Peter E. Katz
Plant General Manager

1650 Calvert Cliffs Parkway
Lusby, Maryland 20657
410 495-4101

Constellation
Nuclear

Calvert Cliffs
Nuclear Power Plant

A Member of the
Constellation Energy Group

January 17, 2002

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
National Pollution Discharge Elimination System Permit No. MD0002399, Special Conditions P, Submittal of Copper Study

In accordance with Section 3.2 of Appendix B, Environmental Protection Plan (Non-Radiological) Technical Specifications, Attachment (1), the Calvert Cliffs Nuclear Power Plant National Pollution Discharge Elimination System Copper Study, as approved by the Maryland Department of the Environment, is provided.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

Peter E. Katz

PEK/MJY/bjd

Attachment: As stated

cc: **(Without Attachment)**
R. S. Fleishman, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
D. M. Skay, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

C001

ATTACHMENT (1)

CALVERT CLIFFS NUCLEAR POWER PLANT

NATIONAL POLLUTION DISCHARGE ELIMINATION SYSTEM

COPPER STUDY

Calvert Cliffs Nuclear Power Plant, Inc.
January 17, 2002

Peter E. Katz
Plant General Manager

1650 Calvert Cliffs Parkway
Lusby, Maryland 20657
410 495-4101

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December 20, 2001

Maryland Department of the Environment
Water Management Administration
2500 Broening Highway
Baltimore, Maryland 21224

RE: Calvert Cliffs Nuclear Power Plant NPDES
Discharge Permit 99-DP-0187 (MD0002399)

Dear Sir:

In accordance with the requirements of the Maryland Department of the Environment NPDES Permit 99-DP-0187, Special Conditions P, and the copper study plan approved by MDE in June 2000, I have enclosed the results of the copper study to determine compliance with state water quality standards at the Calvert Cliffs Nuclear Power Plant. If you have any questions regarding this information, please contact Brenda Nuse at (410) 495-4913.

Sincerely,

Peter E. Katz
Plant General Manager

Enclosures

PEK:BDN

cc: B.D. Nuse
T.G. Ringger
USNRC

Copper Study
Calvert Cliffs Nuclear Power Plant
Constellation Energy Group

Prepared by:

Brenda D. Nuse
Constellation Nuclear
Calvert Cliffs Nuclear Power Plant
1650 Calvert Cliffs Parkway
Lusby MD 20657

December 2001

Table of Contents

Introduction:

The current discharge permit for the Calvert Cliffs Nuclear Power Plant, 99-DP-0187 (MD0002399), became effective December 31, 1999. This permit contains a requirement to develop and implement a study plan for determining compliance with the state water quality standard for dissolved copper. The state water quality standard (COMAR 26.08.02.03-2) is less than 6.1 ppb copper for discharge to the Chesapeake Bay (estuarine water).

The study plan was developed and submitted to the Maryland Department of the Environment (MDE) in March 2000. The plan addresses Outfall 001 (circulating water discharge) and Outfall 002 (sumps and storm water discharge) separately. The plan for 001 involved a three-phase approach. The initial focus of the copper study looked at copper sampling and analysis methods and also looked at background levels in the Chesapeake Bay. If statistical analysis had indicated the water quality standards were not met at the end of the initial phase, then the chemical or biological translators would have been addressed in Phase II. If compliance with the water quality standards was not demonstrated after Phase II, then mixing zones would have been evaluated in Phase III.

The plan for Outfall 002 involved re-routing the discharge piping to combine the Outfall 002 flow with the Outfall 001 flow.

MDE approved the plan in June 2000.

Outfall 001

Sampling and Analysis – Phase 1:

Calvert Cliffs Nuclear Power Plant Chemistry Technicians collected all samples and performed all analyses.

Samples were collected weekly from the intake structure and both the Unit 1 and Unit 2 discharge conduits of Outfall 001. Samples were collected from July 27, 2000 through April 23, 2001. No samples were obtained from the Unit 2 discharge conduit after March 15, 2001, as the unit was not operating and there was no flow through the conduit. A comprehensive blank was run with each set of samples.

