Westinghouse Electric Corporation
Water Reactor Divisions

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

November 30, 1982

AW-82-70

Dr. Cecil O. Thomas, Chief
Standardization and Special Projects Branch
Division of System Integration
U.S. Nuclear Regulatory Commission
Phillips Building
7920 Norfolk Avenue
Bethesda, Maryland 20014

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

SUBJECT: "Properties of Fuel and Core Components Materials" WCAP-9179, Revision 1 (Proprietary)/WCAP-9224 (Non-Proprietary)

REF: Westinghouse Letter No. NS-EPR-2687, Rahe to Thomas dated November 30, 1982

Dear Dr. Thomas:

The proprietary material transmitted by the reference letter supplements the proprietary material previously submitted concerning the material properties of Westinghouse core components (reference: NS-TMA-1995, dated November 10, 1980). Further, the affidavit submitted to justify the material previously submitted, AW-77-47, October 25, 1977, is equally applicable to this material. The previously submitted affidavit AW-77-47 was approved by the Commission by letter Stolz to Wiesemann, dated February 8, 1979.

Accordingly, withholding the subject information from public disclosure is requested in accordance with the previously submitted affidavit and application for withholding, AW-77-47 dated October 25, 1977, a copy of which is attached.

Correspondence with respect to this application for withholding or the accompanying affidavit should reference AW-82-70, and should be addressed to the undersigned.

Very truly yours,

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Regulatory & Legislative Affairs

/kk

cc: E. C. Shomaker, Esq.
Office of the Executive Legal Director, NRC

Attachment 1

Supporting Information for Zircaloy Irradiation
Yield Strength Equations (WCAP-9179)

(Supplement to Question 5 as applies to Zircaloy Cladding.
Ref: Westinghouse letter NS-TMA-1985 dated November 10, 1978)

Background

Considerable Westinghouse and open literature data was initially used to develop irradiated yield strength relationships. This data included cladding of varying material specification and test conditions. A more accurate assessment was made in finalizing WCAP-9179 which limited the data base to current Westinghouse cladding specifications and more standardized and industry accepted testing procedures. Although this reduced the data base, scatter as compared to the original larger data base was substantially reduced such that more reasonable and accurate relationships for irradiation yield strength could be generated. The equations for yield strength shown on pages 2-9 thru 2-10 of WCAP-9179 resulted from this effort. These equations describe fuel cladding uniaxial and biaxial effective yield strengths for irradiated cladding.

Irradiated Unaxial Yield Strength

Data from BMI-NUREG-1948, listed in Table 1, along with Westinghouse proprietary data from tests performed on Point Beach, Zorita, and San Onofre cladding were used to generate irradiated uniaxial yield strength equations 3 and 4 on page 2-8.

These equations, along with the corresponding unirradiated cladding equations, are graphically shown in Figure 1. Note that the BMI-NUREG-1948 data (average yield strength values from Table 1) are well represented by the final equations.

Equation 3 is a best estimate equation with typical scatter usually being within [ ] about the average value. The line was chosen to represent an average behavior for saturation damaged cladding rather than an upper bound limit.

Irradiated Biaxial Effective Yield Strength

Data from BMI-NUREG-1948, listed in Table 2, along with Westinghouse proprietary data from tests performed on Point Beach, Zorita, and San Onofre cladding were used to generate the irradiated biaxial effective yield strength equations 5 and 6 on page 2-9.

These equations, along with the corresponding unirradiated cladding equations, are grapically shown in Figure 2. Note that the BMI-NUREG-1948 data are very well represented by the final equations.

Equation 5 is a best estimate equation with typical scatter usually being within [ ] psi about the average value. The line was chosen to represent an average behavior for saturation hardened cladding rather than an upper limit.

[

] However, at saturation irradiation damage conditions, perhaps there is a tendency for texture hardening from anisotropy to increase the biaxial effective yield strength. Such a condition would explain the [ ] psi increase seen in the irradiated biaxial effective compared to the uniaxial yield strength.

Table 1. Irradiated Uniaxial Yield Strength -- Product-Line Cladding

1. Reference: BMI-NUREG-1948
   Mar 1976

   Strain Rate: 0.017 in/in/min

   Cladding Identity: H. B. Robinson No. 2

Specimen No.	Temperature, °F		Strength, psi 0.2% Offset	
P8-7	80		117,500	
P8-21	80		117,000	118,300 avg.
P8-9	80		120,333	
P8-19	200		110,667	
P8-23	200		108,333	108,800 avg.
P8-37	200		107,333	
P8-8	400		96,667	
P8-38	400		97,500	95,600 avg.
P8-47	400		92,667	
P8-51	600		83,000	
P8-52	600		81,333	83,800 avg.
P8-50	600		87,167	
P8-20	700	a)	70,330	73,200 avg.
P8-34	700	a)	76,000	
H10-20	700		85,000	
P8-53	800		65,600	
H10-15	800		73,330	70,700 avg.
H10-30	800		73,333	

a) Strain rate 0.003 in/in/min

Table 2. Irradiated Biaxial Effective Yield Strength -- Product-Line Cladding

1. Reference: BMI-NUREG-1948
   Mar 1976

   Strain Rate: 2000 psi/min
   Cladding Identity: H. B. Robinson No. 2

Specimen No.	Temperature, °F	Effective Biaxial 0.2% Yield Strength - KSI
A8 (25.5-32.5)*	80°	129.7
A8 (25.5-32.5)	400°	114.9
014 (63-70)	600°	101.2
014 (17.5-24.5)	700°	90.2
A8 (17.5-24.5)	800°	79.7

*inches from bottom of fuel rod.

FIGURE 1 - Cladding-Irradiated Uniaxial Yield Stress vs Test Temperature

+(a,c,g

FIGURE 2 - Cladding-Irradiated Biaxial Effective Yield Strength vs Test Temperature

+(a,c,g)