Duke Power Company
Catawba Nuclear Generation Department
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D. L. Rehn
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DUKE POWER

April 28, 1994

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414
Environmental Protection Plan Reporting

The Environmental Protection Plan (Appendix B to the Catawba Facility Operating License) requires that proposed changes to the NPDES Permit be reported to the NRC at the same time the request is submitted to the permitting agency.

Attached please find a request to use sodium bromide as a treatment chemical in the cooling towers submitted to the South Carolina Department of Health and Environmental Control April 20, 1994.

This reporting did not occur the same time the change was submitted and will be listed as a Environmental Protection Plan non-compliance in the Annual Environmental Operating Report for calendar year 1994.

Very truly yours

D. L. Rehn

Attachments

JTH/EPP 1994

JE25

xc: S. D. Ebneter
Regional Administrator, Region II

R. J. Freudenberger
Senior Resident Inspector
Catawba Nuclear Station

R. E. Martin, ONRR

Duke Power Company
Generation Services Department
13339 Hagers Ferry Road
Huntersville, NC 28078-7929

DUKE POWER

April 20, 1994

Mr. Timothy M. Eleazer
Industrial and Agricultural Wastewater Division
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subject: Catawba Nuclear Station -NPDES Permit No. SC0004278
Sodium Bromide Usage in RC Cooling Towers
File: CN-702.13

Dear Mr. Eleazer:

This letter is to request permission to use sodium bromide in the condenser circulating water system (RC) cooling towers at Catawba Nuclear Station on a permanent basis. To support this request please find as Attachment #1 a report titled *Toxicity of Cooling Tower Water Following 2:1 (Chlorine to Bromine) Treatment* which indicates the solution to be non-toxic.

Duke Power also requests that references made to Free Available Chlorine (FAC) be changed to Free Available Oxidant (FAO) for the RC cooling towers. The existing testing requirement for the RC cooling tower blowdown line (Outfall 005) is for FAC. (See Part III Item #16 and P. 13 or 31) To allow for the usage of sodium bromide, it is requested that references to FAC be changed to FAO within the permit. When chlorine is the only oxidant utilized, then the FAC is the same as the FAO. However, now that an additional oxidant is to be used, FAO is the more appropriate parameter to reference in the permit. Catawba is presently using the DPD Colormetric Method for determination of Free Available Chlorine. Per Standard Methods, (4500-Cl), this analytical method will detect both free chlorine and free bromine.

Background Information

Duke Power Company requested permission to begin using sodium bromide on a trial basis in one of the two RC cooling towers systems at Catawba Nuclear Station in a letter dated May 27, 1993. The State responded to this letter and requested toxicity

testing data be provided on the sodium bromide and sodium hypochlorite solutions i· a letter to Duke Power dated September 16, 1993.

Duke Power then proposed to State by fax (See Attachment #2) a request to perform toxicity testing on the sodium bromide and sodium hypochlorite solution as it would be discharged to Lake Wylie. The test was then conducted and the results are provided in Attachment #1.

Please note that Attachment #1 references Calgon H-940 which is a Calgon Corporation product. This is only a typical product name and other suppliers of sodium bromide will/may be selected in the future.

For you convenience, please find as Attachment #3 the original description of sodium bromide usage. This is the information which is required in Part III Item 9 of the NPDES permit.

Summary

To summarize, Duke Power is requesting approval to use sodium bromide as a maintenance chemical in the RC cooling towers. The original request was f· trial usage. However, if this initial trial is considered successful, Catawba would like to immediately begin using the sodium bromide without seeking further approvals.

It is requested that referenc ı the permit for Free Available Chlorine (FAC) be changed to Free Available FAO) as described above. The existing permitted limits for FAC should be a FAO.

The solution of sodium bromide and sodium hypochlorite will not be discharged directly to Lake Wylie. The compounds will be allowed to decay until the concentration of FAO (as measured with presently certified DPD Colormetric Method for determination of FAC) in the RC cooling tower being treated drops to less than current permit limits. Once a less-than-detectable FAO is reached in the RC cooling tower being treated, residual byproducts will be discharged to Lake Wylie via Outfall 001 by means of the cooling tower blowdown line (Outfall 005). Therefore, only the by-products of these compounds will be seen in the final discharge.