Samples were collected in polypropylene sample containers that were soaked with 0.5% nitric acid for a minimum of twenty-four hours and rinsed with deionized water prior to use. Powder free gloves were worn to collect samples. All samples were collected using metal free sampling equipment. Samples were collected in triplicate from each sample point and immediately preserved with high purity nitric acid to a pH of less than 2.

All samples were analyzed for total copper in accordance with EPA Method 220.2 on a Perkin Elmer 1100B atomic absorption unit with a HGA-700 graphite furnace and AS-70 autosampler. Calvert Cliffs analyzed for total copper, as the permit specifies total copper analysis for Outfall 002. Total copper includes the soluble copper portion, thus is a more conservative value than the soluble copper analysis. The filtering process adds additional risk of contamination of the samples.

Each graphite furnace run included a five standard calibration curve from 2 – 20 ppb (0.002 – 0.020 mg/l) total copper using NIST traceable standards. Control standards were run after every ten samples and an influent sample was spiked to 6 ppb total copper and analyzed with each run (Att.1).

An NPDES inspection in December 2000 identified the copper samples were not digested prior to analysis as required by 40-CFR-136 - *Guidelines establishing test procedures for the analysis of pollutants*. To determine the impact of digestion on the analysis of the intake and outfall samples, samples were analyzed both digested and without digestion.

Each sample was split, one aliquot was analyzed without digestion; the other aliquot was digested in accordance with "Methods for Chemical Analysis of Water and Wastes, 1979 and 1983, Section 4.1.3" prior to analysis. Data was collected for eight weeks (3/7/01 to 4/23/01). The results were recorded and the data sets compared by performing a two-tailed Student's *t* Test at 95 % confidence level. The result of the two-tailed Student's *t* Test indicated the variance between the copper results from the sample aliquots with and without digestion was insignificant. (Att.2)

Outfall 001 Results:

All of the total copper results from the Unit 1 discharge conduit were less than 6.1 ppb (Att. 3). None of the analytical results for Unit 2 discharge conduit exceeded 6.1 ppb total copper (Att. 4). No indication of re-entrainment is evident in the intake copper data (Att.5). Calculations using Calvert Cliffs radiological effluent data indicate the level of re-entrainment is less than 15%.

Outfall 002

After the Outfall 001 copper study was completed, a modification to the plant piping was made. This modification combined the Outfall 002 discharge with the Outfall 001 discharge. This piping modification was completed on May 14, 2001.

The flow from the Outfall 001 is dependent on the number of circulating water pumps operating. Normally, there are twelve circulating water pumps operating at 200,000 gpm each. Even with only one circulating water pump operating (required even if both plants are not operating), the dilution ratio of the Outfall 002:Outfall 001 discharge would be 1:1327.

The impact on the copper concentration of the Outfall 001 discharge by re-routing the 002 flow into the 001 discharge is estimated by

$$(C_1V_1) \div V_2 = C_2$$

using flow and concentration data obtained from samples taken from July 1997 to December 1999.

For Normal operation, with average copper concentration and full cooling water flow:

Where:

C_1 – average copper concentration of the 002 outfall (0.170 mg/l)
V_1 – flow of the 002 outfall (0.217 MGD)
V_2 – flow of the 001 outfall (3456 MGD)
C_2 – increase in copper concentration of the 001 outfall (mg/l)

$$0.170 \text{ mg/l} \times 0.217 \text{ MGD 002 flow} \div 3456 \text{ MGD 001 flow} = 1.0E^{-5} \text{ mg/l copper}$$

For worst case conditions, with highest copper concentration and one circulating water pump:

Where:

C_1 – maximum copper concentration of the 002 outfall (2.881 mg/l)
V_1 – flow of the 002 outfall (0.217 MGD)
V_2 – minimum flow of the 001 outfall (288 MGD)
C_2 – increase in the copper concentration of the 001 outfall (mg/l)

$$2.881 \text{ mg/l} \times 0.217 \text{ MGD 002 flow} \div 288 \text{ MGD 001 flow} = 2.2E^{-3} \text{ mg/l copper}$$

