SUA - 1228

NINE MILE LAKE

REVIEW OF OPERATIONS

APRIL 1980

SUA-1228

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INTRODUCTION

An in situ uranium leaching experiment was operated at Rocky Mountain Energy Company's Bear Creek test site during the summer and fall of 1975. The project was relocated to the Nine Mile Lake site under an Amendment to the Source Material License SUA-1228, granted to the RMEC-Mono Power-Halliburton Joint Venture in October, 1976. A winterized pilot plant was built during 1976, and a test pattern of injection and recovery wells was drilled. The pilot plant included a series of ion exchange columns for uranium recovery, a uranium precipitation circuit and a lixiviant makeup circuit.

GENERAL SITE GEOLOGY

The Nine Mile Lake site is covered by quarternary deposits, alluvial material which overlies the Lewis Shale Formation of Upper Cretaceous Age. The Mesaverde Formation underlies the Lewis Shale. The Lewis Shale is predominently shale and contains only thin lenses of sandstone or sandy shale. The Mesaverde Formation contains three members; the Parkman Sandstone is the lowest and consists of sandstone ranging in thickness from 50 feet to 500 feet; the middle member consists of alternating beds of shale and sandstone ranging in thickness from 60 feet to 340 feet and is known as the Pumpkin Buttes Shale; the Teapot Sandstone is the upper member and consists of fine-to-medium-grained sandstone ranging in thickness from 50 feet to 115 feet. Figure 1 shows a generalized cross section of typical site geology. The mineralized section occurs in the upper portion

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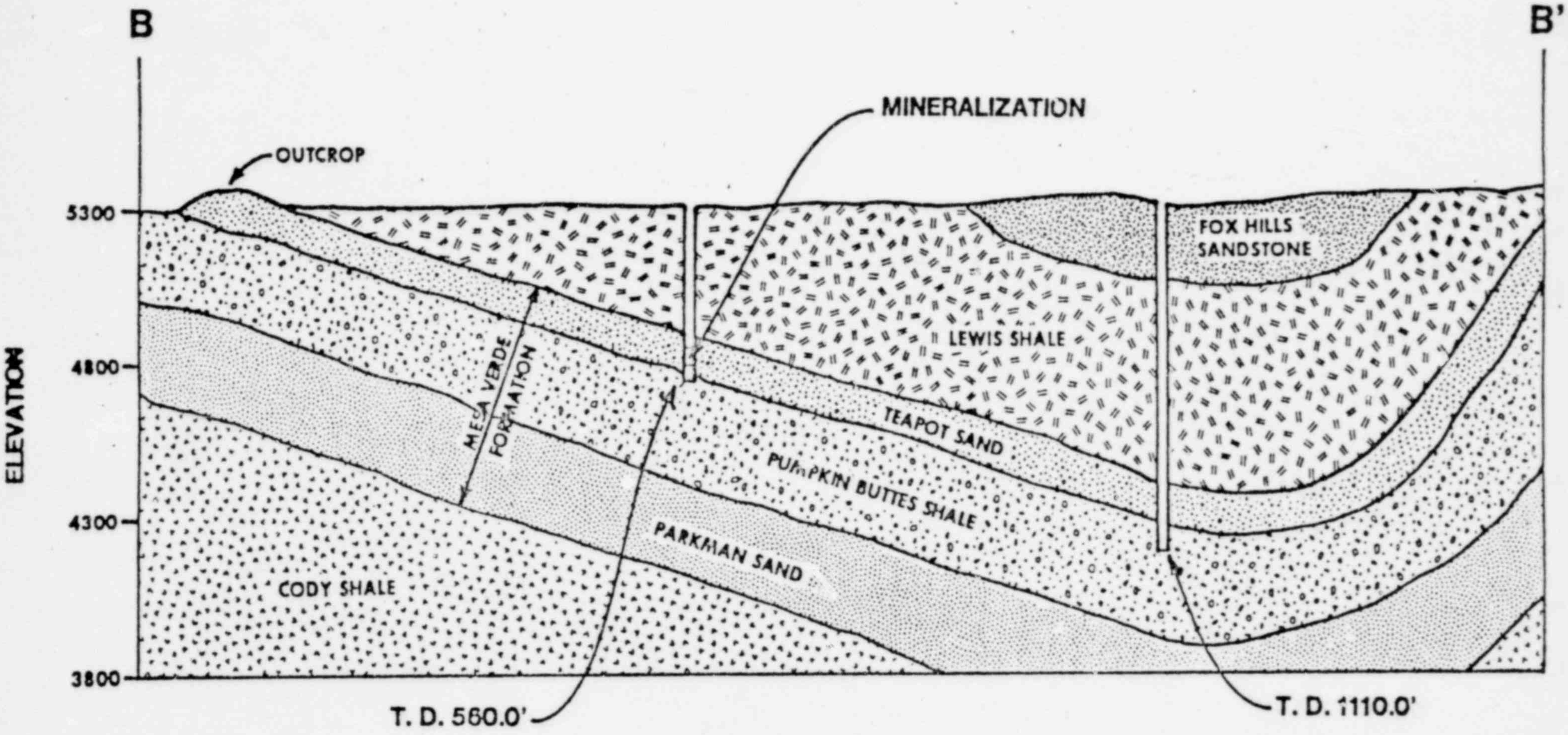

SECTION B-B' ACROSS ORE BODY

FIGURE I

of the Teapot Sandstone and ranges from 20 to 35 feet in thickness. Depths to the uranium mineralization average 500 feet.

The mineralized portion of the Teapot Sandstone is the geologic strata of interest to operations at Nine Mile Lake. Generally, Mesaverde Formation water wells yield 50 gpm (190 l/min.) or more in areas of secondary permeability and high artesian pressure. Only three stock wells exist within a two mile radius of the test site, ranging in depth from 204 to 488 feet (62-149 meters) and generally produce less than 15 gpm (56 l/min.). Groundwater within the Teapot Sandstone is generally of poor quality and is characterized by high levels of sodium sulfate, calcium, bicarbonate and TDS.

PHYSICAL FACILITIES

Surface facilities consist of a process plant, offices, laboratories, generator and storage facilities, and two evaporation ponds. Drawing number 001 shows the surface facilities. The recently constructed treated water reservoir is the small pond located south of the old evaporation reservoir.

OPERATIONS

Pattern #1, drilled in 1976, was a 50-foot radius seven-spot. Production commenced in November of 1976. Initially, wells were constructed in 5-inch PVC pipe, stainless steel screens in the ore sands and cement baskets. The glued joints of the PVC proved unsatisfactory and, hence, a heavy duty PVC casing with locking joints (Yelomine®) was substituted with good results.

Cement baskets proved unsatisfactory at 500 feet and were abandoned for displacement-type well completions. Epoxy-coated submersible pumps corroded and were replaced with stainless steel models. The composition of the lixiviant averaged about 4 g/l

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sulfuric acid, 0.5 g/l iron sulfate and 0.5 g/l hydrogen peroxide. Injection rates averaged 9 gpm per well with production at 40 gpm (151 l/m). Approximately two pore volumes of lixiviant were injected before the testing was stopped.

Results were disappointing in Pattern #1. The wells became plugged with a resultant loss of flow. Attempts to clean the wells were unsuccessful. Uranium recovery was low, primarily due to plugging and possible channeling between the injection wells and the recovery well.

Pattern #2 was drilled during the summer of 1977. The pattern was a 50-foot radius five-spot. The wells were cemented through the entire sand formation and perforated with a water jet. All wells were cased with 5-inch heavy duty PVC. Leaching commenced during the fall of 1977, with 3.0 to 4.0 g/l of H_2SO_4 and 1.0 g/l H_2O_2. No iron sulfates were added. Injection rates were set at 10 gpm for each of the four injectors. Production was maintained at 42 gpm.

Pattern #2 injectivity was further improved by bullet perforation of the production zone. Occasionally, injectivity rates declined; however, injectivity was quickly restored by air-lifting. Uranium pregnant liquor grade was good, averaging approximately 75 mg/l. Scaling and plugging problems were minimal. All in all, the Pattern #2 leaching effort was quite successful.

As part of the pilot testing program, the test patterns were restored after the leaching phase. Pattern #1 was restored with a clean water sweep. This restoration method was water intensive, resulting in a significant amount of water lost to the evaporation pond. Pattern #2 was restored by treating and reinjecting a high percentage of the affected water. The basic restoration circuit consisted of a lime addition step to neutralize acid and precipitate radionuclides and heavy metals, removal of calcium by soda ash precipitation and removal of remaining sodium sulfate by reverse osmosis (R/O). The R/O product was reinjected while the concentrated brine was discharged to the evaporation pond. This restoration circuit began operation in November of 1978, and by September of 1979, Pattern #2 water quality had been restored to the original use category. Appendix A describes Pattern #2 restoration and water quality analyses.

A third well pattern was drilled during 1978. Figure 2 shows the location of Patterns 1, 2, and 3. Acidification commenced in Pattern #3 during the final stages of Pattern #2 restoration. The pattern is a modified seven-spot consisting of six injection wells, each of which is completed into two separate ore zones, one above the other. Instead of one recovery well, Pattern #3 has two wells, one for each ore zone. A primary goal of Pattern #3 is to simultaneously leach the two stacked ore zones. A problem controlling the lixiviant was encountered during the later part of 1979. Because of difficulty in selectively controlling injection rates, the lixiviant flowed at a much greater rate through the upper zone, creating problems controlling the solution. As a result, leachate was detected in two of the four monitor wells in November. Subsequent sampling confirmed the excursion status. However, the excursion was quickly brought under control by means of over-production and separation of the two zones with packers, which permitted better control of injection rates. Appendix B describes the excursion verification chronology and subsequent corrective actions which were taken to control the excursion.

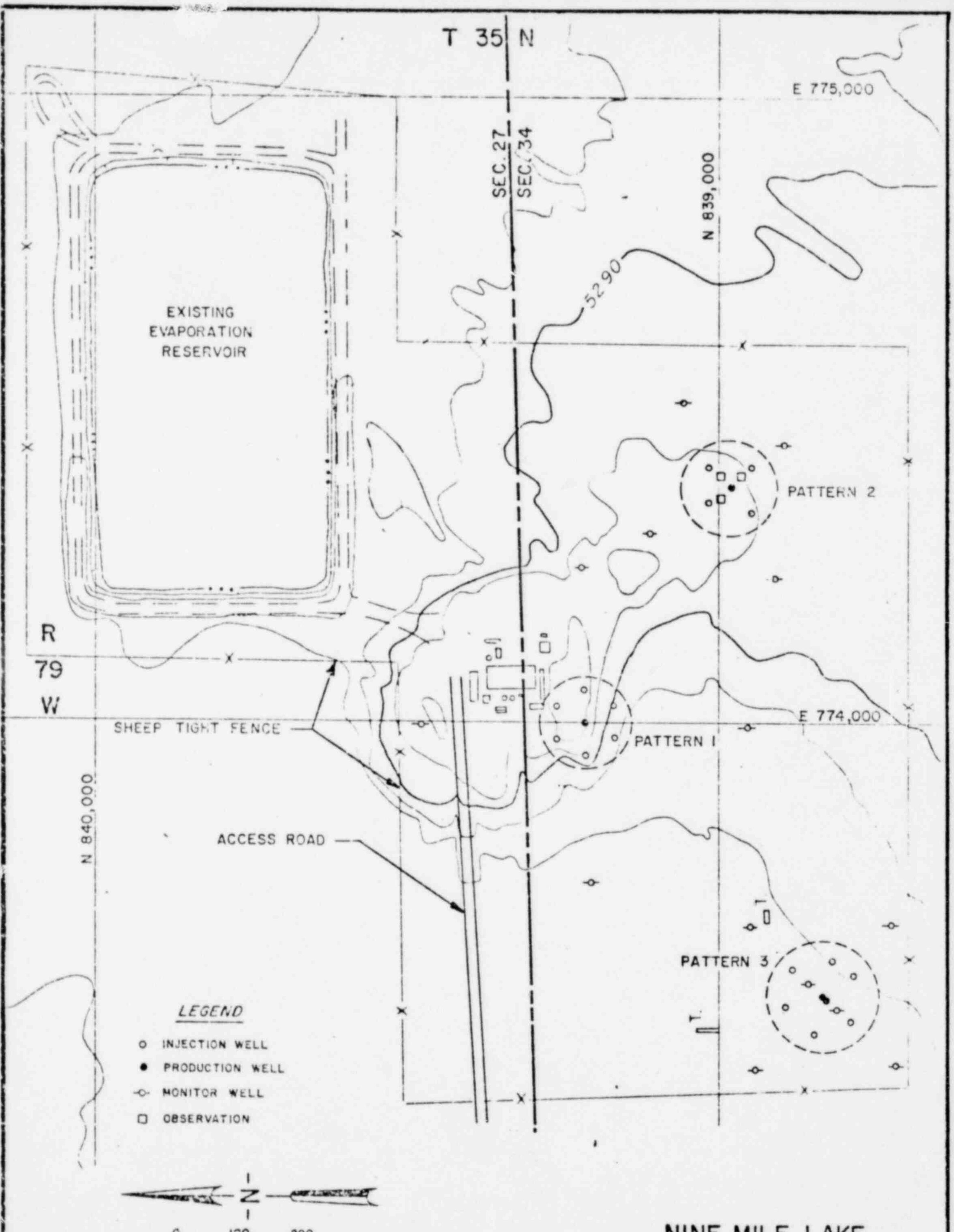

FIGURE 2

NINE MILE LAKE
PILOT PLANT
PLOT PLAN

A new evaporation reservoir was constructed within the existing permit area for the purpose of providing additional pond capacity while bringing the excursion under control. The new reservoir was designed to contain water discharged from a lime neutralization circuit at a nominal rate of 10 gpm (37 l/m) with solid waste containing heavy metals and radionuclides routed to the old evaporation pond. Appendix C is a copy of the DEQ, Water Quality Division, approved permit to construct a reservoir.

Additional goals of Test Pattern #3 were to evaluate oxidants other than hydrogen peroxide. Peroxymono-sulfuric acid (H_2SO_5), a compound prepared by combining sulfuric acid and hydrogen peroxide, was evaluated from October of 1979, until mid-February of 1980. Preliminary results indicate the product to be a viable alternative to adding sulfuric acid and hydrogen peroxide separately. Efforts during the latter half of February and March were directed at testing oxygen as an oxidant. As of April 1, 1980 all injection into Pattern #3 was terminated.

Production from both the upper and lower ore zones was initiated at 5 gpm (18 l/m) from wells P-50 and P-53 for a total production flow of 10 gpm (37 l/m). Production liquor from the two wells is conveyed to the plant where it is passed through the ion exchange resin to remove uranium. From the ion exchange columns, the production flow passes to the lime treatment circuit. When uranium in the production liquor becomes depleted, the production liquor will flow directly to the lime treatment circuit. The liming treatment precipitates most of the heavy metals and radionuclides which are discharged in the sludge underflow to the old evaporation reservoir. Barium chloride is also added in this step to precipitate Ra 226 in the solid underflow. The overflow from the lime treatment circuit, now low in heavy metal and radionuclide content, is discharged to the clay lined treated water reservoir.

