NRC-03-031

10 CFR 50.90

March 19, 2003

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

KEWAUNEE NUCLEAR POWER PLANT
DOCKET 50-305
LICENSE No. DPR-43
LICENSE AMENDMENT REQUEST 187 TO THE KEWAUNEE NUCLEAR POWER PLANT TECHNICAL SPECIFICATIONS (TAC NO. MB5718)

References: Letter from Thomas Coutu (NMC) to Document Control Desk (NRC), "NMC Responses To NRC Request for Additional Information Concerning License Amendment Request 187 to the Kewaunee Nuclear Power Plant Technical Specifications (TAC NO. MB5718)," dated February 27, 2003.

The Nuclear Management Company, LLC, (NMC) submitted a response to the Nuclear Regulatory Commission (NRC) request for additional information (RAI) concerning License Amendment Request (LAR) 187 (reference 1) to the Kewaunee Nuclear Power Plant (KNPP) Technical Specifications (TS) revising KNPP TS to allow transitioning to Westinghouse 422V+ nuclear fuel.

On review of the response NMC submitted for question 58, NMC has determined additional information is necessary to fully answer this question. Attachment 1 is NMC revised response to question 58.

If there are any comments or questions concerning this request please contact Mr. Gerald Riste, of my staff, at (920) 388-8424.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on March 19, 2003.

Thomas Coutu

Thomas Coutu
Site Vice-President, Kewaunee Plant

GOR

cc- US NRC, Region III
US NRC Senior Resident Inspector
Electric Division, PSCW

Enclosure-RAI Question 58 Response

A001

58. Because it is possible for one fuel type to be PCT-limiting, and another to be oxidation-limiting, provide a commitment to report LOCA analysis results for all fuel types (represented in a significant number of assemblies), per 10 CFR 50.46 (a)(3).

Response: The Westinghouse 422V+ and Framatome ANP fuel designs were both evaluated and shown to satisfy the 10 CFR 50.46 acceptance criteria for large break and small break LOCA. The assessments were performed at the uprated power level of 1772 MWt and were consistent with the core designs analyzed for Attachment 4 to LAR 187 (Reference 1) and future expected KNPP reload cores. The results are presented in Tables 58-1 and 58-2 below. The PCT and oxidation assessments are discussed in more detail below.

Large Break LOCA

The values reported in Table 58-1 were generated consistently with the NRC-approved Best–Estimate LOCA (BELOCA) methodology (Reference 2). For example, the oxidation values are calculated for a transient that has a peak cladding temperature in excess of the 95th percentile value, and are reported for the fuel that has the maximum transient oxidation (i.e., fresh fuel). For Kewaunee, the selected transient was a calculation performed for a full core of Westinghouse fuel, which was shown to bound a mixed core configuration as discussed below.

Mixed core assessments were performed using two WCOBRA/TRAC calculations. The first modeled the hot rod/assembly as fresh Westinghouse 422V+ fuel surrounded by partially depleted Framatome ANP fuel. The second modeled the hot rod/assembly as partially depleted Framatome ANP fuel surrounded by Westinghouse 422V+ fuel. The PCT for both mixed core scenarios was less than that calculated using a model representing a full core of Westinghouse fuel.

The Framatome ANP fuel was analyzed in the second WCOBRA/TRAC calculation as though it would operate at the same peaking factors as the Westinghouse fuel (FQ = 2.50, FdH = 1.80). That calculation showed that the partially depleted Framatome ANP fuel was non-limiting with respect to PCT by 125°F at the limiting second reflood peak. However, the Framatome ANP fuel will continue to have peaking factor limits of FQ = 2.35 and FdH = 1.70. Based on power distribution studies performed for Westinghouse fuel that are applicable to Framatome ANP fuel, it is estimated that the lower peaking factors would reduce PCT for the Framatome ANP fuel by 130°F. This information was used to determine the 95th percentile PCT reported in Table 58-1 for the Framatome ANP fuel (Framatome ANP fuel PCT = 2084°F – 125°F – 130°F = 1829°F). This is considered to be a conservatively high value for PCT, as the burnup assumed for the Framatome ANP fuel was much less than what was actually the case for the RTSR core designs. Specifically, a burnup of 3500 MWD/MTU was assumed for the Framatome ANP fuel in the second WCOBRA/TRAC calculation as compared to an actual burnup in the first RTSR transition core design that was greater than 18000 MWD/MTU at the beginning of cycle. Initial stored energy decreases significantly (on the order of 300°F) for high powered fuel rods in their first cycle of operation, due to closing of the pellet-cladding gap. The reduction in PCT for Framatome ANP fuel due to this effect was therefore conservatively accounted for in the mixed core calculation by of the use of the conservatively low burnup.