The toxicity testing provided shows these by-products to be non-toxic. The toxicity testing was performed under worst case scenarios. Typical field conditions are eight parts of once through RC cooling water to one part of RC cooling tower blowdown water (1:8). The toxicity tests performed at various ratios as low as 1:2 were not toxic.

Your approval is requested as soon as possible in order to begin using the sodium bromide within the RC cooling towers. The use of sodium bromide, if successful, will substantially reduce the volume and concentrations of maintenance chemicals used in the RC cooling towers.

Should you need additional information to support this request please feel free to call John Estridge at (704) 875-5965 or Christine Odom at (704)875-4201.

Sincerely,

John S. Carter, Technical System Manager
Environmental Division, Water Protection

jte/311

Attachments

bc: J.T. Harris
M.A. Lascara
C.T. Peed
A.P. Jackson
G.W. Sain
W.J. Davis
J.S. Velte

ATTACHMENT #1

Toxicity of Cooling Tower Water Following 2:1 (Chlorine to Bromine) Treatment

John S. Velte, Duke Power Company, Environmental Division, 13339 Hagers Ferry Rd., Huntersville, NC 28078

EXECUTIVE SUMMARY

A sample of cycled-up (i.e., concentrated via recirculation and evaporation) cooling water from a Catawba Nuclear Station (CNS) cooling tower was treated with chlorine to a free residual of 3 ppm. Half as much Bromine was then added to the sample (i.e., a ratio of 2:1). The sample was stirred at 40.6-43.3°C (105-110°F) to simulate the physicochemical conditions typical in a cooling tower, until the concentration of free available oxidant declined to less than background. The sample was then diluted with various volumes of intake (raw) water from the CNS intake (i.e., Lake Wylie) and tested for toxicity. CNS personnel have estimated that cooling tower "blowdown" waste is typically diluted with raw water to 11.2% waste (a ratio of 1:8) during discharge. This test of simulated waste demonstrated that no toxicity occurred among *Ceriodaphnia*, even when exposed to 33.4% waste (a 1:2 dilution). These test results support the proposed maintenance chemical trial of sodium bromide (Calgon H-940) in conjunction with sodium hypochlorite to control biofouling.

INTRODUCTION

A bench test designed to simulate the behavior of sodium bromide under cooling tower conditions was developed by Duke Power Company. The bench test was used to produce a simulated waste that would allow the evaluation of toxicity from sodium bromide, bromine residuals, and other waste components in the projected "worst-case" ratio of chlorine (Cl) to bromine (Br). South Carolina Department of Health and Environmental Control (SCDHEC) officials identified the need for this information (to ensure that the receiving water body would not be harmed) as a condition for approval to conduct a maintenance chemical trial with sodium bromide.

MATERIALS AND METHODS

Sample Preparation

A 4-L sample of CNS cooling tower water was collect as it spilled to ground level in a Unit-2 cooling tower. The sample had been cycled up to normal blowdown concentration but no maintenance chemicals had been added. Immediately following the collection of this sample, 10 L of subsurface CNS intake water were collected for use as control and dilution water during the planned test. Both samples were placed immediately on ice for transport, logged into the Biomonitoring Lab at < 4°C, and held in a refrigerator at 0 to 4°C thereafter.

Duke Power Company's proposal is that Br in the form of sodium bromide be added to the Cl (presently added as sodium hypochlorite) to improve biofouling control while potentially reducing the amount of Cl presently used. Bromine for this test came from a product called Calgon H-940® (Calgon Corporation) which is 40% sodium bromide.

For convenience, the Cl source was Chlorox® Bleach (Chlorox Company) which contains 5.25% sodium hypochlorite. CNS uses an industrial source of sodium hypochlorite that differs only in the percentage of active ingredient, so with appropriate dilution, no meaningful chemical difference in the lab and field situation existed.

The procedure for sample manipulation was prescribed by Duke Power Nuclear Chemistry personnel to produce a bench-scale sample of effluent that would simulate waste from the cooling towers if treated with the proposed biofouling agents. That procedure is summarized here:

1. Approximately 2.5 L of cooling tower water was warmed quickly to 43.3°C in a water bath. Exactly 2000 mL were measured from the warmed sample, and poured into a 2000 mL glass beaker.

2. The beaker was set on a magnetic stirrer and a large Teflon-coated stir bar was placed in the sample. These components were set up inside a drying oven which had previously been calibrated to operate at 43.3°C. The oven provided an air-tight, dark, and thermally stable environment.

