Public Service Company of Colorado
P.O. Box 840, Denver, Colorado 80201

May 23, 1979
Fort St. Vrain
Unit No. 1
P-79110

Mr. Karl V. Seyfrit, Director
Nuclear Regulatory Commission
Region IV
Office of Inspection and Enforcement
611 Ryan Plaza Drive
Suite 1000
Arlington, Texas 76012

Docket No. 50-267

SUBJECT: I & E Inspection
73-04 Response

Dear Mr. Seyfrit:

This letter is to inform you of the results of the service water system evaluation identified in I & E Inspection Report 73-04.

A corrosion monitoring program was established in 1974 consisting of coupons being placed in the service water system at various locations. The coupons after being exposed to the system were removed and analyzed in accordance with a procedure which meets the intent of NACE Standard TM-01-60, "Laboratory Corrosion Testing of Metals for the Process Industries." Coupon processing results reflect water corrosivity in the form of "mils per year" corrosion rates. (Refer to Attachment 1 for corrosion monitoring program details)

The result of the four year corrosion monitoring program indicate an average service water system corrosion rate of 1.5 mils per year. Such corrosion rates for a polyphosphate and zinc corrosion control system are well within acceptable industrial limits for open cooling water systems.

Based on the above information, we feel the corrosion monitoring program has verified the acceptability of our service water system corrosion treatment program and no further action is required. I & E Inspection Report 73-04 has no remaining open items and is closed by submittal of the attachment document.

Very truly yours,

J. K. Fuller by 7 Edward

J. K. Fuller, Vice President
Engineering and Planning

JKF/vsm

Attachment

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ATTACHMENT I

RESPONSE TO I & E 73-04

CORROSION MONITORING PROGRAM

Service Water System

Fort St. Vrain

NUCLEAR GENERATING STATION

Public Service Company of Colorado
Platteville, Colorado

CONTENTS

INTRODUCTION

In 1974, Public Service Company of Colorado (PSCC) established a corrosion monitoring program for the Service Water System (42) at the Fort St. Vrain Nuclear Generating Station located near Platteville, Colorado. The corrosion monitoring program consisted of exposing mild steel specimens to the water at various locations within the service water system. At periodic intervals (generally 120 days) the specimens were removed, evaluated, and corrosion rates determined. New specimens were installed whenever exposed specimens were removed thus providing a continuous means of determining the corrosion rate.

From the initial data (July, 1974) to the present, the fluctuation in corrosion rates represents the normal variation due to process variables such as temperature and flow. The monitoring period covered by this report is from July, 1974 through September, 1978. During this period, the average corrosion rate for the service water system was 1.5 mils per year.

The corrosion rates varied somewhat during this period, but were less than 5.0 mils per year (mpy). For our system design and corrosion program an optimum corrosion rate of 3 mpy $\pm$ 1 to 2 mpy is desirable. It would appear that the current corrosion rates in this system are under control and well within acceptable limits.

SYSTEM DESCRIPTION

System 42 is a separate cooling water system that provides cooling to a variety of equipment. Corrosion control is maintained by the addition of polyphosphate and zinc solutions to levels of 30 ppm. The pH is controlled by sulfuric acid to a range of 6.8 - 7.0.

TEST PROCEDURES

Test Coupons

All coupons used in this program were prepared and supplied by the Nalco Chemical Company. Coupon evaluation after exposure was performed by Fort St. Vrain chemistry personnel. The test coupons were 3/8" x 3" x 16 gage carbon steel, SAE 1010. Each coupon had been degreased and sandblasted to remove oxides and other surface contaminants. After this cleaning procedure, the coupons were weighed to the nearest 0.1 milligram. The coupons were then carefully stored in an inhibited package until ready for exposure.

Test Probes

Each test probe consisted of a mounting rod, packing gland, and pipe nipple suitable for attaching to a valve. A single test coupon was mounted to the rod in such a manner that it was electrically insulated from any other metallic components. This assured that galvanic (two-metal) corrosion was not present during the test.

At each "probe location" in the subject water system, four valves were provided for corrosion test coupon probes. Therefore, at each location, four coupons were being exposed simultaneously. Since the mounting rod was "retractable", it was possible to insert and/or retrieve each test coupon through the valve without shutting down the water system. When inserted, each corrosion coupon was perpendicular to the water flow.