Pattern #3 production will continue with no injection until Pattern #4 leaching begins. Production will continue at a rate which will ensure that a hydraulic gradient toward the pattern interior will be maintained during this"holding" phase.

PROPOSED ACTIVITIES

Laboratory investigations during 1979 and 1980 have indicated carbonate leaching systems may be a viable alternative to acid. Preliminary laboratory results indicate the carbonate lixiviants may have certain environmental, as well as operational, advantages over acid. For these reasons, RMEC has submitted an amendment request to the NRC for the purpose of modifying the current source material license to permit the evaluation of alternative lixiviants.

RADIOLOGICAL SAMPLING AND MONITORING PROGRAMS

The following section presents results of the radiological sampling program at Nine Mile Lake. The program consists of a number of preoperational (both pilot and commercial scale) and operational sampling programs designed to assess potential impacts of mining operations on the occupational environment, the subsurface environment and the general surface environment.

All data collected to date indicates that radiological impacts to plant personnel, groundwater quality and surface biota have been negligible.

Preoperational radiological data collection was begun in 1977. Environmental sampling stations for groundwater and air particulates were established at the locations shown on Drawing number C-100.

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The particulate sampling stations are located at the upwind boundary (Site 5), at the downwind boundary of the pilot plant site (Site 3), downwind of the proposed commercial plant site (Site 6) and downwind of the proposed commercial reservoir site (Site 7).

Surface soil, vegetation, air particulate and radon gas samples which have been collected since 1977 are summarized in Tables 1, 2 and 3. The graphs following Table 2 (4 pages) plot radon gas values for the four field locations and the pregnant liquor tank. Naturally, the pregnant liquor tank values represent data gathered during the pilot plant operational mode.

Table 4 presents baseline water quality results of radiochemical analysis. The regional monitor wells are also shown on Drawing number C-100. These wells are sampled on a quarterly basis for the purpose of establishing regional groundwater quality.

OPERATIONAL RADIOLOCAL MONITORING

During 1977 and 1978, the Nine Mile Lake Project participated in an EPA study on continuous Radon Progeny sampling. The sampler was located within the pilot plant in a high traffic area adjoining the pregnant liquor tank.

The Radon Progeny Integrating Sampling Unit (RPISU)-thermoluminescent dosimeter (TLD) sampler was developed by Colorado State University in Fort Collins, Colorado, with funds provided by the U. S. Environmental Protection Agency (EPA).

The sampler operates on 115 volt AC line current and utilizes a Dyna-Vac pump assembly. The sampler includes a running time meter, a pressure cutoff switch, and a temperature cutoff switch.

TABLE 1

PREOPERATIONAL RADIOMETRIC ANALYSIS OF SOILS

NINE MILE LAKE PROJECT

Analysis pCi/g*	Sample Date	Site 5	Site 6	Site 7
Natural Uranium	August 1978	6.09	12.2	6.09
Natural Uranium	August 1979	0.63	0.72	0.69
Thorium-230	August 1978	2.7 ± 1.0	4.6 ± 1.2	3.6 ± 1.1
Thorium-230	August 1979	1.7 ± 1.2	1.9 ± 1.5	3.5 ± 2.3
Radium-226	August 1978	0.7 ± 0.5	0.4 ± 0.4	1.9 ± 1.6
Radium-226	August 1979	2.44 ± 0.39	0.91 ± 0.26	2.24 ± 0.37
Lead-210	August 1978	0.0 ± 0.6	0.1 ± 0.8	0.6 ± 0.7
Lead-210	August 1979	1 ± 1	1 ± 1	1 ± 1

PREOPERATIONAL RADIOMETRIC ANALYSIS OF RANGE GRASS

Analysis pCi/gram*	Sample Date	Site 5	Site 6	Site 7
Natural Uranium	August 1978	0.58	0.58	0.58
Natural Uranium	August 1979	0.01	0.13	0.09
Thorium-230	August 1978	0.04 ± 0.06	0.09 ± 0.07	0.07 ± 0.06
Thorium-230	August 1979	1.22 ± 0.56	0.31 ± 0.12	0.07 ± 0.03
Radium-226	August 1978	0.06 ± 0.10	0.05 ± 0.11	0.16 ± 0.17
Radium-226	August 1979	0.62 ± 0.17	0.91 ± 0.13	0.16 ± 0.05

* Results expressed as pCi/g dry weight.

PREOPERATIONAL RADIOMETRIC ANALYSIS OF RABBIT TISSUE

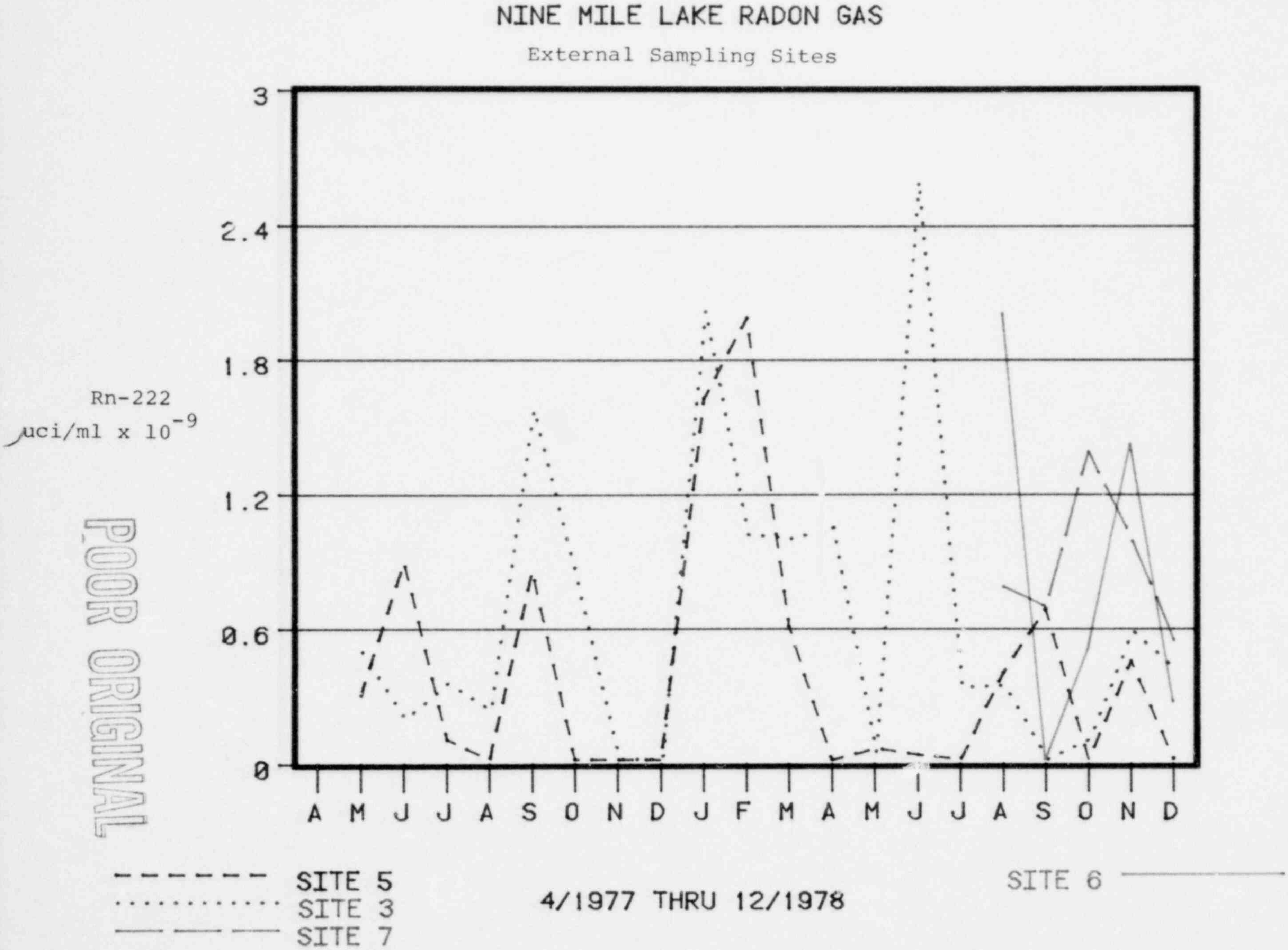
Analysis pCi/g	August 1978	August 1979
Uranium	0.29	0.18
Thorium-230	0.04 ± 0.02	4.09 ± 1.18
Radium-226	0.05 ± 0.02	0.14 ± 0.04
Polonium-210	0.00 ± 0.03	0.10 ± 0.20
Lead-210	0.00 ± 0.03	0.00 ± 0.15

TABLE 2

RADON GAS
NINE MILE LAKE PROJECT
MICROCURIES PER MILLITER X 10^{-9}

Date	Site #5 Upwind Location (Control)	Site #3 Downwind Test Facility Pond	Site #7 Downwind Commercial Pond Site	Site #6 Downwind Commercial Plant Site	Pregnant* Liquor Tank
April, 1977	0.00	0.00			
May	0.31	0.50			
June	0.90	0.20			
July	0.11	0.36			185.70
August	0.00	0.24			31.88
September	0.86	1.58			18.56
October	0.00	0.83			60.55
November	0.00	--			94.88
December	0.00	0.00			--
January, 1978	1.63	2.02			102.26
February	1.99	1.02			35.31
May	0.61	1.00			14.31
April	0.00	1.05			6.28
May	0.07	0.05			4.75
June	0.04	2.60			12.30
July	0.00	0.34			--
August	0.41	0.35	0.79	2.01	1.49
September	0.69	0.00	0.70	--	8.51
October	0.00	0.11	1.39	0.52	2.06
November	0.46	0.59	1.01	1.43	10.91
December	0.00	0.42	0.55	0.28	1.23
January, 1979	--	--	1.68	--	11.42
February	1.32	0.90	0.79	0.00	17.92
March	0.46	0.30	0.99	0.42	34.53
April	0.90	--	0.95	0.37	36.48
May	2.51	1.53	1.14	1.26	43.50
June	--	--	--	--	24.79
July	1.09	1.48	3.93	--	91.05
August	--	--	2.53	--	--
September	3.21	0.75	0.00	0.00	6.09
October	0.12	0.26	0.27	0.24	6.99
November	0.91	0.96	0.39	0.55	0.94
December	--	--	0.39	--	9.45
January, 1980	0.20	--	0.08	0.07	3.15
February	0.24	0.18	0.35	0.21	7.91
March	0.27	0.22	--	0.28	4.49

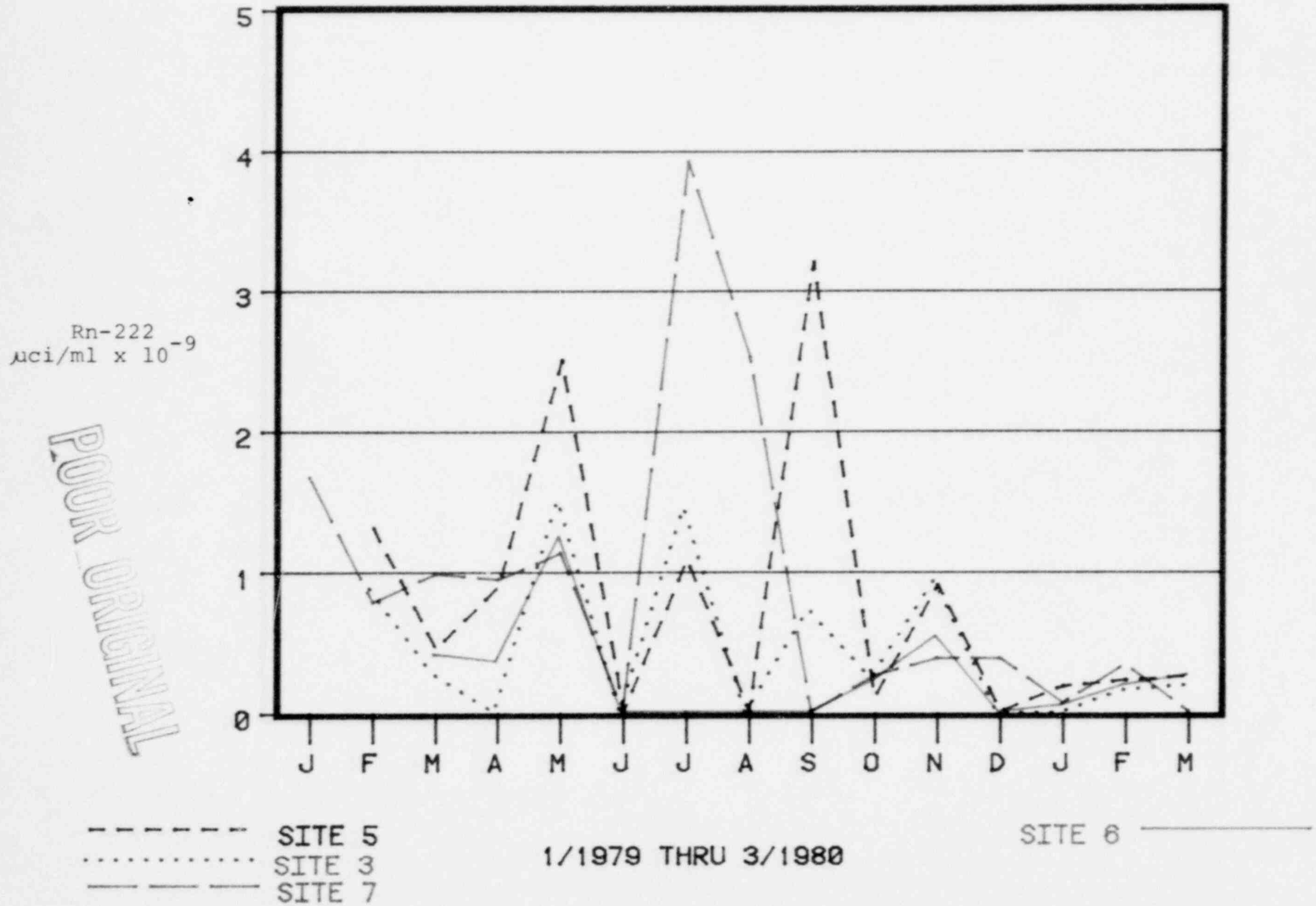
*Sampler located adjacent to pregnant liquor tank near operator sample station.



