Attachment 2 to AEP:NRC:1018

Proposed Revised Technical Specification Pages

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SURVEILLANCE REQUIREMENTS (Continued)

where

$F_Q^M(Z) = F_Q(Z,\ell)$ at ℓ for which

$\frac{F_Q(Z,\ell)}{T(E_\ell)}$ is a maximum

$F_Q^L(Z) = F_Q^L(E_\ell)$ at ℓ for which

$\frac{F_Q(Z,\ell)}{T(E_\ell)}$ is a maximum

$F_Q^M(Z)$ and $F_Q^L(Z)$ are functions of core height, Z, and correspond at each Z to the rod ℓ for which $\frac{F_Q(Z,\ell)}{T(E_\ell)}$ is a maximum at that Z

V(Z) is a cycle dependent function and is provided in the Peaking Factor Limit Report. K(Z) is defined in Figure 3.2-2 for Exxon Nuclear Company fuel and in Figure 3.2-3 for Westinghouse fuel. $T(E_\ell)$ is defined in Figures 3.2-4 and 3.2-5. $E_P(Z)$ is an uncertainty factor to account for the reduction in the $F_Q^L(E_\ell)$ curve due to accumulation of exposure prior to the next flux map.

Westinghouse Fuel	Exxon Nuclear Co. Fuel	
$E_P(Z) = 1.0$	$E_P(Z) = 1.0$	$0.0 \leq E_\ell \leq 17.62$
$E_P(Z) = 1.0$	$E_P(Z) = 1.0 + [.0040 \times F_Q^M(Z)]$	$17.62 < E_\ell \leq 34.5$
$E_P(Z) = 1.0$	$E_P(Z) = 1.0 + [.0093 \times F_Q^M(Z)]$	$34.5 < E_\ell \leq 42.2$
	$E_P(Z) = 1.0 + [.0060 \times F_Q^M(Z)]$	$42.2 < E_\ell \leq 48.0$
	$E_P(Z) = 1.0$	$48.0 < E_\ell \leq 51.0$

LIMITING CONDITION FOR OPERATION (Continued)

Westinghouse Fuel	ENC Fuel	
$F_p = 1.0$	$F_p = 1.0$	$0.0 \le E_\ell \le 17.62$
$F_p = 1.0$	$F_p = 1.0 + [.0015 \times W]$	$17.62 < E_\ell \le 34.5$
$F_p = 1.0$	$F_p = 1.0 + [.0033 \times W]$	$34.5 < E_\ell \le 42.2$
	$F_p = 1.0 + [.0020 \times W]$	$42.2 < E_\ell \le 48.0$
	$F_p = 1.0$	$48.0 < E_\ell \le 51.0$

where W is the number of effective full power weeks (rounded up to the next highest integer) since the last full core flux map.

APPLICABILITY: MODE 1 above the minimum percent of RATED THERMAL POWER indicated by the relationships.*

$$APL = \text{min over Z of } \frac{2.10 \times K(Z)}{F_Q(Z,\ell) \times V(Z)} \times 100\% \quad \text{Westinghouse Fuel}$$

$$APL = \text{min over Z of } \frac{F_Q^L(E_\ell) \times K(Z)}{F_Q(Z,\ell) \times V(Z) \times E_p(Z)} \times 100\% \quad \text{Exxon Nuclear Co. Fuel}$$

where $F_Q(Z, \ell)$ is the measured $F_Q(Z, \ell)$, including a 3% manufacturing tolerance uncertainty and a 5% measurement uncertainty, at the time of target flux determination from a power distribution map using the movable incore detectors. V(Z) is the function given in the Peaking Factor Limit Report. The above limit is not applicable in the following core plane regions.

1. Lower core region 0% to 10% inclusive.
2. Upper core region 90% to 100% inclusive.

* The APDMS may be out of service when surveillance for determining power distribution maps is being performed.

