UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
METROPOLITAN EDISON COMPANY, ET AL.	)	Docket No. 50-289
	)	(Restart)
(Three Mile Island Nuclear Station,	)	
Unit 1)	)	

NRC STAFF TESTIMONY OF JOSEPH R. LEVINE ON CONTENTIONS RELATED TO ONSITE EMERGENCY PLANNING

FEBRUARY 9, 1981

OUTLINE

NRC STAFF TESTIMONY OF JOSEPH R. LEVINE
ON CONTENTIONS RELATED TO ONSITE EMERGENCY PLANNING

This testimony addresses ECNP Contention 2-10 (EP-9) on the meteorological aspects of accident assessment during an emergency. It shows that, in fact, the licensee's use of the "adverse meteorology" assumption in its accident assessment is conservative and will result in an overprediction of offsite radioactive concentrations from a release during an emergency most of the time and will accurately predict such offsite concentrations the rest of the time.

This testimony also addresses ANGRY Contention IIF(2) (EP-3C(2)) on the licensee's MIDAS radiological assessment system. It indicates that this system, in combination with the licensee's meteorologist, provides an information analysis capability equal to the Atmospheric Release Advisory Capability (ARAC) system.

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ECNP CONTENTION 2-10 (EP-9)
ANGRY CONTENTION IIF(2) (EP-3C(2))

Q.1 Please state your name and position with the NRC.

A. My name is Joseph R. Levine. I am a meteorologist with the U. S. Nuclear Regulatory Commission assigned to the Meteorology Section of the Accident Evaluation Branch, Division of Systems Integration, Office of Nuclear Reactor Regulation.

Q.2 Have you prepared a statement of professional qualifications?

A. Yes. A copy of this statement is attached.

Q.3 Please state the nature of the responsibilities that you have had with respect to the Three Mile Island Nuclear Station - Unit 1.

A. I have reviewed the meteorological measurements program and the emergency plan for TMI-1 to prepare the present testimony.

Q.4 Please state the purpose of this testimony.

A. The purpose of this testimony is to address ECNP Contention 2-10, and ANGRY Contention IIF(2), both of which deal with meteorological aspects of accident assessment and radiation monitoring.

Q.5 What is meteorology?

A. Meteorology is the study of the atmosphere and the phenomena that occur within it.

Q.6 How does a knowledge of meteorology aid in the evaluation of a nuclear plant site?

A. In the meteorological review of a plant site, consideration is given to determining normal and extreme conditions of temperature, precipitation, wind speed and wind direction, as well as the atmospheric diffusion conditions resulting from atmospheric turbulence existing at the site and in the surrounding area.

Q.7 What are the meteorological information sources used in the review of the plant site?

A. Long-term observations from nearby National Weather Service stations provide information on normal conditions as well as extremes for temperature, precipitation, wind speed and direction, along with data on cloudiness and restrictions to visibility.

In addition, onsite measurements of wind speed and direction, atmospheric stability and precipitation provide local information to be used for evaluating the transport and diffusion of possible gaseous releases from the plant, either routine or accidental.

Q.8 What is the role of meteorology in evaluating possible radioactive gaseous releases from a nuclear power plant site such as TMI-1?

A. Meteorological information at a site is used for several purposes:

a) to provide guidance for monitoring of radioactive effluent by aircraft or mobile ground equipment during an accidental release to locate the plume,

b) to aid in defining the location of fixed radiation detectors with respect to the effluent plume,

c) to aid in protective action decision-making by locating the potential plume exposure area,

d) to indicate the future direction of effluent travel by forecasting of local and regional meteorological conditions,

e) to allow the determination of the degree of consistency among the field monitoring results, the release (source) information and existing meteorological conditions.

Q.9 How do the site meteorology conditions allow the evaluation of gaseous radioactive releases?

A. Meteorological conditions provide the mechanism for transporting and diffusing gaseous effluents from the plant to receptors situated anywhere around the plant site and are used in mathematical models to calculate the relative concentration of effluent at a location.

Q.10 What are the principal meteorological components of this transport mechanism and how do they operate?

A. Three meteorological factors play a dominant role in the movement of gaseous effluent away from the release point. These are wind speed, wind direction, and atmospheric stability.

Q.11 What does wind speed do?

A. Wind speed provides the travel speed and initial dilution of these gaseous effluents.

Q.12 What does wind direction indicate?

A. Wind direction indicates where the effluent is going.

Q.13 What is meant by atmospheric stability?