NINE MILE LAKE RADON GAS
External Sampling Sites
Rn-222
µci/ml x 10^-9
3
2.4
1.8
1.2
0.6
0
A M J J A S O N D J F M A M J J A S O N D
SITE 5
SITE 3
SITE 7
SITE 6
4/1977 THRU 12/1978

NINE MILE LAKE RADON GAS

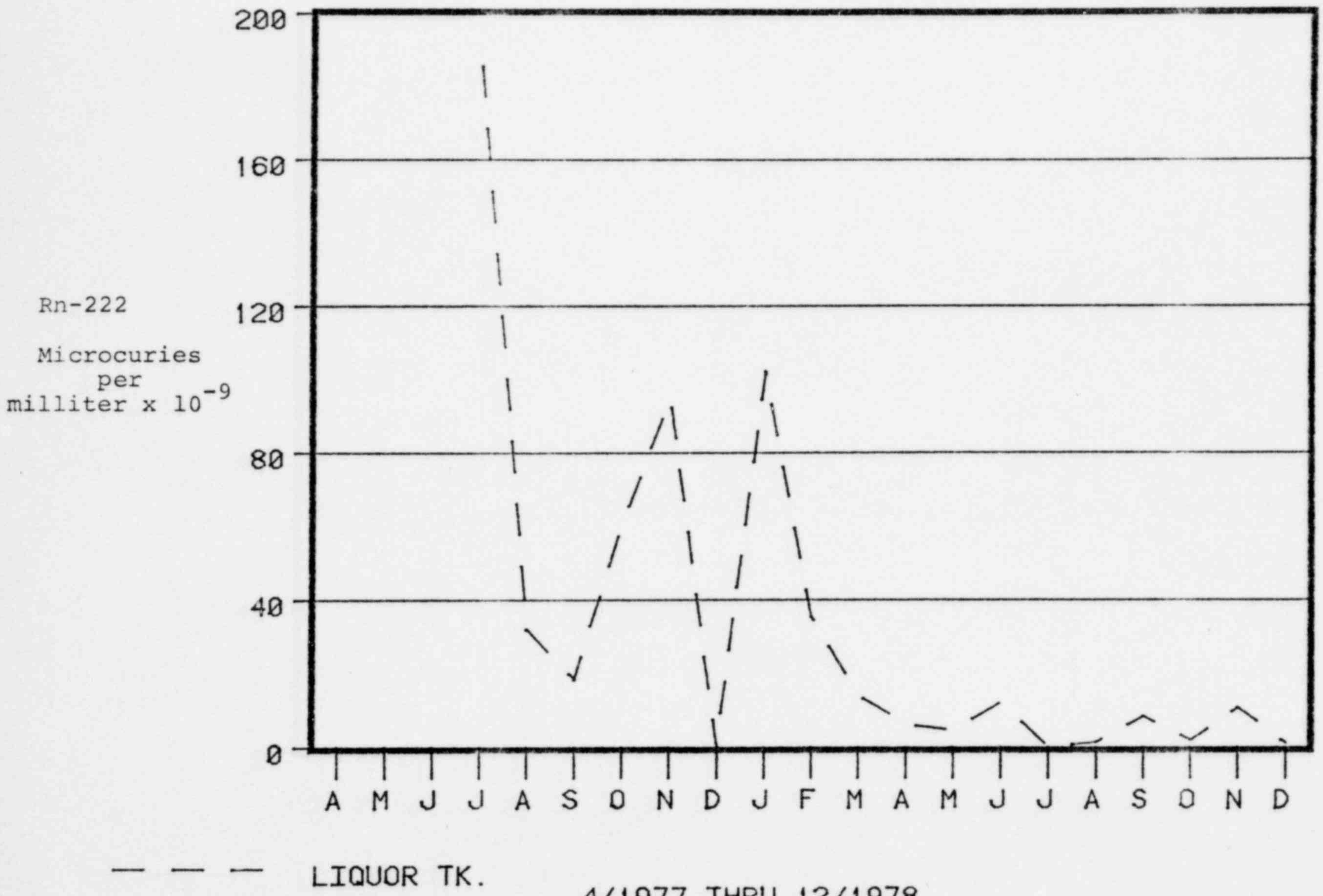
External Sampling Sites



1/1979 THRU 3/1980

NINE MILE LAKE RADON GAS

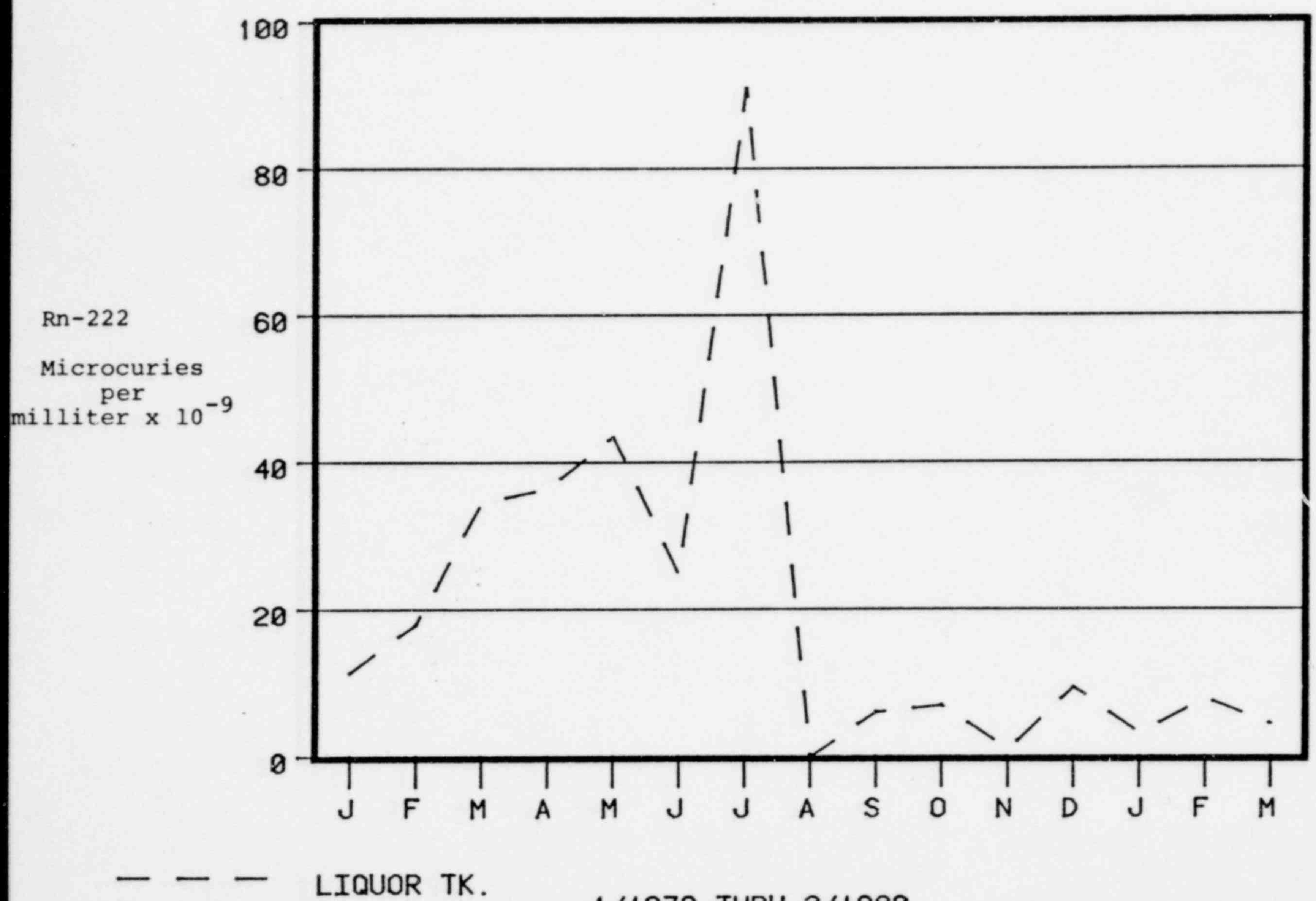
Sampling Site Adjoining Pregnant Liquor Tank



4/1977 THRU 12/1978

NINE MILE LAKE RADON GAS

Sampling Site Adjoining Pregnant Liquor Tank



1/1979 THRU 3/1980

TABLE 3

AIRBORNE RADIOACTIVE PARTICULATES
NINE MILE LAKE ISL PROJECT
AIR QUALITY STATION #3 (DOWNWIND OF TEST FACILITY EVAPORATION POND)

Date	Uranium 10^{-16} µCi/ml	Radium-226 10^{-16} µCi/ml	Thorium-230 10^{-16} µCi/ml
November, 1976	15.7	0.0	3.0
December	--	--	--
January, 1977	10.9	0.0	0.5
February	6.8	0.9	0.5
March	9.0	0.0	1.0
April	5.6	3.1	0.0
May	37.3	1.0	2.5
June	--	--	--
July	10.6	3.6	2.1
August	96.3	1.1	0.6
September	2.2	0.0	0.0
October	41.8	5.3	0.0
November	27.8	12.0	4.1
December	16.2	14.0	0.6
January, 1978	2.7	5.9	2.1
February	2.0	2.4	1.9
March	16.8	1.1	2.7
April	14.9	3.9	4.9
May	324.0	11.0	24.0
June	26.0	3.4	8.0
July	22.0	9.1	2.7
August	14.0	11.0	12.0
September	88.0	9.6	6.4
October	6.8	4.0	11.0
November	18.0	6.4	12.0
December	46.0	10.0	76.0
January, 1979	22.0	4.4	36.0
February	16.0	3.9	3.4
March	7.0	8.0	2.0
April	2.4	2.5	9.1
May	0.5	2.0	1.0
June	4.4	2.0	1.0
July	9.0	7.0	0.0
August	55.6	10.7	14.0
September	6.0	4.0	0.0
October	20.0	14.0	4.0
November	8.0	3.0	1.0
December	9.0	5.0	8.0

TABLE 3 (Continued)

AIRBORNE RADIOACTIVE PARTICULATES
NINE MILE LAKE ISL PROJECT
AIR QUALITY STATION #5 (UPWIND)

Date	Uranium 10^{-16} uCi/ml	Radium-226 10^{-16} uCi/ml	Thorium-230 10^{-16} uCi/ml
November, 1976	5.0	0.5	0.5
December	--	--	--
January, 1977	6.9	3.6	1.0
February	16.0	0.6	1.8
March	14.5	2.1	0.0
April	7.4	3.0	0.0
May	--	--	--
June	24.7	0.0	6.8
July	36.9	3.6	2.7
August	177.9	3.3	0.0
September	8.3	3.0	0.0
October	80.2	5.9	0.0
November	57.5	34.0	8.0
December	16.9	12.0	1.4
January, 1978	5.4	14.0	2.9
February	12.2	8.6	3.9
March	6.0	1.1	9.4
April	19.6	2.4	7.9
May	135.2	20.0	11.0
June	52.0	4.5	5.6
July	95.0	14.0	11.0
August	19.9	2.8	3.0
September	108.0	4.3	3.4
October	5.7	3.7	5.6
November	5.5	3.2	3.5
December	32.0	15.0	18.0
January, 1979	16.0	3.0	4.8
February	6.7	4.5	2.1
March	4.0	1.0	2.0
April	1.6	5.3	2.3
May	0.1	2.0	1.0
June	5.0	2.0	0.0
July	3.0	0.0	1.0
August	31.1	8.9	16.3
September	3.0	0.0	3.0
October	3.0	0.0	3.0
November	3.0	5.0	1.0
December	3.0	3.0	3.0

TABLE 3 (Continued)

AIRBORNE RADIOACTIVE PARTICULATES
NINE MILE LAKE ISL PROJECT
AIR QUALITY STATION #6
(DOWNWIND OF COMMERCIAL PLANT SITE)

Date	Uranium 10^{-16} µCi/ml	Radium-226 10^{-16} µCi/ml	Thorium-230 10^{-16} µCi/ml
August, 1978	27.9	2.5	4.2
September	33.0	22.0	18.0
October	2.8	4.1	3.8
November	2.1	8.0	2.6
December	14.0	7.9	31.0
January, 1979	16.0	4.3	7.9
February	--	--	--
March	4.0	7.0	3.0
April	1.9	1.6	4.6
May	0.1	7.0	2.0
June	1.0	0.0	2.0
July	2.0	8.0	3.0
August	21.7	0.0	21.6
September	3.0	6.0	2.0
October	3.0	6.0	2.0
November	2.0	8.0	1.0
December	3.0	3.0	10.0

TABLE 3 (Concluded)

AIRBORNE RADIOACTIVE PARTICULATES
NINE MILE LAKE ISL PROJECT
AIR QUALITY STATION #7
(DOWNWIND OF COMMERCIAL RESERVOIR SITE)

Date	Uranium 10^{-16} µCi/ml	Radium-226 10^{-16} µCi/ml	Thorium-230 10^{-16} µCi/ml
August, 1978	15.3	2.1	5.8
September	36.0	2.4	4.6
October	3.5	7.7	2.7
November	5.3	2.5	2.8
December	12.0	5.4	3.3
January, 1979	--	--	--
February	9.5	8.7	4.7
March	4.0	9.0	4.0
April	1.8	3.9	2.6
May	0.1	2.0	2.0
June	1.0	0.0	2.0
July	3.0	8.0	4.0
August	58.5	10.7	16.9
September	3.0	7.0	0.0
October	3.0	7.0	0.0
November	1.0	2.0	0.0
December	3.0	17.0	5.0

TABLE 4

REGIONAL BASELINE WATER QUALITY RANGES

Radiochemical Analysis

August 1978 - August 1979

Well Number	Lead-210 pCi/l	Polonium-210 pCi/l	Radium-226 pCi/l	Thorium-230 pCi/l
NML-BM1	3.0-12.0	6.0-12.0	17.0-51.0	0.6-4.8
NML-BM2	4.8-13.0	2.0-11.0	6.1-212	0.6-2.8
NML-BM3	2.0-10.4	2.0-13.0	9.5-23.0	0.6-3.6
NML-BM4	1.5-26.7	1.0-15.0	6.0-51.3	0.6-1.9
NML-BM5	0.1-40.0	9.0-309	1.8-130	0.6-47.0
NML-BM8	1.0-2.4	1.0-7.0	0.5-18.7	0.6-3.3
NML-BM9	0.7-4.0	1.0-17.0	1.2-13.8	0.6-6.3
NML-BM10	2.5-3.0	2.0-7.0	1.9-5.5	0.6-4.6
NML-BM11	0.6-18.4	2.0-20.0	1.0-24.6	0.4-4.0
NML-BM12	2.3-32.0	1.0-24.0	2.5-51.0	0.7-7.0
NML-BM13	5.9-10.1	2.1-5.6	144-181	2.8-5.1
NML-BM14	1.4-2.6	11.4-17.0	11.4-17.0	1.9-4.7
NML-E-P29	16-21.0	15.0-365	3.5-213	0.8-24.6
Robb Well	1.8-18.0	0.3-63.0	0.2-5.1	0.6-13.0

The detector unit consists of a one-half inch "Swinney" type filter holder containing a membrane filter, TLD's, metal washer, and spacers.

The TLD's are CaF:DY (30% by weight) dispersed in a teflon matrix. Each TLD is 12.5mm in diameter and 0.4mm thick. These TLD's are dedosed on a Harshaw Model 2000 Reader, and a calibration to obtain a Working Level-liter per nanocoulomb response is performed each quarter.

The air is pulled through the filter head detector and the particulate radon daughters are trapped on the 0.65 micron pore size filter paper. The subsequent decay energy exposes the first TLD. The second TLD is separated by a metal washer which absorbs any beta particles which pass through the first disk. Thus, the second TLD responds to gamma radiation only. The charge recorded on the second TLD disk, which primarily represents external gamma exposure, is then subtracted from the charge recorded by the first disk; and the net response to the particulate radiation, primarily alpha particles, is obtained. Thus, with the corrected air flow, it is possible to calculate the Working Level exposure. One Working Level is defined as any combination of short-lived radon progeny in one liter of air that will ultimately produce 1.3×10^5 MeV of alpha energy by their complete decay to lead-210.

Table 5 summarizes the test results.