3. A digital thermometer with remote temperature probes was installed with one probe in the sample being stirred and one measuring the air temperature within the oven.

4. The sample was dosed with 6 mL of a 1000-ppm Cl stock solution; sample temperature at this point was 40.3°C. The oven was sealed following this addition and continuously thereafter except when sample measures or manipulations were underway.

5. After 15 minutes, the free available oxidant (FAO) of the sample (i.e., chlorine) was measured with a colorimetric procedure (Hach Company). This required the removal of 25 mL of sample via pipette. The measured FAO was 3.0 ppm.

6. Three mL of a 1000-ppm Br stock solution was added. The sample was then allowed to react in the apparatus for 2 hours and 45 minutes. Another 25 mL subsample was withdrawn and FAO in that sample (i.e., chlorine and bromine) was measured at 0.2 ppm. The temperature had increased to 42.5°C.

7. Five hours and 15 minutes after Br addition, a third withdrawal of 25 mL showed that FAO had declined to 0.11 ppm; temperature was 43.1°C.

8. The sample treatment was stopped after 7 hours and 5 minutes (post Br addition) when the fourth and final 25-mL aliquot revealed that FAO was < 0.1 ppm. A simultaneous test of untreated cooling tower water gave an FAO of 0.12 ppm, so it was assumed that dissipation of Cl in the manipulated sample was complete. Achievement of this endpoint, as determined by CNS Chemistry personnel, is necessary before discharge from the cooling towers is begun. The final temperature reading was 43.3°F.

9. The manipulated sample was refrigerated (0 to 4°C) in a sealed polyethylene container, with no head space, for toxicity testing.

Toxicity Evaluation

Toxicity testing was begun the following day (i.e., the cooling tower sample was 50 hours post collection and approximately 17 hours post manipulation; the CNS intake dilution water sample was approximately 49.5 hours post collection). Toxicity test methods were those prescribed by the U.S. Environmental Protection Agency (1989) and SCDHEC (1989). The procedure was a definitive *Ceriodaphnia* Three-Brood Survival and Reproduction Toxicity Test with a control and series of four treatments. Dilutions of the simulated cooling tower waste were prepared on test days 0, 2, and 4; and solutions in test cups were renewed daily. Cooling tower water that is discharged during "blowdown" of the towers is typically diluted at a ratio of 1:8 with raw water that is pumped through the station. That ratio was used as the basis of the treatment series in an attempt to establish a "dose-response" relationship between the waste, and the test organism (*Ceriodaphnia dubia*).

RESULTS

The measured sample volume after manipulation was 1827 mL. Considering the starting volume of sample, Cl and Br stock solution additions, and FAO sample withdrawals, 82 mL were missing due to evaporation. The timing of additions and withdrawals complicates the interpretation of evaporative effects on the sample. Evaporation had the effect of concentrating the test sample by less than 5% under these test conditions. That effect is considered negligible for this study because ongoing evaporation is a function of full-scale cooling tower operation too. The comparability, however, of evaporation modeled in this study with that which actually occurs in the cooling towers was not determined.

The following table summarizes the survival and reproduction that occurred during the toxicity test in the control and treatments. The tested ratios of cooling tower waste to raw intake water (i.e., 1:16. 1:8, 1:4, and 1:2) are presented as waste percentages to simplify interpretation.

Percent of Cooling Tower Waste in Intake Water	# *C. dubia* Females Exposed	Percent Survival	Total Young Produced	Mean Young Per Female
0 (Control)	10	100	302	30.2
5.8	10	100	283	28.3
11.2	10	100	295	29.5
20.0	10	100	293	29.3
33.4	10	100	297	29.7

These data were evaluated as specified by USEPA for significant (alpha = 0.05) survival and reproduction effects. The lack of any mortality during the test negated the need to look for survival effects. The untransformed data were found to be normally distributed according to a Shapiro-Wilks Test. Bartlett's Test further confirmed that the data are homogeneous. Consequently, Dunnett's T-Test for determining significant differences between the reproductive mean of the control and all treatments was applied. No significant differences between the control and any treatment were found. Copies of the raw test data sheets and a printout of the statistical evaluation are attached as Appendix A.