The substantial similarities in design between the Framatome ANP and Westinghouse fuel allow the transient oxidation corresponding to the PCT for the Framatome ANP fuel to be evaluated based on calculations with Westinghouse fuel that resulted in PCTs close to the Framatome ANP fuel PCT value. Transient oxidation results for six cases with PCT in the range of 1810-1870°F were reviewed, and the reported transient oxidation value for Framatome ANP fuel bounds all cases.

The footnote to Table 58-1 also reports the maximum expected total of the normal operation (pre-transient) and LOCA transient oxidation, for any point in burnup. This maximum value corresponds to end of life conditions, and is almost entirely attributable to pre-transient oxidation. At this point in burnup, the reduction in initial stored energy due to pellet-cladding gap closure, and the reduction in achievable power due to depletion of fissionable isotopes, results in peak cladding temperatures that are too low for LOCA transient oxidation to occur to any significant extent.

Figure 58-1 shows the PCT transients for a full core of 422V+ fuel compared to a transition core with partially depleted Framatome ANP fuel surrounded by 422V+ fuel. This calculation was performed using the reference transient conditions as defined by the Westinghouse methodology in WCAP-14449-P-A. Figures 58-2 and 58-3 compare the RCS pressure transients for those two runs, for the entire transient, and for the reflood portion, respectively. Figure 58-4 compares the hot assembly collapsed liquid level. It can be seen that the core configuration has little effect on the RCS pressure or hot assembly collapsed liquid level. The reflood PCTs from Figure 58-1 are 1763°F for the full core 422V+ fuel calculation, and 1638°F for the calculation with partially depleted Framatome ANP fuel surrounded by 422V+ fuel.

Small Break LOCA

In the SBLOCA analysis, it was determined that the PCT calculated for a full core of Westinghouse 422V+ fuel bounds the transition cycles. Given the low SBLOCA PCT of 1030°F, cladding oxidation during the transient is not a concern. The footnote to Table 58-2 also reports the maximum expected total of the normal operation (pre-transient) and transient oxidation, for any point in burnup. As with the large break LOCA results, this maximum oxidation value corresponds to end of life conditions. It is entirely attributable to pre-transient oxidation.

Framatome ANP Fuel Pre-Transient Oxidation

Pre-transient oxidation for the Framatome ANP fuel has also been addressed through fuel rod design requirements which limit the maximum pre-transient oxidation to <13.2% equivalent cladding reacted (ECR) on a 95/95 basis. The maximum calculated pre-transient oxidation for the FANP fuel through the final transition cycle is <10.6% ECR on a 95/95 basis, appreciably less than 13.2% ECR. Note that maximum pre-transient oxidation and maximum transient oxidation cannot occur in the same fuel rod. Therefore, the summation of the maximum pre-transient and maximum transient oxidation values is not required to meet the 17% maximum cladding oxidation limit of 10 CFR 50.46.

Reference

1. Letter from Mark E. Warner (NMC) to Document Control Deck (NRC), "License Amendment Request 187 to the Kewaunee Nuclear Power Plant Technical Specifications, Conforming Technical Specification Changes for Use of Westinghouse VANTAGE + fuel," dated July 26, 2002

2. S. M. Bajorek, et al., WCAP-12945-P-A (Proprietary), Westinghouse Code Qualification Document for Best-Estimate Loss-of-Coolant Accident Analysis, Volume I, Rev. 2, and Volumes II-V, Rev. 1, and WCAP-14747 (Non-Proprietary), March 1998.

Table 58-1

LBLOCA Fuel Cladding Results

Result	Value	Criteria
50th Percentile PCT (°F)	<1760 (all fuel)	N/A
95th Percentile PCT (°F)	<2084 (Westinghouse fuel) <1829 (Framatome ANP fuel)	<2200
Maximum Cladding Oxidation during LOCA Transient (%)[1]	< 8.44 (Westinghouse fuel) < 4.0 (Framatome ANP fuel)	<17
Maximum Hydrogen Generation (%)	<0.74 (all fuel)	<1
Coolable Geometry	Core remains coolable	Core remains coolable
Long-Term Cooling	Core remains cool in long term	Core remains cool in long term

Note:

1. The maximum total oxidation of any fuel in the core, including pre-transient oxidation, is estimated as < 15%. This maximum value would be for fuel that is ready to be discharged.

