2-3-23

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
WISCONSIN PUBLIC SERVICE CORPORATION	)	Docket No. 50-305
WISCONSIN POWER AND LIGHT COMPANY	)	
AND	)	
MADISON GAS AND ELECTRIC COMPANY	)	
	)	
(Kewaunee Nuclear Power Plant)	)	

AFFIDAVIT IN SUPPORT OF
MOTION FOR SUMMARY DISPOSITION

State of Maryland)
) ss
County of Montgomery)

The undersigned, J. E. Carson, being first duly sworn, hereby deposes and says as follows:

1.

A statement of my background and qualifications has been filed and is a part of the Docket in this matter.

2.

I have provided technical advice on meteorological matters to the individuals who assessed the environmental aspects of the Kewaunee Nuclear Power Plant. This input has been based on my prior education and research activities, and my current investigations of the environmental aspects of

methods for disposal of byproduct heat in the operation of plants producing electricity.

The meteorological effects and the attendant environmental consequences of the Kewaunee Nuclear Power Plant's once-through cooling system and possible alternatives have been considered and significant findings presented in the FES (Sections V.A.1 and V.B.1). Operation of the Plant's open cycle cooling system is expected to result in localized increases in 1) steam fog over the thermal plume in the lake, 2) evaporation of water from the lake, and 3) ice formation on the land near the lakeshore.

3. Steam Fog and Icing

Steam fog is formed whenever very cold air passes over a warm water surface. In addition to very rapid evaporation, heat energy passes from the water to the atmosphere, creating a very unstable density stratification and considerable turbulence in the lowest several feet of air. The warm, humid air rises and mixes with the cooler air aloft; if conditions are proper, some of the water vapor in the mixture condenses out as steam due to the non-linear relation between saturation vapor pressure and temperature. Further vertical mixing tends to re-evaporate the condensed water droplets. Despite some research, the exact criteria for predicting the formation of steam fog are not known since it involves a complex function of water and air temperature, humidity and wind conditions. It is clear that steam fog can be present over

thermal discharges and not over nearby, unheated water. Observations of steam fog at existing power plants on the Great Lakes [Point Beach, Waukegan, Lakeside (Toronto), etc.], show that steam fogs over thermal discharges are thin and wispy, show a considerable amount of turbulence, and cover an area only slightly larger than the plume itself.

Visibilities within the fog area may momentarily drop to tens of feet, but are usually several hundreds of feet and thus no problem to navigation or other uses of water. Thus, steam fog differs in form, density, depth, and liquid water content from other types of fog.

Onshore winds and subfreezing conditions can cause ice deposits on nearby land and vegetation. Observations have shown that the area of icing created by the steam fog moving inland will be extremely small, extending only 10 to 50 feet inland from the shore. Due to the very small size of the droplets, the ice that forms is of very low density and is very fragile. Hence it is less destructive than other ice such as freezing rain.

Thus, based on the physical characteristics of steam fog and of the plume (FES, p. III-9 lines 34-41 regarding area, p. V-7, lines 34-37 regarding location), I have concluded that the expected increase in steam fog over the thermal plume from the Plant will be very localized and will not be a

significant environmental impact (FES at p. V-8, lines 5-10), and that no detrimental effect of fogging and icing on the use of the land is expected. (See: FES, p. V-3, lines 36-37).

4. Evaporation

1000 megawatts of heat will evaporate water at the rate of 14 cubic feet per second. When this quantity of heat is added to a lake, other effects such as conduction and radiation contribute to the heat transfer. A value of 9 ± 2 cubic feet per second (cfs) is derived [1/] for the loss of water by evaporation as a consequence of the advective input of 1000 megawatts into Lake Michigan.

For full power operation, the Plant discharges about 1100 megawatts to the Lake through its once-through cooling system. The resulting evaporation of 10 ± 2 cfs is trivial in comparison with the average annual evaporation rate of 40,000 ± 5000 cfs for Lake Michigan. Thus I conclude that the increased evaporation of water caused by the once-through cooling system is not a significant environmental impact.