DISCUSSION

The lack of a "dose-response" curve from this data preclude the determination of the 7-day EC20 value (as specifically requested by SCDHEC) or any other chronic endpoint. The data do, however, demonstrate that the simulated cooling tower waste was safe for *C. dubia* even at a concentration that was 3 times greater than is expected under actual station discharge conditions. There was no significant difference observed in *C. dubia* survival or reproduction between the control, which consisted of 100% intake water, and any treatment (the highest of which was 33.4% cooling tower waste). A full-scale trial of sodium bromide (used in a manner consistent with the protocol described in this report) would be environmentally compatible based on this test outcome.

REFERENCES CITED

South Carolina Department of Health and Environmental Control. 1989. South Carolina Environmental Laboratory Certification Criteria: Biological Parameters. Columbia, SC

U.S. Environmental Protection Agency. 1989. Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms. 2nd ed. EPA/600/4-89/001. Cincinnati, OH

Appendix A

SP0394J2

Ceriodaphnia dubia Data Sheet for 2:1 Cl to Br Cooling Tower Waste Chronic Toxicity Test

Procedure Number BIO-260.0

March 1994

CONTROL (100% Raw Water)

Day	Replicate 1	2	3	4	5	6	7	8	9	10	Young	Temp	Comments
Initiation												24.7 °C	
1	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	25.1 °C	
2	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	25.0 °C	24.8 JSN 04-1-
3	L,0	L,0	L,0	L,0	L,4	L,5	L,6	L,0	L,0	L,4	19	24.4 °C	
4	L,4	L,4	L,6	L,5	L,0	L,0	L,0	L,4	L,5	L,8	38	24.3 °C	
5	L,12	L,12	L,12	L,8	L,12	L,10	L,10	L,10	L,12	L,8	114a	25.4 °C	Temp 4-5-94
6	L,16	L,13	L,15	L,15	L,17	L,14	L,16	L,13	L,12	L,16	149	25.2 °C	
X												°C	
Total	32	29	33	28	33	31	32	27	29	28	302		

Temp 4-5-94

1 Part Waste : 16 Parts Raw Water

Day	Replicate 1	2	3	4	5	6	7	8	9	10	Young	Temp	Comments
Initiation												24.5 °C	
1	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	25.4 °C	
2	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.8 °C	24.6 JSN 04-01
3	L,0	L,0	L,0	L,0	L,5	L,5	L,6	L,0	L,0	L,5	21	24.2 °C	
4	L,4	L,6	L,5	L,0	L,0	L,0	L,0	L,4	L,5	L,0	24	24.2 °C	
5	L,8	L,10	L,11	L,9	L,11	L,8	L,11	L,8	L,8	L,10	94	25.3 °C	
6	L,15	L,15	L,19	L,15	L,18	L,13	L,15	L,13	L,17	L,16	144	25.2 °C	
X												°C	
Total	16	31	34	24	34	26	32	25	30	31	283		

Temp 4-5-94

1 Part Waste : 8 Parts Raw Water

Day	Replicate 1	2	3	4	5	6	7	8	9	10	Young	Temp	Comments
Initiation												24.6 °C	
1	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	25.6 °C	
2	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.8 °C	24.8 JSN 04-01-94
3	L,0	L,0	L,0	L,0	L,6	L,4	L,0	L,0	L,0	L,6	16	24.4 °C	
4	L,6	L,6	L,4	L,4	L,0	L,0	L,4	L,3	L,4	L,2	33	24.5 °C	
5	L,10	L,8	L,10	L,8	L,12	L,5	L,8	L,12	L,9	L,12	94	24.9 °C	
6	L,12	L,15	L,16	L,15	L,19	L,16	L,13	L,14	L,14	L,10	152	24.3 °C	
X												°C	
Total	38	29	30	27	37	25	25	31	27	36	295		

Temp 4-5-94

1 Part Waste : 4 Parts Raw Water

Day	Replicate 1	2	3	4	5	6	7	8	9	10	Young	Temp	Comments
Initiation												24.9 °C	
1	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.9 °C	
2	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.5 °C	
3	L,0	L,0	L,0	L,0	L,4	L,4	L,5	L,0	L,0	L,5	18	24.4 °C	
4	L,3	L,6	L,3	L,4	L,1	L,0	L,0	L,5	L,4	L,1	27	24.7 °C	
5	L,10	L,10	L,10	L,8	L,7	L,9	L,10	L,9	L,12	L,11	96	25.4 °C	
6	L,15	L,14	L,16	L,13	L,15	L,14	L,13	L,15	L,15	L,17	150	24.7 °C	
X												°C	
Total	28	30	31	25	30	27	28	29	31	34	293		