Table 58-2

SBLOCA Fuel Cladding Results

Result	Criteria	High T_{avg}[2]			Low T_{avg}
		2-Inch	3-Inch	4-Inch	3-Inch
Peak Clad Temperature (°F)	<2200	916	1030	938	861
Peak Clad Temperature Elevation (ft)	N/A	11.00	11.00	9.75	11.00
Maximum Cladding Oxidation During LOCA Transient (%)[3]	<17.0	<0.01	0.01	<0.01	<0.01
Maximum Local Zirc-Water Reaction Elevation (ft)	N/A	11.25	11.00	10.25	11.25
Total Zirc-Water Reaction (%)	<1.0	<1.0	<1.0	<1.0	<1.0
Hot Rod Burst Time (sec)	N/A	No burst	No burst	No burst	No burst
Hot Rod Burst Elevation (ft)	N/A	N/A	N/A	N/A	N/A
Reactor Core Rated Thermal Power[1]		1772 MWt			

Notes:

1. 0.6% is added to the core thermal power to account for calorimetric uncertainties.
2. A high T_{avg} 6-inch break case was performed resulting in no core uncovery.
3. The maximum total oxidation of any fuel in the core, including pre-transient oxidation, is estimated as < 15%. This maximum value would be for fuel that is ready to be discharged.