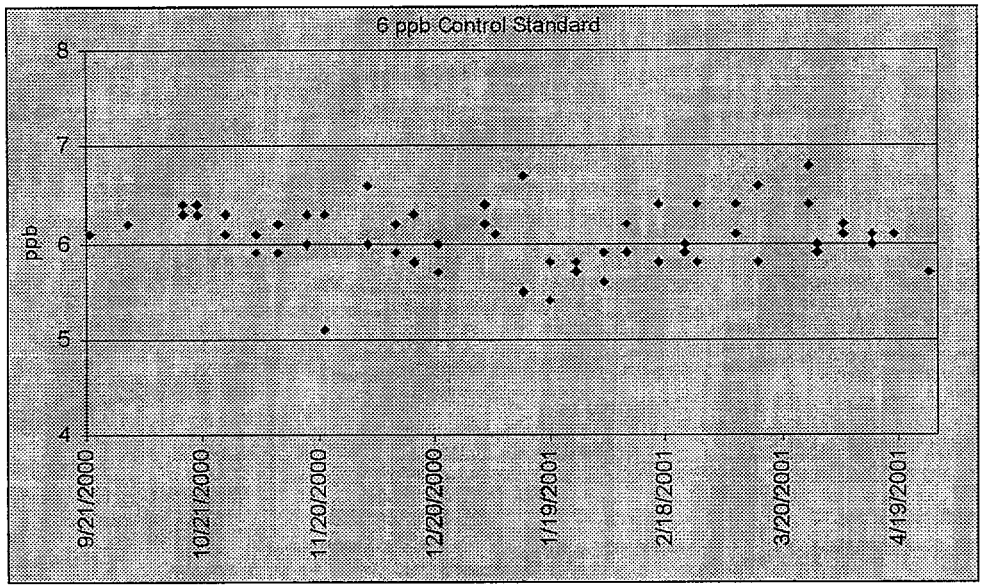
Thus the modification combining the Outfall 002 and the Outfall 001 will not cause the Outfall 001 copper concentrations to exceed the water quality standard for copper.

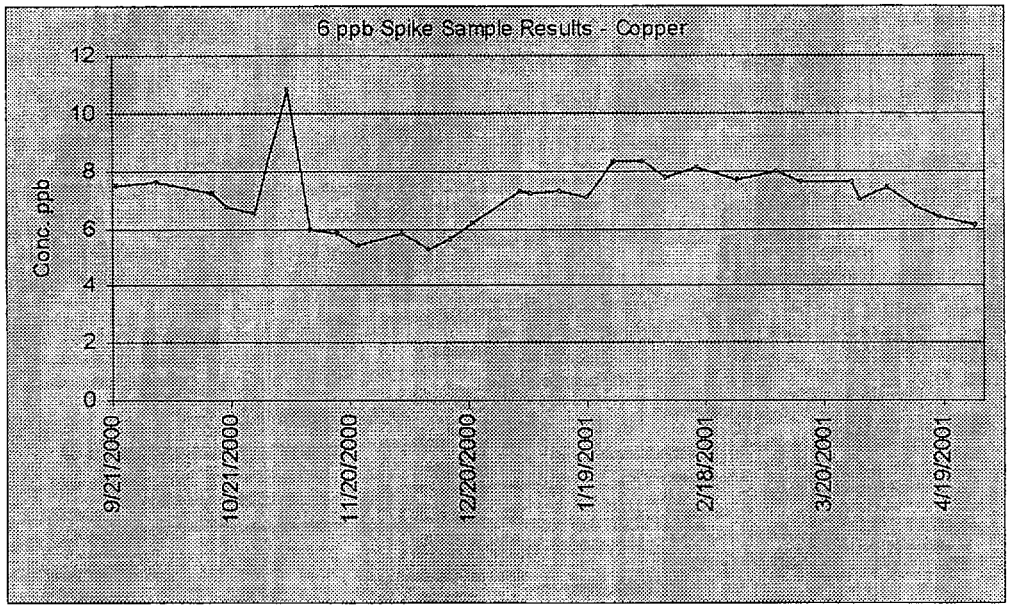
Conclusion

The samples collected from July 27, 2000 through April 23, 2001 indicate the discharge from Calvert Cliffs Nuclear Power Plant does meet the Water Quality Criteria for copper. As the water quality standards were met at the end of the initial phase, Phase II and Phase III of the copper study were not required.

