PDR

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 27 1980

Mr. Robert W. Clark. Jr.
2232 West Joan de Arc Avenue
Phoenix, Arizona 85029

Dear Mr. Clark:

In reply to your letter to Chairman Ahearne dated April 29, 1980, I asked a senior member of my staff to review your work. His comments are enclosed. His findings are that your concerns are not applicable to nuclear reactor regulation because the actual properties of materials are used in conducting design and operation rather than idealized models.

Thank you for your interest in reactor safety.

Sincerely,

Original Signed By
Robert J. Budnitz

Robert J. Budnitz, Director
Office of Nuclear Regulatory Research

Enclosure: Comments

Comments on Letter by Robert W. Clark, Jr.

Dated: April 29, 1980

Mr. Clark has three concerns I address in the order they appear in his letter.

1. "For many years the nuclear power industry claimed a state of perfection ... "

This is incorrect: the Reactor Safety Study, WASH-1400, predicted accident rates that are consistent with the TMI-2 experience. Although the accident at TMI-2 did no direct injury, enough people were severely frightened that the Commission is taking effective action to reduce the expected frequency of severe accidents.

2. The first law of thermodynamics is invalid as evidenced by an hypothetical experiment using Freon-12.

The hypothetical experiment is misapplied if the intent is to consider a highly non-ideal gas (Freon-12) as a simulant of an ideal gas. Mr. Clark uses the ASHRAE Handbook to compute the results of the hypothetical experiment. Of course, so do the engineers who design, operate, and regulate nuclear power reactors when they deal with the real systems involved. Had Mr. Clark conducted his hypothetical experiment with Helium instead of Freon-12 he would have found a much smaller departure from ideality (about 0.003% in his case) than with Freon-12. To do this he would use Table 4i-1 in the American Institute of Physics Handbook. Thus, the departure from ideality is well known even for a gas so nearly perfect as Helium. This is well known, as the text by Fermi, cited by Mr. Clark, points out.

3. Carnot efficiency is not actual efficiency.

Mr. Clark is confused by the relationship of the second law, first law, and the statistical nature of temperature and pressure.

The Carnot efficiency is the best one can do in an ideal heat engine. No practical engine does as well. Measurements of actual efficiency are compared to Carnot efficiency to determine if there is significant room for improvement.

Temperature and pressure are statistical averages of a large ensemble of nearly independent systems. This is discussed in the text by Fermi, Schrodinger's little text (which I prefer), and standard works on the kinetic theory of gases. It is also true that in many molecules, increased kinetic energy implies an increased mean average distance between the atoms - typically the inter-molecular potential has an anharmonic term - but this is by no means universally true.

The second law of thermodynamics is logically independent of the first law.

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ENCLOSURES: AS STATED

REMARKS:
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Incoming: Robert Clark, Jr.
From: Phoenix, Arizona

To: Ahearne Date: 4/29/80
Subject: proposal ~~for~~ on how the major tenets of science of thermodynamics can be corrected

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