Measurements of background radon-222 exhalation rates (radon flux) were also taken during October, 1979. Sampling locations are shown on Drawing number C-100. Samples were taken

TABLE 5

OPERATIONAL RADIOMETRIC ANALYSIS
RADON PROGENY TLD DATA

NINE MILE LAKE PROCESS BUILDING

Stop Date	Working Level
08-01-77	0.006
08-08-77	0.008
08-17-77	0.006
08-26-77	0.010
09-12-77	0.007
09-20-77	0.008
09-27-77	0.008
10-04-77	0.010
10-11-77	0.009
10-18-77	0.008
10-25-77	0.012
11-02-77	0.076
11-09-77	0.121
11-16-77	0.031
11-23-77	0.004
11-30-77	0.284
12-07-77	0.086
12-14-77	0.146
12-21-77	0.076
12-28-77	0.102
01-04-78	0.077
01-11-78	0.298
01-19-78	0.000
01-23-78	0.005
01-31-78	0.051
02-08-78	0.017
02-15-78	0.050
02-24-78	0.048
03-03-78	0.064
03-10-78	0.005
03-28-78	0.044
04-06-78	0.016
04-17-78	0.033
04-25-78	0.016
05-03-78	0.018
05-11-78	0.007
05-17-78	0.018

at the center of the grid and at a distance of 750 feet in each of four directions. Table 6 summarizes the radon flux survey.

Also shown on Drawing number C-100 is the grid point system which was established for measuring the radon flux levels, gamma exposure rates and collecting soil samples. Results of the gamma exposure survey and soil sample analysis are presented in Table 7.

Additional operational data on radon emanations within the process building was collected during a test in October, 1978. The purpose of the test was to determine approximate radon gas levels emanating from the induced venting system within the plant. Samples were collected immediately above the pregnant solution tank, the raffinate tank and the blower. At each location, a 1/4 inch hole was tapped into the duct. Each hole was fitted with a 15 liter sample bag into which air was pumped for five minutes. The samples were then transported to Bear Creek where the following results were obtained.

Sample Location	Rn 222 gas/5 minute sample
Pregnant tank duct	837.99 ± 2.71
Raffinate tank duct	133.80 ± 1.05
Blower duct	466.57 ± 1.97

Note: Blower duct should equal $\frac{\text{pregnant + raffinate}}{2}$

$= 485.90 \approx 466.57$

TABLE 6

PREOPERATIONAL SOIL RADON FLUX MEASUREMENTS

OCTOBER 1979

Site	Time	Date	$pCi/cm^2/sec$
Center	AM	10-23-79	2.91×10^{-4}
Center	AM	10-24-79	2.45×10^{-4}
Center	PM	10-24-79	2.67×10^{-4}
Center	PM	10-24-79	1.96×10^{-4}
750' SE	AM	10-25-79	1.51×10^{-4}
750' SE	PM	10-26-79	1.35×10^{-4}
750' NE	AM	10-25-79	1.55×10^{-5}
750' NE	PM	10-26-79	4.39×10^{-5}
750' SW	AM	10-25-79	2.57×10^{-4}
750' SW	PM	10-26-79	4.78×10^{-5}
750' NW	AM	10-25-79	2.27×10^{-4}
750' NW	PM	10-26-79	2.18×10^{-4}

TABLE 7

PREOPERATIONAL RADIOMETRIC ANALYSIS
NINE MILE LAKE PROJECT

Gamma Exposure Rates and Soils

Grid Number	Gamma Exposure Rate μR/hr	Radium-226 pCi/g	Thorium-230 pCi/g	Lead-210 pCi/g	Uranium pCi/g	Air Dry Loss %
1	12.6	0.6 ± 1.1	4.2 ± 0.8	0.3 ± 0.4	1.1	4.3
2	14.3					
3	13.6	0.6 ± 1.5	6.2 ± 0.9	0.0 ± 0.8	1.1	6.0
4	14.6					
5	12.3	0.8 ± 1.4	--	--	--	2.8
6	12.7					
7	12.6	1.0 ± 1.5	--	--	--	5.0
8	12.9					
9	11.3	0.8 ± 1.4	--	--	--	3.0
10	13.2					
11	13.1	1.2 ± 1.4	--	--	--	2.8
12	13.1					
13	11.3	1.3 ± 1.4	4.6 ± 0.8	0.0 ± 0.4	1.1	4.3
14	12.7					
15	11.5	1.5 ± 1.3	--	--	--	4.5
16	11.5					
17	12.5	0.5 ± 1.6	--	--	--	7.0
18	12.3					
19	12.5	0.6 ± 1.3	--	--	--	5.0
20	13.2					
21	12.5	1.4 ± 1.1	--	--	--	4.5
22	13.8					
23	12.1	1.3 ± 1.3	4.7 ± 0.8	0.0 ± 0.6	1.1	6.4
24	13.3					
25	13.4	0.4 ± 1.6	--	--	--	5.7
26	13.6					
27	13.3	1.6 ± 1.5	--	--	--	6.0
28	13.7					
29	13.3	0.1 ± 1.3	--	--	--	4.8
30	13.4					
31	12.2	0.5 ± 1.4	--	--	--	5.2
32	12.0					
33	12.6	1.1 ± 1.2	3.2 ± 0.7	0.1 ± 0.3	1.1	4.2
34	13.7					
35	12.7	1.5 ± 2.4	--	--	--	4.8
36	12.2					
37	13.2	0.9 ± 1.6	--	--	--	4.4
38	13.7					
39	12.8	0.5 ± 1.6	--	--	--	4.2
40	12.6					
41	13.3	1.5 ± 2.0	--	--	--	3.9
42	12.8					
43	11.2	1.8 ± 1.9	5.8 ± 0.9	0.3 ± 0.7	1.1	6.4
44	10.2					
45	10.6	0.0 ± 2.2	--	--	--	5.6
46	11.3					
47	13.5	1.8 ± 1.5	--	--	--	6.8
48	13.6					
49	14.4	1.2 ± 1.6	--	--	--	11.5
50	14.5					
51	12.3	0.1 ± 1.8	--	--	--	7.8
52	13.1					
53	10.5	0.2 ± 1.7	4.0 ± 0.7	0.1 ± 0.6	1.1	7.6
54	11.7					
55	12.1	1.0 ± 1.6	--	--	--	8.4
56	12.3					
57	13.7	0.7 ± 1.2	--	--	--	8.3
58	13.3					
59	13.7	1.5 ± 1.7	--	--	--	7.8
60	13.4					
61	14.4	1.4 ± 1.4	--	--	--	9.4
62	12.3					
63	12.7	0.4 ± 1.2	3.1 ± 0.6	0.2 ± 0.3	1.1	2.6
64	11.5					
65	9.7					
66	12.7					
67	10.9	0.4 ± 1.7	--	--	--	4.0
68	10.5					
69	10.9	0.6 ± 1.2	--	--	--	--
70	11.1					
71	11.1	0.6 ± 1.2	--	--	--	--
72	13.7					
73	14.0	1.2 ± 1.6	5.5 ± 0.8	0.0 ± 0.6	1.1	--
74	12.4					
75	13.7	0.8 ± 1.4	--	--	--	--
76	13.3					
77	12.6	1.1 ± 1.6	--	--	--	--
78	12.5					
79	11.0	0.5 ± 1.4	--	--	--	--
80	11.9					
81	12.4	0.6 ± 1.3	--	--	--	--
	12.6 ± 1.08					

Calculations:

Total air discharge (ft^3/min.)= air velocity (ft/min) X duct area (ft^2)

= 2250 ft/min x 0.312 ft^2

= 702 ft^3/min

Blower duct: 466.57 pCi/l = 5 min. sample

∴ 93.31 pCi/l = 1 min. sample

1 liter = 0.0353 ft^3

∴ 93.31 pCi/l+ 3.29 pCi/ft^3

Randon emanation (pCi/min) = pCi/ft^3 X ft^3/min

= 3.29 X 702

= 2309.6 pCi/min

This test indicated that a total of 2309.6 pCi/min. of radon gas was being emanated from the pregnant and raffinate tanks.

Currently, efforts are underway to verify these values by conducting a new radon sampling test. The approach being used is to determine a radon "balance" by means of sampling the production fluid as it is pumped out of the wellfield, at the pregnant tank and again at the injection tank prior to reinjection in the wellfield. This approach should provide an estimate of total radon being released from the time the production fluid leaves the wellfield to the time that the uranium barren fluid is reinjected.

RADIOLOGICAL EXPOSURE DOSAGES

As required by 10 CFR 20.407 dosimetry records for each employee are maintained at the Nine Mile Lake Facility. Table 8 is the statistical summary report for the Nine Mile Lake project for the period January 1, 1978 to December 31, 1979. The monitoring report indicates whole body exposures for all Nine Mile Lake personnel. TLD exposure rates are well below the NRC limit of 5 REMS/Year.

TABLE 8

TLD EXPOSURE RATES

Jan. 1, 1978 - Dec. 31, 1978				Jan. 1, 1979 - Dec. 31, 1979			
BADGES	EXPOSURE RANGE			BADGES	EXPOSURE RANGE		
22	LESS	THAN	.010 REM	41	LESS	THAN	.010 REM
15	.010	TO	.099 REM	9	.010	TO	.099 REM
0	.100	TO	.249 REM	0	.100	TO	.249 REM
1	.250	TO	.499 REM	0	.250	TO	.499 REM
0	.500	TO	.749 REM	0	.250	TO	.749 REM
0	.750	TO	.999 REM	0	.750	TO	.999 REM
0	1.000	TO	1.999 REM	0	1.000	TO	1.999 REM
0	2.000	TO	2.999 REM	0	2.000	TO	2.999 REM
0	3.000	TO	3.999 REM	0	3.000	TO	3.999 REM
0	4.000	TO	4.999 REM	0	4.000	TO	4.999 REM
0	5.000	TO	5.999 REM	0	5.000	TO	5.999 REM
0	6.000	TO	6.999 REM	0	6.000	TO	6.999 REM
0	7.000	TO	7.999 REM	0	7.000	TO	7.999 REM
0	8.000	TO	8.999 REM	0	8[illegible]0	TO	8.999 REM
0	9.000	TO	9.999 REM	0	9.000	TO	9.999 REM
0	10.000	TO	10.999 REM	0	10.000	TO	10.999 REM
0	11.000	TO	11.999 REM	0	11.000	TO	11.999 REM
0	12.000	OR	MORE REM	0	12.000	OR	MORE REM

APPENDIX A

RESTORATION OF PATTERN II

The leaching phase of Pattern #2 lasted from December, 1977, through September, 1978. Pattern #2 was a successful ISL test. Since demonstration of restoration was an important part of the test program, Pattern #2 leaching was shut down in mid-September (1978) so that restoration efforts could begin. Tables A and B summarize important parameters at the close of Pattern #2 leaching.

The initial sweep of Pattern #2 was made by injection of local well water (process). Concurrent with the process water sweep, construction began on a pilot restoration circuit. The restoration circuit was designed to treat affected water from Pattern #2 and produce a clean water suitable for reinjection. The test restoration circuit was designed from bench scale test results to serve as a prototype for the proposed commerical restoration circuit. The basic circuit flowsheet calls for:

1. production of affected water from pattern production well;
2. addition of lime to neutralize acid and precipitate heavy metals and radionuclides;
3. a liquid/solids separation, with solids going to the evaporation reservoir and the liquor advancing to a calcium removal step;
4. removal of calcium by precipitation with CO_2 and Na_2CO_3;
5. a liquid/solids separation with the liquor (at this point consisting mostly of sodium sulfate) going to reverse osmosis (R.O.):

Table A

PATTERN 2 INTERIOR WELL DATA

	pH	TDS	Ca	SO_4	Fe	V	U_3O_8	Al	As	Se	Mn	Mo	Zn	Cu	pCi/1 230 Th	226 Ra
Pattern 2 Production Well Baseline	6.9-7.7	2890-3300	90-130	1760-2120	.39-.83	.01	.18-.36	.03-.11	<.01	<.01	.12-.32	<.01	.01-.02	.01-.02	18.2 $\pm$ 28.6	440 $\pm$ 314
Pattern 2 Production Well Early Stage Restoration in Nov. 1978	1.52	6750	200	5745	154	430	58	81	2.6	.08	1.3	0.01	40	1.6	18400 $\pm$ 600	1000 $\pm$ 300
Pattern 2 Production Well at Termination of Restoration Phase September 1979	6.3	2360	60	1380	3.6	10	0.3	1.6	0.35	0.02	0.05	0.02	0.54	0.01	1 $\pm$ .8[1]	76 $\pm$ .20[2]
Observation Well 1 On 9/3/79 Restoration	6.2	2200	54	1410	1.32	4	<0.1	0.2	0.05	0.02	0.12	0.02	0.42	0.01	-----	230 $\pm$ 10
Observation Well 3 On 9/3/79 Restoration	5.9	2150	48	1480	5.15	9	<0.1	3.6	0.1	0.01	0.13	0.02	1.57	0.01	-----	190 $\pm$ 10
Proposed Guidelines For Stockwater	6.0-9.0	5000		3000	.5-20	.1	5	5.0	0.2-1.0	0.5	10.0		25.0	0.5	-----	5

1) Data from June 1979 Sampling

2) Data from 8/14/79 Sampling

PATTERN 2 MONITOR WELL DATA

Description	pH	TDS	Ca	SO_4	Fe	V	U_3O_8	As	Se	Th 230	Ra 226
Monitor Well #20											
Baseline	7.3	3844	130	2081	0.31	0.01	0.51	0.01	0.01	1.8±1.6	178±83
Sept. 1978	6.8	3200	115	1960	1.4	0.06	0.30	0.02	0.01	<1	184±6
Aug. 1979	6.7	3000	72	1310	0.38	0.06	0.20	0.01	0.01	2.9±1	135±15
Monitor Well #21											
Baseline	7.1	2238	82	1295	0.43	0.02	0.13	0.01	0.01	6.2±9.7	161±123
Sept. 1978	6.5	2258	89	1250	0.95	0.06	0.11	0.01	0.01	<1	131±6
Aug. 1979	6.7	2280	85	1379	0.26	0.06	0.11	0.01	0.01	1.2±.5	165±15
Monitor Well #22											
Baseline	7.0	2679	114	1649	0.48	0.02	0.02	0.01	0.01	1.1±.6	182±27
Sept. 1978	7.1	4262	334	2930	0.92	0.06	<0.02	0.01	0.01	<1	27±4
Aug. 1979	6.6	2520	88	1340	1.09	0.08	<0.02	0.01	0.01	8.9±1.6	185±20
Monitor Well #23											
Baseline	7.1	2308	96	1348	0.24	0.02	0.12	0.01	0.01	1.4±1.5	221±71
Sept. 1978	6.4	2130	79	1150	1.0	0.06	0.08	0.01	0.01	<1	176±7
Aug. 1979	6.6	2120	64	1156	0.24	0.13	0.18	0.01	0.01	2.7±1	210±20
Monitor Well #24											
Baseline	7.1	2299	100	1391	0.32	0.01	0.07	0.01	0.01	.48±.32	342±291
Sept. 1978	6.5	2258	89	1250	0.45	0.06	0.10	0.01	0.01	<1	30±8
Aug. 1979	6.5	2000	73	998	2.5	<0.01	0.08	0.01	0.01	1.2±.7	210±20

Table B

6. reverse osmosis to concentrate Na_2SO_4 into a brine stream for disposal in the evaporation reservoir and a clean water stream for reinjection.

