



Duquesne Light

435 Sixth Avenue
Pittsburgh, Pennsylvania
15219

(412) 471-4300

July 20, 1978

Enforcement Division
United States EPA
Region III
Sixth and Walnut Streets
Philadelphia, PA 19106

ATTENTION: MR. BRUCE SMITH

Beaver Valley Power Station - Unit No. 1
NPDES Permit No. PA 0025615
Chlorine Trailing-Out Study Results

Gentlemen:

In accordance with the provisions of Special Condition No. 10 of the subject permit, Duquesne Light Company herewith submits the results of its chlorine trailing-out study. On the basis of the study results, the following are concluded:

1. Chlorine trailing-out beyond two hours per day does occur. For the study period this occurrence was 63% of the test days for total residual chlorine and 36% of the time for free available chlorine.
2. The permit limitations for free available chlorine of 0.2 mg/l - daily average and 0.5 mg/l daily maximum were never exceeded.
3. The level of chlorination performed is required in order to prevent bio-fouling of the condenser.

On the basis of these study results, Duquesne Light Company requests that the two hour limitation contained in Special Condition No. 10 be deleted from the subject permit. If you have any questions, please contact this office.

Very truly yours,

Robert J. McAllister

ROBERT J. McALLISTER
Structural Engineer

Enclosure

78 102 00050 P

cc: H. A. VanWassen
G. W. Moore (3)
S. L. Pernick
G. F. Hickel (2)
F. J. Bissert
L. W. Johnson
R. J. Monroe
J. H. Latshaw

ALL W/ATTACH.

DUQUESNE LIGHT COMPANY
Beaver Valley Power Station

CHLORINATION STUDY

The original 3-month program was initiated on April 1, 1977 and completed on June 30, 1977. This three month study was required by the United States Environmental Protection Agency Permit No. PA 0025615 Special Conditions #9 and #10, and the Nuclear Regulatory Commission Technical Specification Limiting Condition for Operation of Beaver Valley Power Station No. 2.3.1. The study, which concluded in June, 1977, could not be evaluated because of insufficient data due to numerous plant outages and chlorination system malfunctions. At this time, an extension to this study period was requested by Duquesne Light Company so that additional data could be collected and evaluated. A one year extension was granted by the United States Environmental Protection Agency's Enforcement Division with the completed study to be submitted to that agency by July 1, 1978. The four attachments contain all the required information and data collected from July 1, 1977 to April 28, 1978 and displays the trailing out of both free and total chlorine residual in the cooling tower discharge. Additionally, the study displayed that at 100% full power the condenser cooling water could be chlorinated to the full rate of the chlorination system (6500 pounds of chlorine per day) without closely approaching the maximum allowable concentrations of free available chlorine in the cooling tower blowdown.

The study was carried out in accordance with Parts 9 and 10 of EPA Permit No. PA 0025615, BVPS Technical Specification L.C.O. 2.3.1 and the BVPS Chemistry Manual, Chapter 3, Part 10. The study developed a correlation between the amount of chlorine added to the BVPS Unit 1 Circulating Water System under various system conditions and the free available and total residual chlorine discharged into the Unit 1 cooling tower basin and discharge structure. A correlation was also developed between the free available chlorine residual as determined by the continuous chlorine monitor [WT-AN-2], sampling at the condenser discharge, and the free available and/or total chlorine residual sampled at the cooling tower basin and the discharge structure.

In the first part of the study, the analyzer [WT-AN-2] was plagued with sample flow problems due to 1500 feet of sample tubing which was constantly fouling with river silt. These problems were eliminated when the analyzer was moved nearer to the base of the condenser. In addition, a recorder was installed in the chemistry laboratory sample panel in parallel with the one installed in the chlorine building so that both operations and chemistry personnel could observe the condenser outlet chlorine residual. During the past winter, an additional chlorine analyzer was installed at the discharge structure (EPA Outfall 001) to continuously monitor the discharge for free available chlorine. This analyzer also relays its signal to a recorder located in the chemistry laboratory sample room and will alarm an annunciator both locally and in the control room should this concentration of free chlorine in the discharge exceed 0.4 mg/l. This allows time to isolate or decrease chlorine dosage before it exceeds the maximum allowable limit of 0.5 mg/l.

CHLORINATION STUDY (continued)

The data collected does indicate a trailing-out of both free available and total residual chlorine. During normal power operation and station outages, the trailing-out lasted less than five hours after residuals were first detected at the outfall structure. Longer trailing-out periods were noted when a plant "trip" occurred during chlorination. Although detailed measurements of the trailing-out during plant trips could not be obtained (because of their infrequent occurrence), extrapolation of the data that was taken indicates that the trailing-out lasts less than eight hours after residuals were first detected.