Test Probe Locations

Six (6) test probe location (not consecutively numbered) were established in the service water system being monitored. Figure 1 (appendix) schematically shows the system and the relative locations of the six test probes.

The locations for the test probes were selected to provide the best overall evaluation of corrosion rates throughout the particular water system. Probes were positioned downstream of heat exchangers to detect the affect of head load on the corrosivity of the water. Low velocity sections were also monitored to verify the inhibitor's effectiveness in these sections.

Coupon Evaluation

Each corrosion test coupon was removed after a specified time period, approximately 120 days. They were then visually examined, cleaned (including an acid wash), dried, and reweighed. The procedures used for coupon evaluation were those of Nalco Chemical Co.

The actual corrosion rate was calculated for each specimen using the following formula:

$$\text{mils per year (mpy)} = \frac{\text{Factor x weight loss (mg)}}{\text{exposure time (days)}}$$

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The factor for these specimens was 1.11, based on the standard coupon size, corrections for units, and the density of SAE 1010 steel. This is a slight modification of the formula specified in NACE Standard TM-01-69 and basically reflects the standardization of coupon size, coupon material, and a slight relaxation of the accuracy of the calculated surface area.

After a group of test coupons was removed, a new set was installed. Corrosion rates were calculated in "mils per year" based on the actual exposure period. Therefore, the reported data is in increments of three months. For a given time period, the reported rate is the average of four (4) coupons.

TEST RESULTS

All corrosion rates were calculated and reported as "mils per year" (mpy), based on the exposure period for any particular coupon. These corrosion rates, therefore, represent the average corrosion rate during the exposure period (approximately 120 days). Within that exposure period, the actual corrosion rate at any one time (instantaneous) may have been higher or lower than what was finally calculated. However, the intent of this program was to monitor the long term trends of the corrosion rates rather than the short term variations.

The six corrosion probe locations were established in this water system (see Fig. 1). The corrosion rates are given in Table I and graphically presented in Figures 2A and 2B (appendix).

During the monitoring period between July, 1974 and September, 1978, the average corrosion rates at each probe location were as follows:

Probe 1 - 0.7 mpy

Probe 3 - 1.0 mpy

Probe 4 - 2.0 mpy

Probe 5 - 1.6 mpy

Probe 6 - 1.3 mpy

Probe 2 - 1.6 mpy

The overall average of all six probes in the system was 1.5 mpy. All probe locations exhibited similar patterns as the corrosion rates varied.

CONCLUSION

The Service Water System (System 42) corrosion rate of 1.5 mpy certainly falls within the expected corrosion rates for an inhibited, open cooling water system. There were periods when the corrosion rates fluctuated, but this is not abnormal for a cooling water system that is subject to system variation for heat load and flow.