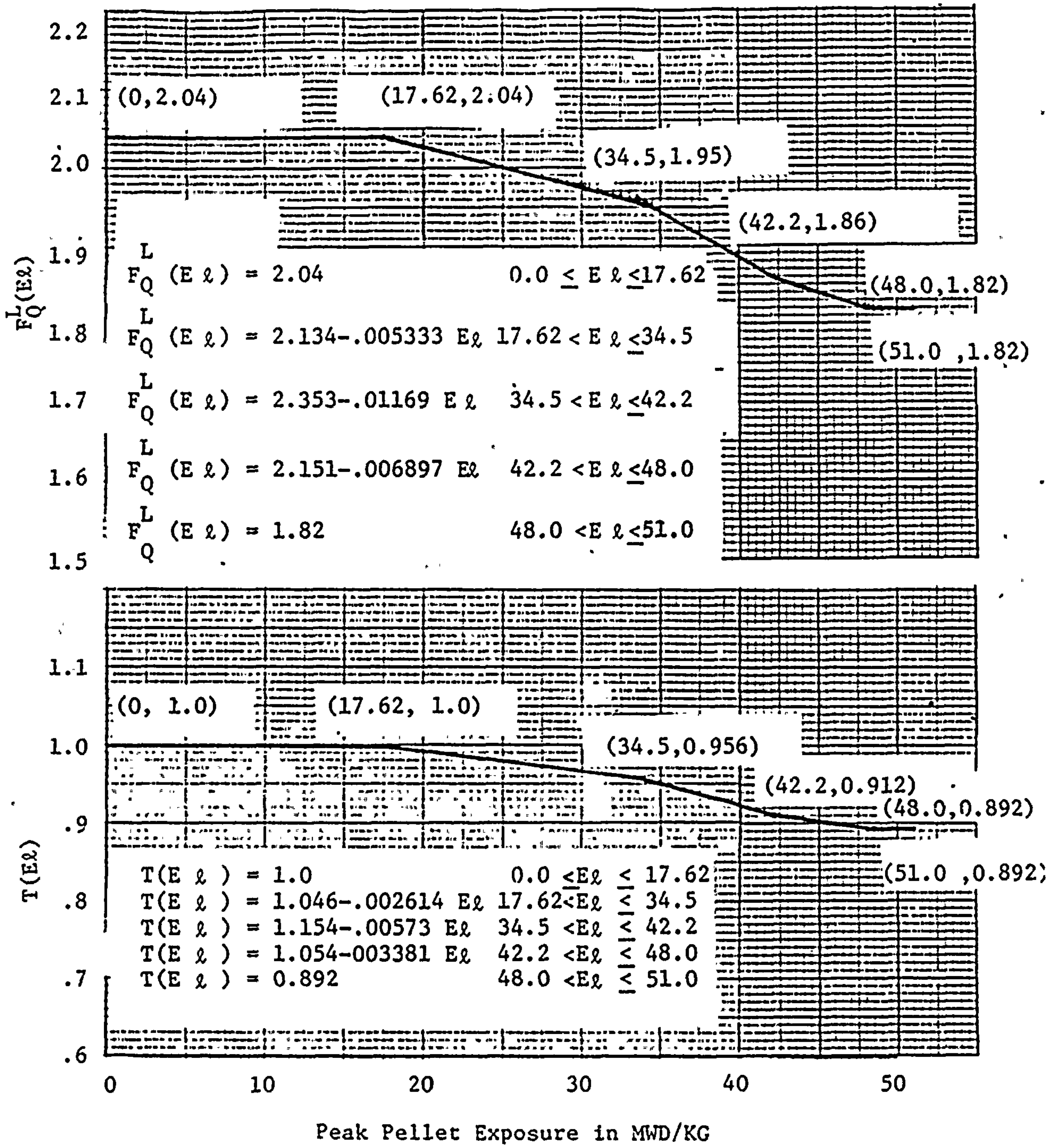

FIGURE 3.2-4

Exposure Dependent F_Q Limit, F_Q^L (Eℓ), and Normalized Limit T (Eℓ) as a function of Peak Pellet Burnup for Exxon Nuclear Company Fuel

