

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
PENNSYLVANIA POWER & LIGHT COMPANY	)	
	)	Docket Nos. 50-387
and	)	50-388
	)	
ALLEGHENY ELECTRIC COOPERATIVE INC.	)	
	)	
(Susquehanna Steam Electric Station,	)	
Units 1 and 2)	)	

AFFIDAVIT OF FRAZIER L. BRONSON IN SUPPORT OF  
 SUMMARY DISPOSITION  
 OF CONTENTION 5(c)

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County of Philadelphia	)	
	:	ss.
Commonwealth of Pennsylvania	)	

Frazier L. Bronson, being duly sworn according to law, deposes and says as follows:

1. I am Vice President, Nuclear Services Division, Radiation Management Corporation ("RMC"). My business address is 3508 Market Street, Philadelphia, Pennsylvania. I give this affidavit in support of Applicants' Motion for Summary Disposition of Contention 5(c) in this proceeding. I have personal knowledge of the matters set forth herein and believe them to be true and correct. A summary of my professional qualifications and experience is attached as Exhibit "A" to my affidavit in support of Applicants' Motion for Summary Disposition of Contention 5(a) herein.

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2. Contention 5(c) alleges that the models used by Applicants to calculate individual and population radiation doses from the Susquehanna Steam Electric Station ("Susquehanna") are inaccurate in that the models "use factors which underestimate the radiation effect, on a per rad basis, for the very low energy beta and gamma radiations, as from H-3 and C-14 (see Health Physics 34, pp. 433-38, 1979)." Contrary to the allegations in the contention, however, the models used for the Susquehanna dose computations utilize conversion factors which are consistent with those proposed in the article, and which are higher (i.e., result in higher doses) than those generally used in the scientific community, and higher than the values specified in 10 CFR Part 20 for dose computations.

3. Two radioactive particles depositing the same amount of energy per unit mass of irradiated tissue (that is to say, imparting the same "dose" in rads) may produce significantly different degrees of biological effect on the affected tissue. Since, in radiation protection work, it is desirable to express on a common scale for all types of radiation the exposure received by an individual, a "quality factor" ("Q") has been defined. Q is a modifying factor which weights the absorbed dose of radiation by the biological effectiveness of the charged particles producing the dose. As a result of the use of Q, doses of different biological effectiveness can be added and measured relative to the effects of a reference radiation (the biological effect of one roentgen of X-rays, known as the "rem").

4. Contention 5(c), and the Health Physics article in which it is based (Reference 1),<sup>1</sup> deal with the appropriate value of Q for "low energy" beta and gamma radiation. What is meant by radioactive particle "energy" (more appropriately, "linear energy transfer" or "LET"),<sup>2</sup> is the energy deposited by the radioactive particle per unit length of traversed tissue.<sup>2</sup> "Low-LET" radiation has an LET between 0.2 and 3.5 keV/ $\mu$ m; low-LET radiation has traditionally been assigned a Q of 1. The article referenced in the contention asserts that different kinds of radiation in the "low-LET" range may have biological effectiveness varying by as much as a factor of 4, yet all have been assigned the same Q of 1. As a proposed solution to this perceived ambiguity, the authors of the article propose that a reference radiation be chosen in the midpoint of the 0.2 - 3.5 keV/ $\mu$ m range. If this were done, some kinds of low-LET radiation would have their Q go up or down by a factor of approximately 2. Alternatively, the article points out, the current values of Q for low-LET radiation could be retained, but a lack of precision in the Q for low-LET radiation of the order of a factor of 2 would have to be accepted.

5. While the concerns expressed in the referenced article may be worthy of further academic exploration, they do not require a change in the Q values applicable to the types of

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1 References cited are listed at the end of the Affidavit.

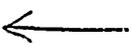
2 LET is the energy loss per unit distance traveled by the particle, usually expressed in kiloelectronvolts (keV) per micrometer ( $\mu$ m).

radiation referenced in the contention, i.e., low-LET beta and gamma radiation. As noted above, low-LET beta and gamma radiation has traditionally been assigned a Q of 1, except for a brief period when the International Commission on Radiation Protection ("ICRP") recommended that the Q for beta and gamma radiation with energies below 30 KeV be raised to 1.7 to account for some biological research which had indicated that the Q for such radiation might lie between 1 and 2 (Reference 2).

