Quivira Mining Company

January 31, 1995

Certified Mail
Return Receipt Requested (P 762 964 220)

Mr. Joe Holonich, Branch Chief
Uranium Recovery Branch
Division of Low-Level Waste Management
and Decommissioning
11555 Rockville Pike
Rockville, MD 20850

Re: **License SUA-1473**
Docket No. 40-8905
1994 ALARA Review

Dear Mr. Holonich,

In accordance with license condition #10 of the above referenced source material license and the *Health Physics and Environmental Programs Manual*, please find attached the 1994 ALARA Review for the Ambrosia Lake facility. This summary reviews the actions taken to maintain occupational exposures and environmental effluent exposures as low as reasonably achievable.

If you have any questions or need additional information, please do not hesitate to call me at (505) 287-8851.

Regards,

Peter Luthiger
Supervisor, Radiation Safety
and Environmental Affairs

Attachment: As Stated

xc: A. Delgado
B. Ferdinand
T. Fletcher
K. Lovato
NRC-Arlington, TX
file

NL05

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QUIVIRA MINING COMPANY

AMBROSIA LAKE FACILITY

License No. SUA-1473
Docket No. 40-8905

ALARA REVIEW
1994

ALARA SUMMARY
January - December 1994

I. Introduction

The annual ALARA summary for Quivira Mining Company's Ambrosia Lake facility for calendar year 1994 is submitted for NRC's review in accordance with License Condition #10 and Quivira Mining Company's ALARA Statement and Policy. The formal management ALARA review was conducted on January 25, 1995 by the facility ALARA audit committee. In attendance were Messrs. Terry Fletcher (General Manager), Peter Luthiger (Radiation Safety Officer), Alberto Delgado (Mill Operations Supervisor), and Mrs. Kathy Lovato (Industrial Relations). Copies of the review were also sent to corporate management.

II. Health Physics Sampling Summary

A. Bioassay

The collection of bioassay samples continued during the year in accordance with the policy statement prescribed in the *Bioassay Program* section of the facility "Health Physics and Environmental Programs Manual".

The policy statement requires yellowcake operators to submit samples at least quarterly with the frequency increasing to semimonthly should airborne concentrations within the area exceed 25 percent of natural uranium Derived Air Concentration (DAC) listed in the revised 10 CFR 20, Appendix B, Table 1.

During the year there were a total of thirty four (34) samples collected from employees associated with yellowcake production. Analytical results indicated that all sample concentrations were below the lower detectable limit of five (5) micrograms per liter (μg/l) with the exception of one sample; which indicated a uranium concentration of 8.9 μg/l. The slightly elevated bioassay sample was anticipated since a lapel sample result indicated elevated airborne concentrations during activities associated with a radiation work permit. Pursuant to Section 7 of Quivira's *Bioassay Program*, the radiation safety officer determined that no additional action was necessary since the concentration was just above the detectable level.

All quality assurance spike samples were within the Regulatory Guide 8.22 variance for acceptable spike results.

The reasons for the negligible bioassay concentrations are:

1. The process is in slurry form.
2. The operators normally spend less than three (3) hours per week in the yellowcake area.
3. Airborne concentrations within the area are normally well below the DAC for soluble natural uranium.

These bioassay results corroborate the airborne yellowcake sampling program sampling results which show very low airborne concentrations.

B. **Personnel Alpha Contamination Checks**

During the review period, there were a total of two hundred sixty five (265) random alpha contamination surveys of employees leaving the restricted area. These checks were performed by health physics personnel. The contamination checks were performed at the end of work shift prior to employees leaving the mill facility. All surveys were well below the 1000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) guideline contained within NRC Regulatory Guide 8.30.

In addition to the random employee surveys by health physics personnel, there were 594 self monitoring checks by the employees. All checks indicated that contamination on personnel and their clothing were also below Regulatory Guide 8.30 suggested limits.

C. **Surface Contamination Checks**

There were 572 surface contamination checks performed during the review period. The surface contamination checks were performed at various places throughout the restricted area including lunch rooms, change rooms, and the guard office. All sample results were below the respective action levels for both controlled and uncontrolled area activity limits of 5000 dpm/100 cm^2 and 1000 dpm/100 cm^2 respectively.

D. Radon Daughter Sampling

During 1994, the annual radon exposure for all employees was 0.0 wlm. This result can be primarily attributed to the measures implemented within the facility's ion exchange plant to reduce airborne radon concentrations. It should also be noted that the radon concentrations measured are inclusive of background concentrations.

1. Mill IX Plant

The average weekly radon daughter concentration during 1994 was 0.04 wl. The 1993 average radon concentration averaged 0.02 wl. There were a total of 295 sample determinations for the area.

Attached in Appendix A is a graph plotting the weekly radon daughter concentration average within the mill IX plant. The linear regression line or trend line is positive which indicates that the airborne concentrations are increasing through time. With increased production within the ion exchange plant, it was expected that airborne concentrations may increase slightly. Another factor contributing to the elevated radon concentrations near year's end is that during the cold weather season the building ventilation is reduced as a result of keeping the large roll-up door closed in order to improve heating efficiency within the building.

2. Yellowcake Area

During 1994, the yellowcake area had a weekly average radon daughter concentration of 0.02 wl. This was based on 263 sample determinations. This represents 6% of the DAC limit of 0.33 wl. The 1994 average radon concentration remained unchanged from the 1993 average radon concentration which also averaged 0.02 wl.

Attached in Appendix A is a graph plotting the weekly radon daughter concentrations average within the yellowcake area. The linear regression line or trend line is relatively horizontal indicating that the minimal airborne concentrations are remaining constant through time.

