09/21/84

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of CAROLINA POWER AND LIGHT COMPANY AND NORTH CAROLINA EASTERN MUNICIPAL POWER AGENCY (Shearon Harris Nuclear Power Plant, Units 1 and 2)	Docket Nos. 50-400 OL 50-401 OL

NRC STAFF TESTIMONY OF JOHN P. CUSIMANO AND SEYMOUR BLOCK CONCERNING JOINT CONTENTION IV

Q1. Mr. Cusimano, please state your name, employer and position.

A1. My name is John P. Cusimano. I am employed by the United States Department of Energy, Radiological and Environmental Sciences Laboratory, as a Senior Physicist in the Dosimetry Branch. I am responsible for the technical development and implementation of personnel dosimetry systems at the Idaho National Engineering Laboratory. A summary of my education and professional experience is contained in Attachment I to this testimony.

Q2. Please summarize your experience in the field of personnel dosimetry.

A2. For the past 23 years I have been directly involved in the evaluation, development and implementation of dosimetry programs using photographic film and, more recently, thermoluminescent dosimetry (TLD) systems manufactured by Eberline, Victoreen, Harshaw, Teledyne and Panasonic. Recently I have been serving as a technical expert to the National Bureau of Standards National Voluntary Laboratory Accreditation Program (NVLAP) in Personnel Dosimetry. I personally handled our laboratory's participation in all three pilot studies of the performance testing standard now used by the NVLAP, including the one reported in NUREG/CR-2891. I have personal knowledge of the accuracy of TLD systems and a familiarity through participation, literature and personal contact with colleagues with the tests reported in NUREG/CR-2891.

Q3. Mr. Block, please state your name, employer and position.

A3. My name is Seymour Block. I am employed as a Senior Health Physicist, in the Division of Systems Integration, Office of Nuclear Reactor Regulation, United States Nuclear Regulatory Commission. A statement of my professional qualifications is attached to this testimony as Attachment II.

Q4. What is the purpose of your testimony?

A4. The purpose of this testimony is to set forth the Staff's conclusion concerning the portion of Joint Contention IV which the Board found to be remaining in the conference call of August 10, 1984. This issue is: "whether the TLD's and measuring equipment and processors to be used at the Harris facility can measure occupational doses with sufficient accuracy to comply with the NRC regulations." Tr. 2218. This testimony also addresses the Board's request for information as to the portions of NUREG/CR-2891 which present data relating to the capability of CP&L to perform personnel dosimeter processing.

Q5. As a general matter, what is the range of doses detectable by a TLD.

A5. In the middle 1960's the TLD was introduced as a replacement for film dosimeters. TLD's have a response range from a few mrem to thousands of rem, good linearity, and are fairly insensitive to various environmental conditions. Most TLD's are tissue equivalent and therefore show good energy response. The response of most TLD's includes low energy x-rays through high energy gamma rays and beta and neutron radiation. Minimum detectable doses with most TLD systems in normal routine operation are in the range of 15 to 20 mrem. Some of the newer systems, such as the Panasonic can yield greater accuracy than manually operated systems.

Q6. Mr. Block, what TLD system do Applicants plan to use at the Harris facility?

A6. It is my understanding that Applicants intend to use TLD's and associated read-out equipment manufactured by the Panasonic Company. I understand that the actual specifications for this system will be provided by Applicants.

Q7. Mr. Cusimano, are you familiar with the Panasonic TLD system to be used by Carolina Power and Light Company?

A7. Yes. Our laboratory surveyed the marketplace and conducted an evaluation of available dosimetry systems. We concluded that the Panasonic dosimetry system was the most promising system for our needs. We then purchased a single reader and a number of test badges and conducted our own hands-on evaluation of the system over a one year period. We confirmed in our own laboratory that the TL reader specifications stated in the product literature are correct. Based on the published information and our own research we have purchased a Panasonic system for the Idaho National Engineering Laboratory and are presently working toward implementation of that system.

Q8. In your opinion does the Panasonic TLD system provide accurate and reliable information?

A8. Yes, the Panasonic TLD system provides accuracy and reliability because of automation and the ability to directly interface with a computerized recordkeeping system.

Due to the long term stability of the TLD reader, recalibration of the reader could easily be done on a quarterly or semiannual basis as long as daily QC checks are performed. The reader has built in self checks on the amount of heat being delivered to the dosimeter element, dark current, background, reference light source, and many other operational checks such as a dosimeter identification, element position during the read process and parity check.

