

3. In response to Interrogatory No. 24¹, the Attorney General indicated that the basis for Contention Basis A.7 is "Appendix 3 (at 3-8) of NUREG-0654, FEMA-REP-1" which states:

"The maximum sound levels received by any member of the public should be lower than 123 dB, the level which may cause discomfort to individuals."

This 123 dB limit is taken from the 123 dB limit recommended to avoid hearing damage in FEMA publication number CPG 1-17, which source is cited on pp. 3-8, 3-9 (twice), 3-10, 3-11 and 3-12 of Appendix 3 of NUREG-0654.

4. I am the principal author of CPG 1-17, which I wrote under United States Government Contract No. DCPA-01-78-C-0329 while an employee of Bolt Beranex and Newman, Inc. (BBN) in the early part of 1979. I wrote CPG 1-17 to be a simple, non-technical "practical guide for public officials" such as fire chiefs planning to install a fire siren.

5. As the author of CPG 1-17, I derived the 123 dB limit "to assure that no person is likely to be subject to a sound level great enough to cause hearing damage" (CPG 1-17, p. 8). The background document to CPG 1-17, BBN Report No. 4100, which I also prepared and which is also cited on pp. 3-8 of Appendix 3 of NUREG-0654, points out that I chose the 123 dB limit from Figure 3 of Karl D. Kryter, Hazardous

1 "Massachusetts Attorney General's Response to First Set of Interrogatories Regarding the Massachusetts Attorney General's Amended Contention of Notification System", dated July 12, 1988.

Exposure to Intermittent and Steady-State Noise", Report of Working Group (WG) 46, National Academy of Sciences - National Research Council (NAS-NRC), Committee on Hearing, Bioacoustics, and Biomechanics, January 1965. (This is referred to below as the "Kryter WG-46 Report".) The 123 dB limit applies to an almost daily exposure over about 10 years to 1-1½ minutes or less of a 1000 Hz tone.

6. Considering the wide usage and lay readership which I contemplated for CPG 1-17, 123 dB is appropriate as a general purpose limit. As indicated in BBN Report 4100, one thousand Hz "...is the highest fundamental frequency produced by any outdoor warning device...identified." Many communities briefly sound their fire sirens or horns once a day, such as at noon. Maintaining levels below 123 dB near the ground is easy to achieve with suitable mounting of any of the sirens or horns on the market in 1979.

7. Thus, the 123 dB limit was considered a safe upper limit which would protect the public regardless of the frequency, duration or number of soundings. The goal of the 123 dB criterion was to provide a safe notification system. This goal may also be achieved by varying other aspects of the design and use of the siren system.

8. In fact, I have reviewed the results of Dr. Kryter's analysis of a 123 dB exposure to the sound from a

non-rotating siren operated for $3/1.5^2$ minutes at 1000 Hz. This siren system, contemplated by NUREG-0654, would affect the average person's hearing by causing a temporary threshold shift at 2 minutes after exposure (TTS₂) of 18/12 dB. This effect would be minor and last only a short time.

9. For comparison, Dr. Kryter also did a calculation of the 134 dB rotating siren at 25 feet sounded for 3 minutes at 550 Hz, this being the siren system to be used by the VANS as detailed in Louis Sutherland's affidavit and which I have personally inspected. This system will cause neither permanent hearing loss nor temporary threshold shift as determined by Dr. Kryter.

10. Further, a document provided by the Massachusetts Attorney General is consistent with the conclusion of Dr. Kryter. In a letter dated May 5, 1988, Gregory C. Tocci informed Mr. Steven Jonas of the Massachusetts Department of the Attorney General of the results of a discussion with Dr. Joseph Sataloff. With reference to the short-term exposure to VANS emergency warning sound levels as high as 132 dBA, Dr. Sataloff stated, "that the likelihood of possible hearing damage under these circumstances was not significant." [Copy of letter attached and marked "B".]

² Three minutes duration per NUREG-0654; One and one-half minutes duration per BBN Report 4100.

11. Thus, the VANS siren system is a safe means of notifying the public in terms of potential hearing damage, and in my opinion meets the safety criteria intended by NUREG-0654.

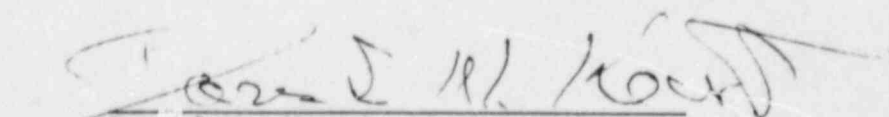
David N. Keast

September __, 1988

The above-subscribed David N. Keast appeared before me and made oath that he had read the foregoing affidavit and that the statements set forth therein are true to the best of his knowledge.

