screening date is now estimated to be 2011. An initial meeting between the staff and Consumers was held on May 15, 1996. Meeting minutes were published on May 31, 1996, which contained questions from the staff. Consumers Power Company responded to those questions in docketed correspondence dated June 12 and June 21, 1996. The August 14 meeting was a follow-up discussion to address the responses provided in those submittals. The discussion during the August 14 meeting centered around the questions provided in Attachment 2. Question 1.1 and 2.3 were discussed during the meeting and a response from the licensee is not required. Responses to the remaining questions are required to be submitted on the docket.

If there are any questions regarding the information presented in the meeting summary or regarding the fluence review, please contact Marsha Gamberoni at (301) 415-3024 or Bob Schaaf at (301) 415-1312.

Original signed by
Robert Schaaf, Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Docket No. 50-255

Attachments: As stated (2)

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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MEETING ATTENDANCE

PALISADES REVISED FLUENCE ANALYSIS REVIEW

August 14, 1996

NAME	AFFILIATION
Marsha Gamberoni	NRC
Lambros Lois	NRC
Matthew Mitchell	NRC
Ed Hackett	NRC
Keith Wichman	NRC
Mike Mayfield	NRC
Maggalean Weston	NRC
John Carew	BNL
E. Dale McGarry	NIST
James Adams	NIST
Jack Hanson	CPCo
Ross Snuggerud	CPCo
George Goralski	CPCo
Charles Kozup	CPCo
Dick Smedley	CPCo
John Perock	Westinghouse
Stan Anderson	Westinghouse
Gary Brassart	Westinghouse
Lynn Connor	STS
Bob Borsum	FTI

ATTACHMENT 1

Request for Additional Information
Palisades Fluence Reevaluation

1. Calculations of the Vessel Fluence

1.1 Discuss the adequacy of the calculations and of the BUGLE-93 library for determining the thermal flux. Discuss the adequacy of this library to determine thermal neutron effects, such as the neutron captures used to generate the gamma source and the effect of the Cd thermal shield on the U-238 dosimeters. One of the early versions of the BUGLE-93 cross section set was withdrawn after its initial release. What version of BUGLE-93 has been used in the Palisades calculations?

1.2 In view of the strong sensitivity of both the neutron and gamma capsule response to the spatial representation of the capsule, how were the Palisades capsule models verified?

1.3 Under certain conditions the flux in the cavity and biological shield exhibit non-physical spatial oscillations due to numerical approximations. Have the transport calculations been verified to insure that such oscillations are not present?

1.4 It is stated in WCAP-14557 that the analysis is consistent with the methods provided in DG-1053. However, no description of the calculation uncertainty analysis (except for the extrapolation from the capsule to the inner-wall) or the periodic calibration of the measurement system has been provided.

2. Dosimeter Measurements

2.1 In view of the substantial differences between the in-vessel and cavity dosimetry, why is the C/M bias determined for the cavity fluence applicable for predicting the vessel inner-wall fluence? Discuss the statistical basis for combining the in-vessel and cavity measurements to determine the calculation-to- measurement bias used for adjusting the vessel fluence. Are the two populations statistically compatible?

2.2 Provide a comparison of the unadjusted calculation-to-measurement (C/M) bias based on: (1) the accelerated capsule, (2) the inner-wall capsule, (3) the cavity capsules and (4) the long-lived Cs-137 fission product.

2.3 Provide the basis for any capsule-specific adjustments made to the capsule measurements, except for the adjustment made using FERRET or explicitly identified such as the photo-fission correction.

2.4 Describe how the shift in the cavity support was determined. Does the shift result in an increase or decrease in the inferred vessel inner-wall fluence? What is the effect of this shift on the capsule measurements on the C/M bias? What is the uncertainty in this shift and how has this been included? Does the FERRET adjustment calculation account for this uncertainty?

ATTACHMENT 2

2.5 Discuss the effect of Pu build-up and changes in the power in the peripheral assemblies during the cycle on the short half-life dosimeter measurements (i.e., the C_j s).

2.6 Why are all in-vessel measurements (except for Ti-46 in A-240 and W290-9) overpredicted?

2.7 The standard deviation in the overall 17% M/C fluence bias given in Table-7.1-1 appears to be larger than what would be expected from the numbers in the table. Please indicate how the standard deviation in the fluence M/C bias was determined. Why was the log-normal least squares adjustment chosen?

2.8 The axial fluence distribution in the cavity is flatter than at the vessel inner-wall and direct application of the chain axial measurements to the (r, θ) calculated inner-wall fluence results in an underprediction of the peak wall fluence. How was this effect accommodated in the interpretation of the (off-midplane) measurements and the prediction of the vessel fluence?

2.9 Have fission products other than Cs-137 (e.g., Zr-95 or Ru-103) been measured in the analysis of the fission dosimeters? If so, do the resulting fluence estimates agree with the Cs-137 fluence predictions?

2.10 Is there any difference between the M/C fluence bias determined for the short-lived fission products, such as Sc-46 (84 d) and Co-58 (71 d), which are sensitive to the recent (~3 month) power-history and the long-lived nuclides, such as Cs-137 (30.2 y), Co-60 (5.3 y), and Mn-54 (312 d), which are sensitive to the power history over several cycles? Note that the Ti-46 appears to be underpredicted for capsules A-240 and W290-9.