Attachment 3 to AEP:NRC:1018

ANF Evaluation of LOCA Considerations

EXXON NUCLEAR COMPANY, INC.
600 108TH AVENUE NE, PO BOX 90777, BELLEVUE, WA 98009
(206) 453-4300

November 11, 1986
ENC/AEP-0535

Mr. Rick Bennett, Engineer
Nuclear Materials & Fuel Management
Indiana & Michigan Electric Company
c/o American Electric Power Service Corp.
One Riverside Plaza, 20th Floor
Columbus, OH 43216-6631

Dear Mr. Bennett:

Attached is a recommended change to the D.C. Cook Unit 1 Technical Specification on F_Q to allow operation of ENC fuel to peak pellet exposures of 51 GWD/MT. A justification of this change is also attached for your use in obtaining NRC approval for this change.

If you have any questions regarding the attachment, please contact our Mr. J.S. Holm (telephone 509 375-8142).

Sincerely,

R. C. Gottula for

H. G. Shaw
Contract Administrator

gf

Attachment

cc: M.P. Alexich
J.M. Cleveland
D.H. Malin
V. VanderBurg
J.S. Holm (ENC)

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PAGE 1 OF 4
ATTN. Rick Bennett

Attachment

D.C. COOK UNIT 1 TECHNICAL SPECIFICATION CHANGE

Ref: (1) XN-NF-85-115, Rev. 1, "D.C. Cook Unit 1 Limiting Break K(Z) LOCA/ECCS Analysis," November 1986.

(2) XN-NF-85-68(P), Rev. 1, "Donald C. Cook Unit 2 Limiting Break LOCA/ECCS Analysis, 10% Steam Generator Tube Plugging, and K(Z) Curve," April 1986.

(3) XN-NF-85-117, Supp. 1, "St. Lucie Unit 1 Revised LOCA/ECCS Analysis with 15% Steam Generator Tube Plugging Break Spectrum and Exposure Results," December 1985.

A LOCA/ECCS analysis justifying the operation of ENC fuel currently in the D.C. Cook Unit 1 reactor is presented in Reference 1. The analysis in that report supports a peak F_Q of 2.04 with an axial dependence as shown in Figure 1. This analysis is applicable to the ENC fuel currently in the D.C. Cook Unit 1 reactor, with a minimum peak rod average exposure greater than 20 GWd/MT and anticipated to be less than 47 GWd/MT.

Justification for an exposure dependent F_Q for D.C. Cook Unit 1 is based on an exposure analysis for D.C. Cook Unit 2 (Reference 2). Peak cladding temperatures are dependent upon fuel rod initial stored energy, which for the EXEM/PWR models increases from 0 to about 2 GWd/MTM and then decreases with exposure. The analysis for D.C. Cook Unit 2 with 17x17 fuel geometry demonstrated that over the exposure range of 0 to 47 GWd/MTM, the peak cladding temperature decreased with exposure for exposures beyond the peak stored energy exposure. A similar trend was observed for St. Lucie Unit 1 with 15x15 fuel geometry (Reference 3). Similar results would be expected for D.C. Cook Unit 1 with 15x15 fuel geometry using EXEM/PWR models. Based on the trend of decreasing peak cladding temperature with increasing exposure, the analysis in Reference 1 is conservative and supports an F_Q of at least 1.95 for ENC fuel at peak rod average exposures between 20 and 47 GWd/MTM. A peak rod average exposure of 47 GWd/MTM is equivalent to a peak pellet exposure of 51 GWd/MTM.