The pilot circuit was constructed at the NML test facility and began operation in late November, 1978. In order to limit the amount of discharge to the evaporation pond, the well water sweep of Pattern #2 was operated at a reduced level until the restoration circuit could be functionally implemented. The restoration circuit began operation in mid-November, 1978; however, because of various equipment and operational problems, it did not achieve full scale operation until the end of March.

During the interim period, Pattern #2 restoration proceeded at reduced flow rates. By the middle of December, 1978, Ca and SO_4 had returned to near baseline conditions. The pH, however, and parameters more dependent on pH for solubility (Fe, V, U_3O_8, etc.), plateaued, as shown in Plates 2.3-1 through 2.3-12. Analysis of bench scale tests performed at the University of Texas indicated that a high pH/TDS injection water actually speeded restoration by neutralizing and exchanging with H^+ ions absorbed on clay lattices; therefore, an injection solution with a high pH and TDS content was used on Pattern #2.

Injection of pH 9-10 Na_2CO_3 solutions at about 6000 mg/l TDS began at the end of March, 1979, and after five days, the Pattern #2 production liquor showed a sharp increase in pH, from 3.7 to 4.4. High pH/TDS injection was stopped after 4.5 days to allow pH to stabilize.

High pH/TDS injection was resumed in mid-May, utilizing NaOH, and continued through mid-June, 1979. NaOH was used to avoid problems with uranium and vanadium mobilization which occurred during Na_2CO_3 addition. Injection of near neutral water, low in TDS, was resumed in late June as Pattern #2 neared restoration.