The station was shut down for maintenance at the end of April, 1978 and a detailed inspection of the cooling tower and condenser tubing was made. The cooling tower was relatively free of organic fouling; however, a thin, black layer of sludge was found to be fouling the condenser tubing. The sludge was analyzed to be 25% organic. Stone and Webster Engineering Corporation calculated that this sludge could cause a loss of 7 megawatts electrical. Since the station has been chlorinating at the maximum dose rate possible during the last year, chlorination at this dose rate should be maintained to prevent further degradation of electrical generation capacity.

In conclusion, the study showed the following:

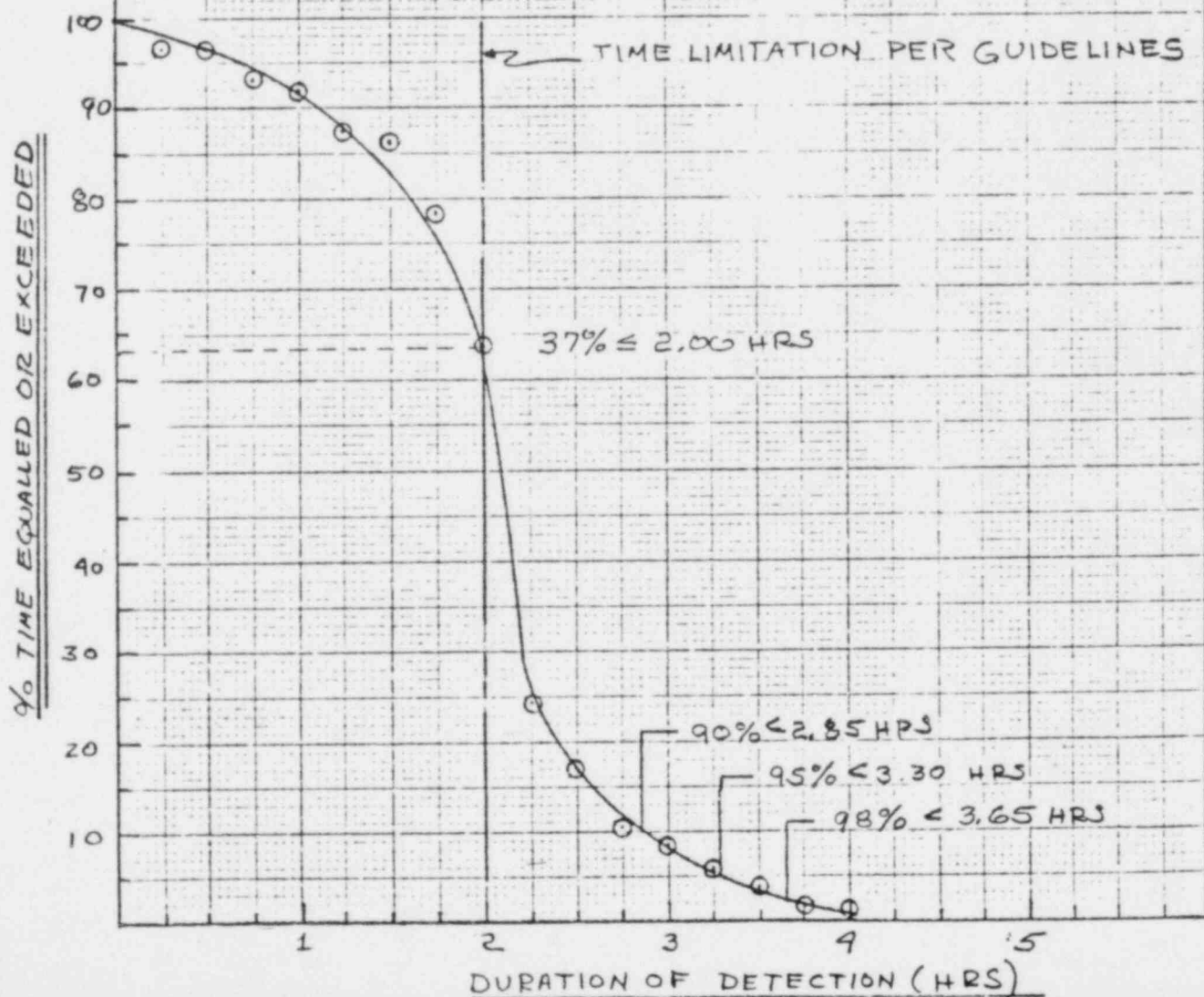
1. A correlation does exist between the free available chlorine residual as determined by the continuous chlorine monitor [WT-AN-2] at the condenser discharge, and the free available and/or total chlorine residual as sampled at the discharge structure and cooling tower basin.
2. The additional chlorine analyzer installed at the discharge structure can also be used to determine free available chlorine discharged to the river.
3. Trailing-out of chlorine does occur. During normal power operations, trailing-out of free chlorine beyond two hours occurs 36% of the time. However, total residual chlorine has occasionally trailed out five hours during power operation and may reach eight hours if a plant trip occurred during chlorination.
4. Chlorination during power operation at the maximum dose rate possible results in concentrations of free available chlorine well below the limits of NPDES Permit No. PA 0025615. Chlorination at the maximum dose rate must be continued to prevent more rapid fouling of the main unit condenser.