The calibration of the reader is performed by reading a series of irradiated dosimeters that were exposed to a known value and calculating the conversion coefficient which is the amount of TL light per unit of exposure. These are then entered and locked into the microprocessor controller in the reader. When an unknown dosimeter is read out, the reader applies the conversion coefficient and then calculates the person's dose. This process can virtually eliminate clerical errors.

Q9. Mr. Cusimano, please describe the third pilot test performed by the University of Michigan.

A9. The third pilot test was conducted by the University of Michigan under the direction of Dr. Phillip Plato. This third pilot test was conducted to examine the practicality of implementing a draft performance testing standard prepared by the Health Physics Society. This standard was entitled "Draft Standard Criteria for Testing Personnel Dosimetry Performance," and identified by the Health Physics Society as HPSSC WG 1.4. It was developed by a working group of technical experts drawn from the industry, utility, university and government laboratory sectors and ultimately approved by the Health Physics Society Standards Committee and was adopted by the American National Standards Institute as ANSI N13.11-1983.

The detailed procedures for the third pilot test are described in a report entitled "Performance Testing of Personnel Dosimetry Services - A Revised Procedures Manual," NUREG/CR-2892 and the actual test results are described in "Performance Testing of Personnel Dosimetry Services - Final Report of Test #3," NUREG/CR-2891.

A brief summary of these procedures follows. The irradiation procedures used in the third pilot test were intended to simulate actual field irradiation conditions with the provision that the delivered doses must be traceable to the National Bureau of Standards. Traceability to the NBS entails a calibration of a transfer standard ionization chamber belonging to the user - in this case the University of Michigan, to known dose rates from the NBS radiation sources. The NBS then determines the appropriate chamber correction factor, which is a function of radiation energy, to be used for that chamber with that particular radiation. The chamber is then sent back to the University of Michigan who in turn uses the chamber and electronics to determine the dose rates from their radiation sources using the same geometry conditions as that of the Bureau. Once that dose rate is established for their radiation source, dosimeters can be irradiated with the same geometry conditions and can be given known doses which are then traceable to the NBS. A more detailed explanation of the radiation source standardization process is given in Section II, pages 3 through 8 of NUREG/CR-2892. Dosimeters were irradiated on plastic blocks intended to simulate the scattering properties of the human torso. Radiation sources included gamma rays from cesium-137, 6 different energies of filtered x-rays, beta rays from a strontium/yttrium-90 source and neutrons from a deuterium oxide moderated californium-252 source. Eight different categories consisting of exposures to individual and combined sources were included in the third pilot test. Those irradiations are representative of the types, energies and intensitites of the radiation sources encountered in actual reactor operating facilities, labotratories etc. The dose rates from all irradiation devices were traceable to the National Bureau of Standards. For each test category, 15 dosimeters were irradiated in groups of 5 over three months to randomly selected doses. The dosimeters were returned to the processor who then evaluated them and reported the results to the University of Michigan. The University of Michigan then calculated a performance statistic for each category which combined the random and systematic uncertainty of the group of 15 dosimeters. The performance index is defined as the dose equivalent reported by the processor minus the dose equivalent assigned by the testing laboratory all divided by the dose equivalent assigned by the testing laboratory. For each group of test dosimeters the average performance index and its associated standard deviation are calculated. If this value is less than or equal to the tolerance level the dosimetry processor will pass that category. If the value is greater than the tolerance level then the processor will fail the category. The choice of tolerance level is described in ANSI N13.11, Appendix D, page 21. Random error is defined as the variation that occurs randomly from one measurement to the next. Systematic uncertainty refers to the bias error that may occur during the evaluation or measurement process.

Q10. What were the results of this third pilot test with regard to Carolina Power and Light Company?

A10. Because the results reported in NUREG/CR-2891 were from a pilot run of the testing standard, participants were assured anonymity. For this reason the results are reported only by a code number. On page 8, the participation of Carolina Power and Light is documented, and from Mr. Stephan A. Browne's affidavit of January 4, 1984, we know that Carolina Power and Light is listed as processor code number 187. The summary results from processor 187 are listed on page 18 of NUREG/CR-2891 and on lines 1432 to 1439 of page D.24 and lines 1440 to 1461 of page D.25.

Processor 187 participated in 7 categories of pilot test three excluding only category eight, a mixture of photons and neutrons. In the 7 categories attempted, the performance statistic calculated by the University of Michigan indicated that the processor passed all categories. These results are reproduced in Attachment 3 along with the passing criterion for each category. It appears that not only did processor 187 pass all 7 attempted categories by he passed them with a fairly comfortable margin. These results are a good indication that processor 187 can perform good quality dosimetry in the workplace situation.