Temp 4-5-94

1 Part Waste : 2 Parts Raw Water

Day	Replicate 1	2	3	4	5	6	7	8	9	10	Young	Temp	Comments
Initiation												24.4 °C	
1	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.8 °C	
2	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	L,0	0	24.6 °C	
3	L,0	L,0	L,0	L,0	L,6	L,5	L,6	L,0	L,0	L,5	22	24.1 °C	
4	L,4	L,5	L,6	L,6	L,0	L,0	L,0	L,4	L,6	L,6	31	24.5 °C	
5	L,10	L,10	L,10	L,12	L,10	L,10	L,10	L,7	L,10	L,11	100	24.9 °C	
6	L,14	L,13	L,13	L,13	L,12	L,15	L,14	L,14	L,13	L,17	144	°C	
X												°C	
Total	28	30	29	31	32	30	30	25	29	33	297		

Temp 3-30-94

(14) (13) (14) (14) (13) (12) (12) (15) (13) (12)

Numbers in parentheses indicate the originating brood sizes. All organisms in a replicate are from the same adult.

Record in order given: a) L=Alive, D=Dead; b) 0-30 = Number of live young, (0-30) = Number of dead young; c) E = Aborted embryos observed

SP0394J2

Ceriodaphnia dubia Test Information and Activity Log for 2:1 Cl to Br Cooling Tower Waste Chronic Toxicity Test, Procedure Number BIO-260.0

Ceriodaphnia dubia Young Production Data - DPC Lab Cultures

Dilution water for adults - 20% Perrier in Milli - Q water: PER - 228 Adults segregated: Date 3/28/94 Time 1542 Initials KRM

Check adults eight hours or less after the segregation time for third or later broods of eight or more neonates.

Adults checked for neonates: Date 3/29/94 Time 2313 Initials KRM Tray F

Number of acceptable broods 17 Number of Neonates 220

Retain extra neonates until after the one hour post-initiation mortality check has been completed.

Test Information

Test Initiation: Date 3/30/94 Time 1108 Test Termination: Date / / Time

Test location: Duke Power Company Biomonitoring Laboratory, 13339 Hagers Ferry Rd., Huntersville, NC 28078

Age at test initiation < 30 h Incubator ID / shelf A / 2 Renewal frequency = Daily

Test vessel: Composition = Polystyrene, Anchor Hocking PI-1 Capacity = 30 mL Solution volume = 15 mL

Day	Diluent (PER-) CNS RAW Initials	Treatment Preparation by	Treatment Delivery by	Feeding: 100 ul YTC (YTC -)/Init.	Feeding: 100 uL Algae (SC -)/Init.	Temperature: Measured by	Temperature: Recorded by	Initiation, Transfer, or Termination Time	Transfers by	Counts by	Survival & Counts Recorded by
0*	228	KSN	Bmy	263 / Bmy	93 / Bmy	Bmy	Bmy	1108	KSN - Bmy	KSN	
1			Bmy	263 / Bmy	93 / Bmy	KSN	KSN	1142	KSN	KSN	KSN
2		KSN	KSN	263 / KSN	93 / KSN	KSN	KSN	1123	KSN	KSN	KSN
3			KAF	263 / Bmy	93 / Bmy	Bmy	Bmy	1047	Bmy	Bmy	Bmy
4		DTC	DTC	263 / DTC	93 / DTC	DTC	DTC	1125 EDST	DTC	DTC	DTC
5		KSN	KSN	263 / KSN	93 / KSN	KSN	KSN	1134	KSN	KSN / DTC	DTC
6		—	—	— / —	— / —	KSN	KSN	1257	KSN	KSN	KSN
7											

NEW TEST TIME = 120

*Neonates checked 1 h after initiation for random mortalities DTC - replace random mortalities and document in the comments section as appropriate.