EXTREMES

MIN. TOTAL CHLORINE - 0 mg/l
 MAX. TOTAL CHLORINE - 0.65 mg/l
 AVERAGE* - 0.20 mg/l.

MIN. TIME - 0 HRS
 MAX TIME - 4.16 HRS
 AVERAGE - 1.98 HRS

* AVERAGE OF DAILY MAX. VALUES



COMPANY

SUBJECT BVPS-1

CHLORINE STUDY

2 OF 3

DEPARTMENT

DURATION OF CHLORINE DISCHARGE

FREQUENCY CURVE (FREE CHLORINE)

DIVISION

COMPILED BY WAR

CHECKED BY

DATE JUNE 8, 197

FORM G23-3112

EXTREMES

MIN. FREE CHLORINE - 0 mg/l

MAX. FREE CHLORINE - 0.32 mg/l

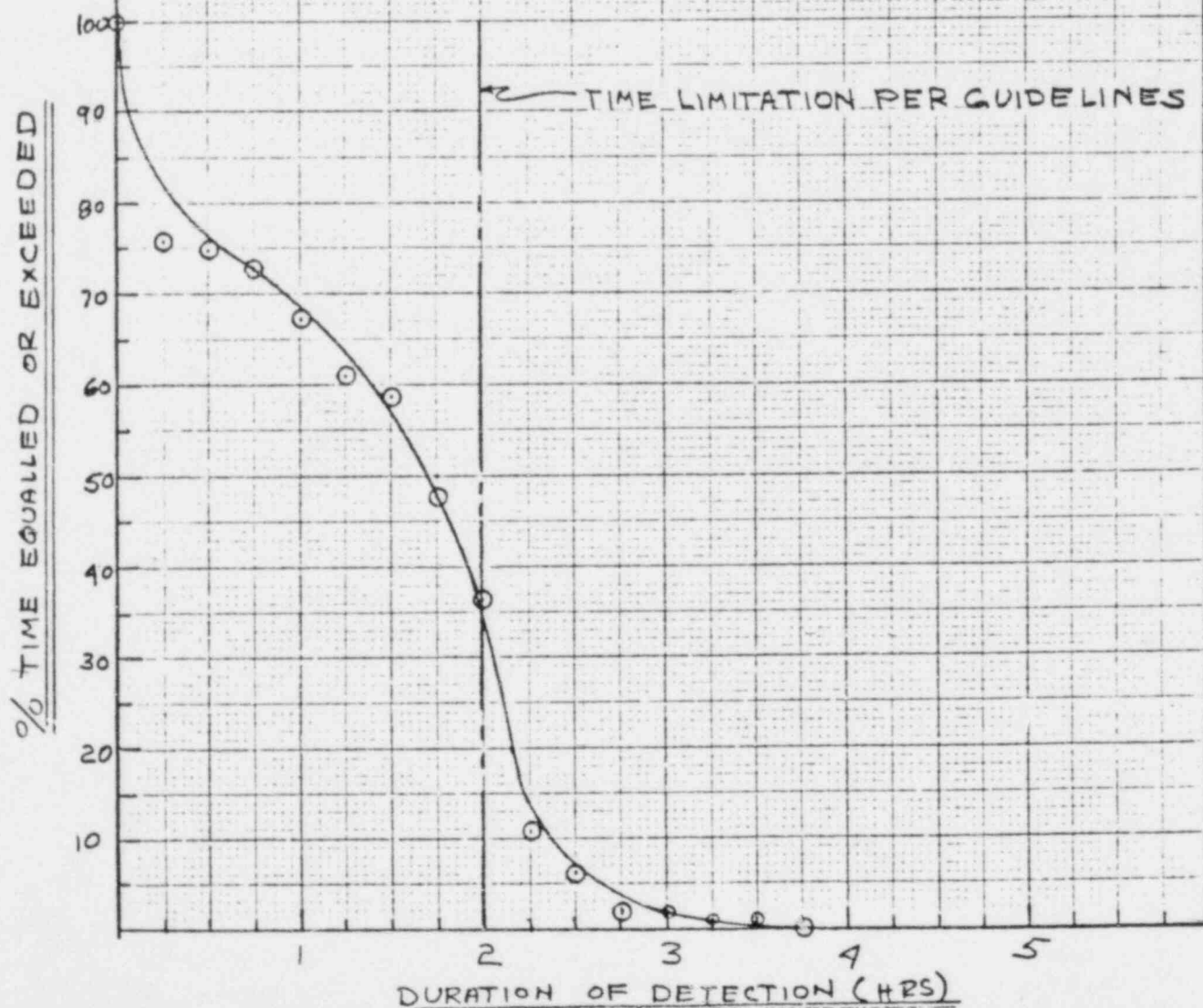
AVERAGE* - 0.08 mg/l

MIN. TIME - 0 HOURS

MAX. TIME - 3.67 HOURS

AVERAGE - 1.32 HOURS

* AVERAGE OF DAILY MAX. VALUES



COMPANY

SUBJECT BUPS-1 CHLORINE STUDY 3 OF 3

DEPARTMENT

CHLORINE CONCENTRATION FREQUENCY CURVE

(TOTAL AND FREE)