The recommended D.C. Cook Unit 1 exposure dependent F_Q Technical Specification Figure 3.2-4 is attached. This figure is the same as the figure in the current D.C. Cook Unit 1 Technical Specification but with the addition of a constant F_Q limit of 1.82 from 48.0 GWd/MT to 51 GWd/MT peak pellet exposure. For consistency with the current D.C. Cook Unit 1 Technical Specification, the curve has been maintained in terms of peak pellet burnup.

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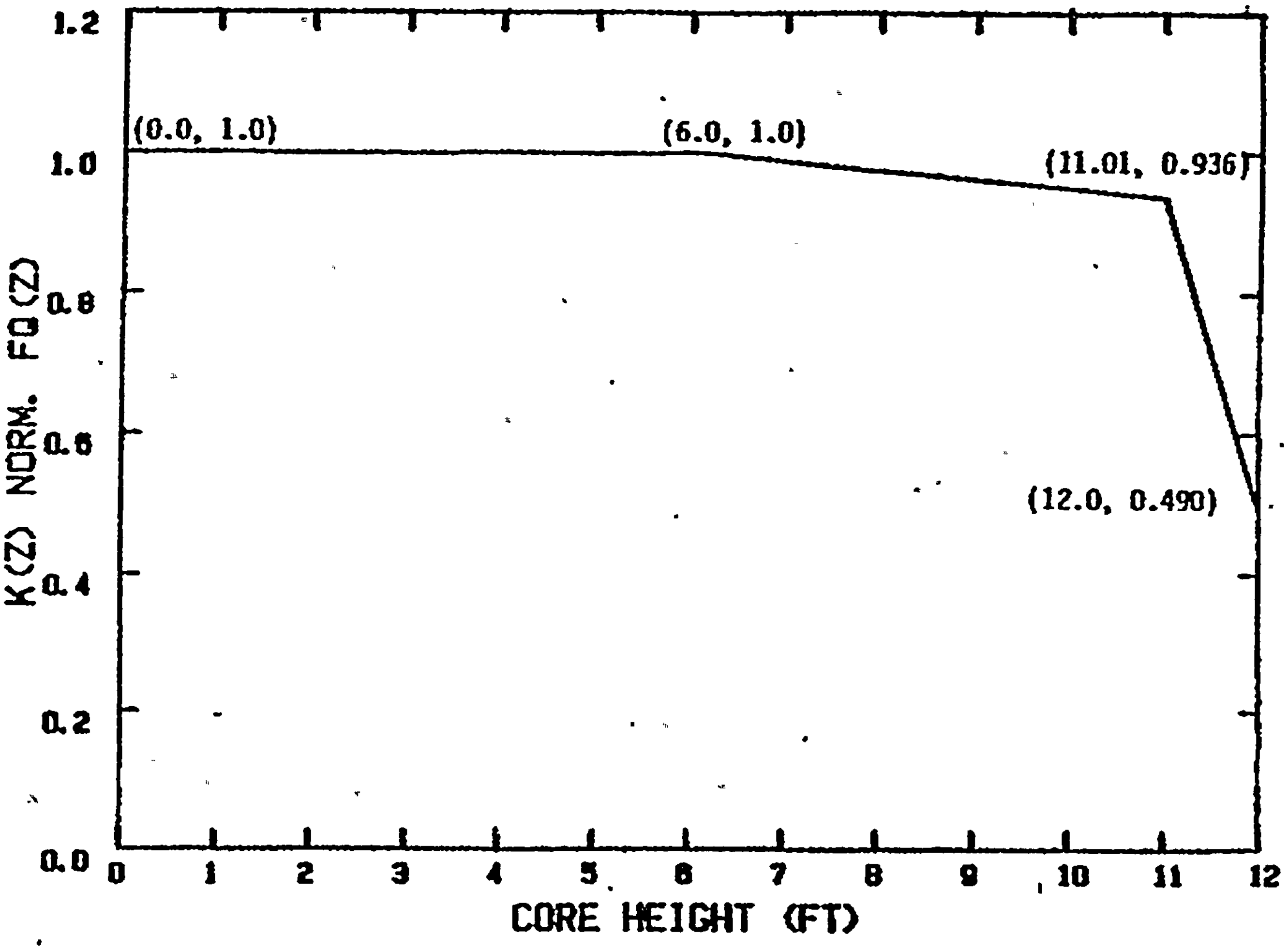