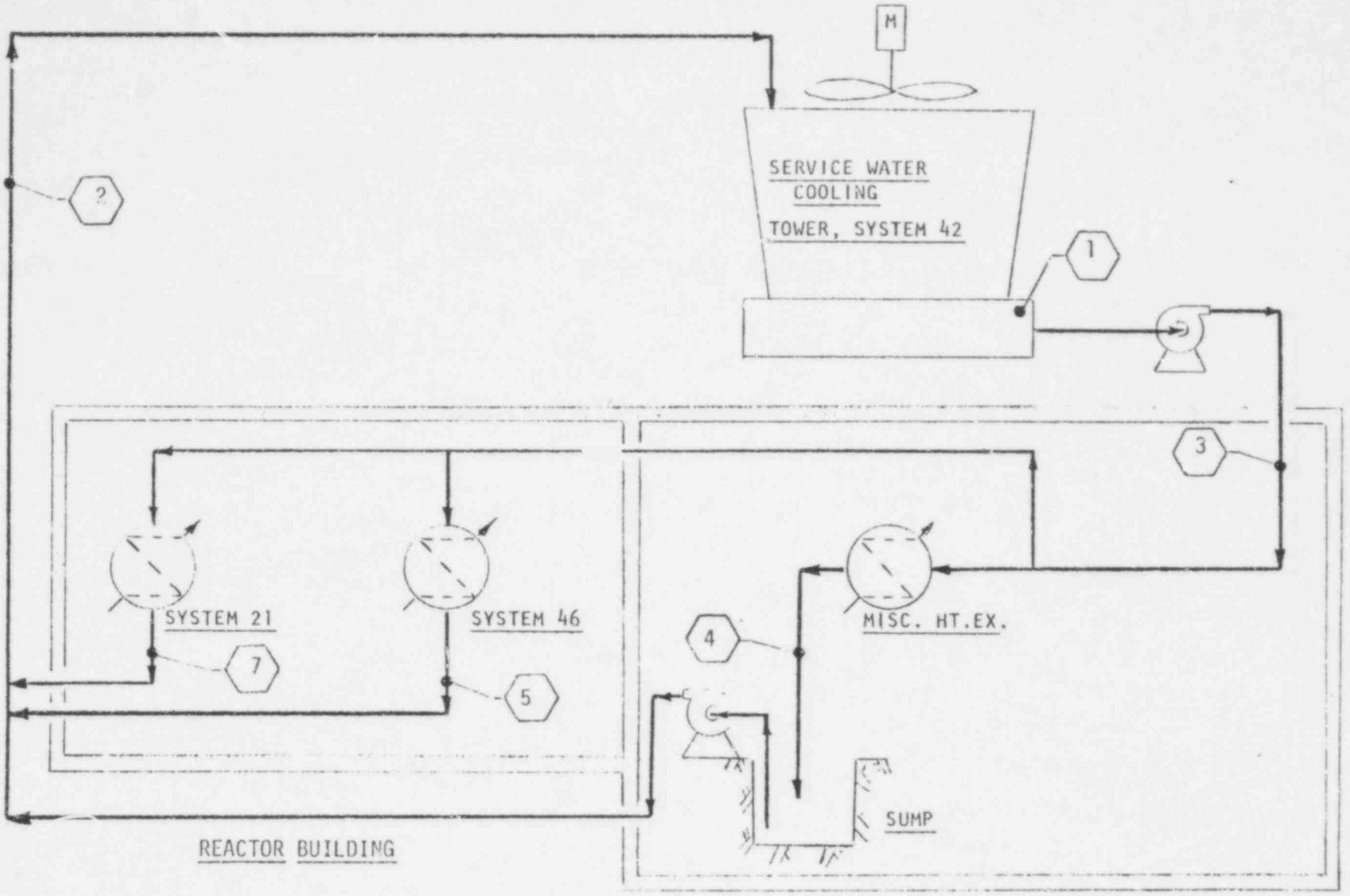
A review of Figures 2A and 2B reveal two corrosion trends which are typical in power plant cooling water systems. The first is a cyclic corrosion rate whose period is approximately one year. The cycle is a result of atmospheric temperature changes associated with seasonal variations. The second is a gradual increasing trend which starts in the later part of 1976. It would appear that the corrosion rate trend somewhat follows or is related to the power output of the plant since the increasing trend starts at approximately the same time Fort St. Vrain first generated power. This correlation is very feasible since corrosion rates increase with increasing temperatures. This gradual increasing trend appears to increase the 1976 to 1978 seasonal high by about one mil per year which is acceptable from a system corrosion viewpoint.

During the period of monitoring the corrosion rates, the most significant upset in corrosion rates occurred at probe location No 7. Upsets of this sort are not uncommon when changes in plant operation can affect the temperature and/or velocity in a cooling water system. In addition, changes in the water treatment program that were made for long

term improvement of the system can sometimes cause short term upsets. More recent data indicates the corrosion rate of location 4 is below 3.0 mpy.

Typical cooling water systems that are treated with polyphosphates, zinc and under good pH control can be expected to have corrosion rates in the range of 2.0 - 3.5 mpy. The corrosion rates indicated for System 42 fall within the acceptable ranges for the type of treatment being used. With the exception of occasional system upsets, it would appear that the service water system at the Fort St. Vrain station is under acceptable corrosion control.

