

50-269/270/287

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TO: Mr Rusche

FROM: Duke Power Company
Charlotte, NC
W O Parker

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DESCRIPTION

Ltr re their 5-13-76 submittal....trans the following:

PLANT NAME: Oconee 1-3

ENCLOSURE

Supporting & addl info re their 5-13-76 request for Appendix B tech specs revisions with regard to increase in upper limit for chemistry effluent ph.....

DO NOT REMOVE

ACKNOWLEDGED

SAFETY

FOR ACTION/INFORMATION

ENVIRO

12-10-76

ehf

ASSIGNED AD:

BRANCH CHIEF:

PROJECT MANAGER:

LIC. ASST. :

Schwencer (5)
Zech
Sheppard

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WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

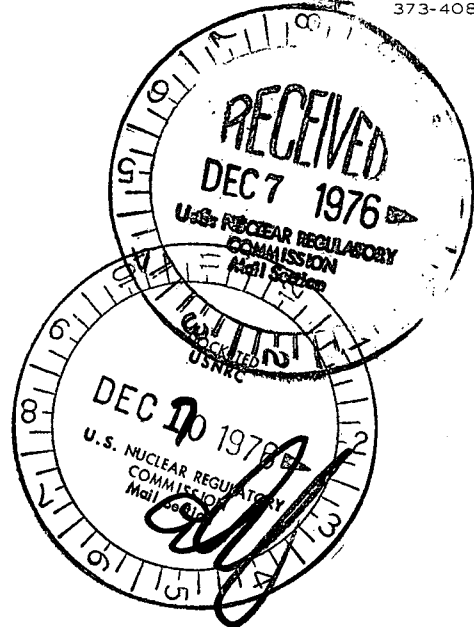
TELEPHONE: AREA 704
373-4083

December 2, 1976

Mr. Benard C. Rusche, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. A. Schwencer, Chief
Operating Reactors Branch #1

Reference: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287



Dear Mr. Rusche:

My letter of May 13, 1976 proposed an amendment to the Oconee Nuclear Station Appendix B Technical Specifications to increase the pH upper limit for chemistry effluents from the station from 8.5 to 9.0. Your letter of August 2, 1976 requested additional information which we subsequently provided in a letter of September 29, 1976. This letter specifically discussed the use of a conservative theoretical model to predict the resulting alkalinity values in the Keowee River for normal and worst case chemical effluent release concentrations. Results indicated that under worst case conditions, release of chemical effluents from the station with a pH to 9.0 would have insufficient alkalinity to affect anything other than a small localized area near the release point. Also, it was noted that under worst case conditions, the alkalinity values in the Oconee effluent discharge stream prior to dilution, are comparable to alkalinities of typical Piedmont South Carolina streams as reported in the "U. S. Geological Survey Water-Date Report SC-75-1."

For the above reasons, it was concluded that an increase in the pH effluent release limit to 9.0 would result in no additional effects on aquatic species populations in the Keowee River. To provide additional information to support this conclusion, the theoretical model used to calculate alkalinity concentrations in the Keowee River at various distances from the waste water treatment system discharge point is included as an attachment. This model is derived from the paper, "The Interrelationship Between Eddy Viscosity, Mixing Length, Entrainment and Width Growth Models in Turbulent Flows," by B. L. Sill and J. A. Schetz, Aerospace Engineering, Virginia Polytechnic Institute and State

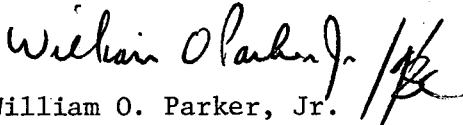
12351

Mr. Benard C. Rusche
Page 2
December 2, 1976

University, Blacksburg, Virginia, NSF Grant No. ENG 73-03735A0.

Table 1 is provided as a summarization of data obtained from adaptation of this model to Oconee Nuclear Station, using both normal and worst case effluent release conditions. The results of these cases were discussed in my previous letter of September 29, 1976.

Very truly yours,


William O. Parker, Jr.