A. Atmospheric stability refers to the ability of the atmosphere to diffuse an effluent into the surrounding air. The degree of turbulent transport of effluent depends on the rate of temperature decrease of the air with height near the surface. With a large decrease of temperature with height, the atmosphere is unstable resulting in rapid diffusion of effluents; a small decrease or increase of temperature with height results in a stable condition and slow diffusion of effluents. Atmospheric stability controls the rate of decrease of effluent concentration with distance from the release point.

Q.14 What is the difference between a "plume" and a "puff"?

A. The effluent plume, if it were visible, would have the appearance of smoke coming out of a chimney. The puff, if it were visible, would resemble smoke from a smoking pipe if it is puffed. In either case, the effluent would travel away from the release point with the approximate speed of the wind in the direction toward which the wind was blowing.

The plume is a continuous stream of effluent from the stack or release point which increases its dimensions and becomes more diffuse with time and distance from the release point.

Theoretically, a puff is an instantaneous release of effluent material. If a puff is released, the material disperses in three dimensions and decreases in concentration. In reality, the puff is a plume which is of short release duration and would not have the appearance of a continuous stream of effluent considered to make up a continuous plume.

Q.15 Would meteorological conditions affect a plume or a puff?

A. Yes. As stated in response to previous Question 10, wind speed, wind direction, and atmospheric stability all affect a plume or a puff.

A.16 What other factors affect a plume or puff besides meteorological conditions of wind and stability?

A. The influence of nearby structures on the released effluent aids in the initial mixing of the effluent in air, thereby reducing the concentration. By increasing the height of the release, the effluent is emitted into usually faster moving air above the ground, thereby lowering ground level effluent concentrations. (Effluent temperature and momentum also can act to increase the height of the effluent from its release point.)

Q.17 Once the meteorological factors of wind speed, wind direction and stability and other factors are determined, what use is made of them?

A. These factors are incorporated in analytical models to estimate the potential radiation exposures that may occur as a result of a release and to assist in determining the potential need for emergency action.

Q.18 Are meteorological models capable of providing useful information about the atmospheric transport and diffusion of radioactivity that would result from an accidental atmospheric release of radioactive materials?

A. Yes. Models for the evaluation of gaseous releases have been used successfully by the NRC and others to arrive at estimates of the consequences of an airborne release. The models currently in use for consequence assessments have been derived from experimental data, and make conservative assumptions about the mode of release and the effects of nearby buildings. The models provide atmospheric diffusion rates as a function of atmospheric stability and the effluent is assumed to be carried in a downwind direction from the release point, along a trajectory modified for terrain influence. The principal basis for the model is the consideration that the effluent has a predictable plume spread rate which results in a constant decrease of effluent concentration in the plume as it is viewed end on. As the plume moves away from the source, the relative concentration averaged over suitable time intervals is constantly decreasing. Field experiments have demonstrated the validity of the diffusion rate assumption and as a result, the model use is appropriate to arrive at estimates of relative concentration.

Q.19 With regard to accident assessment as provided for in the licensee's Emergency Plan, ECNP Contention 2-10 (EP-9) states:

> Reliance on "adverse meteorology" (p.4-5, 4-6), can prove to provide little or no "built-in conservation" (p. 4-7, 4-8) since, for instance, such conditions were not at all uncommon during the nighttime in the nights following the TMI-2 accident (for instance, the night of March 29, from 10 p.m. to 8 a.m., March 30; night of March 31, about 8:00 p.m. to 8.a.m., April 1).

What is meant by "adverse meteorology" as that phrase is used in this contention and in the licensee's Emergency Plan?

A. Adverse meteorology, as used in the emergency plan, is defined as a condition when wind speed is 1.5 mph and the atmospheric stability is Pasquill F resulting in poor dispersion conditions. The selection of this combination of meteorological variables represents conditions observed at the site to provide a conservative estimate of relative concentration at the 610 meter minimum exclusion area radius.

Q.20 Does the "adverse meteorology" defined in the TMI emergency plan as "Pasquill F stability and wind speed of 1.5 mph" produce conservative concentrations?

A. Yes. A conservative formulation was used to translate wind speed, atmospheric stability and the distance to the nearest potential receptor into relative concentration of values for gaseous effluents. Also, more adverse meteorological conditions would occur less than 5% of the time.

Q.21 What is the Pasquill F stability?

