NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NUMBER 50-269/270/287

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TO: Mr Rusche

FROM: Duke Power Company
Charlotte, NC
W O Parker

DATE OF DOCUMENT 12-2-76

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DESCRIPTION

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

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.......

PLANT NAME: Oconee 1-3

ACKNOWLEDGED
DO NOT REMOVE

SAFETY — FOR ACTION/INFORMATION — ENVIRO 12-10-76 ehf

	ASSIGNED AD:			ASSIGNED AD:	
/	BRANCH CHIEF:	Schwencer (5)		BRANCH CHIEF:	
/	PROJECT MANAGER:	Zech		PROJECT MANAGER:	
/	LIC. ASST. :	Sheppard		LIC. ASST. :	

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NRC FORM 195 (2-76)

Regulatory Docket File

DUKE POWER COMPANY

POWER BUILDING

422 SOUTH CHURCH STREET, CHARLOTTE, N. C. 28242

WILLIAM O. PARKER, JR.
VICE PRESIDENT
STEAM PRODUCTION

TELEPHONE: AREA 704
373-4083

December 2, 1976

RECEIVED DEC 7 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

DOCKETED USNRC DEC 10 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

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

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.

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:

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

$$\frac{d}{dx}\left[\int_{A_T} \int \rho U^2 dA\right] = eU_e - T_o P_o$$ 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

$$f = {}^{U-U_e}/_{U_o} - U_e$$

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

Solving the above equations for entrainment yields:

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

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

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

$\bar{U}_e = U_e / \Delta \bar{U}_0$

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

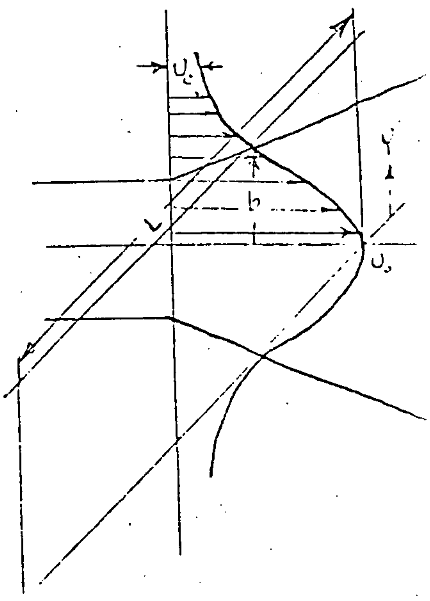
$$e / \rho \Delta U_0 A_T' = I_1 / 2$$

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

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

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

Solution to problem



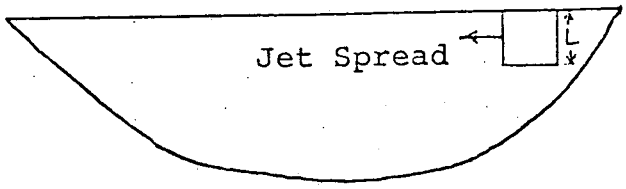
Assume: Two-Dimensional Jet

$U_e = 0$ i.e. $U_{JET} >> U_e$

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

For a cosine velocity profile = $f = \frac{U_0}{2}\left[1 + \cos \pi \, y/b\right]$

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



$d\bar{A} = L dy$

L = depth

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

$$dA/dx = d/dx\,(bL) = L\, db/dx$$

$$e = \rho\, U_0\, L\, db/dx \left(I_1/2\right) = \rho U_0 L\, db/dx \left(1/4\right)$$

$$db/dx = C_j = .22 \Rightarrow b = b_0 + C_j x$$

$$e = \rho U_0 L\, .22/4 = .055\, \rho U_0 L$$

From conservation of momentum

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

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

$$U_0^2 b = U_0^2 / b_0 = C$$

initial

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

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

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

$$v = b_0 + C_j dx$$

$$dv = C_j dx$$

$$= \left[\frac{.055 \rho L \sqrt{C}}{C_j}\right] \int v^{-\frac{1}{2}} dv \qquad C_j/4 = .055$$

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

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

$$\int e\,dx = \left[\frac{\rho L}{2} U_{0\,\text{initial}} \sqrt{b_0}\right] \sqrt{b_0} \left[\left(\frac{b}{b_0}\right)^{\frac{1}{2}} - 1\right]$$

$$Q_{0\,\text{initial}} = U_0 b_0 L$$

$$\int e/\rho\,dx = 1/2\, Q_{0\,\text{initial}} \left[\left(b/b_0\right) - 1\right]$$

$$\text{Concentration Franction} = \frac{1}{1 + \frac{Q_{\text{initial}}}{2} \left[\left(\frac{b}{b_0} \right)^{1/2} - 1 \right] \Big/ Q_{\text{initial}}}$$

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

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

Sample Calculation

Assume - Initial Discharge depth (b_x) = 2'

Distance from WWTS Discharge (x) = 200'

Alkalinity = 26.52 mg/l

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

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

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

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/1

X Distance From Discharge (Ft.)	Concentration Fraction	Case #1 Flow = 22.8 cfs Alkalinity 26.5 mg/1	Case #2 Flow = 7.7 cfs Alkalinity 13.0 mg/1
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	