The addition of the Outfall 002 discharge flow to the Outfall 001 discharge will not cause the Outfall 001 copper concentration to exceed the water quality standard for copper.

Attachment 1- Quality Control Data





Attachment 2 - Comparison of Non-digested with Digested Analysis Results

Sample	Date	Not digested	Digested
Intake	3/7/2001	2.5	2.5
Intake	3/7/2001	2.7	2.5
Intake	3/7/2001	2.7	2.6
Intake	3/12/2001	2	2.6
Intake	3/12/2001	2.8	2.6
Intake	3/12/2001	2.4	2.7
Intake	3/20/2001	2	2
Intake	3/20/2001	2	2
Intake	3/20/2001	2	2
Intake	3/28/2001	2	2
Intake	3/28/2001	2	2
Intake	3/28/2001	2	2
Intake	4/4/2001	2	2
Intake	4/4/2001	2	2
Intake	4/4/2001	2	2
Intake	4/10/2001	2.2	
Intake	4/10/2001	2.1	2
Intake	4/10/2001	2.3	2
Intake	4/17/2001	2	2
Intake	4/17/2001	2	2
Intake	4/17/2001	2	2
Intake	4/23/2001	2	2
Intake	4/23/2001	2	2
Intake	4/23/2001	2	2
Unit 1	3/7/2001	2.4	2.5
Unit 1	3/7/2001	2.6	2.2
Unit 1	3/7/2001	2.6	2.2
Unit 1	3/12/2001	2.7	2.2
Unit 1	3/12/2001	2.9	3
Unit 1	3/12/2001	2	2.6
Unit 1	3/20/2001	2.6	2
Unit 1	3/20/2001	2	2
Unit 1	3/20/2001	2	2.2
Unit 1	3/28/2001	2	2
Unit 1	3/28/2001	2	2
Unit 1	3/28/2001	2	2
Unit 1	4/4/2001	2	2
Unit 1	4/4/2001	2	2
Unit 1	4/4/2001	2	2
Unit 1	4/10/2001	2	2
Unit 1	4/10/2001	2	2
Unit 1	4/10/2001	2	2
Unit 1	4/17/2001	2	2
Unit 1	4/17/2001	2	2
Unit 1	4/17/2001	2	2.3
Unit 1	4/23/2001	2	2
Unit 1	4/23/2001	2	2
Unit 1	4/23/2001	2	2
Unit 2	3/7/2001	2.5	2.2
Unit 2	3/7/2001	3.1	2.2
Unit 2	3/7/2001	2.7	2.9
Unit 2	3/12/2001	3.2	2.7
Unit 2	3/12/2001	2.6	2.8
Unit 2	3/12/2001	2	2.9
Average:		2.2	2.2

All values < 2 are reported and calculated as = 2.

Statistics - Samples not digested prior to analysis		
# of observations	54	
AVG	2.21	
STD DEV	0.34	
"T" test at 95% confidence level to identify outliers:		
Xhigh	3.2	
Xlow	2	
Thigh	2.936	
Tlow	0.640	
critical T	3.158	Value corresponds to # of obs.
Xhigh OUTLIER?	TRUE	True = NO outliers exist.
Xlow OUTLIER?	TRUE	False = outliers exist
Two-tailed Student's *t* test at 95% confidence level:		
%RSD	15.15	
Std. Dev.X	0.0457	
X std.exist chart	2.20	
"t" statisti	0.848	
"t" variate	2.01	Value corresponds to # of obs. - 1
Bias	TRUE	True = bias does NOT exist.
		False = bias does exist

Statistics - Samples digested prior to analysis		
# of observations	53	
AVG	2.20	
STD DEV	0.30	
"T" test at 95% confidence level to identify outliers:		
Xhigh	3.0	
Xlow	2	
Thigh	2.668	
Tlow	0.651	
critical T	3.143	Value corresponds to # of obs.
Xhigh OUTLIER?	TRUE	True = NO outliers exist.
Xlow OUTLIER?	TRUE	False = outliers exist
Outliers removed:		
4/10/01, > 20		
Two-tailed Student's *t* test at 95% confidence level:		
%RSD	13.72	
Std. Dev.X	0.0414	
X std.exist chart	2.20	
"t" statisti	0.091	
"t" variate	2.008	Value corresponds to # of obs. - 1
Bias	TRUE	True = bias does NOT exist.
		False = bias does exist