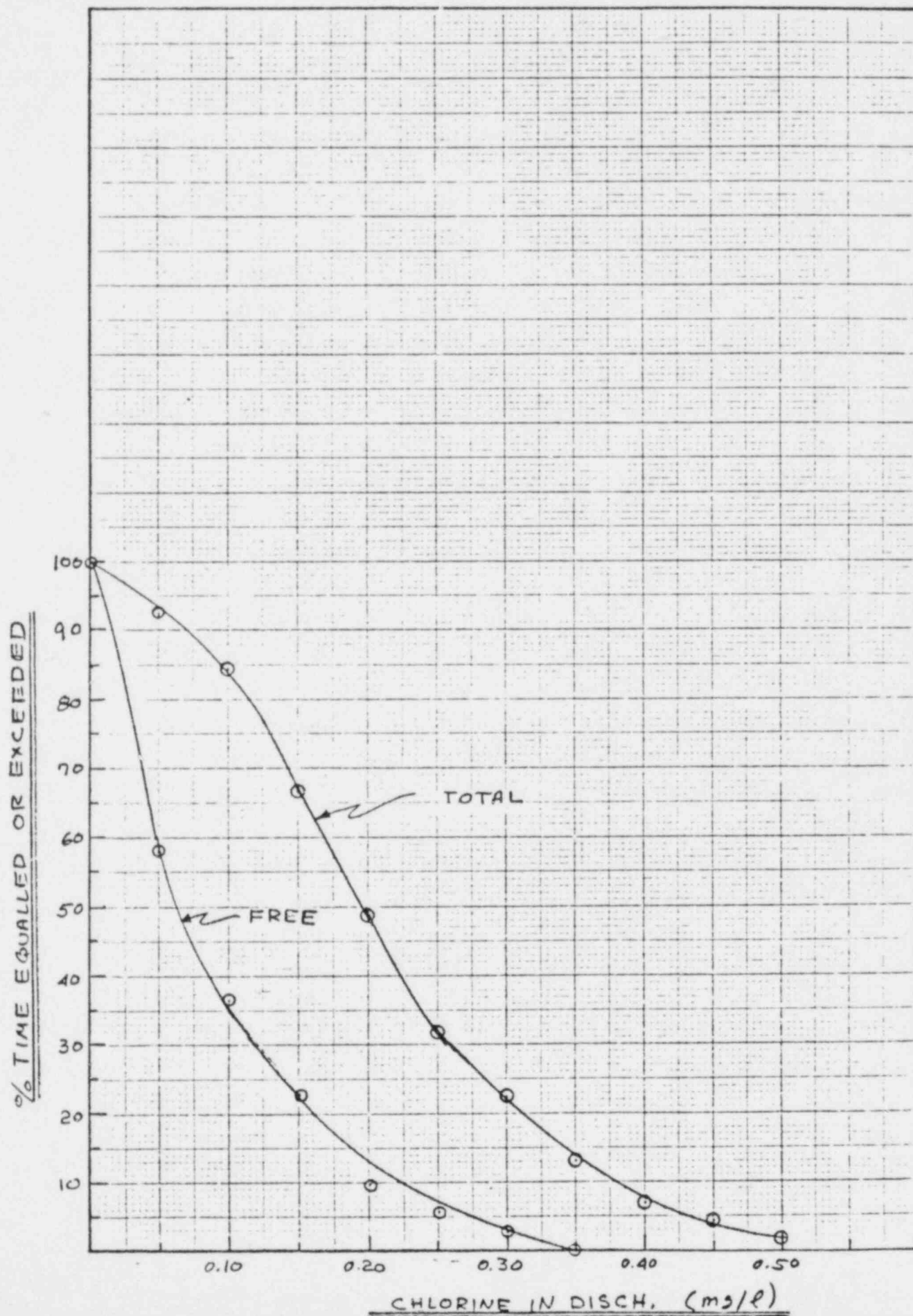
DIVISION

COMPILED BY WAR

CHECKED BY

DATE JUNE 8, 19

FORM G23-3112



CHLORINE STUDY - DATA SUMMARY

WAR

JUNE 6, 1978

	DATE	FREE CL [*] (mg/l)	DURATION ^{**} (HRS)	TOTAL CL [*] mg/l	DURATION [*] (HRS)	REMARKS
						* MAX OBSERVED VALUE AT OUTFALL
1	7-1-77	0	0	0.06	1.33	
2	7-2	0.02	0.16	0.07	2.00	** TIME OF DETECTION (DURATION)
3	7-3	0	0	0.07	2.00	
4	7-4	0	0	0.19	2.00	
5	7-5	0	0	0.03	1.00	
6	7-6	0	0	0.19	2.16	
7	7-7	0	0	0.18	2.08	
8	7-8	0	0	0.18	2.00	
9	7-9	0	0	0.16	2.00	
10	7-10	0.02	0.33	0.20	2.83	
	7-11	SYSTEM MALFUNCTION				
12	7-12	0	0	0.04	1.50	
13	7-13	0.02	1.33	0.07	1.83	
14	7-14	0.02	0.83	0.07	1.83	
15	7-15	0.30	2.50	0.57	3.00	
16	7-16	0.13	2.16	0.21	2.16	
17	7-17	0.30	2.33	0.41	2.33	
18	7-18	0.13	1.83	0.37	2.33	
19	7-19	0.05	1.16	0.15	1.50	
20	7-20	0.10	1.83	0.20	2.00	
21	7-21	0	0	0.15	1.67	
	7-22	0	0	0.10	2.00	
23	7-23	0.21	3.67	0.25	3.83	
24	7-24	0.05	0.83	0.14	0.83	
25	7-25	0.17	2.33	0.26	2.67	
26	7-26	0.03	1.16	0.11	1.16	
27	7-27	0.23	3.00	0.36	3.33	
28	7-28	0.18	3.00	0.27	3.50	
29	7-29	0.21	2.33	0.30	2.83	