A. The Pasquill stability classification system is used to define how a gaseous effluent plume changes its lateral and vertical dimensions and concentration with downwind distance from the source. The classes of stability can be determined by measuring the vertical rate of change of temperature near the ground on a meteorological tower. In general usage, stability classes range from A to F with the dispersion rate decreasing as the stability class goes from A to F.

Q. 22 Could the "adverse meteorology" be expected to last for a prolonged time period?

A. Yes. Atmospheric stability and wind speeds are dynamic meteorological factors and generally are subject to changes in the prevailing large-scale weather systems as well as small-scale topographic influences. As a result of the large-scale interaction, it is possible to observe persistent meteorological conditions at the plant site although the "adverse conditions" would seldom be expected to last for time periods greater than about 12 hours.

Q.23 If "adverse meteorology" only lasts several hours, what might be the effect?

A. The existence of poor dispersion conditions, "adverse meteorology," would limit the rate of dilution of the radioactive gaseous effluent. If the release lasted several hours, one location would seldom be exposed to the plume for the entire release. This expectation is based on the nature of wind direction variability, in addition to the behavior of effluent plumes under light wind and stable atmospheric conditions. The wind direction, under light wind speed conditions, will vary and thus carry effluent in more than one direction. Effluent plumes have been shown to take a meandering path, thereby increasing the dilution of the effluent and lowering the total exposure at a location.

Q.24 What would be the expected relative concentration (X/Q) using the Pasquill F stability and 1.5 mph "adverse meteorology" at the 610 meter exclusion area boundary distance?

A. The relative concentration calculated for these "adverse conditions" would result in a value of 5.2×10^{-4} sec/m^3. This value incorporates a reduction factor due to plume meander based on a conservative analysis of diffusion measurements. The X/Q value chosen by the licensee, 6.8×10^{-4} sec/m^3 is about 1.3 times higher than our evaluation for the same meteorological conditions due to slightly different assumptions in the calculations and is also deemed to be realistically conservative.

Q.25 Why is the X/Q value chosen by the licensee for "adverse meteorology" deemed to be realistically conservative?

A. The value chosen would be exceeded less than five percent of the time and thus have a small probability of being observed. In addition, the emergency action levels would not be based upon exceeding this X/Q threshold, but would be activated at this value.

Q.26 Does the licensee's reliance on such "adverse meteorology" provide "built-in" conservatism?

A. Yes. Selection of a relatively stable atmospheric condition and a low wind speed provides a basis for what would be considered poor dispersion conditions, assuming that the plume concentration is not reduced due to plume meandering. Since the "adverse meteorology" assumed by the licensee should occur only a small percentage of the time, the "adverse meteorology" assumption of the licensee should result in underpredicting dilution, and, therefore, overpredicting radioactive concentration in an airborne release. This would be expected most of the time, or at worst, accurately predicting dilution and radioactive concentrations when poor dispersion conditions actually exist. Thus, selection of F and 1.5 mph provides conservatism compared to use of a more unstable and higher wind speed which would result in lower relative concentrations.

RADIATION MONITORING

Q.27 ANGRY Contention IIF(2) (EP-3C(2)) states:

> The NRC's vague instruction to the licensee to "upgrade" in generally unidentified respects its "Offsite monitoring capability" is insufficient to assure that such upgrading will result in the ability to obtain and analyze the type and volume of information essential for protection of the public health and safety. ANGRY contends that such capability must at minimum encompass the following elements or their equivalent;
>
> > Information analysis capability equal to or greater than that provided by the Atmospheric Release Advisory Capability System (ARAC). This contention now challenges the adequacy of the licensee's MIDAS radiological assessment system (EP, p. 6-9) to the extent that the information analysis capability it provides does not equal or exceed that provided by the ARAC system.

Does an information analysis capability exist at the TMI site?

A. Yes. A total analysis capability requires information on what is being released and from where, in addition to the rate of release, location of receptors and local meteorological conditions. All of this information can be combined to provide a rapid evaluation of potential doses at locations around the site for emergency action. Metropolitan Edison has the Meteorological Information and Dose Acquisition System (MIDAS) and the services of a qualified meteorologist for use in evaluating accidental releases at Three Mile Island.

Q.28 Can MIDAS provide information for evaluating atmospheric releases comparable to the Atmospheric Release Advisory Capability system (ARAC)?

A. Yes. MIDAS is an onsite system that automatically incorporates data from onsite meteorological sensors and gaseous effluent monitors into diffusion calculations for making rapid assessments of offsite doses. Also, Metropolitan Edison employs a qualified meteorologist to modify the MIDAS output for offsite meteorological conditions, especially for long distances.