Figure 1 Hot Channel Factor Normalized Operating Envelope, F_Q=2.04, K(Z) Function

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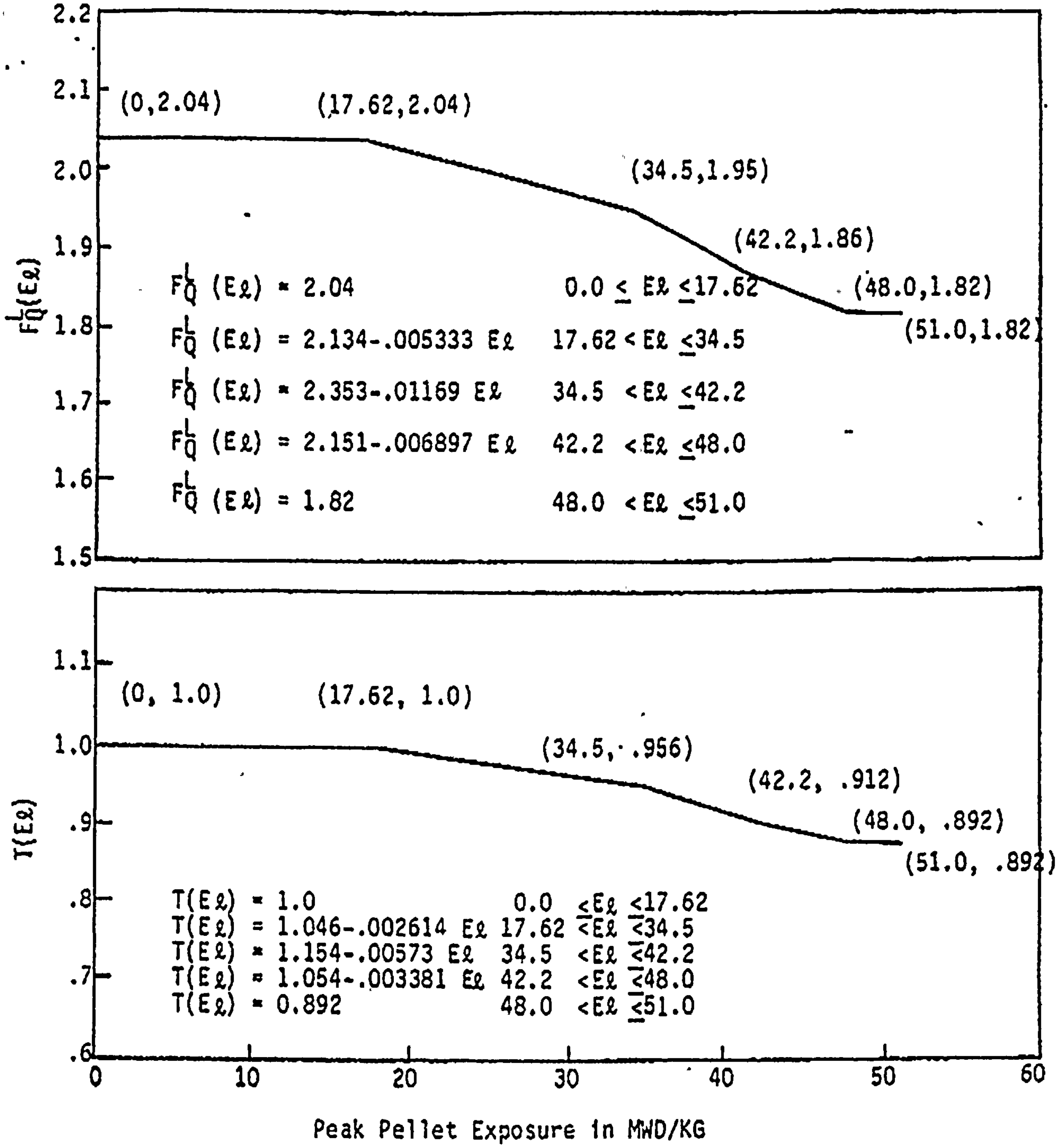