30	7-30	0.26	2.83	0.35	3.50	
31	7-31	0.20	2.33	0.38	2.83	
	Σ	2.63	35.94	6.09	66.03	
	n/n ⁺	30/30	30/30	30/30	30/30	
	AVG.	0.09	1.20	0.20	2.20	
	AVG. ⁺	0.09	1.20	0.20	2.20	+ CUMULATIVE

2 OF 10

BVPS-1
CHLORINE STUDY - DATA SUMMARY
WAR

JUNE 6, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
					SEE 1 OF 10
8-1-77	0.32	3.00	0.43	3.00	
8-2	0	0	0.30	3.50	
8-3	0.04	2.16	0.30	3.67	
8-4	0.05	1.16	0.27	3.33	
8-5	0	0	0.16	1.83	
8-6	0.03	0.33	0.20	3.00	
8-7	0	0	0.20	2.50	
8-8	0	0	0.14	1.16	
8-9	0	0	0.15	2.16	
8-10	0	0	0.05	2.00	
8-11	0	0	0.10	1.50	
8-12	0	0	0.04	1.00	
8-13	0	0	0	0	
8-14	0.02	0.33	0.18	3.33	
8-15	NO	CHLORINATION.			
8-16	0.08	2.00	0.33	3.00	
8-17	0.28	1.67	0.56	1.83	
8-18	0	0	0.13	3.00	
8-19	0	0	0	0	
8-20	0.02	1.16	0.26	4.00	
8-21	0.08	1.67	0.34	4.16	
8-22	0.25	2.00	0.35	2.00	
8-23	0.08	1.83	0.13	2.16	
8-24	0.06	2.50	0.22	2.83	
8-25	0.08	2.50	0.14	2.67	
8-26	NO SAMPLES - STATION OUTAGE				
8-27	↓	↓	↓	↓	
8-28					
8-29					
8-30					
8-31	↓	↓	↓	↓	
Σ	1.39	22.31	4.98	57.63	
n/n ⁺	24/54	24/54	24/54	24/54	
AVG	0.06	0.93	0.21	2.40	
AVG ⁺	0.07	1.08	0.21	2.29	