3. Chemistry Lab

The weekly radon daughter concentration average for the year was 0.02 wl which equates to 6% of the DAC limit of 0.33 wl. A total of 104 samples were collected in the area in 1994. The 1993 average weekly radon concentration was 0.01 wl. The slight increase in the minimal radon daughter concentrations within the chemistry laboratory is well within the variability of natural background concnetrations.

As shown in the Appendix A, the trend line is slightly positive, or in other words, the radon daughter concentrations are increasing through time.

4. Raffinate Building

Radon daughter samples were collected weekly within this area. These samples were used to determine radon daughter exposure due to the receiving raffinate material from Sequoyah Fuels. Although no shipments were received in 1994, sampling in this area continued since the building is occasionally utilized for other activities. The 1994 weekly average radon daughter concentration was 0.01 wl, compared to 0.01 wl for 1993. A total of 52 samples were collected. This represents 3% of the DAC limit of 0.33 wl.

Contained in Appendix A is a trend line of the weekly concentrations for the raffinate building. The slope of the line is horizontal, which indicates the normally minimal airborne concentrations are constant through time.

5. General Shop

The weekly radon daughter concentration average at the shop was 0.01 wl. A total of 104 measurements were made during the year. The 1994 average radon concentration remained unchanged from the 1993 average radon concentration which also averaged 0.01 wl. The minimal radon concentrations within the shop represents 3% of the DAC limit of 0.33 wl.

Presented in Appendix A is the trend line of weekly concentrations

within the maintenance shop areas. The slight increase in the minimal radon daughter concentrations within the maintenance shop is well within the variability of natural background concnetrations.

6. Leach Building

The weekly radon daughter concentration average at the leach building was 0.03 wl. A total of 104 measurements were made during the year. The annual average at the leach building during 1993 was 0.02 wl.

Attached in Appendix A is a trend line of the weekly concentrations for the leach building. The trend line is positive, which indicates the radon concentrations are increasing through time.

7. Slurry Loading Station

The weekly radon daughter concentration average at the Slurry loading station was 0.02 wl. A total of 52 measurements were made during the year. This represents 6% of the annual MPC limit of 0.33 wl. The 1994 average radon concentration remained unchanged from the 1993 average radon concentration which also averaged 0.02 wl.

Attached in Appendix A is a trend line of the weekly concentrations for the slurry loading station. The slight increase in the minimal radon daughter concentrations within the slurry loading station is well within the variability of natural background concnetrations.

E. Yellowcake Samples

There were 624 routine air samples taken for airborne yellowcake activity. The samples were obtained weekly at random times at twelve locations within the precipitation area. The annual weekly average for 1994 was 4.1×10^{-12} microcuries per milliliter (μCi/ml), which represents 0.83% of the DAC for soluble natural uranium. The 1994 weekly average represents the fifth consecutive year where the weekly average concentrations have been reduced.

The weekly airborne concentrations are shown in Appendix A. As indicated from the graph, the line is horizontal indicating that the minimal airborne concentrations for yellowcake dust are constant over time. The graph shows

a spike for one week (6.8% of DAC), which was caused by activities on a radiation work permit within the yellowcake area. Subsequent weekly concentrations returned to expected concentrations for the area.

F. Soluble Uranium Intake

As a result of the implementation of the revised 10 CFR 20 regulations and the addition of 10 CFR § 20.1201(e), which limits soluble uranium intake to 10 milligrams per week, weekly intake values were determined for the yellowcake area by utilizing data obtained from the air sampling program. For conservatism, the weekly intake values assume continuous occupancy (40 hours) within the area.

The weekly intake values for soluble uranium, based on continuous occupancy, are presented in Appendix A. During 1994, the average weekly intake of soluble uranium was 0.29 milligrams per week; with a maximum intake for one week of 2.41 milligrams per week. This spike was associated with activities on a radiation work permit within the yellowcake area. Subsequent weekly intake values returned to levels expected for the area.

G. Uranium Ore Dust

During the review period, there were no routine uranium ore dust samples taken as the crushing circuit has been shutdown with the area in standby.

H. Non-Routine Removable Alpha Contamination Surveys

There were four (4) quarterly removable alpha contamination surveys conducted during the year with a total of 81 samples collected. These samples are taken to ensure that contamination has not accidently been spread outside the confines of the controlled areas into uncontrolled areas. The results indicated that all samples were below the specified limits with the exception of two (2) samples that indicated isolated contamination present. Both areas were washed down to eliminate any potential contamination problem.

I. **Gamma Surveys**

There were two semiannual gamma surveys conducted during the year as suggested by Regulatory Guide 8.30. A total of 68 different locations were checked throughout the mill and all areas surveyed were properly posted in accordance with 10 CFR § 20.1902.

III. Exposure Summary

With the revised radiation protection regulations becoming effective on January 1, 1994, all licensees were required to ensure compliance with the occupational dose limits specified within 10 CFR § 20.1201(a). This regulation established an annual limit based on internal exposures as well as external exposures. Annual exposure to employees are determined by calculating exposures to radon daughters, soluble airborne yellowcake dust, and gamma radiation. Each component of the annual exposure is discussed in more detail in subsections B through D below.

A. **Total Effective Dose Equivalent**

The total effective dose equivalent (TEDE) exposure results for all employees is presented in Table 1 below. The TEDE is the sum of the deep dose equivalent (external exposures) and the committed effective dose equivalent (internal exposures).

