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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

July 20, 1984

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD
Glenn O. Bright
Dr. James H. Carpenter
James L. Kelley, Chairman

In the Matter of CAROLINA POWER AND LIGHT CO. et al. (Shearon Harris Nuclear Power Plant, Unit 1)	Docket 50-400 OL ASLBP No. 82-468-01 OL

Wells Eddleman's Proposed Findings and Conclusions
Concerning Contention 8F1 (Coal Particulates)

As ordered orally by the Board on June 19, 1984, I hereby

attach a copy of my proposed findings of fact and conclusions of law

concerning Eddleman contention 8F1 concerning the health effects of

coal particulates.

Wells Eddleman

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FINDINGS OF FACT

1. Contention 8F(1) states:

Appendix C of the DEIS underestimates the environmental impact of the effluents in Table S-3 for the following reasons:

(1) health effects of the coal particulates 1,154 MT per year, are not analyzed nor given sufficient weight.

2. Applicants submitted the testimony and exhibits of Dr. Leonard Hamilton, Head of the Biomedical and Environmental Assessment Division in the National Center for Analysis of Energy Systems at Brookhaven National Laboratory.

3. The NRC Staff submitted the testimony and exhibits of Drs. Loren J. Habegger (environmental systems engineer in the Energy and Environmental Systems Division, Argonne National Laboratory), A. Haluk Özkaynak (research fellow and project Director for the Study on Health Effects of Exposures to Airborne Particulates in the Energy and Environmental Policy Center at the John F. Kennedy School of Government, Harvard University) and Mr. Ronald L. Ballard, Chief of the Environmental and Hydrologic Engineering Branch, Division of Engineering, Office of Nuclear Reactor Regulation at the Nuclear Regulatory Commission; these 3 witnesses appeared as a panel.

4. Wells Eddleman presented one Exhibit, a typescript by G.L. Fischer and D.F.S. Natusch, "Size Dependence of the Physical and Chemical Properties of Fly Ash" (Tr. 1319) Witness Hamilton stated his opinion of this document was that "I think on the whole I am impressed by the work of Fisher and Natusch. I have seen it, and it seems to be pretty standard, high-quality work." (Tr. 1317-18).

5. The lower limit of health effects of coal particulates as set forth in Table S-3 of 10 CFR 51.20 of the NRC rules, is zero. All witnesses agreed on this point. (See Tr. 1229, Hamilton; Staff Panel (witness Özkaynak) Tr. 1576-77)(See also Tr. 1308, Hamilton, "doesn't make sense ... that breathing these particles is good for you?" A: "Correct.")

6. The upper bound of the health effects of the Table S-3
particulate emissions also needs to be examined, as all witnesses
agreed. (Hamilton, Tr. 1229 "And one really needs, if you are being
realistic, to use both models ... rather than ... just ... this upper
boundary of damage."   Staff Panel, Tr.

Dr. Hamilton stated it is conservatsive to use the upper limit (Tr. 1332)

7. Dr. Hamilton testified repeatedly that particulates, as
regards their health effects, were being used as a "surrogate for
air pollution in general" (Tr. 1225; see also 1233-34 (Hamilton)
fine particulates damage functions "are surrogates for air pollution
as a whole. That's the way they are really being used and functioning."
See also Tr. 1237 ("very clear that when we use (damage functions)
we are using them as a surrogate ..."), 1309, surrogate "for air
pollution as a whole"; 1350-51, particle as a surrogate for air pollution.)
7A. Total pollution related deaths range up to 50,000 -100,000/year (Tr. 1309-10)
8. Staff Exhibit # 1 (the Shearon Harris Final Environmental
Statement, NUREG-0972) states at page C-2 that the air pollutants
associated with the nuclear fuel cycle for Harris (per Table S-3) are
about 0.02% of the national emissions of such pollutants. This
is 2/10,000 of the national total (Tr. 1311). The Staff panel testified,
based on Council on Environmental Quality Reports (see Tr. 1478-81)
that stationary source combustion products were 1.7 to 2.8 million (metric)
tons per year (tr. 1480-81).

The Table S-3 1154 metric tons is, at minimum, a 0.04% increase
in these emissions; at maximum, a 0.07% increase (Tr. 1485-86).

9. There is evidence both ways on whether coal particulates
are more,or less,dangerous than other pollutants in the air, or other
                See Staff panel, Tr. 1413.
particulates. There are metallic (Tr. 1197) and organic (Tr. 1326, e.g.).
All witnesses stated that these effects were captured in the uncertainty
of the particulate damage functions. (Tr. 1413-1414; Tr.   )

10. However, the cross-sectional studies do not capture air pollution data except for the year of a person's death. (Witness *See Tr 1329*

Özkaynak, Tr. 1420 -21: "the variable ... used for air pollution there is a concentration of pollutants in the year of a person's death? A. That's Correct. Q. No previous years? A. No.") Both witness Hamilton and the Staff panel agreed that cross-sectional data do not pick up the effects of past exposure (beyond the year in which a person died) to particulates. Özkaynak, Tr. 142l-22; Hamilton, Tr. 1334 "... mortality you see represents not the mortality that is due to the year in which you are making the measurement but ... it is this previous longstanding exposure to those pollutants that have gone on 30 or 40 years earlier. And that (mortality) is the result". See also Tr. 1335 "...What you are seeing is the effect, either in the induction of cancer or the induction of chronic lung disease, (of) the very long term exposure to these particles in order to get the cancer or the lung disease manifest.")