Diluent Cycled-Up Cooling Tower Water (recieved 03-28-94)

Toxicants Br (as 40% NaBr; Calgon H-940) and Cl (as 5.25% NaOCl; Chlorox) Source = Nuclear Chemistry (Steve Davenport)

Cl Stock Solution Preparation: 4.0 mL product diluted to 100mL with diluent = 1000 ppm Cl stock solution

Br Stock Solution Preparation: 0.322 mL product diluted to 100mL with diluent = 1000 ppm Br stock solution

Dilution Scheme Recorded by John L. Vette 3-29-94 Checked by Keith A. Finley 3/29/94

Dilute 167 mL of treated cooling tower water to 500 mL with diluent for a final concentration of 1:2	= 333 mL Diluent -	33.4%
Dilute 100 mL of treated cooling tower water to 500 mL with diluent for a final concentration of 1:4	= 400 "	20%
Dilute 56 mL of treated cooling tower water to 500 mL with diluent for a final concentration of 1:8	= 444 "	11.2%
Dilute 29 mL of treated cooling tower water to 500 mL with diluent for a final concentration of 1:16	= 471 "	5.8%
Dilute 0 mL of treated cooling tower water to 500 mL with diluent for a final concentration of 100% raw water Control	= 500 "	0%

Food YTC adjusted to 1800 mg/L total solids, Procedure Number BIO-88.0, Daphnid YTC Food Preparation

Selenastrum capricornutum cell density = 3.42 x 10E7 , Procedure Number BIO-84.1, Mass Algal Culture for Daphnid Feeding

Temperature

Test temperatures measured by device: ELENV- 31189 , Procedure Number BIO-200.0, Temperature Determination

DO NOT DISPOSE OF SOLUTIONS OR DILUENT UNTIL REPORT FORMS HAVE BEEN APPROVED

Final Data Sheet Check by Keith A. Finley Date 4/5/94

Revised 3/29/94

SP0394J2

2:1 Cl to Br Cooling Tower Waste Toxicity Test
7-Day Ceriodaphnia Survival and Reproduction Test
Water Chemistry Data

Control

Parameter		Day 0	Initials	Day 1	Initials	Day 2	Initials	Day 3	Initials	Day 4	Initials	Day 5	Initials	Day 6	Initials	Day 7	Initials
D.O. (mg/L)	(Initial)	8.6	JSN	8.2	JSN	8.7	JSN	8.7	KAF	8.7	DJC	8.6	JSN				
	(Final)	8.1	JSN	8.3	JSN	8.3	KAF	8.4	DJC	8.3	JSN	8.5	kam				
pH (Units)	(Initial)	7.5	JSN	7.6	JSN	7.5	JSN	7.4	KAF	7.5	DJC	7.4	JSN				
	(Final)	7.6	JSN	7.7	JSN	7.6	KAF	7.7	DJC	7.5	JSN	7.6	kam				
Tot. Alk.(mg/L)		15.9	JSN														
Tot.Hard.(mg/L)		15.5	JSN														
Cond. (uS/cm)		92	JSN														

1 Part Waste : 8 Parts Raw Water (expected discharge conc.)

Parameter		Day 0	Initials	Day 1	Initials	Day 2	Initials	Day 3	Initials	Day 4	Initials	Day 5	Initials	Day 6	Initials	Day 7	Initials
D.O. (mg/L)	(Initial)	8.5	JSN	8.1	JSN	8.5	JSN	8.8	KAF	8.7	DJC	8.5	JSN				
	(Final)	8.0	JSN	8.3	JSN	8.3	KAF	8.8	DJC	8.3	JSN	8.5	kam				
pH (Units)	(Initial)	7.6	JSN	7.5	JSN	7.6	JSN	7.5	KAF	7.5	DJC	7.6	JSN				
	(Final)	7.7	JSN	7.7	JSN	7.6	KAF	7.7	DJC	7.6	JSN	7.6	kam				
Tot. Alk.(mg/L)		16.2	JSN														
Tot.Hard.(mg/L)		20.6	JSN														
Cond. (uS/cm)		126	JSN														