6. In 1969, however, the ICRP published a new report (Reference 3), indicating that further research and study showed that a Q value of 1 was the best estimate for low-LET beta and gamma emitters. Since that time, all major national and international advisory and regulatory groups have used a Q of 1 for low-LET beta and gamma radiation. In particular, the NRC has established by regulation a Q of one for beta and gamma radiation. See 10 CFR §20.4(c)(2). Also, the most recent ICRP standard, contained in ICRP Publication 30 (Reference 4), retains a Q of 1 as the recommended value for low-LET beta and gamma radiation.

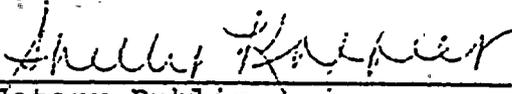
7. Even if the redefinition of Q proposed in the article cited in the contention were accepted and applied to low-LET beta and gamma emitters, this would not require a change in the dose estimates from low-LET beta and gamma emitters released from Susquehanna. For, in computing those estimates, a Q of 1.7 was used for low-LET beta and gamma emitters. This was done in accordance with the original formulation of

the equations for calculating internal dose commitments developed for the NRC by Battelle Pacific Northwest Laboratories, see NUREG-0172 (Reference 5), at p.3. In the Battelle study, the earlier recommendations of ICRP with respect to using a Q of 1.7 for low-LET beta and gamma radiation were followed. Thus, the Susquehanna dose computations for low-LET beta and gamma radiation (which <sup>in</sup> is my opinion are very conservative on the high side) utilize essentially the same Q proposed by the authors of the article cited in the contention.



  
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Frazier L. Bronson

Subscribed and sworn to before me this 15<sup>th</sup> day of June, 1981.

  
\_\_\_\_\_  
Notary Public

SHELLY KOFFLER  
Notary Public, Phila., Phila. Co.  
My Commission Expires March 23, 1985

## REFERENCES

1. Bond, V. et al., "Low Dose RBE and Q for X-Ray Compared to Gamma-Ray Radiation," 34 Health Physics 433-438 (1978).
2. International Commission on Radiation Protection, "Report of Committee II on Permissible Dose for Internal Radiation," ICRP Publication 2, Pergamon Press (1959).
3. Dunster, H., "News and Comments (Progress Report ICRP)," 17 Health Physics 389 (1969).
4. International Commission on Radiation Protection, "Limits for Intake of Radionuclides by Workers," ICRP Publication 30, Annals of the ICRP, Vol. 3 (1979).
5. Hoenes, G.R. and J.K. Soldat, "Age-Specific Radiation Dose Commitment Factors for a One-Year Chronic Intake," U.S. Nuclear Regulatory Commission, Rep. NUREG-0172 (1977).

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(Susquehanna Steam Electric Station, )  
Units 1 and 2) )

Docket Nos. 50-387  
50-388

CERTIFICATE OF SERVICE

This is to certify that copies of the foregoing Applicants' Motion For Summary Disposition Of Contention 5, Statement of Material Facts As To Which There Is No Genuine Issue To Be Heard (Contention 5), Affidavit of Frazier L. Bronson in Support of Summary Disposition of Contention 5(a), Affidavit of John C. Dodds in support of Summary Disposition of Contention 5(b), and Affidavit of Frazier L. Bronson in Support of Summary Disposition of Contention 5(c), were served by deposit in the United States Mail, First Class, postage prepaid, this 25th day of June, 1981, to all those on the attached Service List.

*Matias F. Travieso-Diaz*  
\_\_\_\_\_  
Matias F. Travieso-Diaz

Dated: June 25, 1981.

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NUCLEAR REGULATORY COMMISSION

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(Susquehanna Steam Electric Station, )  
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Docket Nos. 50-387  
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