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TO: NRC

FROM: Iowa Elect. Light & Power Co.
Cedar Rapids, Iowa 52406
Keith D. Young

DATE OF DOCUMENT: 02-28-77
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DESCRIPTION: Ltr. Trans The Following:

ENCLOSURE: Consists of Thermal Plume Study for DUANE ARNOLD concerning, temperature measurements in the river during representative low flow conditions....

DO NOT REMOVE

PLANT NAME: DUANE ARNOLD

jcm

ACKNOWLEDGED

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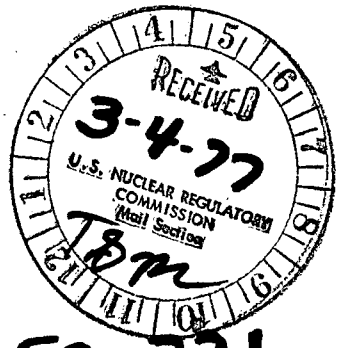
IOWA ELECTRIC LIGHT AND POWER COMPANY

DUANE ARNOLD ENERGY CENTER
P. O. Box 351
Cedar Rapids, Iowa 52406

February 28, 1977
DAEC-77-140



50-331

Director, Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
1717 H. Street N.W.
Washington, D.C. 20545

SUBJECT: Thermal Plume Study

FILE: A-118e

Regulatory Docket File

Dear Sir:

As required by Appendix B, Environmental Technical Specifications 4.1.1.11 temperature measurements in the river were made during representative low flow conditions. A report of the findings are attached.

In addition calculated thermal plume area was 2.3 acres instead of one acre as stated in Appendix B, Environmental Technical Specification 2.1.1 bases.

Sincerely,

Bill Kuehn FOR
Keith D. Young
Radiation Protection Engineer
Duane Arnold Energy Center

Approved: E L Hammond / dh
E. L. Hammond
Chief Engineer
Duane Arnold Energy Center

ELH/KDY/lh

Enclosures

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THERMAL PLUME STUDY

Low flow conditions have persisted in the Cedar River since June of 1976. This discussion will be confined to the period September 1976-January 1977, when significant temperature differences between upstream and downstream stations were observed.

During that period temperature differentials in excess of 5°F above ambient were observed during routine sampling at the DAEC downstream station, about 140 feet below the discharge canal, on eight occasions. Since this station is within the mixing zone this is not unexpected. Temperature differentials in excess of 5°F above ambient have been observed at the Comp Farm station about ½ mile below the plant during only two sampling periods out of 10 during the September 1976-January 1977 period. These two periods, when downstream temperatures were in excess of 5°F, occurred on October 11 and November 16, during periods of low river flow (550 and 640 cfs respectively). Although no thermal plume studies were made on these dates, plume configurations were determined on October 16 and December 2 when river discharges were 534 and 502 cfs respectively.

During the October 16 study it was evident that the plume from the discharge canal hugged the shoreline throughout most of its length. Ambient upstream temperatures was 49.1°F while discharge canal temperature was 63.5°F. Temperature in the river directly in front of the discharge canal was 58.1°F and the maximum extent of the 5°F excess isotherm was approximately 600 feet downstream and 85 feet offshore. The estimated area of the river subjected to a temperature of 5°F or greater was ca. 2.3 acres.

It is likely that the large plume observed during this study was a result of the extremely low river flow and high discharge canal temperature present at the time of sampling. Low flow and lack of turbulence caused the heated water to float on the surface of the river and extend a considerable distance downstream prior to mixing. Similar conditions were in all likelihood present on October 11 and November 16 and would not be unexpected during fall and winter low flow periods when mixing is minimal and the temperature differentials between the discharge canal and the river are relatively high. By calculation it can be determined that following complete mixing of the discharge with the river water the temperature increase in the downstream river would be minimal, even during low flow periods. For example, a temperature increase of approximately 0.3°F would have been reached following mixing, even assuming no heat loss to the atmosphere on October 11 when river flow was 550 cfs with a maximum blowdown discharge of 9 cfs, resulting in a 61 fold dilution factor. Dividing the temperature differential between the river and the discharge canal by the dilution factor gives the downstream temperature increase following mixing well below the regulatory limit of 5°F.

During the December 2 study temperatures in the discharge canal were considerably lower (41.9°F) and the size of the thermal plume was minimal. At that time the maximum ΔT observed in the river was 5.9°F, approximately 25 feet downstream from the discharge. Recirculation of blowdown water into the intake structure to maintain ice free conditions also increased turbulence and contributed to the small size of the thermal plume at the time.

Since water temperatures in the vicinity of the discharge canal have been well within the range tolerated by the native fish community during the October-January period, it is unlikely that any deleterious effects were experienced by fish in the area. Although cold shock, resulting from rapid drop in water temperatures following plant shut down or cessation of blowdown discharge, is possible at temperature differentials greater than 10°F there if no evidence to indicate that this condition has occurred. Recirculation of heated water into the intake bag has caused some increase in impingement rates, but due to the design of the intake structure and the relative small volume of water needed for the closed cycle cooling system, total impingement numbers remain low and impingement is not considered to be a significant problem at the station.