Before me,

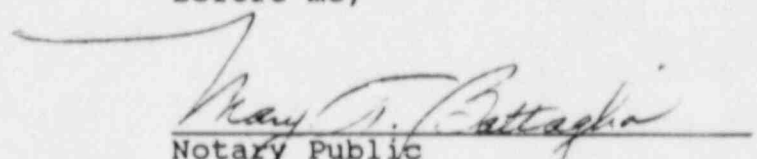
Notary Public
My Commission Expires:


David N. Keast

September 16, 1988

The above-subscribed David N. Keast appeared before me and made oath that he had read the foregoing affidavit and that the statements set forth therein are true to the best of his knowledge.

Before me,



Notary Public
My Commission Expires:
MARY T. BATTAGLIA, Notary Public
My Commission Expires September 16, 1994

WARNING SYSTEM SERVICES

RESUME

David N. Keast, Principal Consultant
Warning System Services

PROFESSIONAL EXPERIENCE

Mr. Keast's experience includes a wide range of projects involving acoustics, communications, electronic instrumentation and computer applications. His specific project responsibilities have involved research and consulting, lecturing, technical writing, serving as an expert witness, project management and general management. In general, Mr. Keast's work has been in the following areas:

- o Design or performance analysis of mass public warning systems at over 20 locations in the United States near nuclear power plants, chemical facilities and downstream of high-hazard dams.
- o Research on the propagation of sound out of doors over the ground, and on how this propagation is affected by meteorological conditions. Design and programming of algorithms to predict sound propagation.
- o Measurement and analysis of ambient noise levels in communities, of the spatial and temporal variability of these levels and of how people react to noise in their environment.
- o Studies of the attenuation of sound by building structures.
- o Studies of the noticeability of noise and warning sounds by people, and of the intelligibility of speech signals under a variety of conditions.
- o Design of electronic instrumentation and analog data analysis equipment. Electronic instrument manufacturing and marketing. General management of an electronic instrument company.
- o Analysis of community, office-building and industrial noise problems; and the design of noise-control solutions for these problems.
- o Writing of books, handbooks, guides, sponsored reports and technical papers; adjunct lectures and expert testimony at civil trials and administrative hearings.

EDUCATION

- o B.A., Amherst College
- o B.S., M.S. in Electrical Engineering, Massachusetts Institute of Technology

WARNING SYSTEM SERVICESPROFESSIONAL ACTIVITIES

- o Acoustical Society of America, Fellow
- o Institute of Electrical and Electronic Engineers, Senior Member.
- o Institute of Noise Control Engineering, Affiliate
- c Visiting lecturer: Massachusetts Institute of Technology, acoustic measurements; Battelle Pacific Northwest Laboratories workshops: "Emergency Preparedness for Nuclear Power Facilities" and "Emergency Preparedness Plans and Programs"; The Harvard School of Public Health, "Planning for Nuclear Emergencies".
- o National Science Foundation, review of grant proposals for research on outdoor sound propagation.
- o Standards-writing committees for the Power Engineering Society, the Instrument Society of America and the American Institute of Aeronautics and Astronautics.
- o Invited technical papers before the Acoustical Society of America, the International Institute of Noise Control Engineering, the Institute of Electrical and Electronic Engineers, the American Society of Heating, Refrigerating and Air-Conditioning Engineers and the Air Pollution Control Association
- o Sigma Xi, Eta Kappa Nu, Tau Beta Pi

PREVIOUS POSITIONS

- 1983-1988 HMM Associates, Inc.: Vice President and Senior Project Manager, Acoustics, Emergency Warning Systems and Computer Support.
- 1973-1983 Bolt Beranek and Newman, Inc.: Supervisory Consultant and Manager of the Environmental Technologies Department.
- 1971-1973 M.F.E. Corporation: Vice President of Engineering.
- 1966-1971 Data Equipment Company (Bolt Beranek and Newman): Divisional Vice President and General Manager.
- 1963-1966 Bolt Beranek and Newman, Inc.: Manager of Instrumentation, Los Angeles Office.
- 1954-1963 Bolt Beranek and Newman, Inc.: Acoustical Consultant.