The ARAC system can provide two types of evaluations. The first type of evaluation is performed by an onsite (or local) terminal which utilizes local meteorological information to provide rapid assessments at distances less than 10 miles and is similar to MIDAS. The second type of evaluation is performed at Lawrence Livermore Laboratory and utilizes regional meteorological and topographical information and a large computer to provide assessments at distances beyond 5 to 10 miles. The second evaluation utilizes a communications link with the site to provide assessment results and would have turnaround times of 1 to 2 hours.

A comparison of the ARAC and MIDAS systems indicates that both can provide a rapid assessment of the radiation exposures fro. a release under prevailing meteorological conditions using a Gaussian plume model for the determination of relative concentration and dose locations within 10 miles. Also, both MIDAS output, as modified by a meteorologist, and ARAC provide an assessment capability over long distances.

The MIDAS system was successfully used for the evaluation of the Krypton release at TMI-2 and the control of the release as a function of meteorological conditions and amount of activity being released. This same capability exists for TMI-1. I believe that the use of MIDAS and a qualified meteorologist at TMI provides assessment capability equivalent to ARAC.

Joseph R. Levine
Meteorology Section
Accident Evaluation Branch

Office of Nuclear Reactor Regulation Professional Qualifications

My name is Joseph Richard Levine. I have been a meteorologist with the Office of Nuclear Reactor Regulation, since October 1974

I received my B.S. degree from the City College of New York in June 1962 with a major in meteorology. Following graduation I accepted a position with the U. S. Weather Bureau at its Richmond, Virginia airport station. The duties at Richmond included; meteorological observation, preparation and dissemination of routine forecasts and severe weather bulletins, upper air (PIBAL) and radar operation.

In June 1963, I entered active duty with the U. S. Army serving as a meteorologist research officer with the Electronics Research and Development Activity Arizona, located at Fort Huachuca Arizona. During this time I worked on varied meteorological problems related to Army operations and interests. During 1964 I spent approximately 5 months at the U. S. Army Chemical Corps Proving Ground, Dugway Utah, as a meteorological team commander involved with the observing and collecting of meteorological data in support of varied field experiments.

In June 1965 after completing my military service I returned to the U. S. Weather Bureau, at the Pittsburgh, Pennsylvania airport office where I prepared weather forecasts and severe weather bulletins for Western Pennsylvania, as well as for the Pittsburgh metropolitan area. Until establishment of a separate radar unit, I operated and interpreted weather radar during appropriate weather conditions. Telephone and in person weather briefings were also given to aviation interests as well as the general public.

In September 1966, I left the Weather Bureau to attend Rutgers university, after being accepted and offered a research assistantship the previous summer. My M.S. degree was granted in 1968 with a major in Meteorology.

I accepted a position with the Atmospheric Sciences Laboratory, Fort Monmouth, New Jersey in July of 1968. During the period 1968-1974 I was engaged in work on various problems and tasks assigned to our laboratory by higher headquarters as well as providing technical assistance to other Fort Monmouth laboratories. Shortly after a Ph.D. level program in Geophysical Fluid Dynamics began at Rutgers University, I was accepted on a part time basis into the program in which I remained until the winter of 1973-74 when I terminated my activity in the program.

I accepted my present position during the summer of 1974 and began work in October of that year. In my position, I assist the senior branch meteorologist in the evaluation of the meteorological factors affecting nuclear power plant sites and the effects of a plant on the local environment meteorology and climatology.

In the Spring of 1975, I attended the EPA course, "Diffusion of Air Pollution - Theory and Application" and in October of 1975, I attended the Ninth Conference on Severe Local Storms sponsored by the American Meteorological Society. In June of 1976 I attended a week-long tornado symposium sponsored by the Texas Tech University and during September of 1976 I was present at the American Meteorological Society sponsored conference on Coastal Meteorology.

In August 1977, I attended the week long conference on Alternate Technologies of Electric Power Generation: Their Overall Fuel Cycles and Environmental Effects, held at the University of California, Berkeley. In November 1977, I presented a paper, co-authored with E. H. Markee, Jr. of NRC, at the Fifth Conference on Probability and Statistics in Atmospheric Sciences. The paper described the probabilistic evaluation method for atmospheric diffusion conditions at nuclear power plant sites used by NRC.

I am a Professional Member of the American Meteorological Society and an Associate Member of Sigma Xi National Honor Society.