5. Impact of Closed-Cycle Sytems

The environmental consequences of meteorological effects associated with a once-through system for the Kewaunee Plant are expected to be extremely

small, as explained above, and acceptable. Nonetheless, it is instructive to consider the meteorological effects of other cooling methods, even though of the various cooling procedures, once-through cooling on a large body of water has by far the lowest potential for creating adverse meteorological effects. 2/

Natural draft cooling towers (FES at p. XI-6 to 9) can create visible water-droplet plumes 10 miles or more in length on cold days. These plumes rarely, if ever, reach the ground. Hence, their potential to create ground-level fogging and icing is near zero. But the plumes will reduce sunshine in the area, occasionally create clouds, and may interact with existing clouds to cause precipitation. The plumes will always have an adverse visual impact as will the towers themselves because of their physical dimensions.

Mechanical draft cooling towers (FES at p. XI-9 to 11) will also create extended water-droplet plumes (especially in winter) and, because of their low level of release, can create extensive areas of surface fogging and icing. Of the various alternate cooling procedures, mechanical draft towers have the greatest potential for causing an adverse meteorological impact. The proximity of a state highway would cause problems specific to the Kewaunee Plant.

Spray canals, (FES at p. XI-12 to 13) based on experience at Dresden, have a somewhat lower potential for creating fog, due to their longer zone of contact between air and water. Because of drift*, icing within 100 to 500 feet of the canal can be severe. Cooling ponds (FES at p. XI-11 to 12) also release their heat and water vapor at ground level, much as the situation for once-through cooling. Because of the large area of release, fogging is restricted to areas quite close to the pond.

The Applicant has generally been realistic in his evaluation of the environmental impact of the cooling towers. For example, the statements regarding natural draft towers, on pages 2.5-37 to 42 of the Environmental Report, are accurate as to fogging. At times his evaluation has been conservative. For example, with regard to drift, recent data complied by EPA indicate that drift losses from properly designed natural-draft hyperbolic towers is about 0.003% of the cooling-water flow, instead of the 0.3% value quoted on p. 2.5-40. Thus, the Applicant's estimates of drift are probably too high. Also, the comments on p. 2.5-42 and 43 probably minimize rather that exaggerate the effect of fogging from mechanical draft towers on Highway 42.

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* Draft is mechanically entrained water droplets. In a cooling tower, they are generated inside the tower and carried along with the air exhausted to the environment. The bulk of the droplets are the result of condensation as the plume cools by entrainment. A similar process is associated with the spray modules in a spray canal.

I do not consider the environmental impact of the cooling alternatives in regard to fogging, icing and aesthetics a serious one, although each has a greater impact than the once-through system (FES at p. XI-19). The assignment of a minor aesthetic impact to a natural draft tower is based on the remote location of the Plant. The small fogging and icing impact ascribed to the alternate cooling methods, in spite of their proposed locations near the highway which bisects the Plant site (FES at p. XI-7), is based on an expectation of low frequency of occurrence.

In summary, the alternative cooling methods are not objectionable from the viewpoint of excessive environmental impacts from meteorological effects, but the existing method produces lesser impacts and ones which are inconsequential.

REFERENCES

1. J.G. Asbury, "Effects of Thermal Discharges on the Mass/Energy Balance of Lake Michigan," U.S.A.E.C. Report ANL/ES-1, Center for Environmental Studies, Argonne National Laboratory, Argonne, Illinois, July, 1970.

2. J.E. Carson, "The Atmospheric Effects of Thermal Discharge into a Large Lake," J. Air Poll. Cont. Assoc. 22, 523-528 (1972.

J. E. Carson

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Subscribed to and sworn before
me this 3rd day of February, 1973

Anne C. Harris

My Commission expires 9/21/76