CHLORINE STUDY - DATA SUMMARY

JUNE 6, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
Q-1-77	NO SAMPLES - STATION OUTAGE				SEE 1 OF 10
Q-2					
Q-3					
Q-4					
Q-5					
Q-6					
Q-7					
Q-8					
Q-9					
Q-10					
Q-11					
Q-12					
Q-13					
Q-14					
Q-15					
Q-16					
Q-17					
Q-18					
Q-19					
Q-20					
Q-21					
Q-22					
Q-23					
Q-24					
Q-25					
Q-26					
Q-27					
Q-28					
Q-29					
Q-30					
Σ					
n					
AUG					
AUG+	0.07	1.08	0.21	2.29	

4 OF 10

BVPS-1
CHLORINE STUDY - DATA SUMMARY
WAR

JUNE 6, 1978

DATE	FREE CL mg/l	DURATION (HRS)	TOTAL CL mg/l	DURATION (HRS)	REMARKS
10-1-77	STATION OUTAGE				SEE 1 OF 10
10-2					
10-3					
10-4					
10-5					
10-6					
10-7					
10-8					
10-9					
10-10					
10-11					
10-12					
10-13					
10-14					
10-15					
10-16					
10-17					
10-18					
10-19					
10-20					
10-21					
10-22					
10-23					
10-24					
10-25					
10-26					
10-27					
10-28					
10-29					
10-30					
10-31					
Σ					
n					
AUG					
AUG	0.07	1.08	0.21	2.29	

CHLORINE STUDY - DATA SUMMARY

WAR

JUNE 6, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
					SEE 1 OF 10
11-1-77	0	0	0	0	
11-2	0	0	0	0	
11-3	0	0	0	0	
11-4	0	0	0	0	
11-5	0	0	0.32	3.00	
11-6	0.16	2.67	0.21	3.33	
11-7	0.18	2.67	0.20	2.67	
11-8	0.15	2.33	0.16	2.33	
11-9	0.07	2.00	0.12	2.00	
11-10	0.16	2.33	0.25	2.33	
11-11	0.18	2.67	0.22	2.67	
11-12	NO CHLORINATION				
11-13	0.05	1.00	0.24	1.00	
11-14	0	0	0.02	0.50	
11-15	0.06	1.33	0.15	2.16	
11-16	NO CHLORINATION				
11-17	0.07	0.83	0.65	2.00	
11-18	NO CHLORINATION				
11-19	0.12	1.00	0.40	2.50	
11-20	0.16	2.16	0.41	3.50	
11-21	0.02	1.67	0.39	2.33	
11-22	0.03	0.83	0.35	2.00	
11-23	0.12	1.50	0.39	2.00	
11-24	0.16	2.00	0.48	2.33	
11-25	0.18	2.33	0.36	2.30	
11-26	EQUIPMENT FAILURE				
11-27	-do-				
11-28	0	0	0.20	2.33	
11-29	0.01	0.67	0.13	0.67	
11-30	0.01	0.50	0.49	2.16	
Σ	1.89	30.49	6.14	46.14	
n/n ⁺	25/79	25/79	25/79	25/79	
AVG	0.08	1.22	0.25	1.85	
AVG ⁺	0.07	1.12	0.22	2.15	

