Comment on "Time-Independent Neutronic Analysis of the Chernobyl Accident"

The paper by Landeyro and Buccafurni on the Chernobyl accident[1] was very interesting, but it would have been better if Ref. 24 in it had read: M. RAJAMÄKI and F. WASASTJERNA, *Nucl. Sci. Eng.*, **101**, 41 (1989). This work is publicly available, unlike a private communication, and in addition, mentioning only my name obscures the contribution of Dr. Rajamäki: Investigating the reactivity effects of cooling caused by fuel fragmentation in the Chernobyl accident was his idea; I carried out the calculations. Of course, since our paper appeared only a few months before Landeyro and Buccafurni submitted theirs, it is understandable that it may have been too late for inclusion among their references.

Landeyro and Buccafurni wrote[2]: "The increase in the water/fuel ratio can lead to an initial growth in reactivity. . . ." If this refers to our work, it appears to be a misunderstanding. What we found was that a decrease in the total density of the homogenized fuel-and-water mixture initially led to increased reactivity, which we attributed to decreased resonance absorption. This should be clear from the paper by Rajamäki and me, but I may, of course, have expressed myself unclearly in the private communication referred to by Landeyro and Buccafurni.

More importantly, I was gratified to note that Landeyro and Buccafurni used a realistic ^{135}Xe concentration in their calculations. This is a point that would have deserved more emphasis, since it may not be widely known that the void coefficient of an RBMK reactor depends strongly on the ^{135}Xe concentration in the fuel. Xenon-135 absorbs neutrons mainly below 0.1 eV, and the hardening of the thermal spectrum with increasing void shifts neutrons out of this range, resulting in decreasing absorption in the ^{135}Xe. This makes the void coefficient significantly more positive at high ^{135}Xe concentrations.

A rough quantitative estimate of the above effect, based on CASMO-HEX calculations, is provided in Table I. According to this, going from no xenon to 2.267 times the steady-state concentration (a rough estimate of what the concentration may have been at the time of the accident) increases the change in k_∞ from complete voiding by ~70%. (Here, k_∞ was used rather than k_{eff} because k_∞ gives more insight into local physics.) Admittedly, Table I should not be taken too seriously because CASMO-HEX is unreliable for RBMK calculations above ~50% void (the method of calculating the resonance absorption uses an approximation that is invalid in this range), but it does indicate the importance of using a realistic value for the ^{135}Xe concentration.

TABLE I

Effect of the ^{135}Xe Concentration on the Void Coefficient in an RBMK Reactor

^{135}Xe Concentration Relative to Steady State	Δk_∞ on Increase of Void	
	0 to 50%	0 to 100%
0.000	0.00948	0.01016
2.267	0.01114	0.01752
4.534	0.01250	0.02350

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REFERENCES

1. P. A. LANDEYRO and A. BUCCAFURNI, *Nucl. Sci. Eng.*, **108**, 126 (1991).

2. P. A. LANDEYRO and A. BUCCAFURNI, *Nucl. Sci. Eng.*, **108**, 142 (1991).

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I thank F. Wasastjerna very much for his comments on our paper, and I apologize for not mentioning M. Rajamäki's name.

The work[1] we referred to is a Nuclear Energy Agency Committee on Reactor Physics report that, as is well known, can only be referenced as a private communication. The quoted sentence is the last in a paragraph that lists some phenomena which occur during fuel bursting and their contrasting effects on reactivity.

The work of Rajamäki and Wasastjerna and the Ref. 23