PUBLICATIONS

- o Author or coauthor of over 100 books, papers and sponsored reports, including:
 - "Emergency Warning Systems: Your Last Line of Defense", Industrial Fire World 3, pp.9-11 (February 1988)
 - "Outdoor sirens, how do they work for people indoors?", J. Acoust. Soc. Amer. S47, p.82 (1987)(A). An invited paper presented at the 114th meeting of the Acoustical Society of America.
 - "U. S. requirements for public warning sirens near nuclear power plants", Proceedings of InterNoise '87, Beijing, 1, pp.155 (September 1987).
 - "Emergency Warning Systems", a CAER Program handbook published by the Chemical Manufacturers Association, Washington, DC, 1987.
 - "Procedures for Analyzing the Effectiveness of Siren Systems for Alerting the Public", NUREG/CR-2654, PNL-4227, Battelle Northwest Laboratories, Richland, WA, 1982. A companion report, "Evaluation of Prompt Alerting Systems at Four Nuclear Power Stations", NUREG/CR-2655, PNL-4226, is available from the same source.
 - "Electrical substation design practice in the United States and its influence on transformer noise in surrounding communities", Proceedings of InterNoise '81, pp.627 (1981)
 - "The use of sound to locate infiltration openings in buildings", Proceedings of the ASHRAE/DOE-ONRL Conference on Thermal Performance of Exterior Envelopes of Buildings, ASHRAE SP 28, p.85 (1981)
 - "Outdoor Warning Systems Guide", CPG 1-17, Federal Emergency Management Agency, Washington, DC, March 1, 1980. (Also BBN Report 4100 of the same title, as referenced in NUREG-0654).
 - Brief articles on measurement apparatus in Encyclopedia of Science, McGraw-Hill Book Company, New York, NY, 1960, 1965, 1980.
 - "Acoustic location of air-infiltration openings in Buildings", Proceedings of InterNoise '79, Warsaw (September 1979). An invited paper.
 - "Energy conservation and noise control in residences", S/V Sound and Vibration pp.18-22 (July 1979). Also presented at Noisexpo '79, Chicago, April, 1979.
 - "Assessing the impact of audible noise from AC transmission lines: a proposed method", Paper F79237-9 presented at the IEEE Winter Power Meeting, New York (February 1979).
 - "Attenuation of northern dwellings to a linear source of noise" (with D.A. Driscoll and J.P. Dulin), J. Acoust. Soc. Amer. 63 Supp. 1 (1978)(A).
 - "Regulatory aspects of audible noise from EPV/UHV transmission lines", an invited paper before the IEEE/PEG meeting, South Bend, IN (September 1977).

WARNING SYSTEM SERVICES

"Effectiveness of Audible Warning Devices on Emergency Vehicles" (with R.C. Potter, S.A. Fidell and M.M. Miles), DOT-TSC-OST-77-38, U.S. Department of Transportation, Washington, DC 20590 (August 1977).

"Some pitfalls of community noise measurement", J. Air Pollution Cont. Assn. 25(1), pp.36-39 (January 1975).

"Development of a procedure for predicting noise environments around industrial sites", BBN Report 2987 prepared for the Long Island Lighting Company (September 1974).

"An instrument for automated community noise monitoring" (with B.E. Blanchard), an invited paper presented before InterNoise '74, Washington, (September 1974).

"Ambient noise studies in suburban and rural areas (with E.W. Wood and J.D. Barnes), an invited paper presented before InterNoise '74, Washington (September 1974).

"Summer acoustic environment of the Jamesport and Shoreham sites", BBN Report 2656 prepared for the Long Island Lighting Company (October 1973).

Measurements In Mechanical Dynamics, McGraw-Hill Book Company, Inc., New York, NY, 1967.

"A survey of graphic input devices", Machine Design (August 1967).

"The noise environment of the California Condor", BBN Report 1259 (October 1965).

"Analog vs. digital data analysis: an introduction", SAE paper 650818 presented at the SAE National Aeronautics and Space Engineering and Manufacturing Conference, Los Angeles (October 1965).

"Some studies of Titan II noise and vibration data" (with P.A. Franken), J. Acoust. Soc. Amer. (1965)(A).

"Noise and vibration characteristics of large rocket motors with thrust vector control" (with P.A. Franken and D.E. Newborough), J. Acoust. Soc. Amer. (1964)(A).

"Digital computer processing of telemetered vibration data" (with W.E. Fletcher and J. Gibbons), J. Acoust. Soc. Amer. 34 (1962)(A).

"Airborne vibration spectrum analysis: some techniques and limitations" (with J. Gibbons and W.E. Fletcher), a paper presented at the 31st Symposium on Shock, Vibration and Related Environments (October 1962).

"An analog system for the analysis of random data signals up to 10 Kilocycles", IRE Trans. on Instrumentation, I-11, pp.52-57 (September 1962).

"Measurement of rocket engine noise", Noise Control 7, pp.25-36 (1961). (Also presented as an invited paper at the 60th meeting of the Acoustical Society of America.)

"Basic Sound Measuring System", Chapter 5 of Noise Reduction, L. L. Beranek, ed., McGraw-Hill Book Company, New York, NY, 1968.