The result in Table 1 indicate that the highest employee TEDE exposure was 0.257 rems. This exposure represents 5% of the annual allowable occupational dose limit specified within 10 CFR § 20.1201(a).

TABLE 1
1994 TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)

Exposure (REM)	0-.05	.05-.10	.10-.25	.25-.50	.50-1.0	1.0-2.5	2.5-5.0	> 5.0
# of Employees	19	14	6	2	0	0	0	0

10 CFR § 20.1502 requires exposure monitoring of any individual likely to

receive a dose in excess of 10% of the occupational dose limits prescribed in 10 CFR § 20.1201. Based on the annual exposures determined for facility personnel, individual exposure monitoring of visitors will not be necessary.

B. **Deep Dose Equivalent (Gamma Exposure)**

Gamma exposures are determined by the results of individual TLD badges worn by all employees and analyzed in accordance with National Voluntary Laboratory Accreditation Program (NVLAP) procedures and specifications by an accredited outside contract laboratory. Table 2 summarizes the 1994 employee gamma dose exposures. The highest annual gamma exposure incurred by an employee was 0.250 rems.

TABLE 2
1994 GAMMA DOSE EXPOSURES

Exposure (REM)	< .05	.05-.10	.10-.25	.25-.50	.50-.75	> .75
# of Employees	19	14	8	0	0	0

Upon comparing the total effective dose equivalent (TEDE) and the deep dose equivalent (DDE) exposures for 1994 confirms that almost all employee exposure is a result of external radiation.

C. **Radon Daughters Exposures**

All radon daughter exposures for employees are calculated using a time weighted average format as outlined by the Mine Safety and Health Administration (MSHA) in 30 CFR 57.5040. Air samples are obtained in accordance with the facility sampling program at various work locations throughout the facility. Occupancy times are then factored into these values in order to obtain an employee's internal exposure to radon daughters for that time period. The annual radon daughter exposure results are presented below in Table 3.

TABLE 3
1994 RADON DAUGHTER EXPOSURES

Exposure (w/m)	0.0	0.1-0.3	0.3-0.6	0.6-0.8	0.8-1.0	> 1.0
# of Employees	41	0	0	0	0	0

D. **Yellowcake and Uranium Ore Dust**

As a result of the implementation of the revised 10 CFR 20 regulations and the addition of 10 CFR 20 § 20.1204 requiring determination of internal exposures to employees, internal exposures are now being included within the employee exposure records.

Internal exposures to soluble uranium are determined by analyzing the yellowcake samples for gross alpha activity to obtain an average air concentration for the area. Air samples are obtained in accordance with the facility sampling program as well as from radiation work permits which may require personnel sampling. Occupancy times are then factored into these values in order to obtain an employee's internal exposure for that time period or task.

Table 4 summarizes the 1994 employee internal exposures to soluble uranium. The maximum exposure received by an employee during 1994 was 4.8 derived air concentration-hour (DAC-Hr); which corresponds to less than 1% of the annual limit of intake (ALI) for soluble natural uranium.

TABLE 4
1994 SOLUBLE URANIUM (YELLOWCAKE) EXPOSURES

Exposure (DAC-Hr)	< 0.1	0.1-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-5.0	> 5.0
# of Employees	15	16	4	2	0	4	0

Due to the standby status and minimal airborne concentrations, all exposures to internal radionuclides are significantly below 25 % of the DAC limit. The

average weekly yellowcake airborne concentration during the year was less than 1% of the DAC limit.

E. Raffinate

During 1994, no shipments of alternate feed material (raffinate) were delivered for processing at the Ambrosia Lake facility.

Exposures resulting from the processing of the alternate feed material have also been minimal. The air sampling program implemented within the thickener area resulted in a monthly average airborne yellowcake dust concentration of less than 1% of the DAC limit. The reason for the negligible concentrations are:

1. To date, all processing activities are performed within the thickener area;
2. The material is continually maintained in slurry form;
3. Compliance with established standard operating procedures.

IV. Miscellaneous ALARA Activities

A. Daily Inspections

During the year, daily inspections and sample surveys resulted in 10 mill corrective orders being issued. Mill corrective orders are normally issued when an area requires clean up and that item involves radiological conditions which are below the recommended regulatory guide limits. Mill corrective orders are issued when the job does not require a RWP.

The mill corrective orders involved clean up or the washing down of areas contaminated by process spills. The orders have been filed for future reference and inspection.

B. Safety and Training Activities

During the year, there was one (1) new full time employee hired, one (1) inter-company transfer, and four (4) temporary employees hired. These individuals received all required training in accordance with MSHA

regulations and Quivira's "Radiation Safety Training Program".

The annual eight (8) hour refresher course was completed for all employees and included the topics as outlined in Quivira Mining Company's "Radiation Safety Training Program". In conjunction with the annual refresher course, all employees completed the respirator fit test.

All employees also received a pulmonary function evaluation during 1994. Results from these spirometry tests indicated that all employees are medically qualified to wear respiratory protection equipment except for one employee. Upon notification from the physician, this employee was informed of this situation and has not been permitted to wear respiratory protection equipment until subsequent pulmonary function evaluations indicate acceptable results.

Safety meetings, conducted throughout the year, reviewed various topics pertaining to radiation safety including bioassay program, respiratory protection program, standard operating procedures, radiation work permit system, and contamination control.

C. Performance of Emission Control Equipment

Due to no yellowcake drying activities occurring in 1994, the facility emission control equipment such as the wet scrubber and the baghouse were not operated.

