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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

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 Dependenceof 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 conservative 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 particulates. See Staff panel, Tr. 1413. 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 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. 142-22; 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.")

See Tr 1329

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 conservatively 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 coal particulate air pollutants specified for the Harris plant fuel cycle by Table S-3.

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 exposure 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 Fig. 7, p.11 thereof; Tr. 1292, 1297, it shows isopleths of exposure depending on where the plant is located. The U.S. average exposure for a plant located randomly within the US is 92.6 person/$\mu g/m^3$ 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-$\mu g/m^3$ 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) 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 assuming 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-$\mu g/m^3$-Metric Ton, times 1154 metric tons, is 115,400 person-$\mu g/m^3$ of exposure per year. The lower limit of the 95% confidence interval is 0.7 deaths per year per 100,000 (10^5) person-$\mu g/m^3$ exposure (28 deaths over the 40-year "pollucant 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 high 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.

Brad, Ed Boman