Attachment 3 - Unit 1 Discharge Total Copper

Date	Sample results, ppb
7/27/2000	2
7/27/2000	2
7/27/2000	2
8/3/2000	2
8/3/2000	2
8/3/2000	2
8/9/2000	2
8/9/2000	2
8/9/2000	2
8/15/2000	2
8/15/2000	2
8/15/2000	2
8/22/2000	2
8/22/2000	2
8/22/2000	2
8/28/2000	2
8/28/2000	2
8/28/2000	2
9/7/2000	2
9/7/2000	2
9/7/2000	2
9/12/2000	2
9/12/2000	2
9/12/2000	2
9/21/2000	2
9/21/2000	3
9/21/2000	2
9/30/2000	11.7
9/30/2000	2
9/30/2000	2
10/13/2000	2
10/13/2000	2
10/13/2000	2
10/19/2000	2
10/19/2000	3.3
10/19/2000	2.4
10/25/2000	2
10/25/2000	2
10/25/2000	2
11/3/2000	2
11/3/2000	2
11/3/2000	2
11/8/2000	2
11/8/2000	2
11/8/2000	2
11/16/2000	2
11/16/2000	2
11/16/2000	2
11/21/2000	2
11/21/2000	2
11/21/2000	2
12/1/2000	2
12/1/2000	2
12/1/2000	2
12/6/2000	2
12/6/2000	2
12/6/2000	2

All values < 2 are reported and calculated as = 2.

# of obs (average of 3 samples)	38
AVG	2.3
STD DEV	0.61

"T" test at 95% confidence level to identify outliers:

Xhigh	5.2	
Xlow	2	
Thigh	4.81	
Tlow	0.49	
critical T	3.003	Value corres. to # of obs.
Xhigh OUTLIER?	FALSE	True = NO outliers exist.
Xlow OUTLIER?	TRUE	False = outliers exist

Outliers removed: None, all results < 6.1 ppb

Date	Average
7/27/2000	2
8/3/2000	2
8/9/2000	2
8/15/2000	2
8/22/2000	2
8/28/2000	2
9/7/2000	2
9/12/2000	2
9/21/2000	2.3
9/30/2000	5.2
10/13/2000	2
10/19/2000	2.6
10/25/2000	2
11/3/2000	2
11/8/2000	2
11/16/2000	2
11/21/2000	2
12/1/2000	2
12/6/2000	2
12/15/2000	2
12/20/2000	2
12/29/2000	2.8
1/4/2001	2.2
1/10/2001	2.3
1/17/2001	2
1/25/2001	3
1/31/2001	2.6
2/8/2001	3.1
2/15/2001	3.2
2/22/2001	3.1
3/7/2001	2.3
3/12/2001	2.6
3/20/2001	2.1
3/28/2001	2
4/4/2001	2
4/10/2001	2
4/17/2001	2.1
4/23/2001	2

Attachment 3 - Unit 1 Discharge Total Copper

12/15/2000	2
12/15/2000	2
12/15/2000	2
12/20/2000	2
12/20/2000	2
12/20/2000	2
12/29/2000	2.6
12/29/2000	3
12/29/2000	2.8
1/4/2001	2
1/4/2001	2.5
1/4/2001	2
1/10/2001	2.4
1/10/2001	2.2
1/10/2001	2.4
1/17/2001	2
1/17/2001	2
1/17/2001	2
1/25/2001	3
1/25/2001	3
1/25/2001	3
1/31/2001	2
1/31/2001	2.8
1/31/2001	2.9
2/8/2001	2.9
2/8/2001	3.3
2/8/2001	3.1
2/15/2001	3.2
2/15/2001	3.1
2/15/2001	3.2
2/22/2001	3.1
2/22/2001	3
2/22/2001	3.1
3/7/2001	2.5
3/7/2001	2.2
3/7/2001	2.2
3/12/2001	2.2
3/12/2001	3
3/12/2001	2.6
3/20/2001	2
3/20/2001	2
3/20/2001	2.2
3/28/2001	2
3/28/2001	2
3/28/2001	2
4/4/2001	2
4/4/2001	2
4/4/2001	2
4/10/2001	2
4/10/2001	2
4/10/2001	2
4/17/2001	2
4/17/2001	2
4/17/2001	2.3
4/23/2001	2
4/23/2001	2
4/23/2001	2