D. Operational Procedures & Emergency Response Actions

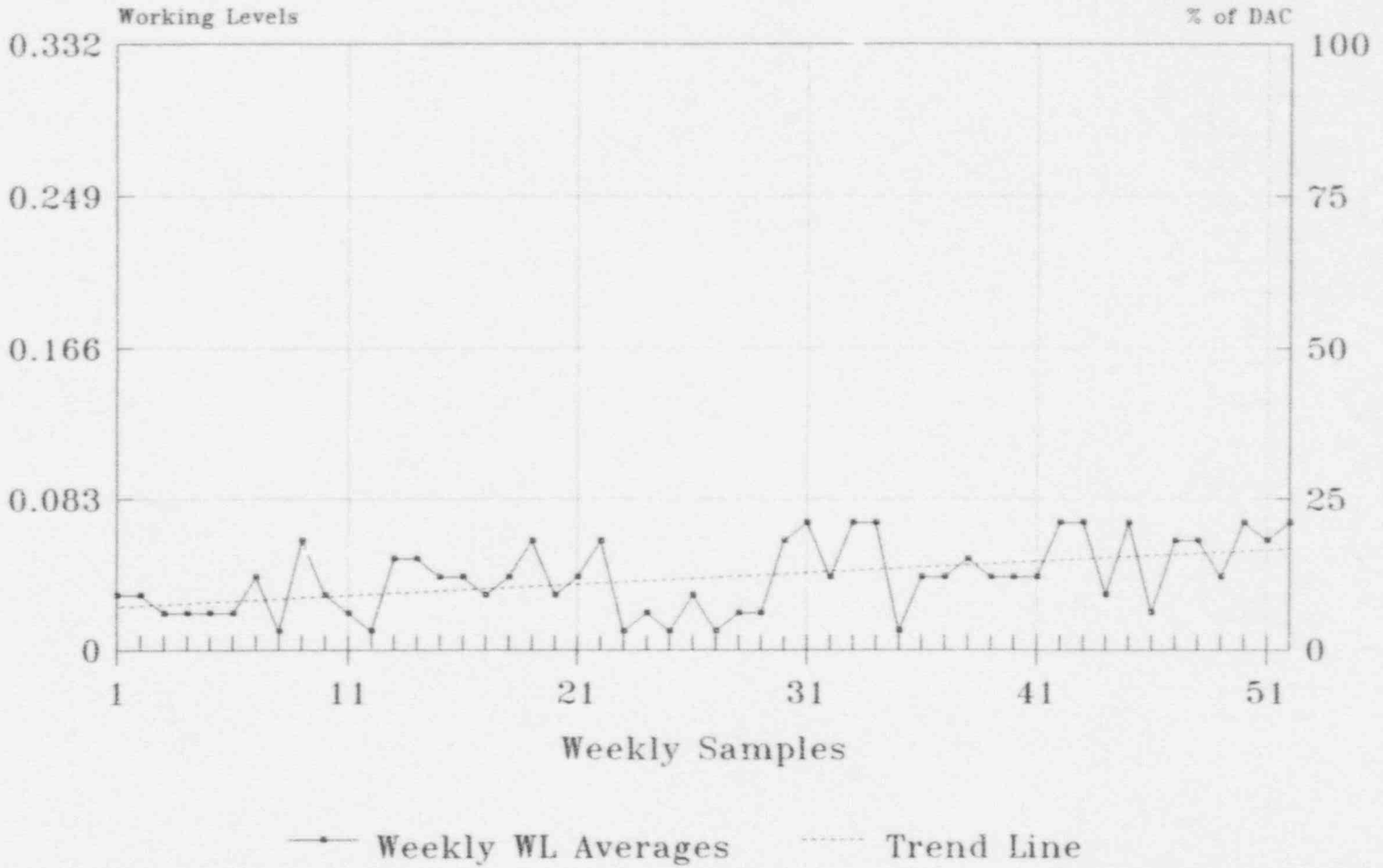
During the year, all Standard Operating Procedures (SOP) and Emergency Response Procedures were reviewed and updated, if necessary, to ensure that proper radiation protection principles are applied.

In addition, all procedures utilized within the radiation safety program were reviewed and updated, as necessary.