1 Part Waste : 2 Parts Raw Water (high conc.)*

Parameter		Day 0	Initials	Day 1	Initials	Day 2	Initials	Day 3	Initials	Day 4	Initials	Day 5	Initials	Day 6	Initials	Day 7	Initials
D.O. (mg/L)	(Initial)	8.4	JSN	8.1	JSN	8.6	JSN	8.8	KAF	8.7	DJC	8.4	JSN				
	(Final)	8.0	JSN	8.2	JSN	8.3	KAF	8.3	DJC	8.2	JSN	8.4	kam				
pH (Units)	(Initial)	7.7	JSN	7.7	JSN	7.7	JSN	7.4	KAF	7.5	DJC	7.6	JSN				
	(Final)	7.7	JSN	7.7	JSN	7.6	KAF	7.7	DJC	7.6	JSN	7.7	kam				
Tot. Alk.(mg/L)		19.5	JSN														
Tot.Hard.(mg/L)		20.5	JSN														
Cond. (uS/cm)		193	JSN														

* In the event that mass mortality makes this concentration inappropriate, monitor the next highest concentration and note when this occurs on the data sheet

NO MORTALITY OCCURRED, THUS FISHER'S EXACT TEST FOR SIGNIFICANT MORTALITY DOES NOT APPLY.

SHAPIRO-WILKS TEST FOR NORMALITY OF UNTRANSFORMED REPRODUCTION DATA

Analysis Variable : YOUNG

TREAT=control

Minimum	Maximum	Sum	Mean	Std Dev
27.0000000	33.0000000	302.0000000	30.2000000	2.2509257

TREAT=treat1

Minimum	Maximum	Sum	Mean	Std Dev
16.0000000	34.0000000	283.0000000	28.3000000	5.5986109

TREAT=treat2

Minimum	Maximum	Sum	Mean	Std Dev
25.0000000	37.0000000	295.0000000	29.5000000	4.1699987

TREAT=treat3

Minimum	Maximum	Sum	Mean	Std Dev
25.0000000	34.0000000	293.0000000	29.3000000	2.4966644

TREAT=treat4

Minimum	Maximum	Sum	Mean	Std Dev
25.0000000	33.0000000	297.0000000	29.7000000	2.2135944

Univariate Procedure

Variable=DIFF

Moments

N	50	Sum Wgts	50
Mean	0	Sum	0
Std Dev	3.453481	Variance	11.92653
Skewness	-0.55866	Kurtosis	2.23593
USS	584.4	CSS	584.4
CV	.	Std Mean	0.488396
T:Mean=0	0	Pr>|T|	1.0000
Num ^= 0	50	Num > 0	26
M(Sign)	1	Pr>=|M|	0.8877
Sgn Rank	17.5	Pr>=|S|	0.8678
W:Normal	0.965742	Pr<W	0.2641

PROBABILITY < W (0.2641) IS GREATER THAN 0.01, SO CONCLUDE THAT UNTRANSFORMED REPRODUCTION DATA ARE NORMALLY DISTRIBUTED.

BARTLETT'S TEST FOR HOMOGENEITY OF REPRODUCTION DATA VARIANCE AMONG TREATMENTS

BARTLETT'S TEST: CHI-SQUARE=12.726632948 ALPHA=0.0126917128 .

Compare to critical B as approximated from the Chi-square distribution at (p-1) degrees of freedom at a 0.01 level of significance. If the computed B is less than the critical (Chi-square) value, the variances are equal.

ALPHA (0.01269) IS GREATER THAN 0.01, SO CONCLUDE THAT DATA ARE HOMOGENEOUS

Listing of Input Data

Data Checked By: J.S. Vale Date: 4-7-94	Total Live Young Per Replicate									
	1	2	3	4	5	6	7	8	9	10
	N	N	N	N	N	N	N	N	N	N
Treatment										
control	32	29	33	28	33	31	32	27	29	28
treat1	16	31	34	24	34	26	32	25	30	31
treat2	28	29	30	27	37	25	25	31	27	36
treat3	28	30	31	25	30	27	28	29	31	34
treat4	28	30	29	31	32	30	30	25	29	33

DUNNETT'S T-TEST FOR DETERMINING SIGNIFICANT DIFFERENCES IN REPRODUCTION BETWEEN CONTROL AND TREATMENTS

Dunnett's Test at an alpha = 0.05 level of significance
General Linear Models Procedure

Dunnett's One-tailed T tests for variable: YOUNG

NOTE: This tests controls the type I experimentwise error for comparisons of all treatments against a control.

Alpha= 0.05 Confidence= 0.95 df= 45 MSE= 12.98667
Critical Value of Dunnett's T= 2.222
Minimum Significant Difference= 3.5817

Comparisons significant at the 0.05 level are indicated by '***'.