Attachment 4 - Unit 2 Discharge Total Copper

Date	Sample results, ppb
7/27/2000	2
7/27/2000	2
7/27/2000	2
8/3/2000	2
8/3/2000	2
8/3/2000	2
8/9/2000	2
8/9/2000	2
8/9/2000	2
8/15/2000	2
8/15/2000	2
8/15/2000	2
8/22/2000	2
8/22/2000	2
8/22/2000	2
8/28/2000	2
8/28/2000	2
8/28/2000	2
9/7/2000	2
9/7/2000	2
9/7/2000	2
9/12/2000	2
9/12/2000	2
9/12/2000	2
9/21/2000	2.7
9/21/2000	3.6
9/21/2000	4.2
9/30/2000	2
9/30/2000	2
9/30/2000	4.1
10/13/2000	2
10/13/2000	2
10/13/2000	2
10/19/2000	2
10/19/2000	2
10/19/2000	5.1
10/25/2000	2
10/25/2000	2
10/25/2000	2
11/3/2000	2
11/3/2000	2
11/3/2000	2
11/8/2000	2
11/8/2000	2
11/8/2000	2
11/16/2000	2
11/16/2000	2
11/16/2000	2
11/21/2000	2
11/21/2000	2
11/21/2000	2
12/1/2000	2
12/1/2000	2

All values < 2 are reported and calculated as = 2.

# of obs (average of 3 samples	32
AVG	2.3
STD DEV	0.51

"T" test at 95% confidence level to identify outliers:

Xhigh	3.7	
Xlow	2	
Thigh	2.686	
Tlow	0.663	
critical T	2.938	Value corres. to # of obs.
Xhigh OUTLIER?	TRUE	True = NO outliers exist.
Xlow OUTLIER?	TRUE	False = outliers exist

Outliers removed: None, all results < 6.1 ppb

Date	Average
7/27/2000	2
8/3/2000	2
8/9/2000	2
8/15/2000	2
8/22/2000	2
8/28/2000	2
9/7/2000	2
9/12/2000	2
9/21/2000	3.5
9/30/2000	2.7
10/13/2000	2
10/19/2000	3.0
10/25/2000	2
11/3/2000	2
11/8/2000	2
11/16/2000	2
11/21/2000	2
12/1/2000	2
12/6/2000	2
12/15/2000	2
12/20/2000	2
12/29/2000	2.8
1/4/2001	2.2
1/10/2001	2.4
1/17/2001	2
1/25/2001	2.8
1/31/2001	2.2
2/8/2001	2.8
2/15/2001	3.4
2/22/2001	3.7
3/7/2001	2.4
3/12/2001	2.8

Attachment 4 - Unit 2 Discharge Total Copper

12/1/2000	2
12/6/2000	2
12/6/2000	2
12/6/2000	2
12/15/2000	2
12/15/2000	2
12/15/2000	2
12/20/2000	2
12/20/2000	2
12/20/2000	2
12/29/2000	3.1
12/29/2000	2.6
12/29/2000	2.6
1/4/2001	2
1/4/2001	2.4
1/4/2001	2.3
1/10/2001	2.4
1/10/2001	2.4
1/10/2001	2.4
1/17/2001	2
1/17/2001	2
1/17/2001	2
1/25/2001	2.9
1/25/2001	2.7
1/25/2001	2.9
1/31/2001	2
1/31/2001	2
1/31/2001	2.5
2/8/2001	2.7
2/8/2001	3
2/8/2001	2.8
2/15/2001	3.2
2/15/2001	3.3
2/15/2001	3.6
2/22/2001	3.4
2/22/2001	4.2
2/22/2001	3.5
3/7/2001	2.2
3/7/2001	2.2
3/7/2001	2.9
3/12/2001	2.7
3/12/2001	2.8
3/12/2001	2.9