Figure 3.2-4

Exposure Dependent F_Q Limit, $F_Q^L(E\ell)$, and Normalized Limit $T(E\ell)$ as a function of Peak Pellet Burnup for Exxon Nuclear Company Fuel

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PAGE 4 OF 4
ATTN.

A F F I D A V I T

STATE OF WASHINGTON)
) ss.
COUNTY OF BENTON)

I, H. E. Williamson being duly sworn, hereby say and depose:

1. I am Manager, Licensing and Safety Engineering, for Advanced Nuclear Fuels Corporation ("ANF"), and as such I am authorized to execute this Affidavit.

2. I am familiar with ANF's detailed document control system and policies which govern the protection and control of information.

3. I am familiar with the Letter HGS-87-55(P) entitled "DC Cook Unit 1 Peak Pellet Burnup Extension" referred to as "Document." Information contained in this Document has been classified by ANF as proprietary in accordance with the control system and policies established by ANF for the control and protection of information.

4. The document contains information of a proprietary and confidential nature and is of the type customarily held in confidence by ANF and not made available to the public. Based on my experience, I am aware that other companies regard information of the kind contained in the Document as proprietary and confidential.

5. The Document has been made available to the U.S. Nuclear Regulatory Commission in confidence, with the request that the information contained in the Document will not be disclosed or divulged.

6. The Document contains information which is vital to a competitive advantage of ANF and would be helpful to competitors of ANF when competing with ANF.

7. The information contained in the Document is considered to be proprietary by ANF because it reveals certain distinguishing aspects of PWR Fuel Design methodology which secure competitive advantage to ANF for fuel design optimization and marketability, and includes information utilized by ANF in its business which affords ANF an opportunity to obtain a competitive advantage over its competitors who do not or may not know or use the information contained in the Document.

8. The disclosure of the proprietary information contained in the Document to a competitor would permit the competitor to reduce its expenditure of money and manpower and to improve its competitive position by giving it extremely valuable insights into PWR Fuel Design methodology and would result in substantial harm to the competitive position of ANF.

9. The Document contains proprietary information which is held in confidence by ANF and is not available in public sources.

10. In accordance with ANF's policies governing the protection and control of information, proprietary information contained in the Document has been made available, on a limited basis, to others outside ANF only as required and under suitable agreement providing for non-disclosure and limited use of the information.

11. ANF policy requires that proprietary information be kept in a secured file or area and distributed on a need-to-know basis.

12. This Document provides information which reveals PWR Fuel Design methodology developed by ANF over the past several years. ANF has invested thousands of dollars and several man-months of effort in developing the PWR Fuel Design methodology revealed in the Document. Assuming a competitor had available the same background data and incentives as ANF, the competitor might, at a minimum, develop the information for the same expenditure of manpower and money as ANF.

THAT the statements made hereinabove are, to the best of my knowledge, information, and belief, truthful and complete.

FURTHER AFFIANT SAYETH NOT.

H. E. Williamson

SWORN TO AND SUBSCRIBED

before me this 10th day of

February, 1991.