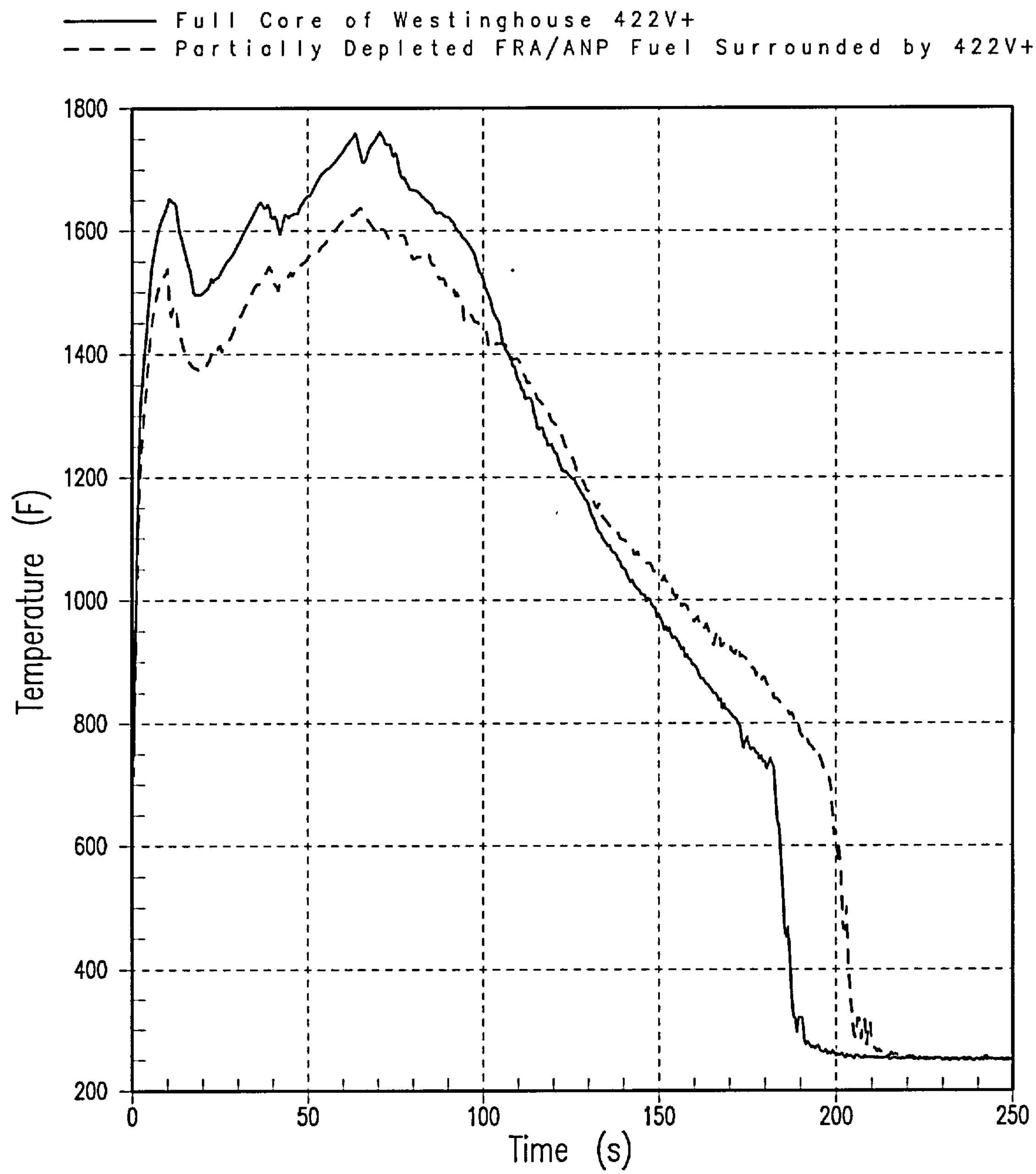

Figure 58-1: Peak Cladding Temperature Comparison

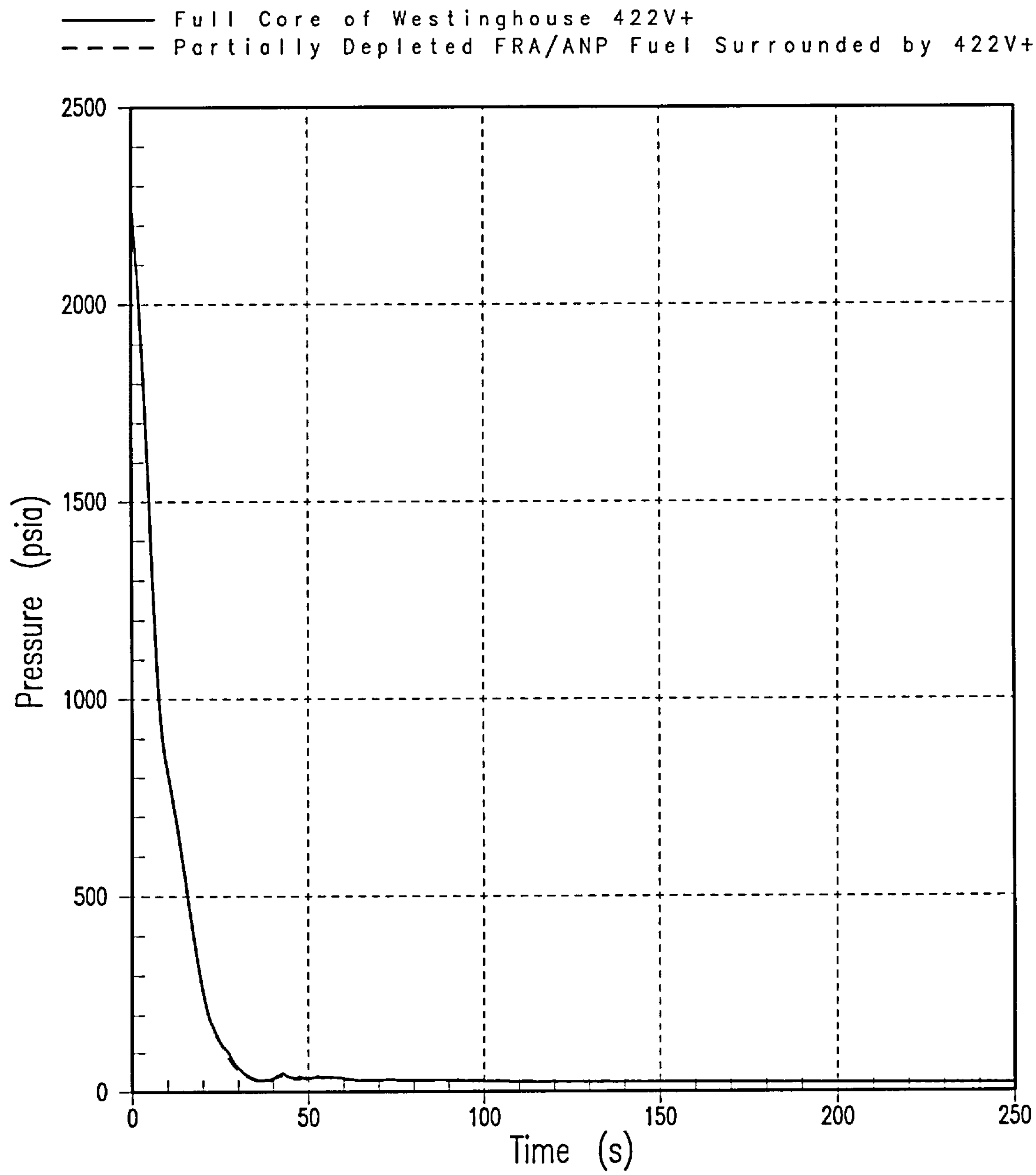