2.11 The measured and calculated flux values for W-290 appear to be lower in WCAP-14557 compared to those reported in WCAP-10637. What is the justification for the new values given that the computational methodology has not changed. What is the corresponding change for the accelerated capsule?

3. <u>Least-Squares Measurement Adjustments</u>

3.1 What are the changes (in magnitude and sign) in the flux and each of the dosimeter cross sections resulting from the adjustment procedure? How do these changes compare with the assumed uncertainties?

3.2 The WCAP-14557 Chapter-6 FERRET adjustments result in a ~ 5% decrease in all of the E>1.0 Mev fluence measurements and, also, in the calculated fluence. Provide a technical justification/explanation for this FERRET reduction in both the calculations and measurements.

3.3 Noting that the same DORT calculation is being used to calculate the dosimeter reaction rate and the dosimeter cross section, how is the correlation between the uncertainties in these two parameters accounted for in the FERRET analysis?

3.4 Recognizing the substantial uncertainty in the cross section covariance data, what is the effect on the FERRET fluence adjustment of taking the covariances to be zero? Are cross section covariances available for all dosimeter cross sections and, if not, how are these cross sections treated?

3.5 Provide a quantitative basis for the FERRET methodology assumptions, concerning the specific form of the spectrum correlation matrix, $P_{gg'}$, and assumed values of the parameters θ and γ, for application to the Palisades in-vessel and cavity dosimetry? Why doesn't the correlation matrix allow for anticorrelation? What is the sensitivity of the FERRET fluence adjustment to these assumptions?

3.6 Provide an analysis indicating the sensitivity of the FERRET 5% fluence reduction to increasing and decreasing the input uncertainty estimates by a factor of two.

3.7 The spatial dependence of the dosimeter cross section is determined by the local spectrum and should be unique for a given location. In the FERRET analysis, is a unique dosimeter reaction cross section determined for each of the following locations: (1) the accelerated capsule (2) the inner-wall capsule, and (3) the cavity capsule? If not, provide a comparison of the cross sections determined by FERRET at each of these locations for each reaction type.

3.8 How are the paired capsule reaction rates in Table-6.1-1 used in the FERRET analysis?

3.9 The FERRET analysis determines the dosimeter fluence using an initial fluence guess based on the DORT calculation. If the fluence determined by FERRET is then used as a more accurate initial fluence guess for a subsequent FERRET calculation, how does the fluence determined by this second FERRET calculation compare to the DORT calculation and the first FERRET calculation. Is the convergence error, indicated by the difference between the two FERRET calculations, small compared to the 5% FERRET fluence adjustment?

3.10 The reliability of the M/C fluence bias and the FERRET adjustment procedure depends on reasonable agreement between the measured and calculated reaction rates. However, the measured reaction rates are sensitive to the capsule location and the position of the dosimeters inside the capsule, and the as-built positions of the dosimeters (relative to the core) typically include a substantial degree of uncertainty. Provide an estimate of the uncertainty in the dosimeter locations and the resulting uncertainty in the measured reaction rate. Describe how this uncertainty is included in the FERRET analysis. How does this uncertainty compare with the uncertainty in the calculated bias?

3.11 How is the correlation between cross sections determined for two dosimeters using the same nuclide but only one of which has a thermal shield?

4. <u>CPC Response to RAI-1 (Reference-1)</u>

4.1 In Response-1.1 (item-2), it is stated that comparisons of the DORT calculations with the pin-wise sources determined by PDQ and SIMULATE-3 yield consistent results. Provide the comparison of these results.

4.2 In Response-1.1 (Item-3), why are the bypass temperatures used for Cycles 1 and 2 lower than the temperatures used for later cycles?

4.3 In Response-1.1 (Item-4.3), it is stated that the nominal vessel IR was determined by an average of the maximum and minimum measurements. What is the average of all the measurements?

4.4 In Response-1.2, it is indicated that he use of independent cycle sources results in a reduction in the vessel fluence in Cycles 1 and 2. Since combining the cycle sources before running the DORT calculations or using cycle-specific sources and combining the fluences after running the DORT calculations should yield the same result; what is causing the 4% and 14% fluence reductions in Cycles 1 and 2, respectively.

4.5 It is indicated in Response-1.2 that the new explicit modeling of the ex-vessel dosimetry resulted in up to a 23% increase in the fluence. In view of the sensitivity of the measurements and the M/C bias to the capsule modeling, describe the in-vessel and ex-vessel capsule/dosimeter geometry and materials and how they were modeled in DORT. Is air or water included inside of the capsule?

4.6 In Response-2.1.3, how has the effect of the photons produced as a result of boron capture accounted for in the photo-fission correction?

4.7 In Response-2.3 it is indicated that a 16% correction has been made to the W290 U-238 dosimeter measurement to account for U-235 content and Pu build-in. In view of the increased sensitivity of the E>1.0 MeV fluence to the U-238 measurements, describe how these corrections were determined. How was the effect of the Cd shield included?

4.8 The uncertainty estimates of Response-3.1.2.5 appear low. How is the uncertainty in the power-history modeling and data, and the C_j's included?

Reference 1 "Palisades Plant Updated Reactor Vessel Fluence Submittal-Additional Information," Letter, R.W. Smedley (CPC) to USNRC, June 21, 1996.