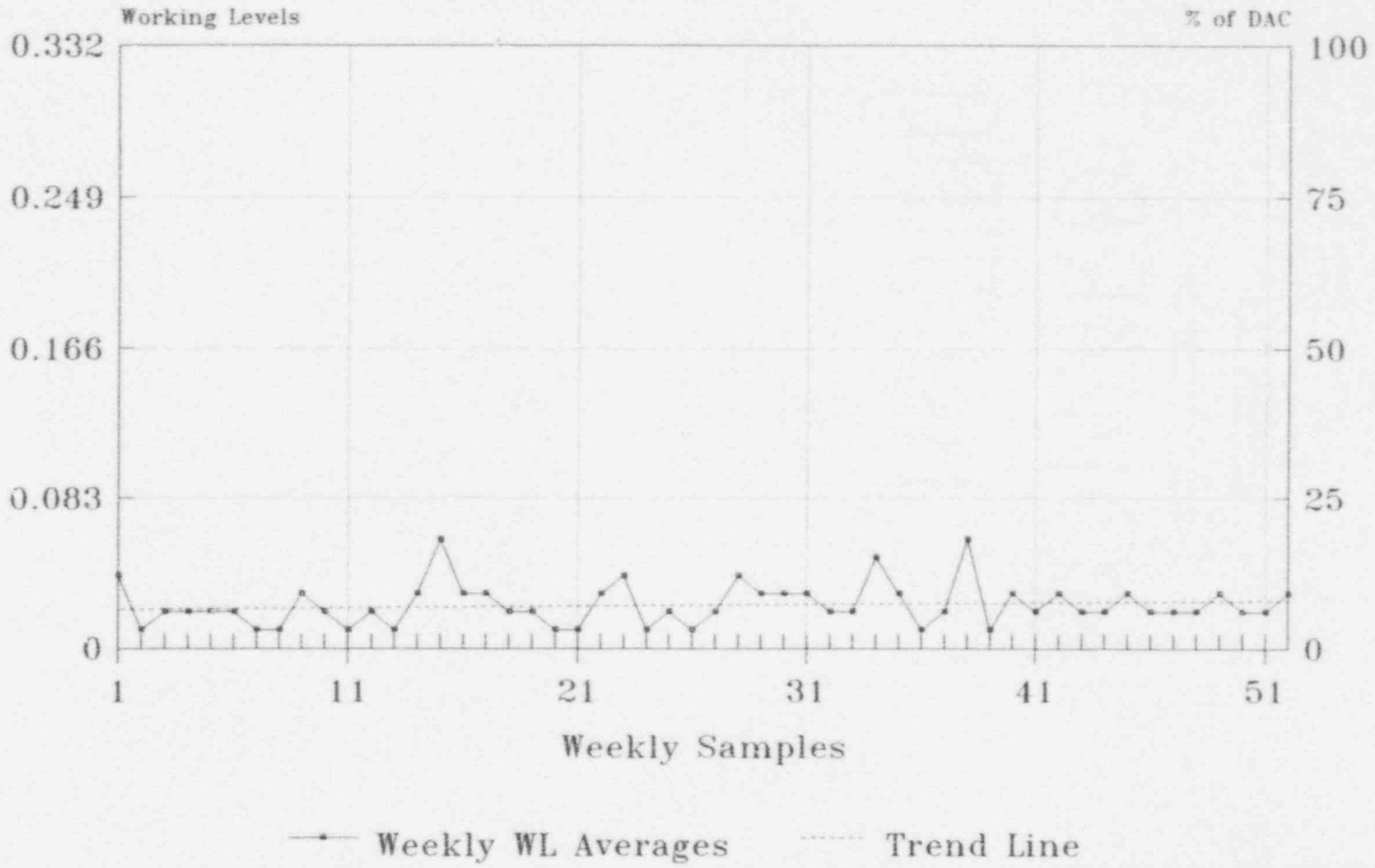
APPENDIX A

Time Versus Concentration Plots

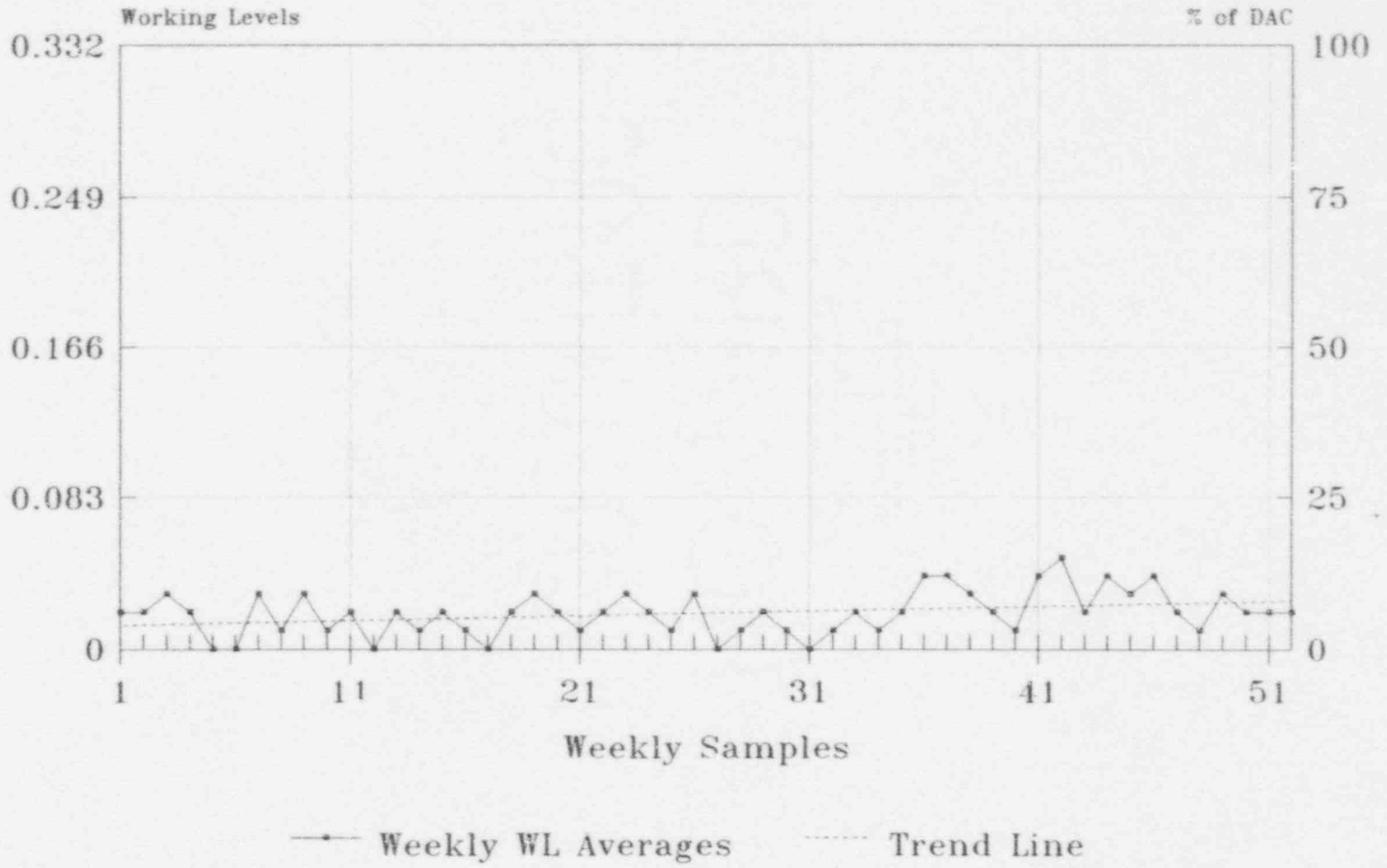