Figure 58-2: Full Transient RCS Pressure Comparison

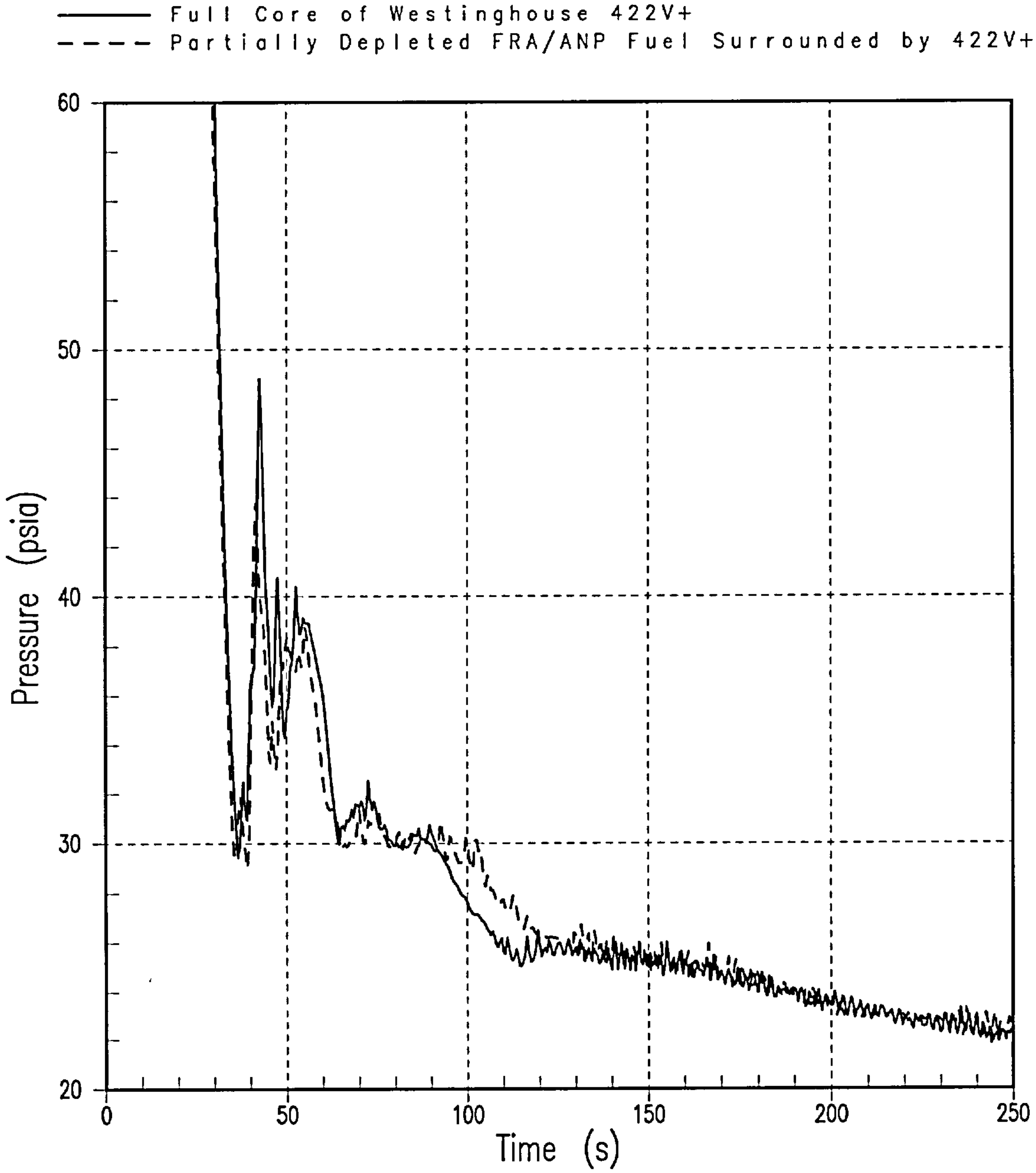