086-03-6-146

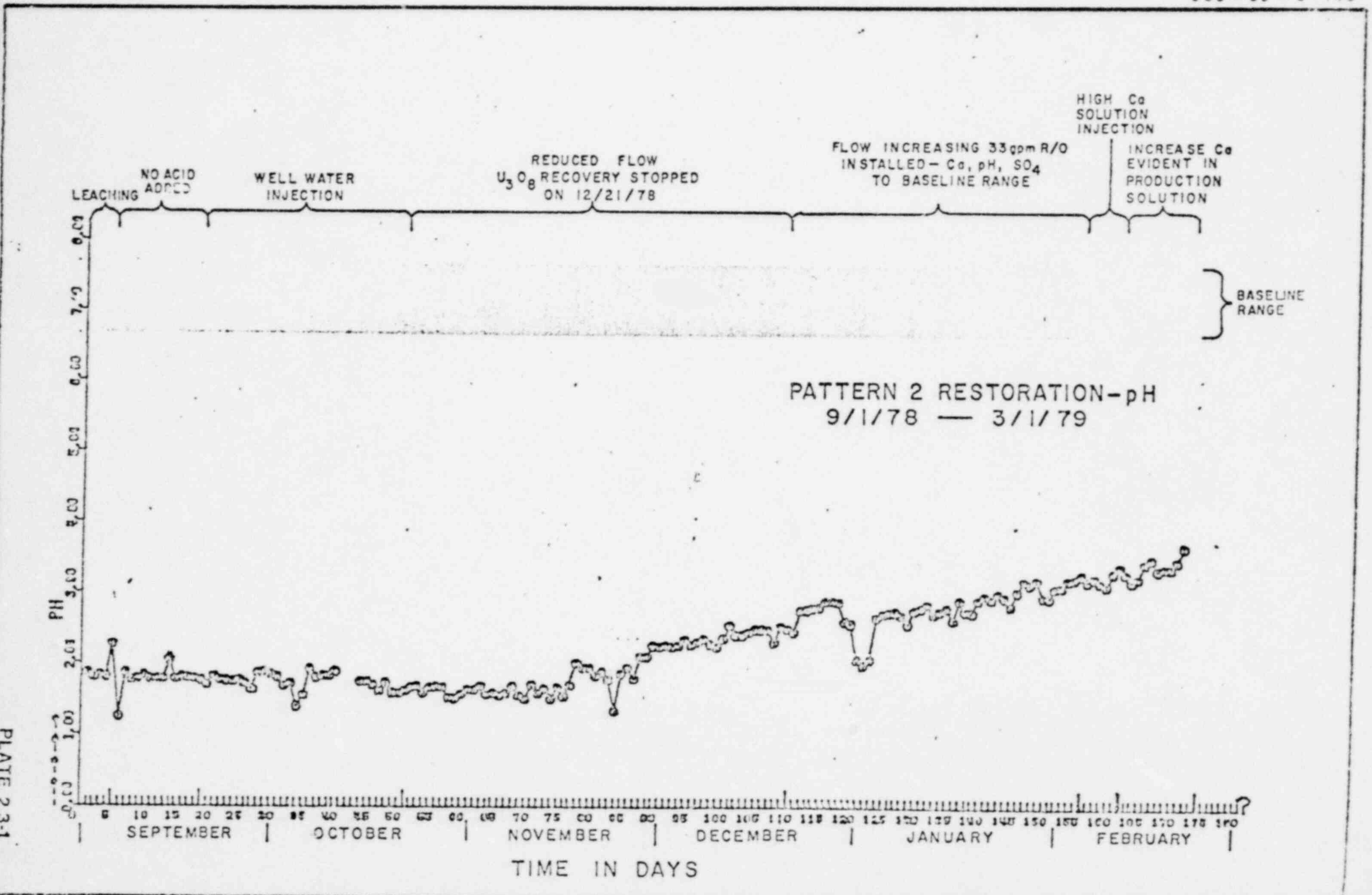


PLATE 2.3-1

086-03-G-147

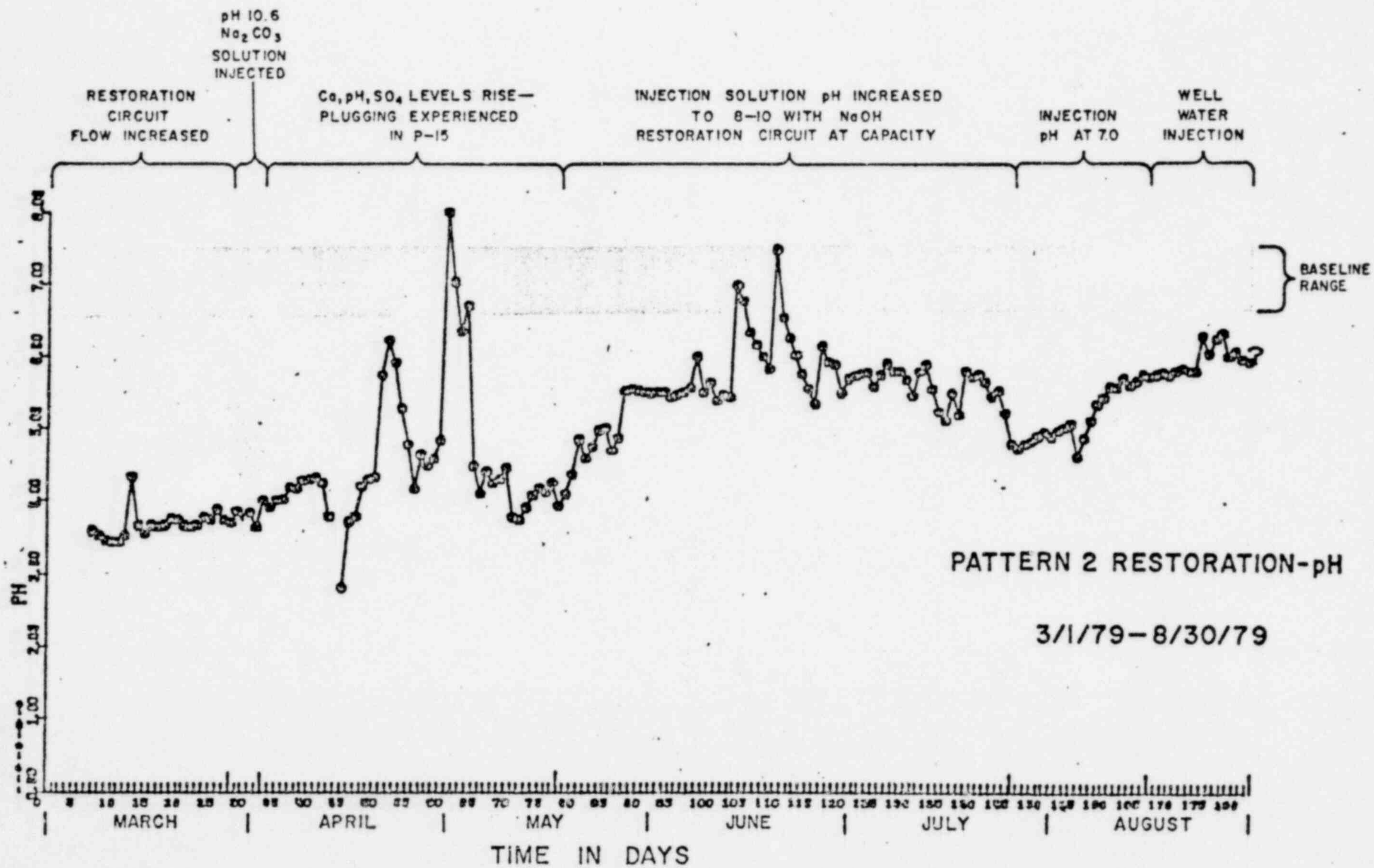


PLATE 2.3-2

086-03-G-148

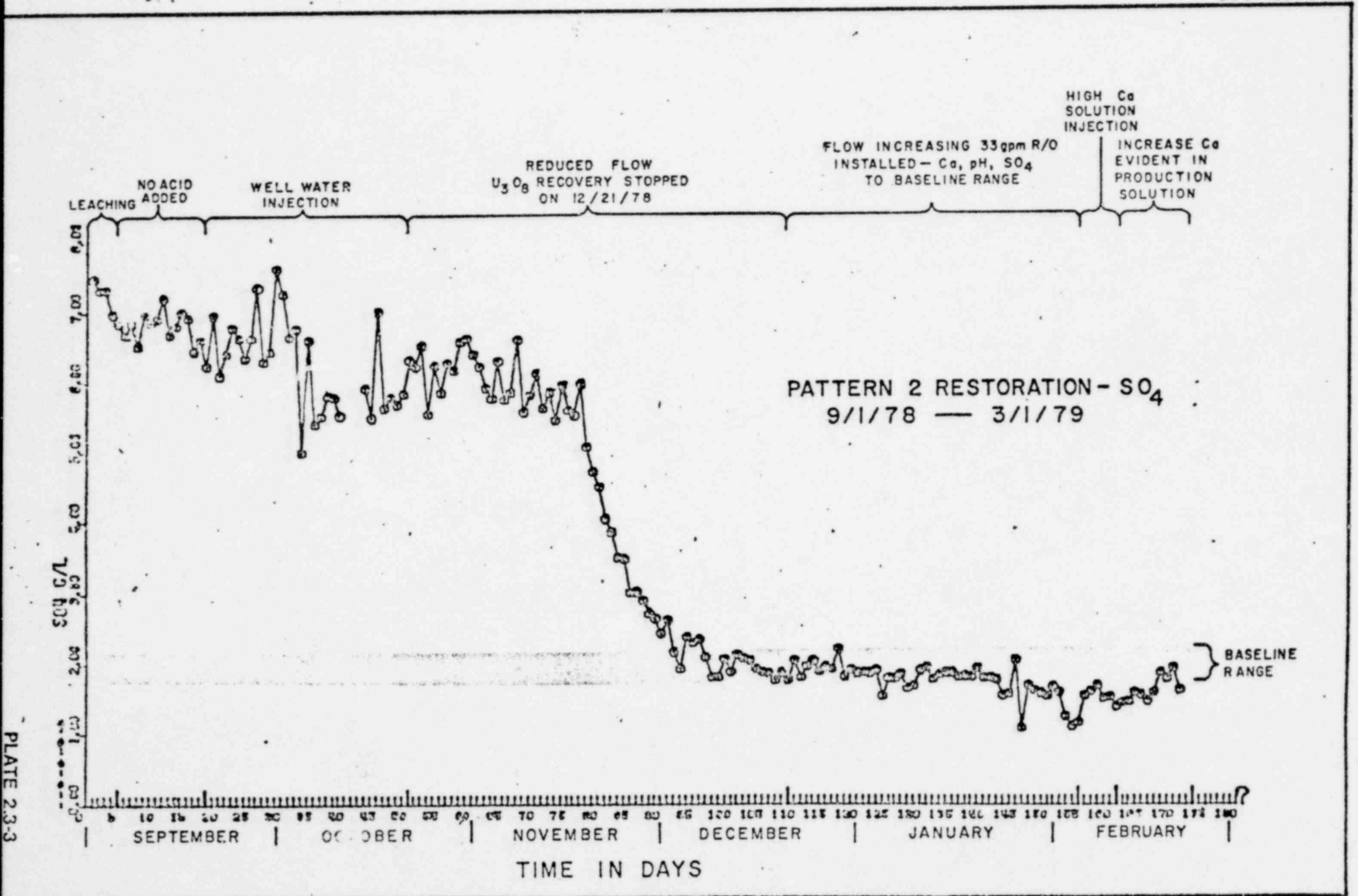


PLATE 2.3-3

086-03-G-145

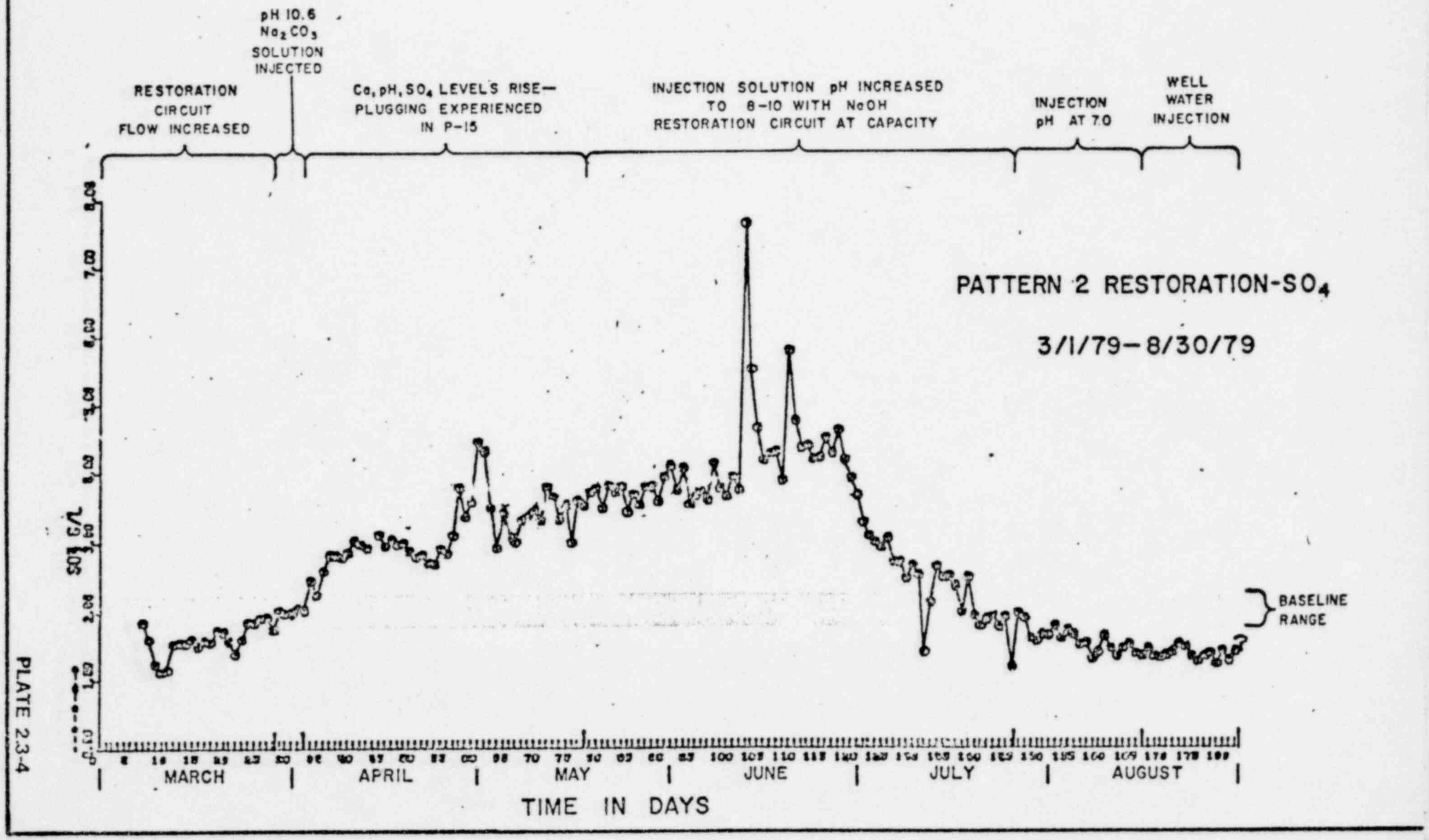


PLATE 2.3-4

086-03-G-150

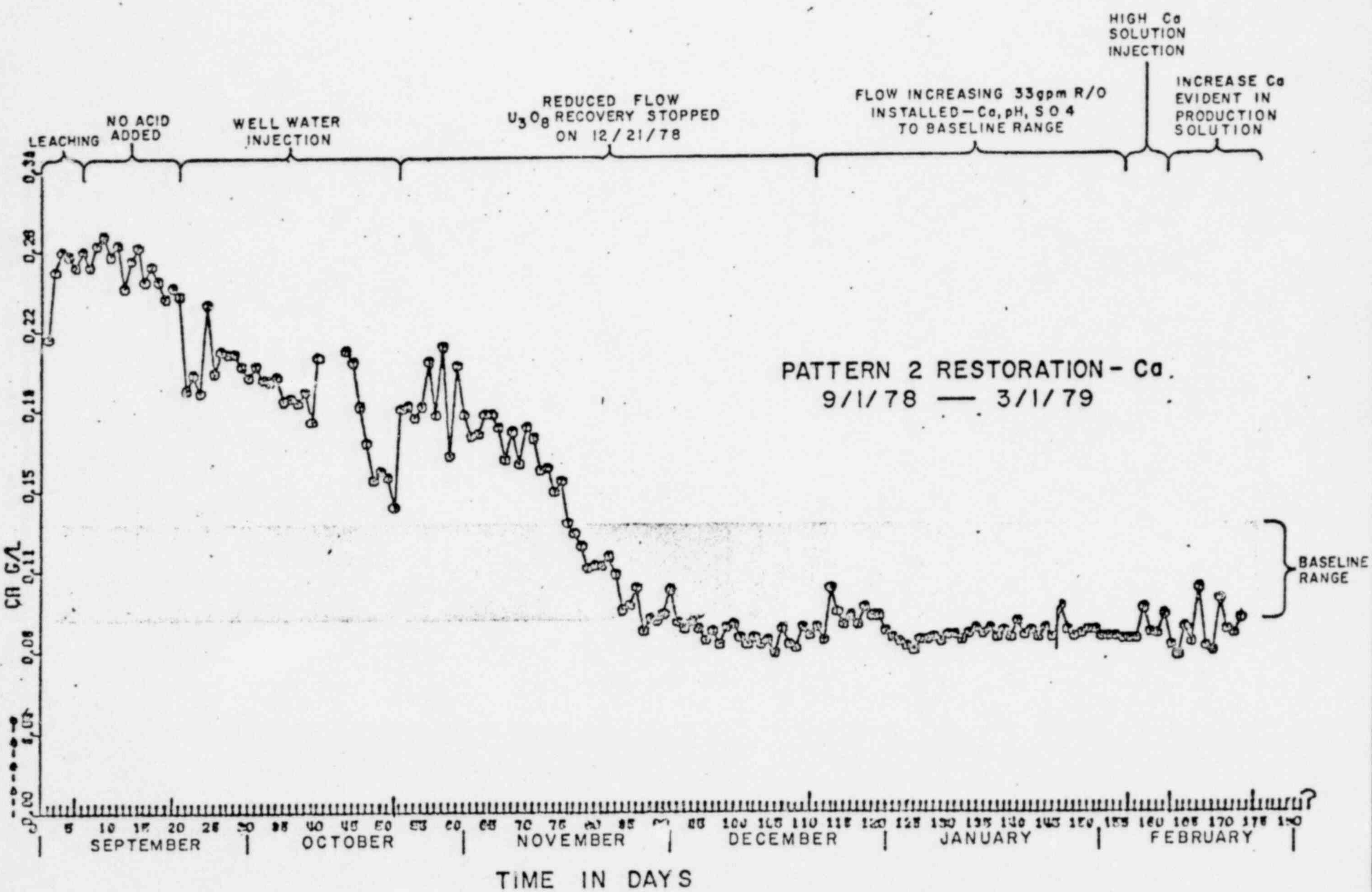


PLATE 2.3-5

086-03-G-151

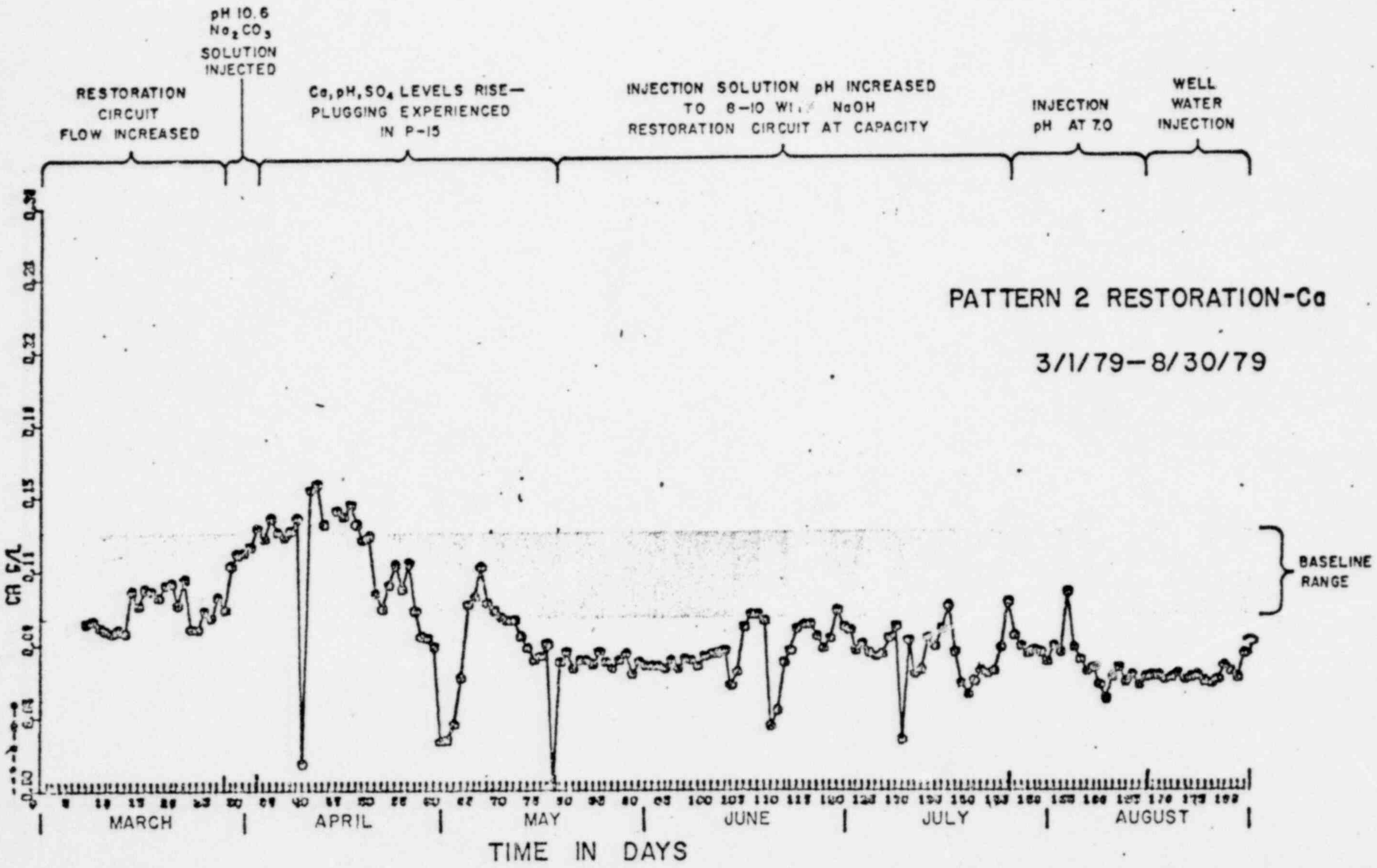


PLATE 2.3-6

086-03-G-152

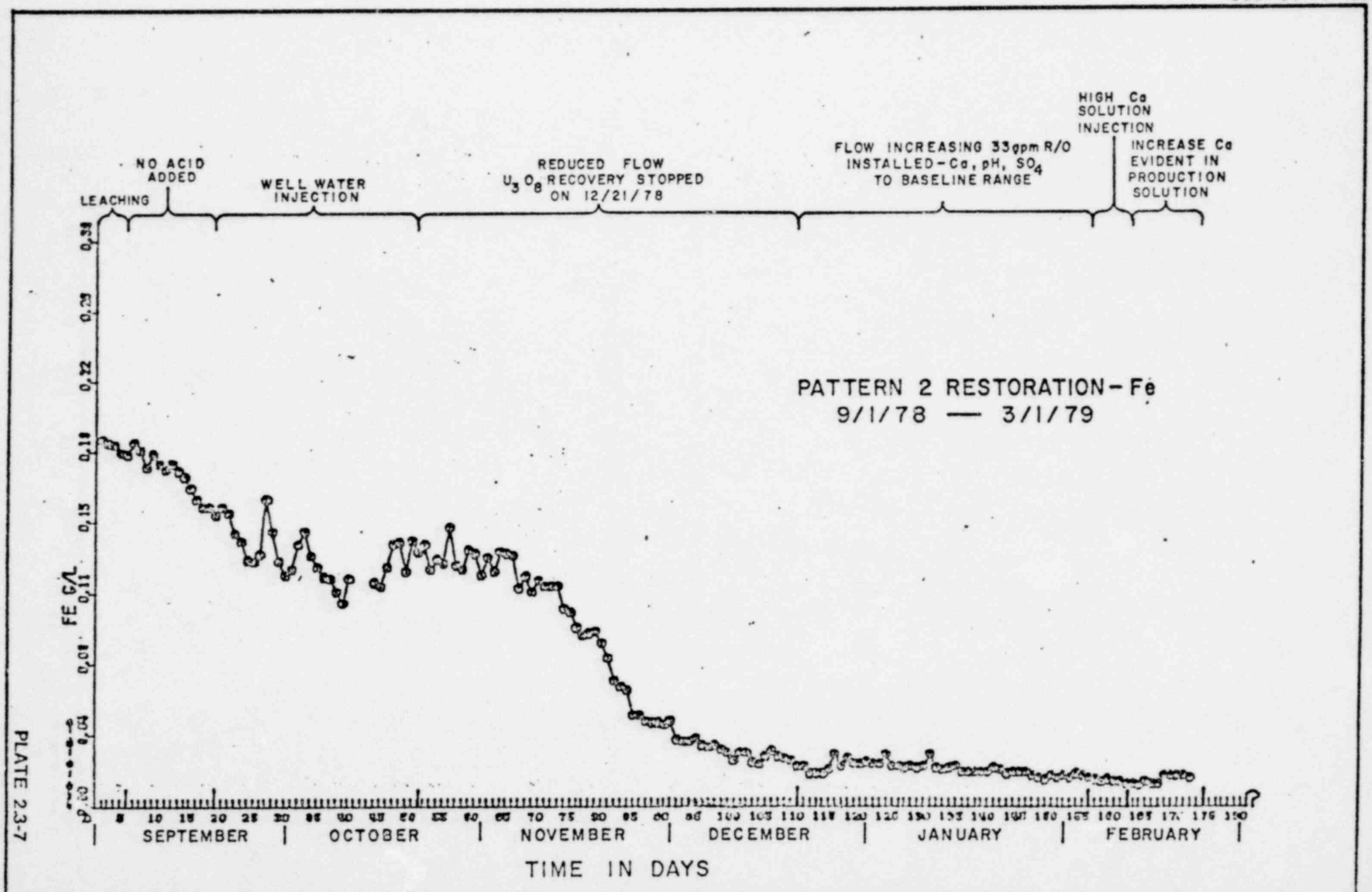