Q11. Mr. Block, what is the Staff's conclusion concerning the adequacy of Applicants' personnel monitoring program?

A11. Based on the above discussion, and on the testimony of Mr. Ross Albright of NRC Region II, the Staff concludes that Applicants' personnel monitoring program, which includes the Panasonic TLD system and the technical expertise to operate that system, will be adequate to protect the health and safety of the workers at Shearon Harris, and is in compliance with Section 20.202(a) of the Commission's regulations.

CURRICULUM VITAE

NAME: John P. (Jan) Cusimano, Senior Physicist

ORGANIZATION: Dosimetry Branch, Radiological and Environmental Sciences Laboratory

U.S. Department of Energy
550 Second Street
Idaho Falls, Idaho

EDUCATION:

School	Degree	Year	Discipline
Syracuse University New York	Engineering Physics	1961	Physics-Math
University of Idaho	None	Misc.	Statistics, Math-Physics

PROFESSIONAL EXPERIENCE:

Total Years of Professional Experience	28 years
Years in Nuclear Field	23 years
Years in Dosimetry-Health Physics Research	23 years
Years in Electronics Research	5 years

SPECIALTIES EXPERIENCE:

TL Dosimetry Research	21 years
Film Dosimetry Research	10 years
Microwave Tube Research	3 years
Electronic Development Research	5 years

PROFESSIONAL SOCIETIES, COMMITTEES, ETC:

Member of Health Physics Society-1966

Member of State & Federal Legislation Committee-1969

Consultant on Dosimetry to the Conference on Radiation Control-1971

Member of Dosimetry Capabilities Evaluation Committee for Conference on Rad Control-1972-1972

Chairman-TLD Performance Standard-Health Physics Society, 1972-1976.

Consultant to TLD Performance Standard Committee-1976-Present

Member-Affiliates Committee-1978-1980

Past President and other offices-Eastern Idaho Chapter of the Health Physics Society

Dosimetry technical expert to assess and evaluate personnel radiation dosimetry processors for the National Voluntary Laboratory Accreditation Program

WORK EXPERIENCE:

Current Employer: U.S. Department of Energy, Radiological and Environmental Sciences Laboratory

Date: 1975 to Present

Position: Sr. Physicist, Dosimetry Branch

Provides technical direction and assistance for INEL personnel, environmental and special problem dosimetry and programs. Serves as a working leader in experimental research in applied dosimetry techniques. Evaluated, tested and implemented an Albedo Neutron Dosimetry program for INEL usage. Coordinated and assisted in developing a Nuclear Accident Dosimetry System for the INEL. Directs and coordinates the upgrading of the Dosimetry Branch Calibration Facility, including a X-ray machine and various gamma and neutron radiation sources. Has direct responsibility for implementing an automatic TL Dosimetry system at the INEL.

Employer: AEC-ERDA, Health Services Laboratory

Date: 1967-1974

Position: Chief, Applied Research Section, Dosimetry Branch

Developed a technique for in-core gamma heat measurements using TL materials. Developed and implemented an environmental TLD monitoring system for INEL & NRC use. Supervised and directed the operations of an HP portable instrument calibration and repair section (1100 instruments) and evaluated newly developed instruments for INEL application. Performed research on a semi-automated TL Teflon Dosimetry System (patented). Provided guidance and direction toward an in-house computer capability for dose evaluation and a personnel dosimetry record storage and rapid retrieval system.

Employer: AEC, Health Services Laboratory

Date: 1961-1966

Position: Physicist

Developed solid state dosimetry techniques for personnel dosimetry, environmental measurements and special radiation measurements. Developed and implemented the first TL personnel dosimetry monitoring system in the United States. Performed extensive research in film dosimetry for evaluating beta, gamma, X-ray, and neutron personnel exposures and high-level dosimetry.

Employer: U.S.A.F., Systems Command, Rome Air Development Center

Dates: 1956-1961

Position: Electronic Physicist, RF Transmitter Branch

Performed research, development and design engineering of rf and microwave components for ground radar equipment.

PUBLICATIONS:

Over a dozen publications and articles on dosimetry.