APPENDIX



FORT ST. VRAIN
NUCLEAR GENERATING PLANT
SERVICE WATER, SYSTEM 42

CORROSION TEST SPECIMEN LOCATIONS

FIGURE 1

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TABLE 1

SERVICE WATER SYSTEM 42

PROBES 1, 3, 4, 5, 7 and 2

Average Rates: Probe 1: 0.7 mpy Probe 5: 1.6 mpy
Probe 3: 1.9 mpy Probe 7: 1.3 mpy
Probe 4: 2.0 mpy Probe 2: 1.6 mpy

CORROSION RATE, mpy

DATE	PROBE 1	PROBE 3	PROBE 4	PROBE 5	PROBE 7	PROBE 2
July 1974	0.5	1.5	1.6	1.7	2.1	1.0
Aug. 1974	0.4	1.4	1.5	1.3	1.0	0.8
Sept.1974	0.4	1.4	1.5	1.3	1.0	0.8
Oct. 1974	0.5	1.2	2.1	1.5	0.8	0.9
Nov. 1974	0.5	1.2	2.1	1.5	0.8	0.9
Dec. 1974	0.9	1.6	3.3	2.5	1.1	1.4
Jan. 1975	1.1	2.4	3.8	3.1	1.4	1.8
Febr.1975	1.1	2.4	3.8	3.1	1.4	1.8
Mar. 1975	0.9	1.8	2.5	2.4	1.9	1.3
Apr. 1975	0.5	0.8	0.9	1.0	1.3	0.7
May 1975	0.5	0.8	0.9	1.0	1.3	0.7
June 1975	0.2	0.5	0.3	0.7	0.8	0.4
July 1975	0.2	0.4	0.2	0.8	1.0	0.3
Aug. 1975	0.2	0.5	0.2	0.9	1.0	0.3
Sept.1975	0.2	0.6	0.3	0.7	1.0	0.4
Oct. 1975	0.2	0.8	0.5	0.7	0.6	0.5
Nov. 1975	0.2	0.9	0.7	0.7	0.4	0.7
Dec. 1975	0.2	1.0	0.9	0.6	0.3	0.8
Jan. 1976	0.3	1.2	1.0	0.6	0.3	0.8
Febr.1976	0.3	1.0	1.1	0.6	0.3	0.8
Mar. 1976	0.4	1.3	1.3	0.6	0.3	1.0
Apr. 1976	0.4	1.4	1.6	0.6	0.4	1.1
May 1976	0.4	1.5	1.9	0.6	0.5	1.4
June 1976	0.4	1.9	2.3	0.7	0.5	1.8
July 1976	0.5	2.1	2.1	0.8	0.5	2.1
Aug. 1976	0.5	2.4	2.5	1.0	0.5	2.5
Sept.1976	0.6	2.4	2.4	1.2	0.6	2.5
Oct. 1976	0.5	2.2	2.2	1.3	0.7	2.2
Nov. 1976	0.5	1.9	2.5	1.2	0.7	1.9
Dec. 1976	0.6	1.6	2.0	1.1	0.8	1.5
Jan. 1977	0.6	1.5	1.7	1.1	0.9	1.4
Febr.1977	0.6	1.5	1.7	1.0	0.9	1.3
Mar. 1977	0.7	1.6	1.4	1.3	0.9	1.3
Apr. 1977	0.8	1.6	1.5	1.5	1.0	1.5
May 1977	0.8	1.6	1.6	1.8	1.2	1.9
June 1977	0.9	2.3	1.9	2.0	1.7	2.1
July 1977	0.9	2.5	2.0	2.0	1.9	2.3
Aug. 1977	0.9	2.4	2.4	1.9	2.3	2.2
Sept.1977	1.0	2.8	2.7	1.8	2.4	2.4
Oct. 1977	1.1	2.9	2.7	1.9	2.1	2.4
Nov. 1977	1.2	2.8	2.9	2.0	2.0	2.2
Dec. 1977	1.2	3.1	2.9	2.1	1.7	2.6

TABLE 1 (continued)

CORROSION RATE, mpy

DATE	PROBE 1	PROBE 3	PROBE 4	PROBE 5	PROBE 7	PROBE 2
Jan. 1978	1.2	3.1	3.1	2.2	1.6	2.7
Febr.1978	1.3	2.9	3.3	2.4	2.7	2.9
Mar. 1978	1.4	3.2	3.6	3.1	2.9	3.3
Apr. 1978	1.6	3.4	3.7	3.2	3.1	3.4
May 1978	1.7	3.2	3.6	3.3	3.0	3.2
June 1978	1.6	3.2	3.4	3.1	1.7	[illegible]0
July 1978	1.4	2.8	2.9	2.6	2.6	[illegible]6
Aug. 1978	1.3	2.4	2.7	2.4	2.0	2.4
Sept.1978	1.1	2.2	2.4	2.2	2.1	1.9