PLATE 2.3-7

086-03-G-153

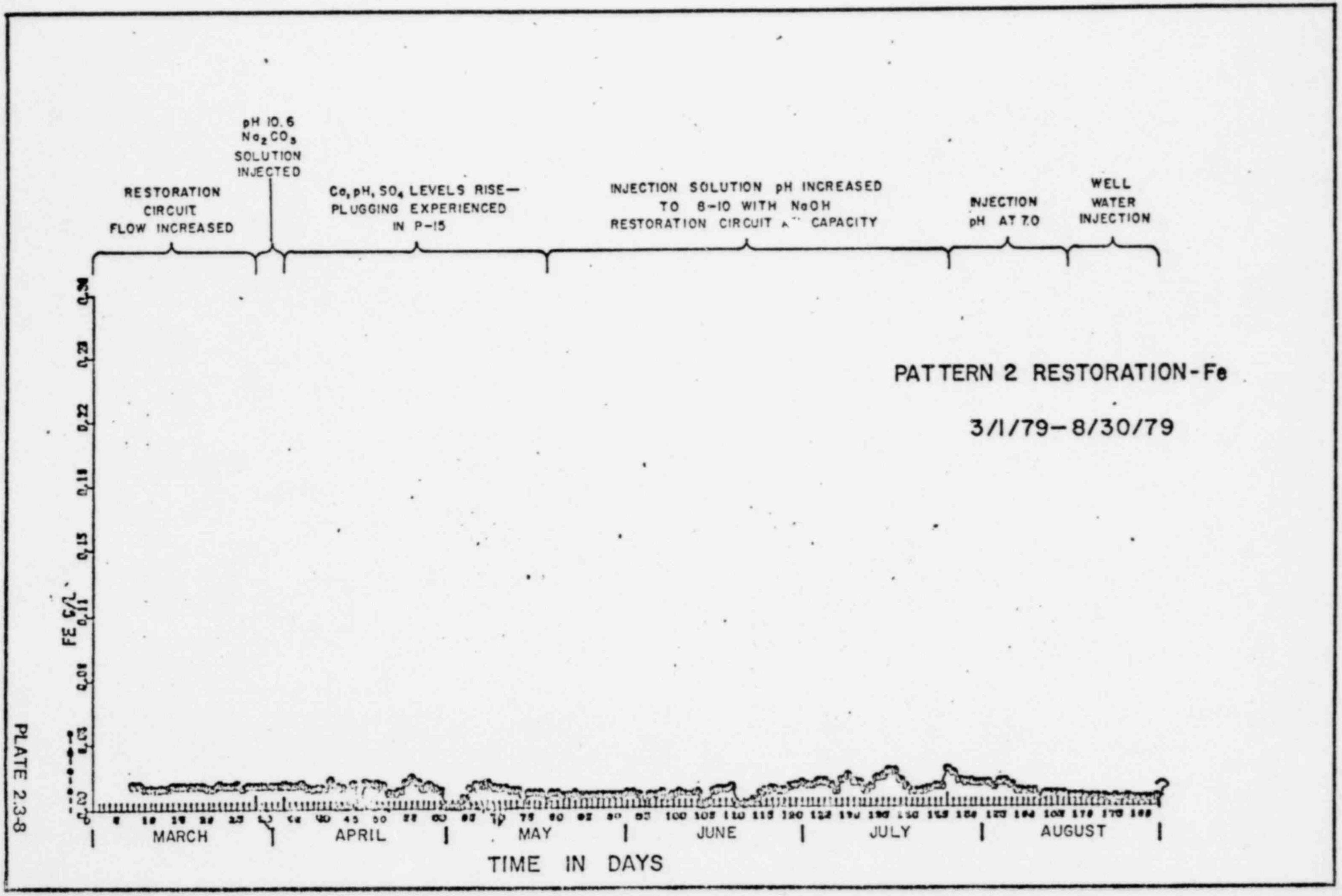


PLATE 2.3-8

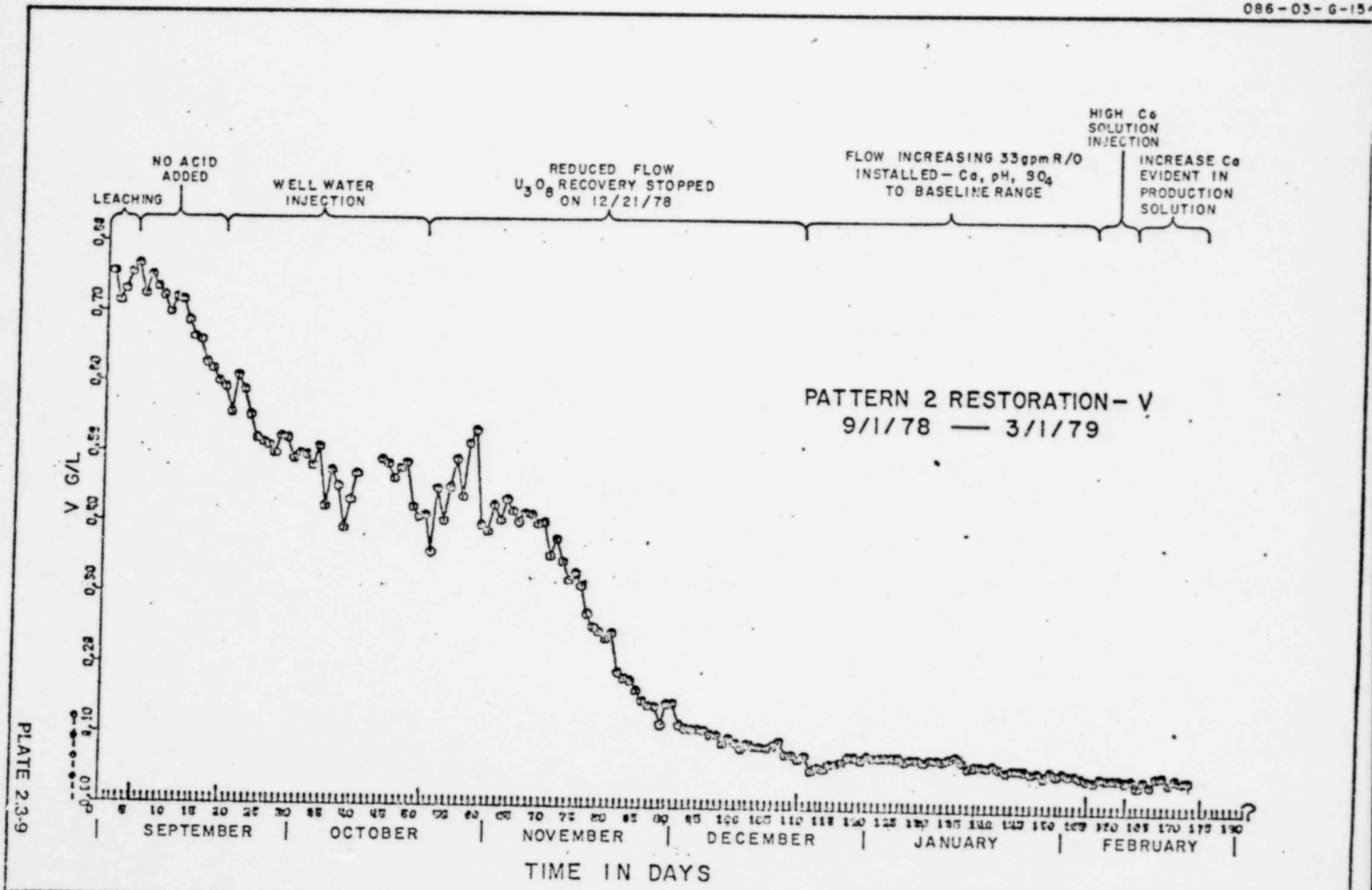

LEACHING
NO ACID ADDED
WELL WATER INJECTION
REDUCED FLOW
U3O8 RECOVERY STOPPED ON 12/21/78
FLOW INCREASING 33gpm R/O INSTALLED — Ca, pH, SO4 TO BASELINE RANGE
HIGH Ca SOLUTION INJECTION
INCREASE Ca EVIDENT IN PRODUCTION SOLUTION
PATTERN 2 RESTORATION — V
9/1/78 — 3/1/79
V G/L
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
TIME IN DAYS