CHLORINE STUDY - DATA SUMMARY

WAR

JUNE 7, 1976

DATE	FREE CL (mg/L)	DURATION (HRS)	TOTAL CL (mg/L)	DURATION (HRS)	REMARKS
12-1-77	NO	CHLORINATION			SEE 1 OF 10
12-2	0.32	2.33	0.40	2.33	
12-3	0.18	2.00	0.23	2.50	
12-4	0	0	0.46	3.33	
12-5	0	0	0.32	1.83	
12-6	0	0	0.21	1.83	
12-7	0	0	0.46	2.00	
12-8	0	0	0.16	2.00	
12-9	0	0	0.61	2.00	
12-10	0	0	0	0	
12-11	0	0	0.32	2.00	
12-12	0	0	0.32	2.00	
12-13	0	0	0.21	2.00	
12-14	0.11	2.00	0.14	2.00	
12-15	0.05	1.50	0.09	1.50	
12-16	0.03	1.67	0.05	1.67	
12-17	0.06	1.83	0.16	1.83	
12-18	0	0	0	0	
12-19	NO	CHLORINATION			
12-20	0.11	1.67	0.18	1.83	
12-21	0.19	2.00	0.29	2.16	
12-22	0.14	2.16	0.24	2.33	
12-23	0.15	2.67	0.22	2.67	
12-24	0.04	1.67	0.24	2.33	
12-25	0.06	2.00	0.27	2.00	PACEM ENTERED
12-26	0.07	1.83	0.26	2.50	
12-27	0.05	2.16	0.24	2.50	
12-28	0.03	2.00	0.20	2.33	
12-29	0.02	1.33	0.14	2.00	
12-30	0	0	0.05	0.83	
12-31	0.03	2.00	0.24	2.50	
Σ	1.64	32.82	6.71	56.80	
n/n^+	29/108	29/108	29/108	29/108	
AVG	0.06	1.13	0.23	1.96	
AVG ⁺	0.07	1.13	0.22	2.10	

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
					SEE 1 OF 10
1-1-78	0.03	2.00	0.24	2.50	
1-2	0.11	2.00	0.23	2.67	
1-3	0.19	2.16	0.42	2.33	
1-4	0.15	2.16	0.47	2.16	
1-5	0.22	2.16	0.25	2.16	
1-6	0.02	0.83	0.23	2.00	
1-7	0.08	1.67	0.10	2.00	
1-8	0.08	1.83	0.12	1.83	
1-9	0.09	2.00	0.15	2.33	
1-10	0.04	1.50	0.10	1.83	
1-11	0.03	1.50	0.08	1.83	
1-12	0.07	1.00	0.11	1.67	
1-13	0	0	0.11	1.83	
1-14	0	0	0.25	1.50	
1-15	EQUIPMENT		MALFUNCTION		
1-16	0	0	0.39	2.00	
1-17	0	0	0.11	1.50	
1-18	0	0	0.17	1.83	
1-19	0	0	0.10	1.83	
1-20	0.08	1.50	1.09	1.50	
1-21	0	0	0.14	1.67	
1-22	0	0	0.12	1.33	
1-23	0.05	1.16	0.13	1.83	
1-24	0.27	1.50	0.32	2.00	
1-25	0.21	2.00	0.23	2.16	
1-26	0.25	2.00	0.35	2.00	
1-27	NO SAMPLES				
1-28	0	0	0.05	1.00	
1-29	0.06	1.83	0.13	2.00	
1-30	0.10	1.50	0.13	2.00	
1-31	0.11	2.00	0.15	2.16	
Σ	2.24	34.30	5.47	55.45	
n/n+	29/137	29/137	29/137	29/137	
AUG	0.08	1.18	0.19	1.91	
AUG*	0.07	1.14	0.21	2.06	

BUPS-1 8 OF 10

CHLORINE STUDY - DATA SUMMARY

WAR JUNE 7, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS	
2-1-78	0.05	0.83	0.07	1.00	SEE 1 OF 10	
2-2	0.10	2.00	0.14	2.00		
2-3	0.10	0.83	0.15	1.83		
2-4	0.30	0.83	0.06	1.83		
2-5	0	0	0.02	0.67		
2-6	0.07	1.83	0.12	2.00		
2-7	0.06	1.50	0.21	1.67		
2-8	0.06	2.00	0.09	2.00		
2-9	0.06	1.67	0.11	1.83		
2-10	0.05	1.83	0.21	2.00		
2-11	0.04	2.00	0.15	2.00		
2-12	0.10	1.83	0.15	1.83		
2-13	0.08	0.83	0.10	0.83		
2-14	0.11	2.00	0.15	2.00		
2-15	0.11	1.83	0.14	1.83		
2-16	0.06	1.83	0.08	1.83		
2-17	0.08	1.83	0.10	1.83		
2-18	0.13	2.00	0.18	2.00		
2-19	0.13	2.16	0.20	2.16		
2-20	0.09	1.83	0.14	1.83		
2-21	NO CHLORINATION					
2-22	0.08	1.83	0.10	2.00		
2-23	0.10	2.00	0.11	2.00		
2-24	0.04	1.67	0.21	1.67		
2-25	0.04	1.67	0.16	1.83		
2-26	0.02	1.67	0.15	2.16		
2-27	0.02	1.50	0.16	2.00		
2-28	0	0	0.10	1.67		
Σ	2.08	41.80	3.56	48.30		
n/n ⁺	27/164	27/164	27/164	27/164		
AVG	0.08	1.55	0.13	1.79		
AVG ⁺	0.07	1.21	0.20	2.01		