Attachment 5 - Intake Total Copper

Date	Sample results, ppb
07/27/00	2
07/27/00	2
07/27/00	2
08/03/00	2
08/03/00	2
08/03/00	2
08/09/00	2
08/09/00	2
08/09/00	2
08/15/00	2
08/15/00	2
08/15/00	2
08/22/00	2
08/22/00	2
08/22/00	2
08/28/00	2
08/28/00	2
08/28/00	2
09/07/00	2
09/07/00	2
09/07/00	2
09/12/00	2
09/12/00	2
09/12/00	2
09/21/00	2.7
09/21/00	3.1
09/21/00	3.4
09/30/00	2
09/30/00	3.2
09/30/00	2
10/13/00	2
10/13/00	2
10/13/00	2
10/19/00	2
10/19/00	2
10/19/00	2
10/25/00	2
10/25/00	2
10/25/00	2
11/03/00	2
11/03/00	2
11/03/00	2
11/08/00	2
11/08/00	2
11/08/00	2
11/16/00	2
11/16/00	2
11/16/00	2
11/21/00	2
11/21/00	2
11/21/00	2
12/01/00	2
12/01/00	2
12/01/00	2
12/06/00	2
12/06/00	2
12/06/00	2

All values < 2 are reported and calculated as = 2.

# of obs (average of 3 samples)	38
AVG	2.2
STD DEV	0.36

"T" test at 95% confidence level to identify outliers:

Xhigh	3.1	
Xlow	2	
Thigh	6.218	
Tlow	0.608	
critical T	3.014	Value corres. to # of obs.
Xhigh OUTLIER?	FALSE	True = NO outliers exist.
Xlow OUTLIER?	TRUE	False = outliers exist

Outliers removed: None, all results < 6.1 ppb

Date	Average
07/27/00	2
08/03/00	2
08/09/00	2
08/15/00	2
08/22/00	2
08/28/00	2
09/07/00	2
09/12/00	2
09/21/00	3.1
09/30/00	2.4
10/13/00	2
10/19/00	2
10/25/00	2
11/03/00	2
11/08/00	2
11/16/00	2
11/21/00	2
12/01/00	2
12/06/00	2
12/15/00	2
12/20/00	2
12/29/00	2.5
01/04/01	2.4
01/10/01	2.5
01/17/01	2
01/25/01	2.9
01/31/01	2.4
02/07/01	3.0
02/15/01	3.0
02/22/01	3
03/07/01	2.5
03/12/01	2.6
03/20/01	2
03/28/01	2
04/04/01	2
04/10/01	2
04/17/01	2
04/23/01	2

Attachment 5 - Intake Total Copper

12/15/00	2
12/15/00	2
12/15/00	2
12/20/00	2
12/20/00	2
12/20/00	2
12/29/00	2.5
12/29/00	2.4
12/29/00	2.5
01/04/01	2
01/04/01	3.2
01/04/01	2
01/10/01	2.5
01/10/01	2.3
01/10/01	2.6
01/17/01	2
01/17/01	2
01/17/01	2
01/25/01	2.4
01/25/01	3
01/25/01	3.2
01/31/01	2
01/31/01	2.8
01/31/01	2.5
02/07/01	2.9
02/07/01	3
02/07/01	3
02/15/01	3
02/15/01	3.2
02/15/01	2.9
02/22/01	3.1
02/22/01	2.9
02/22/01	3
03/07/01	2.4
03/07/01	2.5
03/07/01	2.6
03/12/01	2.6
03/12/01	2.6
03/12/01	2.7
03/20/01	2
03/20/01	2
03/20/01	2
03/28/01	2
03/28/01	2
03/28/01	2
04/04/01	2
04/04/01	2
04/04/01	2
04/10/01	>20
04/10/01	2
04/10/01	2
04/17/01	2
04/17/01	2
04/17/01	2
04/23/01	2
04/23/01	2
04/23/01	2