PLATE 2.3-9

086-03-G-155

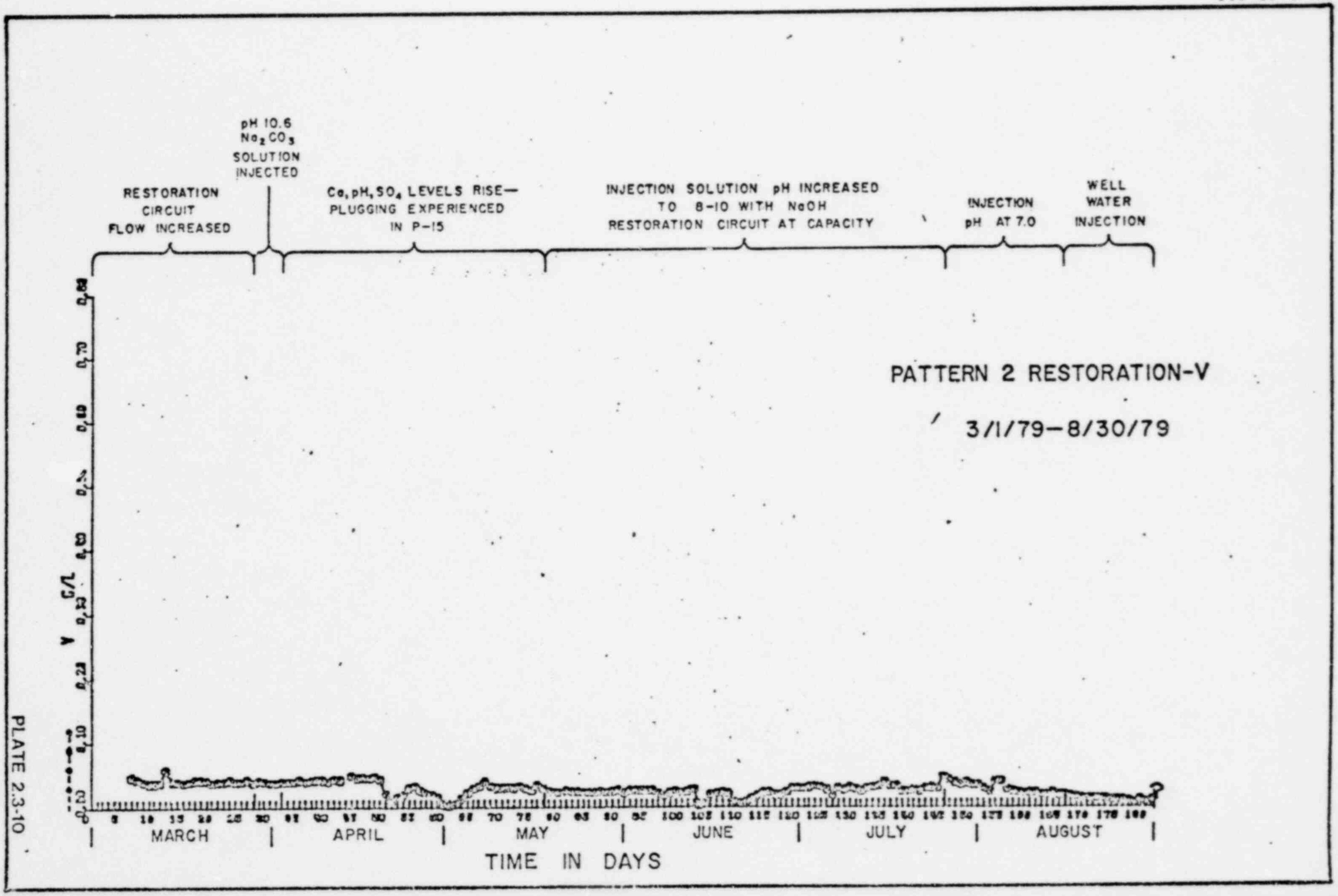


PLATE 2.3-10

086-03-G-156

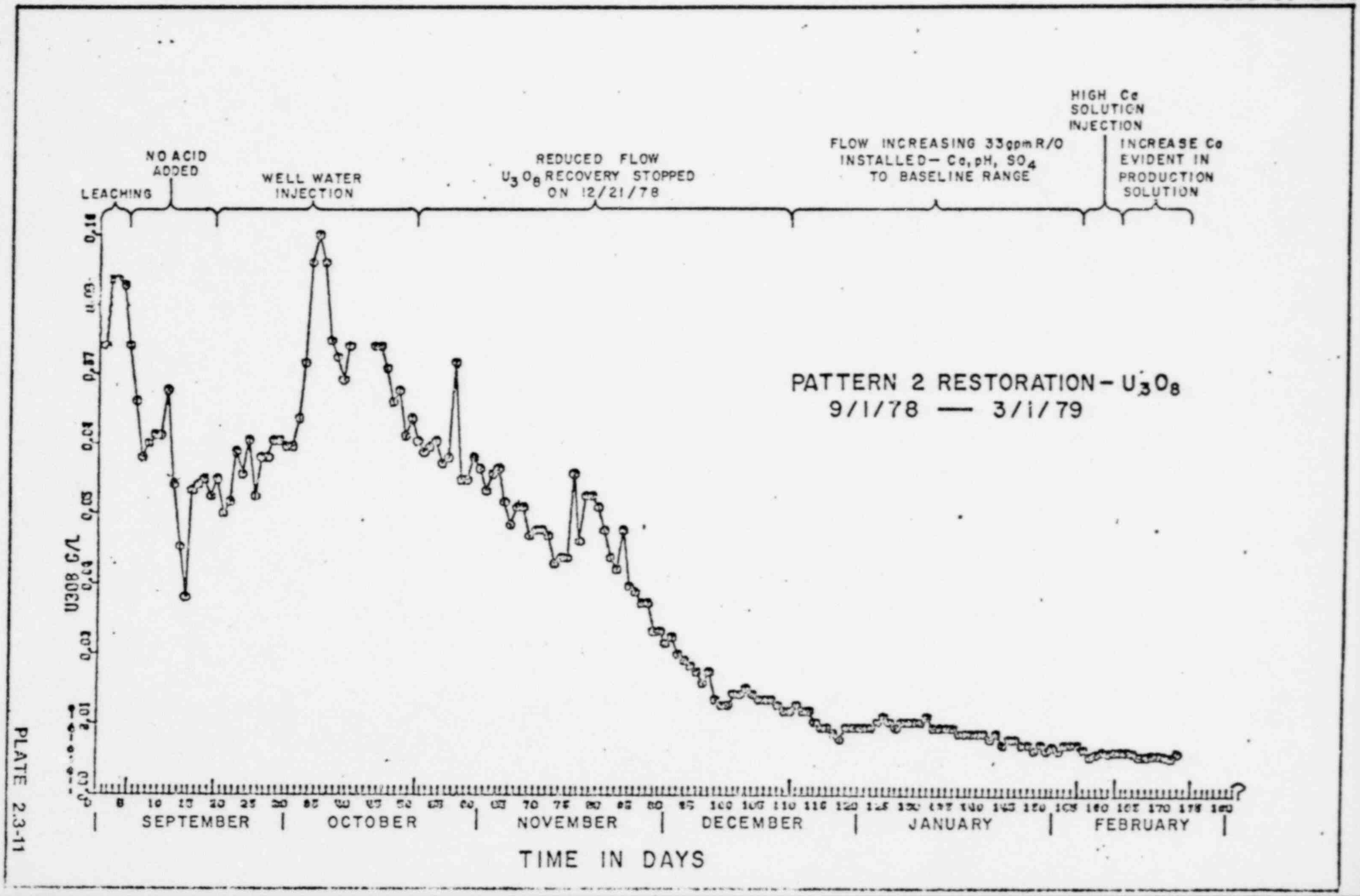


PLATE 2.3-11

086-03-G-157

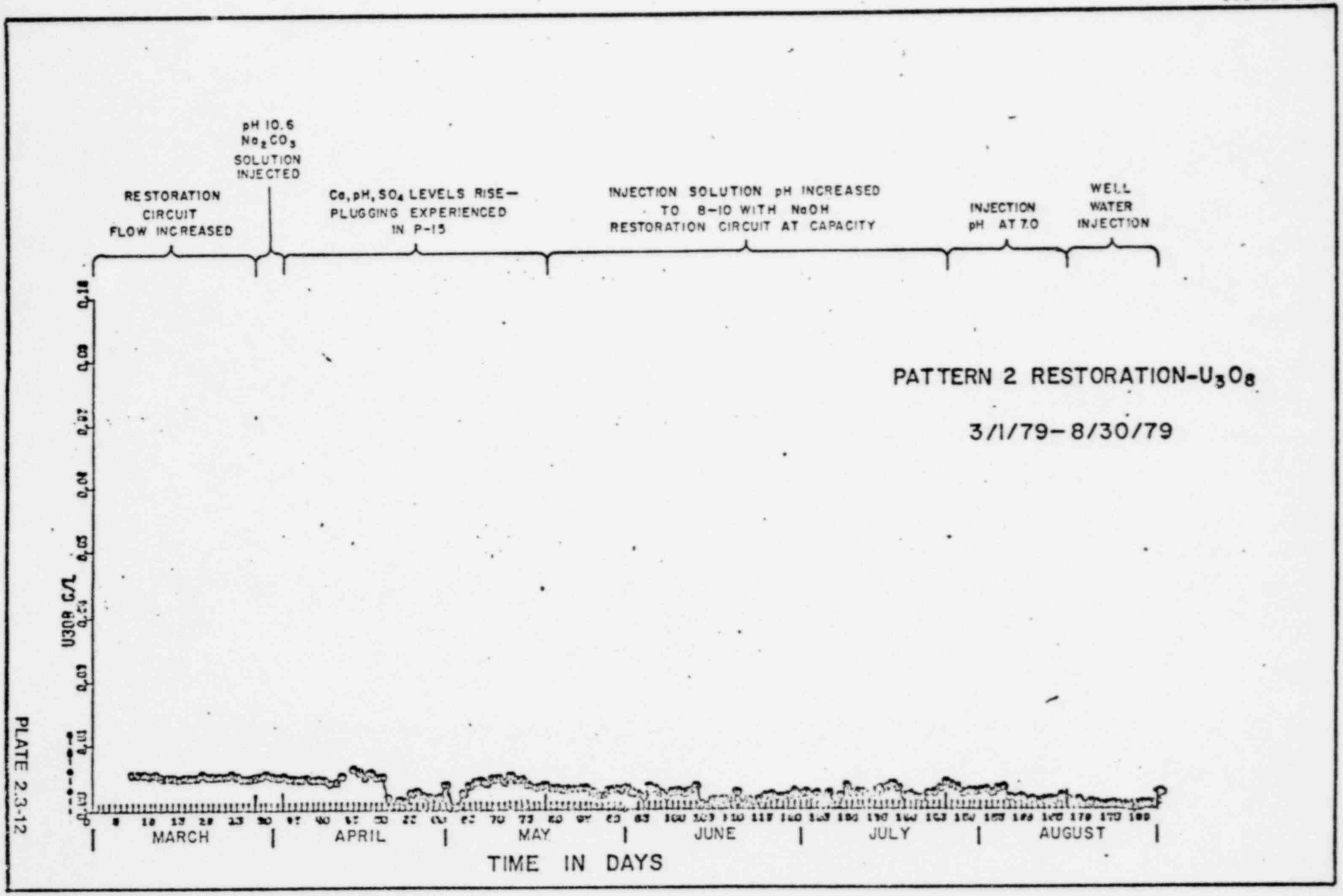


PLATE 2.3-12

The final stage of Pattern #2 restoration began on 8-14-79 when Teapot Formation water injection was resumed. By the first week of September, all parameters had returned to Original Use category and Pattern #2 was shut down as restored.

Pattern #2 restoration was accomplished with about 7 million gallons of reinjection water versus about 13.8 million gallons used for mining. This corresponds well with bench test data indicating that about one-half the leaching pore volumes are required to restore. The apparent long time period involved in Pattern #2 restoration was a result of comparatively low flow rates from restoration circuit equipment. Pattern #2 experience indicates that restoration flow rates should approximate mining flow rates so that flow nets are approximately equal.

Tables A and B present restoration data for Pattern #2 production well P-15 and surrounding monitoring wells. As noted, Ca, SO_4 and TDS levels are actually substantially below baseline ranges and well within the proposed values for stock-water use.

Vanadium is the only constituent which has not yet stablized within baseline use category, although values are returning returning toward baseline. The elevated values are a result of mobilization of vanadium to high levels during the leaching phase of the Pattern and the resulting precipitation during the initial restoration pH changes. The precipitated vanadium, while relatively insoluble, is thought to have contributed to the elevated final vanadium levels.

Had the test pattern utilized a vanadium recovery circuit during the mining mode of pattern operation, the problems encountered with vanadium precipitation when beginning restoration could have been avoided. Current plans for the commercial facility based upon the use of sulfuric acid as the lixiviant would employ a vanadium recovery circuit.

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
November 13, 1979	Monthly sampling of Monitor Wells 40 and 43 (Pattern No. 3) indicated abnormally low pH and abnormally high conductivity in M-40; M-43 within acceptable control limits	
November 14, 1979	• Remaining monitor wells (41, 42) were sampled, and found within acceptable control limits.	• Injection rates on 3 wells on side of Monitor Well 40 were reduced, while maintaining normal production rate.
November 15, 1979	• All Pattern 3 Monitor Wells were sampled (40, 41, 42, 43). Wells 40 and 43 showed low pH and elevated conductivity, elevated sulfate, and elevated uranium. • Monitor Wells I-9 and I-10 of restored Pattern No. 1 were sampled and found to be within baseline control limits.	• Injection on all wells was curtailed; production was continued to create an enhanced net withdrawal.
November 16, 1979	• All Pattern 3 Monitor Wells (40, 41, 42, 43) were resampled. Wells 40 and 43 were confirmed to be in excursion status. Wells 41 and 42 remain within control limits. Sampling was conducted selectively in each production sand horizon. Results indicate only upper sand unit is in excursion.	• Installation of packers on five injection wells was completed. Lost packer in one injection well (No. 48); will not be able to properly install. Well to be cemented and abandoned and a replacement well drilled. Installation of packers on injection wells allows independent control of flows into upper and lower sand units of the production zone.

November 16, 1979 (Continued)	• Notification of Wyoming Department of Environmental Quality and U. S. Nuclear Regulatory Commission of excursion situation and corrective action plan.	• Overproduction continued without any injection. • Installation of packer to commence as soon as possible in Monitor Well M-40 to allow confirmation whether one or both production sand units are in excursion. • No injection is planned to resume until completion and segregated sampling of the packer equipped Monitor Well (M-40).

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
November 17, 1979		Rate reduced from 40 gpm to 5 gpm on P-50, the lower ore zone production well.
November 18, 1979	Monitor Well M-43 was sampled and found to be within baseline range pH, conductivity and sulfate. The well continues to show slightly elevated uranium and other metals.	New monitor wells were drilled at angles 25' from M-40; M-40A to be completed in the lower ore zone, M-40B in the upper ore zone.
November 19, 1979		Rate reduced from 32 gpm to 5 gpm on P-53, the upper ore zone production well.
November 21, 1979	Monitor Well M-40 was sampled and found to have improved pH, conductivity, sulfate and metals values, including uranium.	pH ----------------2.6 Conductivity-------5500 Sulfate -----------3558 mg/l U_3O_8 --------------4.1 mg/l
November 26, 1979	Sampled Monitor Well M-43 and found pH, sulfate and conductivity to be within baseline ranges. The uranium and other metal values were slightly elevated.	Packer was installed in M-40 to allow segregated sampling of both production ore zones.

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
November 27, 1979	Monitor Well M-40 was sampled with a packer installed. Pumping rates indicated little solution in the lower production ore zone. Analysis of the sample showed some improvement in water quality; however, a faulty packer was suspected that would allow solution from the upper production ore zone to contaminate the sample.	Completed drilling and completing M-40A, the new lower ore zone monitor well.
November 29, 1979	Monitor Well M-40 was sampled. Analysis showed all parameters to be within baseline ranges, indicating the excursion to be confined to the upper ore zone. All chemical parameters show considerable improvement since the excursion verification.	Removed packer from M-40. M-40 pH ---------------4.4 Conductivity ----2700 Sulfate ---------1406 mg/l U_3O_8 ------------0.8 mg/l
December 4, 1979	All Pattern #3 monitor wells were sampled. Wells M-40A, M-41, and M-42 continue to show analyses within baseline ranges. Well M-43 appears within baseline ranges with the exception of slightly elevated metals, including uranium. Well M-40 continues to show improvement, approaching baseline for some parameters.	M-40 pH ---------------5.7 Conductivity ----3000 Sulfate ---------1481 mg/l U_3O_8 ------------0.7 mg/l

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
December 5, 1979		Injection was resumed into the lower production zone at a rate of 20 gpm. Production from the lower zone was controlled at 21 gpm. Injection did not resume into Well I-45, the nearest well to the excursion, or Well I-48, on the opposite side of the Pattern.
December 7, 1979	New Monitor Well M-40B, completed in the upper ore zone, was sampled and revealed slightly elevated values for conductivity, sulfate and metals, again indicating the excursion to be confined to the upper ore zone.	
December 10, 1979	Samples were taken from M-40, M-40A, M-40B and M-43. Analyses indicated very little change with the exception of M-40, which showed a drop in water quality. All M-40 parameters showed a significant deterioration of water quality.	<u>M-40</u> pH ---------------- 3.0 Conductivity ------- 3300 mg/l U_3O_8 --------------- 1.8 mg/l

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
December 13, 1979		Using a water sampling truck, production was initiated from Injection Well I-45 in hopes of accelerating "clean-up" of the excursion area. Pump failures plagued the effort for several days; however, by December 18th, the Well was producing at 20 gpm.
December 17, 1979	Monitor Wells M-40, M-40A, M-40B and M-43 were sampled. No change was noted in M-40, M-43 and M-40A. Well M-40B appeared to be within baseline ranges for all parameters.	M-40 ------------ pH 3.1 M-40A ----------- pH 6.7 M-40B ----------- pH 7.0 M-43 ------------ pH 6.7
December 26, 1979	Monitor Wells M-40, M-40A, M-40B and M-43, were sampled. No change was seen in M-40A, M-40B and M-43; however, values for M-40 showed some improvement.	<u>M-40</u> pH -------------- 3.1 Conductivity ---- 3600 Sulfate --------- 1932 mg/l U_3O_8 ----------- 0.1 mg/l
December 31, 1979	Monitor Well M-40 was sampled and, again revealed a significant improvement in all test parameters. Conductivity, pH, sulfate and the metals approached baseline values.	<u>M-40</u> pH -------------- 6.1 Conductivity ---- 1800 Sulfate --------- 1415 mg/l

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
January 2, 1980	All Pattern #3 monitor wells were sampled and, including M-40, were within baseline ranges for pH, conductivity and sulfate.	M-40 pH --------------- 6.7 Conductivity ----- 2800 Sulfate ---------- 1435 mg/l U_3O_8 ------------- 0.14 mg/l
January 4, 1980		I-45, which had been in a production mode, was returned to an injection status.
January 11, 1980	Monitor Wells M-40, M-40A, M-40B and M-43 were sampled. Wells 40-A, 40B and 43 were within baseline ranges. Well 40, again, showed a pH drop to 3.8.	In response to the downturn in M-40 water quality, injection of lixiviant was halted in I-45. A potassium chloride solution was injected into M-40B to trace the flow.
January 12, 1980		Injection of process water was started into Monitor Well M-40B at 5 gpm. Injection Well I-45 was put into production at 18 gpm.

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
January 14, 1980	Monitor [illegible] M-40, M-40A, M-40B and M-43 were sampled. Wells 40A, 40B and 43 were within baseline ranges for most parameters. Well 40 shows considerable improvement in water quality, thus indicating the corrective actions taken on January 12th are working in a positive fashion.	M-40 ---------- pH 6.7 M-40A --------- pH 7.3 M-40B --------- pH 6.9 M-43 ---------- pH 6.8
January 16, 1980	Monitor Well M-40A sampled. Excursion parameters within baseline ranges.	
January 17, 1980	Monitor Well M-40 sampled. Sulfate, pH and Conductivity are within baseline ranges.	pH ----------- 6.7 Conductivity -- 2800 SO_4 ----------- 1247 U_3O_8 ---------- 0.33
January 18, 1980	Monitor Well M-40 sampled. Again, baseline ranges were attained for pH, sulfate and conductivity.	pH ----------- 6.8 Conductivity -- 2500 SO_4 ----------- 1128 U_3O_8 ---------- 0.32
January 21, 1980	Monitor Well M-40 sampled. For the fourth consecutive sampling, baseline ranges were reached for pH, conductivity and sulfate. Calcium, iron and TDS were within baseline ranges.	pH ----------- 6.9 Conductivity -- 2800 SO_4 ----------- 1151 U_3O_8 ---------- 0.20

DATE	EXCURSION VERIFICATION CHRONOLOGY	EXCURSION CONTROL AND CORRECTIVE ACTIONS
January 26, 1980		Resumed injection into I-46 after well treatment.
January 28, 1980		Injection halted in I-44 due to pressure.
January 30, 1980		Ceased production from I-45A.
February 4, 1980	Pattern #3 monitor wells were sampled.	Began injection into I-44 after well treatment

	pH	Cond.	SO_4	TDS
M-40	6.6	2800	1083	2340
M-40A	6.8	2900	1188	2540
M-40B	6.8	2750	1227	2440
M-41	6.7	2400	869	2040
M-42	6.8	2400	865	2160
M-43	7.0	2400	865	2080

February 7, 1980		Injection halted in I-48 due to pressure. I-46 airlifted.
February 8, 1980		Airlifted I-49 due to pressure.

Rocky Mountain Energy Co.

APPENDIX C

PERMIT TO CONSTRUCT

/x/ New

/_/ Renewal

/_/ Modified

Permit No. 79-713

NINE MILE LAKE TREATED WATER RESERVOIR
(Name of Facility)

This permit hereby authorizes the applicant:

Attention: Mr. M. R. Neumann

Rocky Mountain Energy Company
(Last) (First) (Middle)

4704 Harlan Street
(Street or P.O. Box)

Denver, Colorado 80212
(City) (County) (State)

to construct, install, or modify a evaporation pond facility located in Sections 27 and 34, T.35N., R.79W.
(Legal Description)

in the County of Natrona, in the State of Wyoming. This permit shall be effective for a period of two (2) years from the date of issuance of this permit not to exceed five (5) years.

E: See Condition Attached to this Permit.

AUTHORIZED BY:

REGISTERED PROFESSIONAL ENGINEER
WILLIAM L. GARLAND
P.E. # 1479
STATE OF WYOMING

William L. Garland
Administrator
Water Quality Division

REGISTERED PROFESSIONAL ENGINEER
ROBERT E. SUNDIN
NO. 285
STATE OF WYOMING

Robert E. Sundin
Director
Wyoming Dept. of Environmental Quality

December 21, 1979
Date of Issuance

"The authority to construct granted by this permit does not mean or imply that the Wyoming Department of Environmental Quality guarantees or insures that the permitted facility, when constructed, will meet applicable discharge permit conditions or other effluent or opertional requirements."

No. 79-713
Condition Attached to Permit to Construct

Nine Mile Lake Treated Water Reservoir
Rocky Mountain Energy Company

Records of all sample analysis results, as mentioned in Section III.B. Water Quality Control of the "Supplement to Application for Treated Water Reservoir," shall be maintained at the Nine Mile Lake office of the permittee, and must be made available upon request to representatives of the Department of Environmental Quality.

Any concentrations of radionuclides, in excess of those anticipated by the permittee, which are found in the permitted facility shall be reported in writing to the Administrator of the Water Quality Division within 72 hours of the discovery of such concentrations.

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