UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket Nos. 50-250 OLA
	)	50-251 OLA
FLORIDA POWER AND LIGHT COMPANY	)	
	)	
(Turkey Point Nuclear Generating, Unit Nos. 3 and 4)	)	

AFFIDAVIT OF YI-HSIUNG HSII
REGARDING CONTENTION (d)

I, Yi-Hsiung Hsii, being duly sworn, state as follows:

1. I am a Nuclear Engineer in the Core Performance Branch of the Division of Systems Integration in the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. A summary of my professional qualifications and experience is attached.

2. The purpose of this Affidavit is to address Intervenors' Contention (d) which states:

> The proposed decrease in the departure in the nucleate boiling ratio (DNBR) would significantly and adversely affect the margin of safety for the operation of the reactors. The restriction of the DNBR safety limit is intended to prevent overheating of the fuel and possible cladding perforation, which would result in the release of fission products from the fuel. If the minimum allowable DNBR is reduced from 1.3 to 1.7 (sic: 1.17) as proposed, this would authorize operation of the fuel much closer to the upper boundary of the nucleate boiling regime. Thus, the safety margin will be significantly reduced. Operation above the boundary of the nucleate boiling regime could result in excessive cladding temperatures because of the departure from the nucleate boiling (DNB) and the resultant sharp reduction in heat transfer coefficient. Thus, the proposed amendment will both significantly reduce the safety margin and significantly increase the probability of serious consequences from an accident.

3. I have read the "Licensee's Motion for Summary Disposition of Intervenors' Contention (d)" and the "Licensee's Statement of Material Facts as to Which There Is No Genuine Issue to be Heard With Respect to Intervenors' Contention (c)," dated August 10, 1984. The facts presented in relation to Contention (d) are correct and are supported by the findings and conclusions of the NRC Staff's Safety Evaluation, dated December 23, 1983, in support of Amendment Nos. 99 and 93 to the facility operating licenses for Turkey Point Plant Units No. 3 and 4, respectively. The following information and details expand on the factors and con siderations provided in the above referenced Safety Evaluation relating to Contention (d).

4. Turkey Point Units 3 and 4 previously operated with cores loaded with Westinghouse 15 x 15 Low-parasitic (LOPAR) fuel. Beginning with Unit 3 cycle 9 and Unit 4 cycle 10 reloads, both units were refueled with Westinghouse 15 x 15 Optimized Fuel Assemblies (OFA). Therefore, during the transition period until eventually a full core of OFA is obtained, both units will operate with LOPAR-OFA mixed cores.

5. As indicated in Section 3 of the Staff Safety Evaluation, critical heat flux (CHF) for the LOPAR fuel is calculated with the W-3 L-Grid CHF correlation as was done for the previous reloads, whereas CHF for the OFA fuel is calculated with the WRB-1 correlation. Both W-3 and WRB-1 correlations have been approved for safety analysis with respective Departure from Nucleate Boiling Ratio (DNBR) limits. The DNBR limit for the W-3 correlation is 1.3 and the DNBR limit for the WRB-1 correlation is 1.17. These DNBR limits are imposed for the respective CHF correlations as the specified acceptable fuel design limits to ensure with a

95 percent probability at 95 percent confidence level, as specified in NUREG-0800, "Standard Review Plan" (SRP), Section 4.4, that the hot fuel rod in the core will not experience departure from nucleate boiling during normal operation and anticipated operational occurrences. The DNBR limit of 1.3 for the W-3 correlation has not been reduced. Rather, the reduction of DNBR limit from 1.3 to 1.17, as stated in the contention, reflects the use of a different CHF correlation (WRB-1) for the OFA fuel.

6. To ensure that the fuel does not experience departure from nucleate boiling (DNB), reactor operation is restricted so that the heat flux is below the CHF which is the maximum heat flux occurring just before a change of boiling heat transfer mode resulting in a fuel cladding temperature excursion. CHF is calculated using empirical correlations developed based on experimental CHF data. The original W-3 correlation was developed from CHF tests conducted with water flowing inside heated tubes. Subsequent modifications were made to the W-3 correlation, designated as W-3 L-Grid correlation, to apply to the test results representative of the L-Grid LOPAR fuel design. The more recent WRB-1 CHF correlation was developed based on the CHF test data of the rod bundle best representative of the reactor fuel assembly geometry and operating ranges. The DNBR is defined as the critical heat flux divided by the actual local heat flux. If the exact CHF is calculated, a DNBR greater than 1.0 would ensure that the actual heat flux is below CHF and DNB would be avoided. Because of random variations in the data, a CHF correlation does not predict the exact CHF. A DNBR limit greater than 1.0 is imposed to account for the uncertainties of the correlation in the CHF predictions. This DNBR limit ensures with a 95 percent probability

at 95 percent confidence level that DNB will be avoided when DNBR is greater than this value. The DNBR limit for a correlation depends upon the ability of the correlation to predict the measured CHF data. For every CHF test data point, a CHF prediction is made using the correlation and a comparison is made between the measured and the predicted CHF values. A probability distribution of the measured to predicted CHF ratios is obtained for all the CHF data points. Statistical analysis is performed to obtain the estimated mean and standard deviation of the measured to predicted CHF ratio population. The DNBR limit is derived from the one-sided tolerance limit using the acceptance criterion of 95 percent probability at the 95 percent confidence level specified in the SRP.