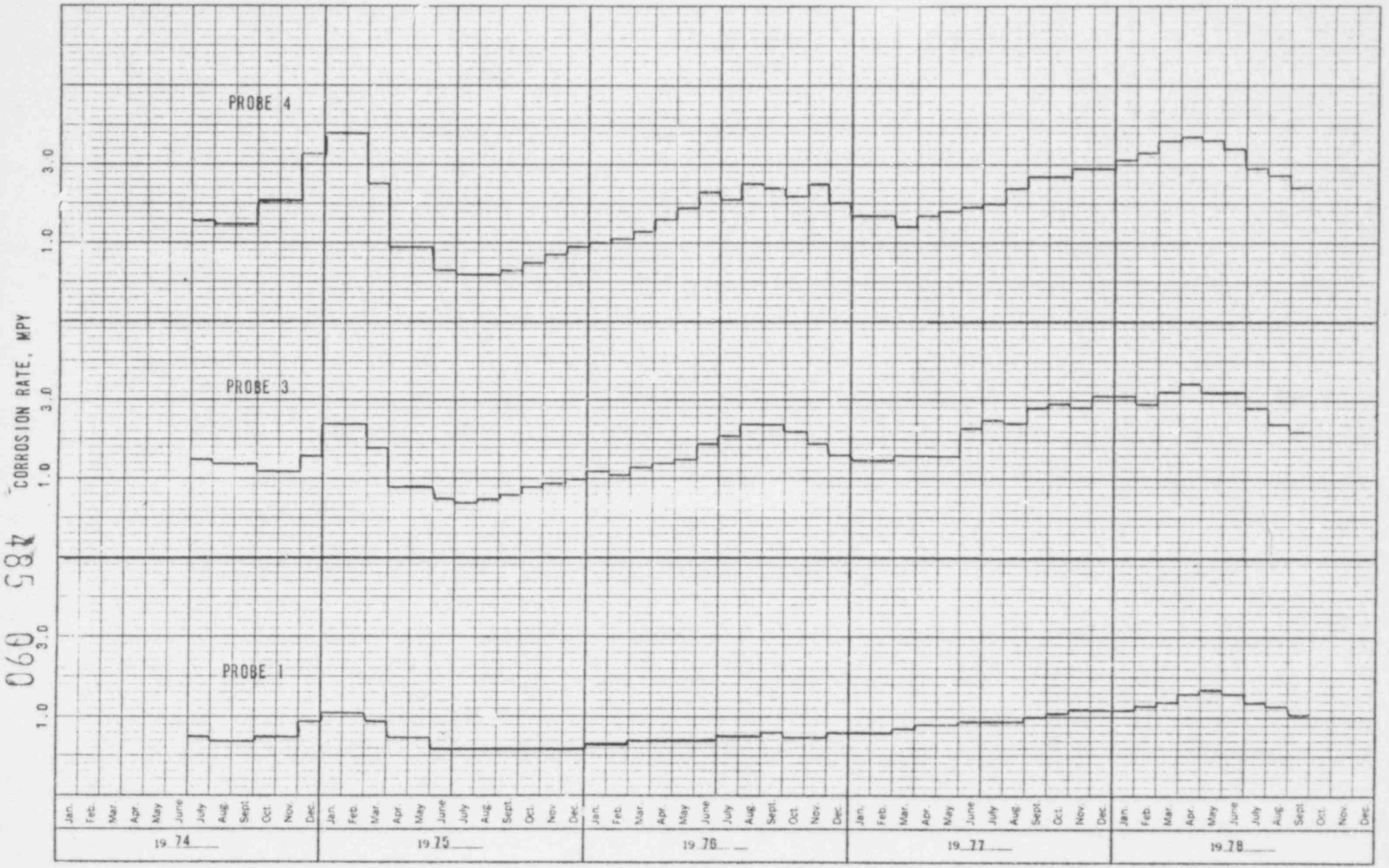

FIGURE 2A
CORROSION RATE vs TIME
SERVICE WATER, SYSTEM 42