9 of 10

BUPS-1
CHLORINE STUDY - DATA SUMMARY
WAR

JUNE 7, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
3-1-78	0	0	0.04	0.67	SEE 10F 10
3-2	0.02	1.00	0.15	2.00	
3-3	0.03	0.50	0.17	1.67	
3-4	0.04	1.50	0.20	2.00	
3-5	0.02	0.67	0.17	2.00	
3-6	0.16	2.16	0.16	2.16	
3-7	0.12	2.16	0.14	2.16	
3-8	0.08	1.50	0.08	1.50	
3-9	0	0	0.05	0.67	
3-10	0.15	1.83	0.15	1.83	
3-11	0.19	2.00	0.20	2.00	
3-12	0.31	2.16	0.34	2.16	
3-13	0.08	1.83	0.12	2.00	
3-14	0.06	1.67	0.10	2.00	
3-15	EQUIPMENT		MALFUNCTION		
3-16	0.03	1.00	0.16	2.00	
3-17	0.10	2.16	0.30	2.16	
3-18	0.05	2.00	0.24	2.00	
3-19	0.06	1.83	0.19	1.83	
3-20	0.07	1.83	0.19	1.83	
3-21	0.05	2.00	0.25	2.00	
3-22	0.08	2.00	0.29	2.00	
3-23	0.01	1.00	0.18	2.00	
3-24	0.08	2.00	0.33	2.16	
3-25	0.15	2.00	0.34	2.00	
3-26	0.07	1.83	0.28	1.83	
3-27	0.07	2.00	0.27	2.00	
3-28	NO		CHLORINATION		
3-29	0.09	2.16	0.34	2.16	
3-30	0.27	2.33	0.32	2.33	
3-31	0.20	2.00	0.27	2.00	
Σ	2.58	47.12	6.02	55.12	
n/n ⁺	29/193	29/193	29/193	29/193	
AVG	0.09	1.62	0.21	1.90	
AVG ⁺	0.07	1.27	0.20	2.00	

BVPS-1 10 OF 10

CHLORINE STUDY - DATA SUMMARY

WAR JUNE 7, 1978

DATE	FREE CL (mg/l)	DURATION (HRS)	TOTAL CL (mg/l)	DURATION (HRS)	REMARKS
					SEE 1 OF 10
4-1-78	NO	CHLORINATION			
4-2	NO	CHLORINATION			
4-3	0.11	2.00	0.15	2.00	
4-4	0.15	1.83	0.22	2.16	
4-5	0.18	2.00	0.27	2.00	
4-6	0.20	1.83	0.31	1.83	
4-7	0.13	1.00	0.30	1.00	
4-8	0.14	1.83	0.31	1.83	
4-9	0.21	1.83	0.39	1.83	
4-10	0.16	1.00	0.34	1.00	
4-11	0	0	0	0	
4-12	0.08	2.00	0.19	2.00	
4-13	0.05	2.00	0.14	2.00	
4-14	0.11	2.50	0.25	2.50	
4-15	0.18	2.33	0.35	2.50	
4-16	0.15	2.00	0.21	2.16	
4-17	0.18	2.16	0.24	2.16	
4-18	0.15	2.16	0.20	2.16	
4-19	0.10	1.83	0.14	2.00	
4-20	0.12	2.00	0.18	2.33	
4-21	0.14	2.00	0.20	2.00	
4-22	NO	CHLORINATION			
4-23	0.03	1.33	0.04	1.33	
4-24	NO	CHLORINATION			
4-25	NO	CHLORINATION			
4-26	0.16	1.50	0.25	1.50	
4-27	0.15	2.00	0.26	2.16	
4-28	0.11	2.00	0.20	2.00	
4-29	STATION OUTAGE				
4-30	STATION OUTAGE				
Σ	2.99	41.13	5.14	42.45	
n/n ⁺	23/216	23/216	23/216	23/216	
AVG	0.13	1.79	0.22	1.85	
AVG ⁺	0.08	1.32	0.20	1.98	