[signature]

NOTARY PUBLIC

Attachment 5 to AEP:NRC:1018

ANF Evaluation (Non-Proprietary) of Mechanical Design Considerations for Peak Pellet Exposures up to 48.7 Mwd/kg

DC Cook Unit 1 - Peak Pellet Burnup Extension

Background:

The last reload of ANF (formerly ENC) fuel supplied for the DC Cook Unit 1 reactor is currently in its last cycle of operation. A burnup extension analysis had been performed for this fuel in 1984 in order to support burnup levels of 41.0, 43.7, and 48.0 GWD/MtU respectively for peak assembly, peak rod, and peak pellet. Reactor operating conditions since that time have resulted in higher axial peaking than originally projected. Consequently, the peak pellet burnup is now expected to approach a level of 48.5 GWD/MtU. The peak rod and peak assembly burnup levels are not affected. A review of the original analyses supporting the burnup extension has been conducted in order to determine the consequences of an increase in peak pellet exposure. The review considered an additional increase in peak pellet exposure to 48.7 GWD/MtU to provide margin for a potential end of cycle coastdown.

Summary of Burnup Extension Analysis Review:

The original burnup extension analysis, reported in XN-NF-84-25, Rev. 0 (Reference 1), addressed the following aspects of design: (1) Steady State Stress, (2) Steady State Strain, (3) Cladding Corrosion and Hydrogen Absorption, (4) Transient Stress and Strain and Cladding Fatigue, (5) Cladding Creep Collapse, (6) Fuel Rod Internal Gas Pressure, (7) Fuel Rod Growth, (8) Spacer Spring Force, and (9) Fuel Assembly Growth. Of these, only Steady State Strain, Corrosion and Hydrogen Absorption, and Fuel Rod Internal Pressure are significantly affected by the axial profile of the fuel rod. The remainder of the items are essentially independent of the peak pellet exposure. The results reported in XN-NF-84-25, Rev. 0 remain valid for these items.

The power history used for the original burnup extension analysis was based on a conservative best-estimate of the maximum discharge exposure rod, assuming full power operation. In reality the operation of the reactor has been limited to 90 percent of full power. Therefore, the original power history projection represents a bounding case for this fuel.

The revised analysis shows that clad strain, corrosion and hydrogen absorption remain within the design limits, and the fuel rod pressure remains below system pressure.

Steady State Strain, Cladding Corrosion and Hydrogen Absorption:

The maximum cladding strain, corrosion and hydrogen absorption were determined to occur at the peak axial region in the original burnup extension analysis. Review of this analysis showed the results from the previous analysis to have been taken for a peak pellet exposure of 48.3 GWD/MtU. Because of the substantial margin for these design criteria a simple extrapolation was used to project the conditions for a peak pellet exposure of 48.7 GWD/MtU. Extrapolating the results of the original analysis and including an uncertainty of five percent yields the following results:

	Projected	Criteria
Total Positive Strain, (%)	[	]
Maximum Positive Strain Increase, (%)	[	]
Cladding Corrosion, (inch)	[	]
Hydrogen Absorption, (ppm)	[	]

Therefore, the fuel will remain well within the criteria for these items.

Fuel Rod Internal Pressure:

A new RODEX2 (Reference 2) analysis was performed using the approved methodology for internal gas pressure determination and the bounding power history. The axial peaking factor from the original extension analysis was increased by 2% at the maximum axial region in order to bound the 1.5% increase in burnup from 48.0 to 48.7 GWD/MtU. The results of this analysis showed a peak internal pressure of [ ] psia over the design life of the fuel. This value is well within the criteria limit of the 2250 psia reactor operating pressure as given in XN-NF-84-25, Rev. 0.

Conclusion:

Review of the analysis for the ANF fuel supplied to the DC Cook Unit 1 reactor has shown the fuel capable of meeting all design criteria at a peak pellet exposure of 48.7 GWD/MtU. The results presented in the extended burnup report XN-NF-84-25, Rev. 0 with the addition of the results presented in this letter remain valid for the fuel.

Ref: (1) XN-NF-84-25, Revision 0, Mechanical Design Report Supplement for DC Cook Unit 1 Extended Burnup Fuel Assemblies, April 1984.

(2) XN-NF-81-58 (P)(A), Revision 2, RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model, March 1984.