MILL IX PLANT
WL Concentrations - 1994



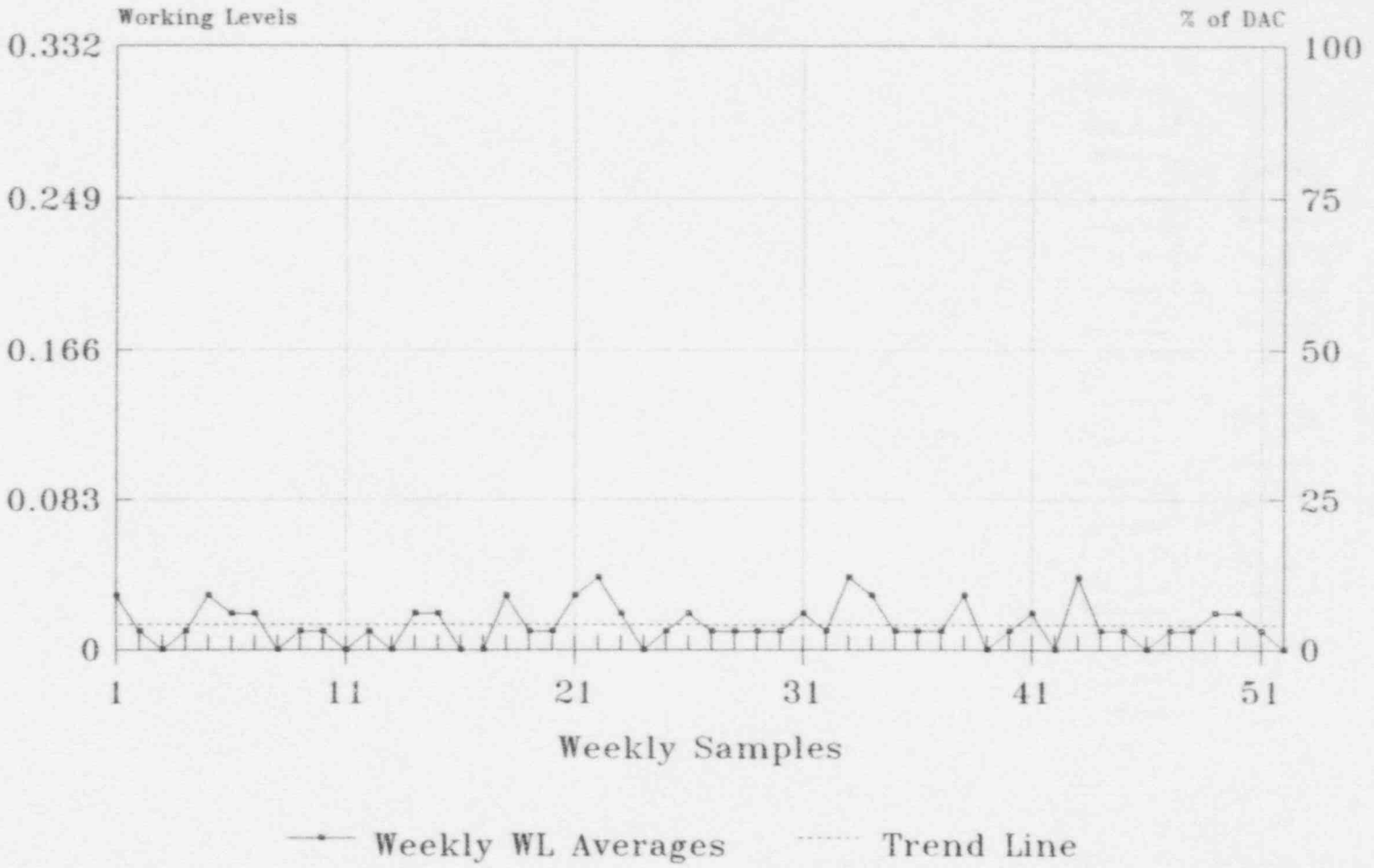
PRECIPITATION AREA
WL Concentrations - 1994