7. The lower DNBR limit of 1.17 for the WRB-1 correlation reflects a correlation more capable of predicting CHF data with less uncertainty. The improvement of the correlation results from a better understanding of the CHF phenomenon and therefore a better correlation formulation. The improvement also results from an improved CHF test facility and better data acquisition techniques that result in more accurate measured CHF data. These factors result in narrower probability distribution of the measured to predicted CHF ratios and result in a smaller estimated standard deviation. In addition, the large data base of more than 1100 data points used to obtain the WRB-1 correlation has resulted in requiring a smaller multiple of the estimated standard deviation in deriving the DNBR limit. The net result is a lower DNBR limit which still ensures with a 95 percent probability at 95 percent confidence level that DNB will be avoided. Therefore, imposing a DNBR limit of 1.17 for

WRB-1 as the acceptable specified fuel design limit provides the same assurance as the DNBR limit of 1.3 for W-3 and meets the acceptance criterion of the SRP.

8. Section 3 of the Staff Safety Evaluation indicated that there may be a small (less than 2 percent) uncertainty associated with application of WRB-1 to the 15 x 15 OFA due to lack of CHF data on the 15 x 15 OFA. The WRB-1 correlation had previously been approved for application to the 15 x 15 and 17 x 17 R-Grid LOPAR fuel and 17 x 17 OFA fuel with a DNBR limit of 1.17. To justify the application of WRB-1 to the 15 x 15 OFA, Westinghouse submitted additional CHF test data from test assemblies representative of the 14 x 14 OFA. The Staff evaluation of these additional data has found that WRB-1 is applicable to the 14 x 14 OFA with the same DNBR limit of 1.17. Since the 15 x 15 OFA has similar mixing vane grid design as that of the 14 x 14 and 17 x 17 OFA, and since the pin diameter, rod pitch, heated length and grid spacing of the 15 x 15 OFA are within the applicability range of the WRB-1 correlation, application of WRB-1 to 15 x 15 OFA is acceptable with the same DNBR limit of 1.17. As indicated in the Staff Safety Evaluation, however, the Turkey Point Units 3 and 4 safety analysis uses a minimum DNBR limit of 1.34 using WRB-1 for the OFA fuel. This DNBR limit is 12.7 percent higher than the approved DNBR limit of 1.17. This 12.7 percent margin is sufficient to compensate for possible small uncertainty associated with application of WRB-1 to the 15 x 15 OFA and other uncertainties identified in the staff safety evaluation report. Therefore, the DNBR limit of 1.17 for WRB-1 as applied to the Turkey Point 15 x 15 OFA does not result in significant reduction in safety margin.

9. In summary, based on the NRC Staff's Safety Evaluation, the amendments do not significantly reduce the safety margin or significantly increase the probability of serious consequences from an accident.

The foregoing and attached statement of professional qualifications are true and correct to the best of my knowledge and belief.

Yi-Hsiung Hsii

Subscribed and sworn to before me
this 6th day of September, 1984

Walinda L. McDonald
Notary Public

My commission expires: 7/1/86

Yi-Hsiung Hsii
Core Performance Branch
Division of Systems Integration
U. S. Nuclear Regulatory Commission

PROFESSIONAL QUALIFICATIONS

I am employed as a Nuclear Engineer in the Core Performance Branch of the Division of Systems Integration. In my present work assignment, I have been working as a technical reviewer on safety evaluation reports and reload methodological topical reports in core thermal hydraulic area submitted by applicants and licensees. I also serve as technical monitor and project manager of a few technical assistance programs granted to national laboratories.

I graduated from Taiwan University with a BS in Mechanical Engineering in 1964. After one year of military service in Taiwan, I attended North Carolina State University, where I received A Ph.D in Mechanical Engineering in 1972. I am a registered Professional Engineer, Certificate Number 10352, in the state of Virginia.

Prior to joining the NRC staff in January 1981, I was employed by the Babcock and Wilcox Company for a total of eleven years. From January 1967 to August 1968 I was employed as an Engineer in the Thermal Analysis Group. From 1971 to 1981, I was employed as a Senior Engineer and then Principal Engineer in the Technical Staff Section. My work at B&W included PWR core thermal hydraulic design analysis, and development of computer codes in the areas of containment systems, reactor system transients, and fuel pin thermal performance analysis, as well as general-purpose heat transfer codes.