General Linear Models Procedure

TREAT Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
treat4 - control	-4.082	-0.500	3.082
treat2 - control	-4.282	-0.700	2.882
treat3 - control	-4.482	-0.900	2.682
treat1 - control	-5.482	-1.900	1.682

SIGNIFICANT DIFFERENCES AT ALPHA = 0.05 WERE NOT OBSERVED BETWEEN THE CONTROL AND ANY OF THE FOUR TREATMENTS. THIS TEST DISPLAYED NEITHER ACUTE NOR CHRONIC TOXICITY OF THE SIMULATED COOLING TOWER WASTE TO THE TEST SPECIES, CERIODAPHNIA DUBIA, AT ANY TESTED DILUTION.

CHECKED BY: PJ Boughton
DATE: 4/2/94

ATTACHMENT #2

CATAWBA NUCLEAR STATION
COOLING TOWER TOXICITY TEST
SODIUM BROMIDE MIXED WITH SODIUM HYPOCHLORITE

In order to simulate the field conditions after mixing the sodium hypochlorite and sodium bromide to determine the toxicity, the following steps will be performed.

1. The cooling towers at Catawba will be cycled up to normal blow down concentrations without the use of any maintenance chemicals. A sample of this cooling water would be pulled and deliverd to out toxicity laboratory at Duke Power's Environmental Center.

2. A sample of raw lake water from Lake Wylie will also be delivered to the Environmental Center at the same time.

3. The cooling water sample will be placed into a heated stirrer to approximatly 110° F to simulate the temperature of the actual cooling towers.

4. A worst case scenario of sodium hypochlorite and sodium bromide will be added to the cooling water sample. Sodium hypochlorite will be added until a free chlrorine residual of 3.5 ppm is obtained.

   Approximately 1 ppm of sodium bromide will then be added to the mixture.

5. The sample will be mixed until no free oxidant is measured.

6. At the point in which no free oxidant is measured, the sample will be mixed with the raw lake water sample in the following quantities: 8 parts raw lake water to 1 part cooling water.

   This 8 to 1 ratio will simulate the actual conditions prior to the discharge monitoring point. The cooling tower blowdown rate is approximatly 5000 gpm. This is mixed with once through cooling water of approximatly 45,000 to 50,000 gpm prior to being discharged to Lake Wylie.

7. A sample will then be pulled for toxicity testing purposes.

ATTACHMENT #3

CATAWBA NUCLEAR STATION

PROPOSED SODIUM BROMIDE USAGE

MAY 27, 1993

NPDES PERMIT SC0004278
PART III ITEM 9 REQUIREMENTS

1) NAME AND GENERAL COMPOSITION OF THE MAINTENANCE CHEMICAL

a) Liquid Sodium Bromide (40 to 46% solution)

2) QUANTITIES TO BE USED

Approximtely 100 gallons of product.

2) FREQUENCY OF USE

Every two days.

4) PROPOSED DISCHARGE CONCENTRATION

Since chlorine and bromide are both oxidants it is proposed that the current limits on Outfall 005 of 0.2 mg/l monthly average and 0.5 mg/l daily maximum for Free Available Chlorine be changed to Free Available Oxidant. (Outfall 005 is an internal outfall that discharges upstream of Outfall 001. Flow through Outfall 001 typically allows for an approximate 9 to 1 dilution ratio.)

5) EPA REGISTRATION NUMBER

The EPA Registration Number for one of the sodium bromide products under evaluation is 1706-168. Once the actual manufacturer/supplier is selected an update can be provided if needed.

6) AQUATIC TOXICITY INFORMATION

a) SODIUM BROMIDE

96 hour static acute LC 50 to Fathead Minnow = 16,479 ppm.
96 hour static acute LC 50 to Poecilia reticulata = 225 ppm.
48 hour static acute LC 50 to Daphnia magna = 7,900 ppm.

b) HYPOBROMOUS ACID (acid generated from Sodium Bromide)

96 hour static acute LC50 to Bluegill Sunfish = 0.52 ppm (as Br2)
96 hour NOEC for Bluegill Sunfish is 0.30 ppm based on no mortality.

48 hour static acute LC50 to Daphnia Magna = 0.71 ppm (as Br2)
48 hour NOEC for Daphnia magna is 0.41 ppm based on no mortality.