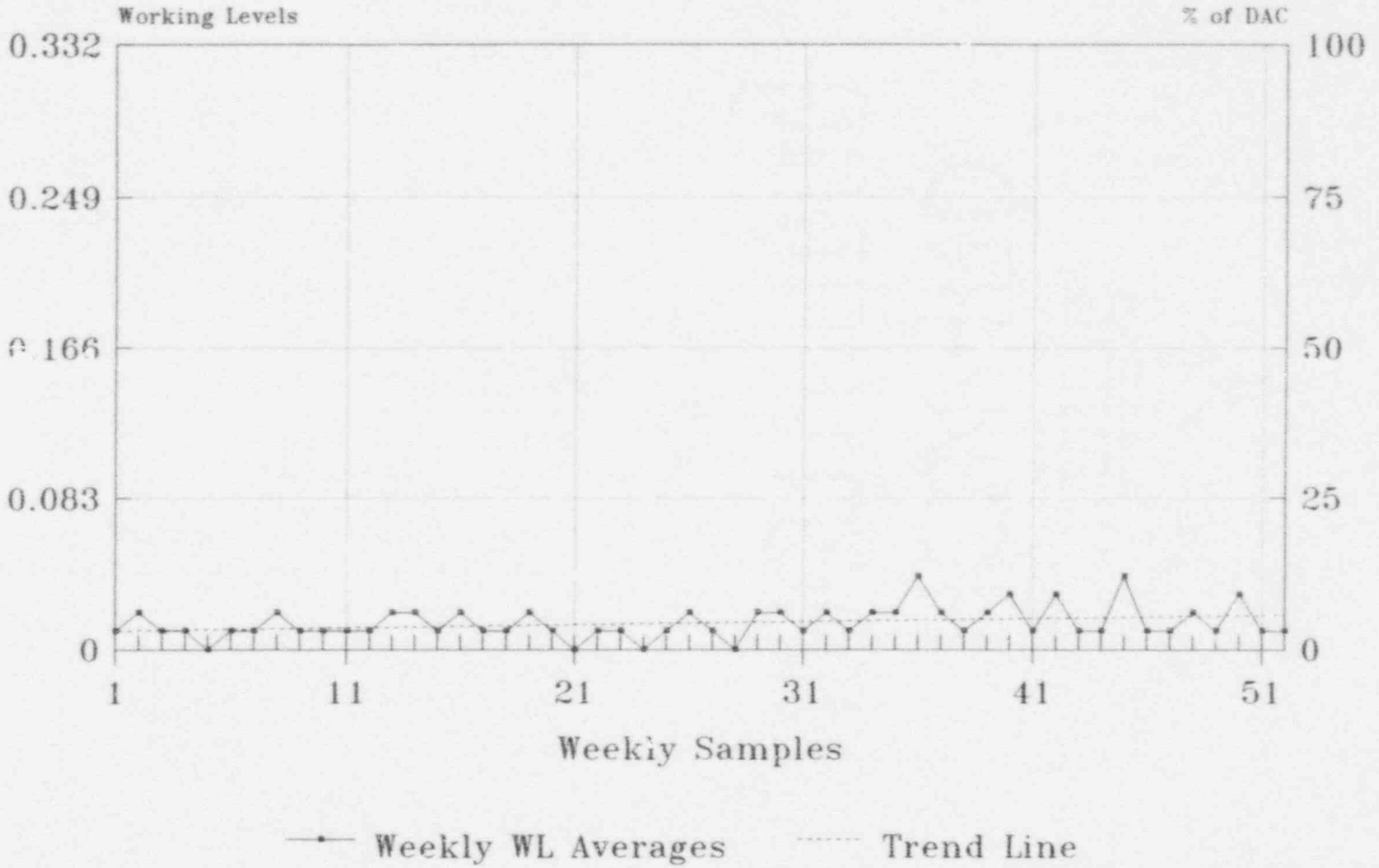
CHEMISTRY LABORATORY
WL Concentrations - 1994



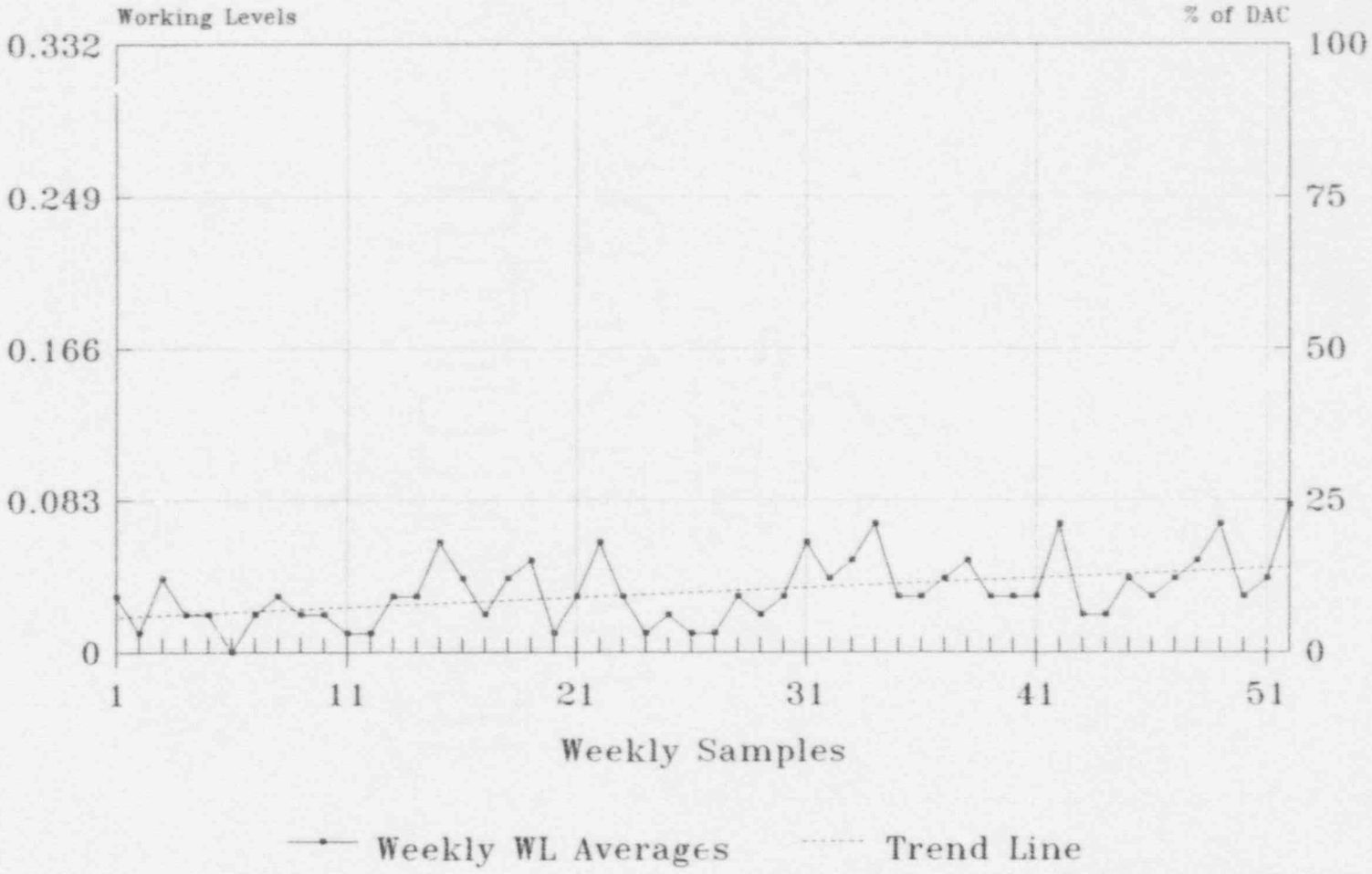
RAFFINATE BUILDING
WL Concentrations - 1994