WARNING SYSTEM SERVICES

"Acoustical measurements in the 1/3-scale Minuteman missile silo", 29th Symposium on Shock, Vibration and Associated Environments (November 1960).

"Acoustic instrumentation for measurements in the Minuteman missile silo" (with G.W. Kamperman), J. Audio. Eng. Soc., pp.180-184 (1960).

"Experimental study of the propagation of sound over ground" (with F.M. Wiener), J. Acoust. Soc. Amer. 31, pp.724-733 (1959).

"Calibration of accelerometers in a simulated space environment", J. Acoust. Soc. Amer. 31, pp.584-587 (1959).

"Equipment and procedures for field measurements of aircraft noise and flight paths" (with W.E. Clark and W.J. Galloway), J. Acoust. Soc. Amer. 30, pp.953 (1958)(A).

"An empirical method for estimating wind profiles over open level ground" (with F.M. Wiener), Trans. Am. Geophys. Union 39, pp.858-864 (1958).

"Instrumentation for the study of the propagation of Sound over Ground" (with F.M. Wiener and K.N. Goff), J. Acoust. Soc. Amer. 30, pp.960-966 (1958).

"On the prediction of the attenuation of sound propagated over ground" (with F.M. Wiener), J. Acoust. Soc. Amer. 29, pp.1953 (1957)(A).

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ADMINISTRATOR
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May 5, 1988

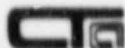
Mr. Steven Jonas
Department of the Attorney General
One Ashburton Place
Boston, MA 02108-1698

Dear Steve,

About 2 weeks ago we discussed the possibility of hearing damage associated with short term exposure to VANS emergency warning sound levels as high as a 132 dBA. At that time I indicated that even a single incident of brief exposure to sound this loud could result in permanent hearing damage. I also mentioned that available criteria for permanent hearing threshold shifts, as hearing damage is most commonly referred, are only available for the work place where sound level exposure occurs on a day to day basis. I also mentioned that we would pursue this further with Dr. Joseph Sataloff, M.D. who is a well known expert in this area.

Tom Bouliane of our office discussed this matter with Dr. Sataloff who responded with the attached letter dated April 29, 1988. Since his letter was rather vague with respect to criteria for hearing damage associated with single brief exposures to high sound levels, I called Dr. Sataloff to discuss this further. Dr. Sataloff was more specific when I spoke with him and indicated that there are currently no available criteria upon which to base the likelihood of permanent hearing threshold shifts associated with single, brief exposures to levels as high as those expected to be produced by the VANS system. Moreover, Dr. Sataloff went further to say that the likelihood of possible hearing damage under these circumstances was not significant.

Hence, we believe that the Department of Attorney General comments regarding hearing damage of the general populace resulting from the VANS system should emphasize the need for prudence in the use of the system and ask for clarification on procedures for avoiding excessive exposure.



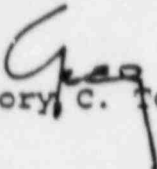
Mr. Steven Jonas

Page 2

If I can provide any further detail, please do not hesitate contacting me.

Sincerely yours,

CAVANAUGH TOCCI ASSOCIATES, INC.


Gregory C. Tocci

cc:

encl:

GCT/alw/7233

JOSEPH SATALOFF, M. D.
1721 PINE STREET
PHILADELPHIA, PA 19103

215-545-3322

April 29, 1988

Thomas G. Bouliane
Consultant
Cavanaugh Tocci Associates, Inc.
327 F Boston Post Road
Sudbury, MA 01776

Dear Mr. Bouliane:

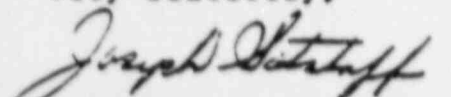
Thank you for letting me review the information describing the VANS system proposed to alert listeners to a threat to their safety. First I would preface my comment that the technical methods used for this alarm are somewhat surprising. There has been so much experience in the United States and London to alert individuals to air raids. I have seen much more effective systems and I somewhat wonder about this rather strange idea.

If the ears of human beings are exposed to over 120 decibels (dB) over periods of time from a loud speaker system, there can result high frequency sensorineural hearing loss both temporarily and permanently. I do not believe the damage can be severe but it can definitely be present and has been recorded in instances from exposure to rock and roll music of much lesser intensity, but probably longer duration.

If such an alarm system goes off during sleeping hours, it may not damage hearing quite as much because individuals are a greater distance away. However, it can have a rather disturbing shock experience and I feel certain that there are other ways to resolve the situation besides this type of loud speaker system.

Thank you very much. I will be pleased to discuss it in greater detail with you.

Very sincerely,


Joseph Sataloff, M.D.

Dictated but not signed

JS/rg
Enclosure

MAY 02 88