EDB:vr
Attachment

Derivation of the Theoretical Model Utilized to Calculate
Alkalinity Concentrations in the Keowee River Resulting
from Oconee Nuclear Station Chemical Effluent Releases

The initial equations are:

$$\frac{d}{dx} \left[\int_{A_T} f U dA \right] = e \quad \text{mass flux/unit length} = \text{entrainment}$$

$$\frac{d}{dx} \left[\int_{A_T} f \rho U^2 dA \right] = e U_e - T_o P_o \quad \text{momentum flux}$$

Note: A_T Flow cross-sectional area for entire control
volume

e Entrainment

U_e External Velocity

T_o Shear Stress

P_o Peripheral length of the control volume

f Velocity Profile Function

$$f = \frac{U - U_e}{U_o - U_e}$$

$f(0) = 1, f(1) = 0$ and U_o Varies with streamwise direction

Solving the above equations for entrainment yields:

$$e / \rho U_0 A_T' = \frac{I_1}{2} \left(\frac{(1 + \bar{U}_e^2 / I_2 + 2\bar{U}_e / I_1)}{(1 + \bar{U}_e I_1 / 2I_2)} \right)$$

Where $I_1 = \int_0^1 f d\bar{A}$

$$I_2 = \int_0^1 f^2 d\bar{A}$$

$$\bar{U}_e = U_e / \Delta U_0$$

Assume symmetrical flow fields in the absence of solid boundaries and $U_0 \gg U_e$.

$$e / \rho \Delta U_0 A_T' = I_1 / 2$$

$$Q_{JET} = Q_{JET_0} + \int e / \rho dx$$

$$\text{Concentration} = Q_{JET_0} / Q_{JET}$$

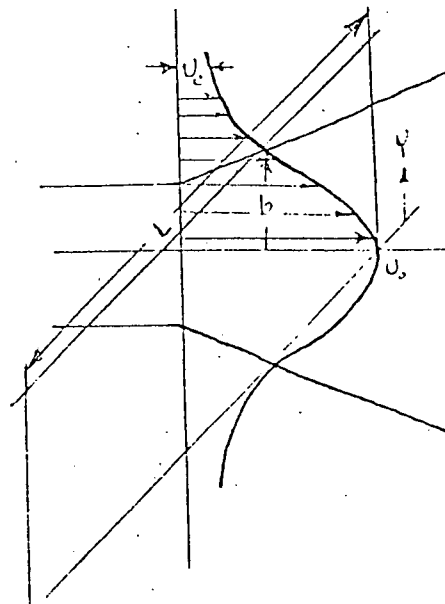
$$\text{Concentration Fraction} = \frac{Q_{JET_0}}{Q_{JET_0} + \int e / \rho dx} = \frac{1}{1 + \frac{\int e / \rho dx}{Q_{JET_0}}}$$

Solution to problem

Assume: Two-Dimensional Jet

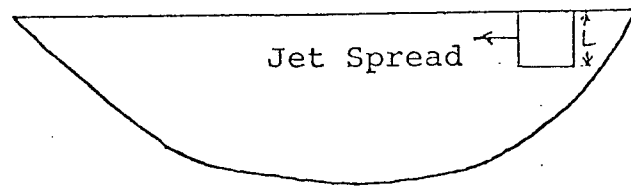
$$U_e = 0 \quad \text{i.e.} \quad U_{JET} \gg U_e$$

$$\text{then } \bar{U}_e = 0 \quad \Delta U_0 = U - U_e = U_0$$



For a cosine velocity profile $f = \frac{U_0}{2} \left(1 + \cos \pi \frac{y}{b} \right)$

$$I_1 = \int f d\bar{A}$$



$$d\bar{A} = L dy$$

$$L = \text{depth}$$

$$I_1 = \int_0^1 \left[\frac{U_0}{2} \left(1 + \cos \frac{y}{b} \right) \right] L dy = \frac{1}{2}$$

$$\frac{dA}{dx} = \frac{d}{dx} (bL) = L \frac{db}{dx}$$

$$e = \rho U_0 L \frac{db}{dx} \left(\frac{1}{2} \right) = \rho U_0 L \frac{db}{dx} \left(\frac{1}{4} \right)$$

$$\frac{db}{dx} = C_j = .22 \Rightarrow b = b_0 + C_j x$$

$$e = \rho U_0 L \cdot \frac{.22}{4} = .055 \rho U_0 L$$

From conservation of momentum

$$\frac{d}{dx} \left[\rho U_0^2 (bL) \int f^2 d\bar{y} \right] = 0$$

$$\rho U_0^2 (bL) = \text{Constant}$$

$$U_0^2 b = \frac{U_0^2}{b_0} = C$$

initial

$$U_0 = \text{Centerline Velocity} = \sqrt{\frac{C}{b}} = \sqrt{\frac{C}{b_0} + C_j x}$$