Figure 58-3: Reflood RCS Pressure Comparison

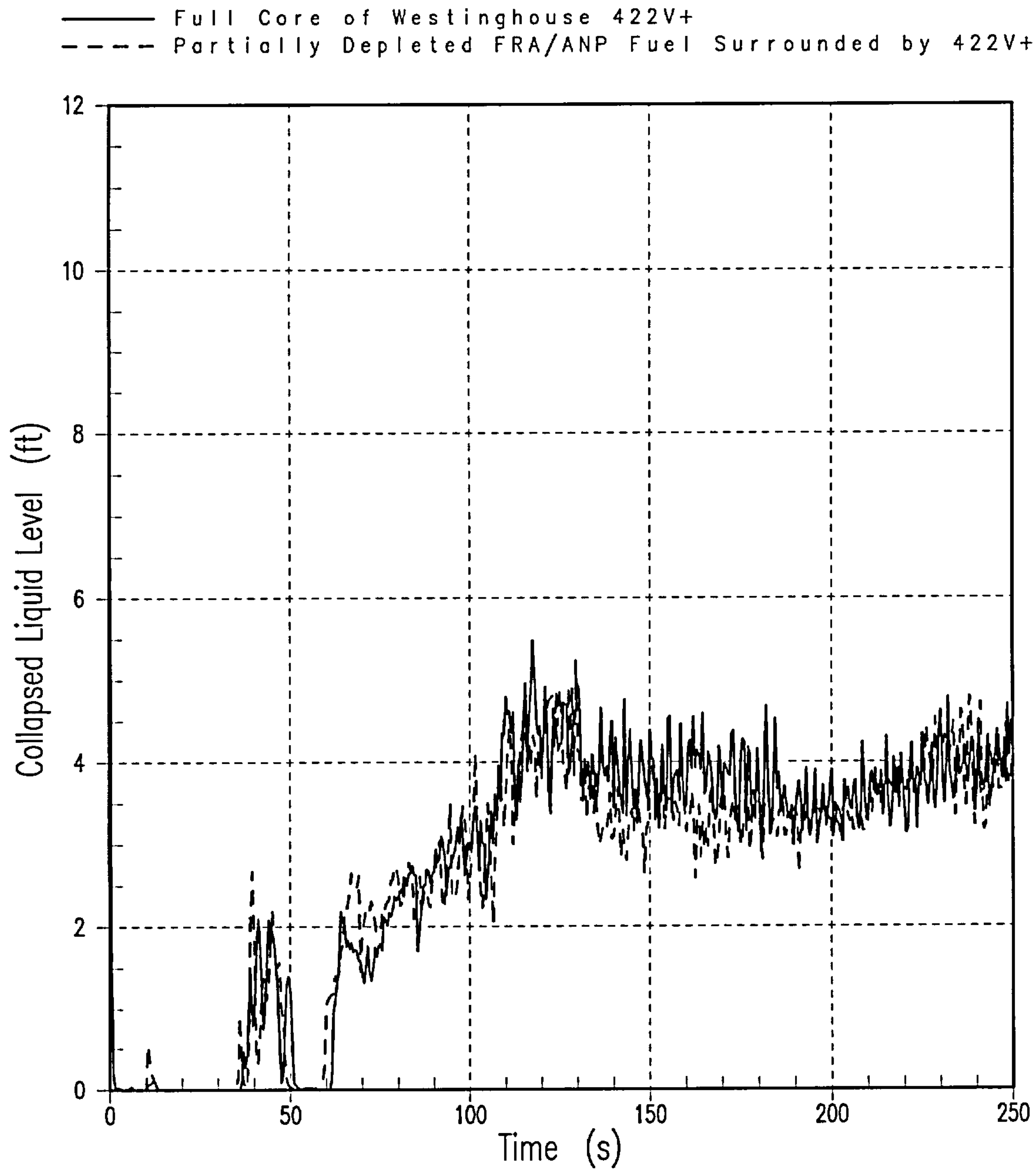

Figure 58-4: Hot Assembly Liquid Level Comparison