Attachment 2

SEYMOUR BLOCK

PROFESSIONAL QUALIFICATIONS

RADIOLOGICAL ASSESSMENT BRANCH

DIVISION OF SYSTEMS INTEGRATION

I am employed as a member of the staff of the Radiological Assessment Branch, Division of Systems Integration, U.S. Nuclear Regulatory Commission, Washington, D.C. My duties include the determination and evaluation of the design and operation of operating nuclear power plants as well as review of Safety Analysis Reports of applicants for construction permits and operating licenses of nuclear power plants with respect to safety and environmental impact considerations including matters related to Health Physics Radiation Protection Programs.

I first became associated with the atomic energy program in 1944 when I was trained and educated as a Health Physicist at Clinton Laboratories in Oak Ridge, Tennessee, during the Manhattan Engineering Project. I later joined the Brookhaven National Laboratories as a Health Physicist responsible for radiological safety of Chemistry and Reactor operations. In 1953 I transferred to the University of California Radiation Laboratory and set up a small Health Physics program at the Livermore site. When the Livermore Hazards Control Department was formed in 1959, I was made Section Leader of the Special Projects Research and Development Group. For twelve years I engaged in Research and Development in Radiological Instrumentation and Applied Health Physics.

I am a Certified Health Physicist and former Treasurer of the Health Physics Society. I am Past President of the Northern California Chapter of the HPS and a former consultant to Physics International Corporation in San Leandro, California.

From 1938 - 1941 I attended City College in New York. I was inducted into the Army Air Force in 1942 and attended the University of Pennsylvania, Moore School of Electrical Engineering from 1943 - 1944.

I have published numerous articles in technical journals on instrumentation development and radiation dosimetry. I am a member of the Health Physics Society.

SOME SELECTED RELEVANT PUBLICATIONS

1. "A survey Meter for Soft Betas in Air," S. Block, Nucleonics. April 1951, pp. 51-54.

2. "Some Comments on the Decay Scheme and Dosimetry of ^{137}Cs," S. Block, Health Physics, 1858, Vol. 1, p. 357.

3. "Neutron Dose Measurements by An Attenuation Technique," S. Block, F. J. Shon, Health Physics, 1962, Vol. 8, pp. 533-541.

4. "Angular Dependence of Eastman Type A (NTA) Personnel Monitoring Film," Ronald L. Kathran, Charles T. Prevo, Seymour Block, Health Physics, 1965, Vol. 11, pp. 1067-1069.

5. "The Effects of Cadmium Ratio on Film Badge Neutron Dosimetry by Capture Gammas," S. Block, Health Physics, 1965, Vol. 11, pp. 785-786.

6. "A Small Continuous Air Monitor For Field or Laboratory Use," S. Block, E. Beard, O. Barlow, Health Physics, 1966, Vol. 12, pp. 1609-1616.

7. "Laboratory Sources Enhanced in 0.5 ev to 200 KeV Neutrons for Instrument Evaluation," S. Block, et al., Health Physics, 1967, Vol. 13, pp. 1025-1031.

8. "Radiation Dosimetry and Spectral Distribution of the SNAP-19 Source," S. Block, Charles T. Schmidt, Ronald L. Kathran, UCRL-50539, 1968.

9. "Rapid Assessment of Pulsed Neutron Doses by an Energy - Independent Foil Activation System," S. Block, Health Physics, 1969, Vol. 16, pp. 93-98.

10. "Recent Technique in Tritium Monitoring by Proportional Counters," S. Block, D. Hodnins, O. Barlow, UCRL-51131, 1971.

11. "A Commentary on Beta Dosimetry Methods and Associated Misconceptions," S. Block, J. F. Tinney. Presented at the International Beta Dosimetry Symposium, Washington, D. C., February 15-17, 1983.

12. "Development of a LIF Dosimetric Material," D. Jones, J. Gaskill, A. Burt, S. Block, UCRL-12151, October 15, 1974. Presented by S. Block at International Symposium from External Sources, Paris, France, November 23-27, 1964).

Attachment 3

Summary of results of processor 187 taken from page 18 of NUREG CR-2891

	Category	Performance Statistic for Processor 187		Maximum Value of Performance Statistic Permitted to Pass
		Shallow	Deep	
I.	X-Ray Accident		0.2406	0.3
II.	Gamma Accident		0.1052	0.3
III.	X-ray	0.1041	0.1228	0.5
IV.	Gamma		0.0614	0.5
V.	Beta		0.3053	0.5
VI.	Gamma plus X-ray	0.0583	0.1594	0.5
VII.	Gamma plus Beta	0.1640	0.1060	0.5