$$\int e dx = .055 \rho L \int U_0 dx$$

$$= .055 \rho L \sqrt{C} \int (b_0 + C_j x)^{-\frac{1}{2}} dx$$

$$v = b_0 + C_j dx$$

$$dv = C_j dx$$

$$= \left[\frac{.055 \rho L \sqrt{C}}{C_j} \right] \int v^{-\frac{1}{2}} dv$$

$$\frac{C_j}{4} = .055$$

$$= \frac{.055 L \sqrt{C}}{C_j} \left[\frac{v^{\frac{1}{2}}}{\frac{1}{2}} \right]_{v_0}^v \quad v = b$$

$$= \frac{\rho L}{2} \sqrt{C} \left[b^{\frac{1}{2}} - b_0^{\frac{1}{2}} \right]$$

$$\int e dx = \left[\frac{\rho L}{2} U_0 \quad \sqrt{b_0} \right]_{\text{initial}} \sqrt{b_0} \left[\left(\frac{b}{b_0} \right)^{\frac{1}{2}} - 1 \right]$$

$$Q_0 \text{ initial} = U_0 b_0 L$$

$$\int e / \rho dx = \frac{1}{2} Q_0 \text{ initial} \left[\left(\frac{b}{b_0} \right) - 1 \right]$$

$$\text{Concentration Fraction} = \frac{1}{1 + Q} \frac{\left[\left(\frac{b}{b_0} \right)^{\frac{1}{2}} - 1 \right]}{\frac{\text{initial}}{2} Q}$$

$$\text{Concentration Fraction} = \frac{1}{1 + \frac{1}{2} \left[\left(\frac{b}{b_0} \right)^{\frac{1}{2}} - 1 \right]}$$

$$\text{Where } \frac{b}{b_0} = 1 + C_j \frac{x}{b_x}$$

Sample Calculation

Assume - Initial Discharge depth (b_x) = 2'

Distance from WWTs Discharge (x) = 200'

Alkalinity = 26.52 mg/l

$$\frac{b}{b_0} = 1 + C_j \frac{x}{b_x}$$

$$\frac{b}{b_0} = 1 + .22 \left(\frac{200}{2} \right) = 23$$

$$\text{Conc. fraction} = \frac{1}{1 + \frac{1}{2} \left[\left(23 \right)^{\frac{1}{2}} - 1 \right]} = .345$$

Alkalinity initially at 26.52 mg/l has been diluted to

.345 (26.52 mg/l) = 9.15 mg/l at a point 200' below discharge.

Table 1

For: Keowee River Flow = 48.0 cfs
 Keowee River Alkalinity = 7.5 mg/l

<u>X Distance From Discharge (Ft.)</u>	<u>Concentration Fraction</u>	<u>Case #1 Flow = 22.8 cfs Alkalinity 26.5 mg/l</u>	<u>Case #2 Flow = 7.7 cfs Alkalinity 13.0 mg/l</u>
10	.817	21.7	10.6
20	.717	19.0	9.3
30	.651	17.3	8.5
40	.602	16.0	
50	.563	14.9	
70	.506	13.4	
100	.448	11.9	
150	.386	10.2	
200	.345	9.1	
250	.316	8.4	

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TBAbernathy
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Docket Nos. 50-269
50-270
and 50-287

December 1, 1976

Duke Power Company
ATTN: Mr. William O. Parker, Jr.
Vice President
Steam Production

Post Office Box 2178
422 South Church Street
Charlotte, North Carolina 28242

Our review of past operating reports from nuclear power facility licensees has indicated wide variations in content and arrangement. Since most power reactor facilities now have consistent reporting requirements, we have prepared a model annual operating report and we are considering preparing a Regulatory Guide on this subject. The object of the Regulatory Guide would be to assure consistent content and arrangement of facility annual operating reports. However, until a Regulatory Guide is issued you might find the enclosed model report useful, particularly with regard to the preparation of your 1976 annual operating report.

The enclosed model annual report is the result of discussions held between the NRC staff, several licensees and the Atomic Industrial Forum. Those who reviewed the model report agree that the usefulness of the annual operating reports would be improved if they are all arranged similarly and include all the suggested information. For completeness, additional information may be included as desired.

Accordingly, I request you review the enclosed model annual operating report and determine if it is an appropriate model for your 1976 annual operating report. I would appreciate hearing from you on this matter and specifically I would appreciate hearing whether you will submit your 1976 annual operating report in conformance with the enclosed model.

Sincerely,

Ben C. Rusche, Director
Office of Nuclear Reactor Regulation

Enclosure:
As stated

cc: See page 2

OFFICE >	DOR:ORB-1	DOR:ORB-3	DOR:ORB-1			
SURNAME >	DNeighbors	DElliott	ASchwencer			
DATE >	12/1/76	12/1/76	12/1/76			

Duke Power Company

- 2 - December 1, 1976

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