11. Thus, even though all witnesses agreed the damage coefficients from the cross-sectional studies of air pollution health effects were statistically significant, and the best data available (Staff panel testimony at 33,34; Dr. Hamilton,testimony p.10; tr. 1225), they do not capture these long-term effects.

12. Therefore, an upper bound can be conservativevely calculated by taking the fraction of emissions of Table S-3 air pollutants nationwide, which is represented by the Harris plant fuel cycle (0.02% or 2/10,000, Staff Exhibit 1 p. C-2) and multiplying it by Dr. Hamilton's upper limit of total deaths due to air pollution (100,000 a year, see finding 7A, supra, Tr. 1309-10) times a 40 year plant operating life (as set in Staff Exhibit 1 for radioactive effluent extimates). This is approximately 800 deaths. This number is conservative since not all deaths are solely due to particulates (Tr. 1310). But the effects solely of particulates may not be separable. Dr. Hamilgton says they are not, see e.g. Tr. 1237.

13. Having established both an upper and lower end, it is appropriate
to try to locate the middle, or more likely effects of the 1154 metric
tons of _∧air pollutants specified for the Harris plant fuel cycle by
Table S-#3.

(handwritten insertion above "air": coal particulate)

14. It is not appropriate to limit consideration of such health
effects to just a 50-mile radius around the sources from which these
particulates would be emitted. (See Tr. 1259: the same particle has
the same health effects no matter where it comes from; health effects
throughout the US are considered in Dr. Hamilton's second analysis;
See also Tr. 1569 (Staff panel) nothing stops the health effects at
50 miles, but the Staff's modeling is unable to capture effects
beyond that distance (Tr. 1569-70)).

15. In considering nationwide health effects of coal particulates,
it is appropriate to use Dr. Hamilton's 90 person-microgram/m^3 per
U.S. ton expxosure function. While this estimate could be improved
by using the actual plant location and $\;$ stack $\;$ height limited to 200
meters (BNL 51305, Hamilton reference 4, see Tr. 1292, identifying

(handwritten in left margin: also See Tr 1272)

Fig. 7, p.11 thereof; Tr. 1292, 1297, it shows isopleths of exposure
depending on where the plant is located. The U.S. average expxosure
for a plant located randomly within the US is 92.6 person/µg/m^3 per US
ton. (Tr. 1268; Tr.1271 (plant location); Tr. 1285 (US tons).)
Since a metric ton (2204 lbs) is 1.102 US tons, we can take
100 person-µg/m^3 per metric ton emission as a good round number.
(see Tr. 1270 re round numbers).

16. The latest and most appropriate damage function is the
Harvard fine particulate damage function of 2.31 $\pm$ 0.81 deaths
per 10^5 persons per microgram/m^3 year of exposure. (See Tr. 1435-36)
A 95% confidence interval is appropriate to use for this data (2
standard deviations) (Hamilton, Tr. 1331; Staff panel Tr. 1437)

(handwritten: Staff testimony, p. 22)

This range is 0.69 to 3.93 deaths/10^5person ug/m^3 year. (see Tr. 1438-39
and correcting math by direct calculation.)

This coefficient has a reduction of standard error, and increased statistical significance, compared to other measures (Tr. 1441-42). And it is based on fine particulates, the kind most emitted from coal-fired power plants. Witness Habegger testified he could not tell how much, if any, conservatism there was in assuring that all the fine particulates were emitted from the coal-fired power plant. (Tr. 1473).

17. Applying the damage coefficient of finding no.16 and the nationwide exposure data to the 1154 metric tons of particulates specified in Table S-3, the following 95% confidence interval of likely deaths is calculated: 100 person-μg/m^3-Metric Ton, times 1154 metric tons, is 115,400 person-μg/m^3 of exposure per year. The lower limit of the 95% confidence interval is 0.7 deaths per year per 100,000 (10^5) person-μg/m^3 exposure (28 deaths over the 40-year "pollutant life" of the Harris plant), or about 32 deaths over the operating life of the plant for pollution calculation purposes. (115,400 x 28/100,000 is about 32). The upper limit is 3.9 deaths/year (156 deaths/plant life) per unit of exposure, or about 180 deaths over the operating life of the plant. These estimates may be too hxigh in the sense that only 68% of the output of the coal plants is fine particulates, and the respirable particulate damage function is less than the FP function. See Tr. 1287 Non-sampling and sampling statistical errors could also affect it. (Tr.

18. Morbidity due to Table S-3 pollution (staff testimony, Table 3) ranges from 0 to about 3 emergency room visits, and 0 to about 45 respiratory disease incidents per year. This is about an upper limit of 120 emergency room visits and 1800 disease incidents over a 40-year plant life; lower limit is zero for all. (95% confidence limits.)

CONCLUSIONS

1. Staff's entire consideration of coal particulates was 2 lines in the FES (Tr. 1315) This is inadequate.

2. Adequate analysis would include the findings and conclusions above.

Wells Eddleman