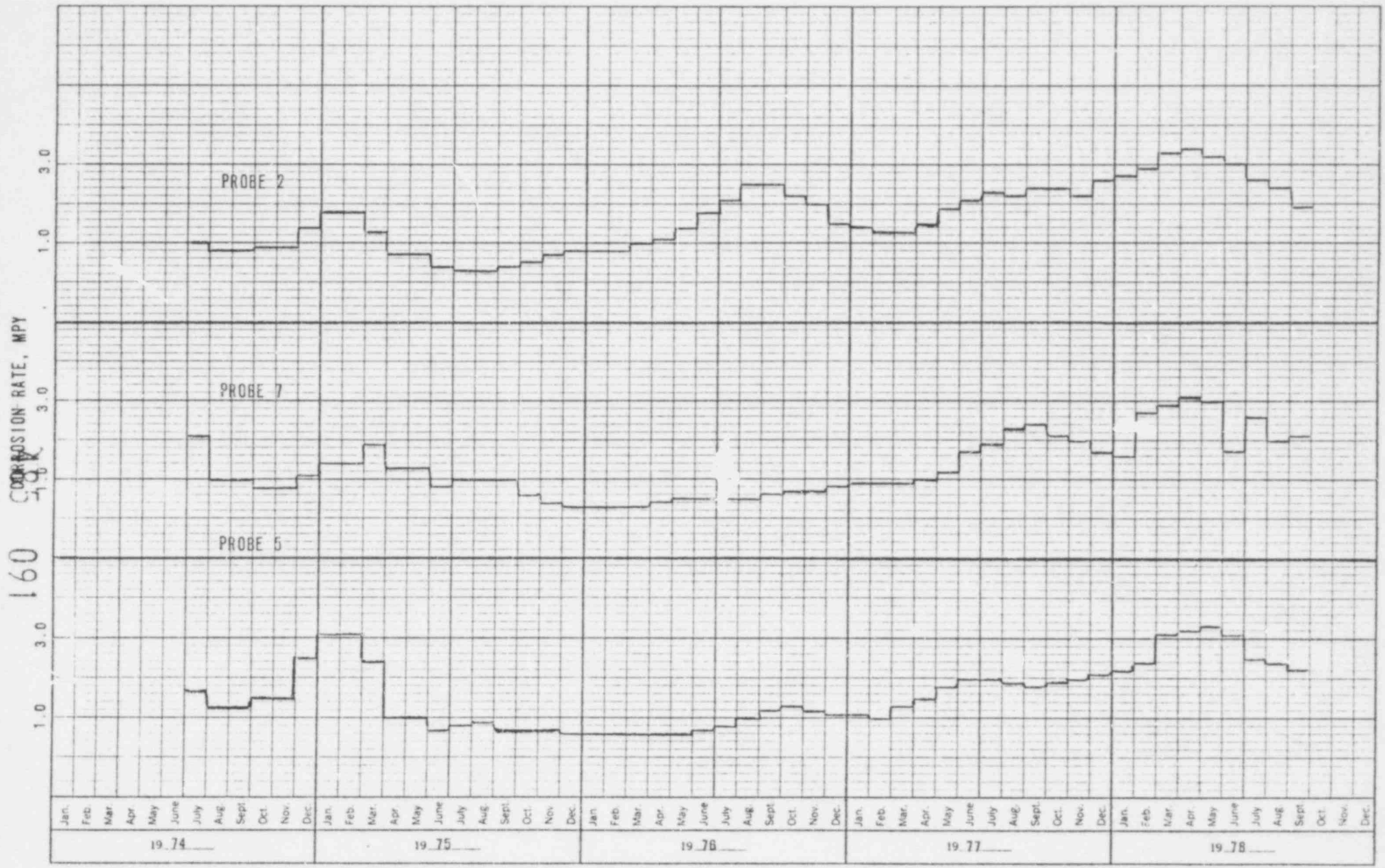

FIGURE 2B
CORROSION RATE vs TIME
SERVICE WATER, SYSTEM 42