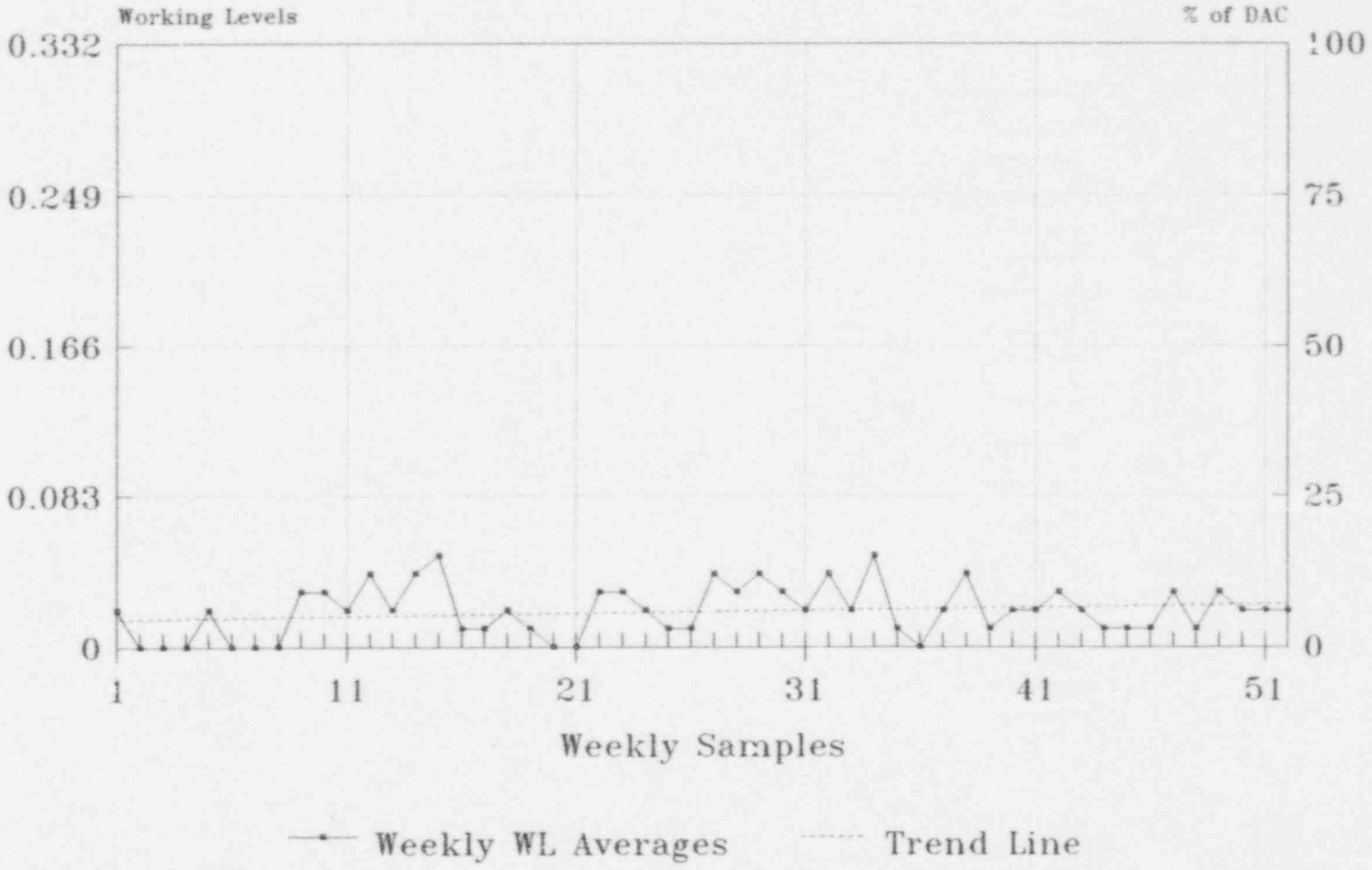
GENERAL SHOP
WL Concentrations - 1994



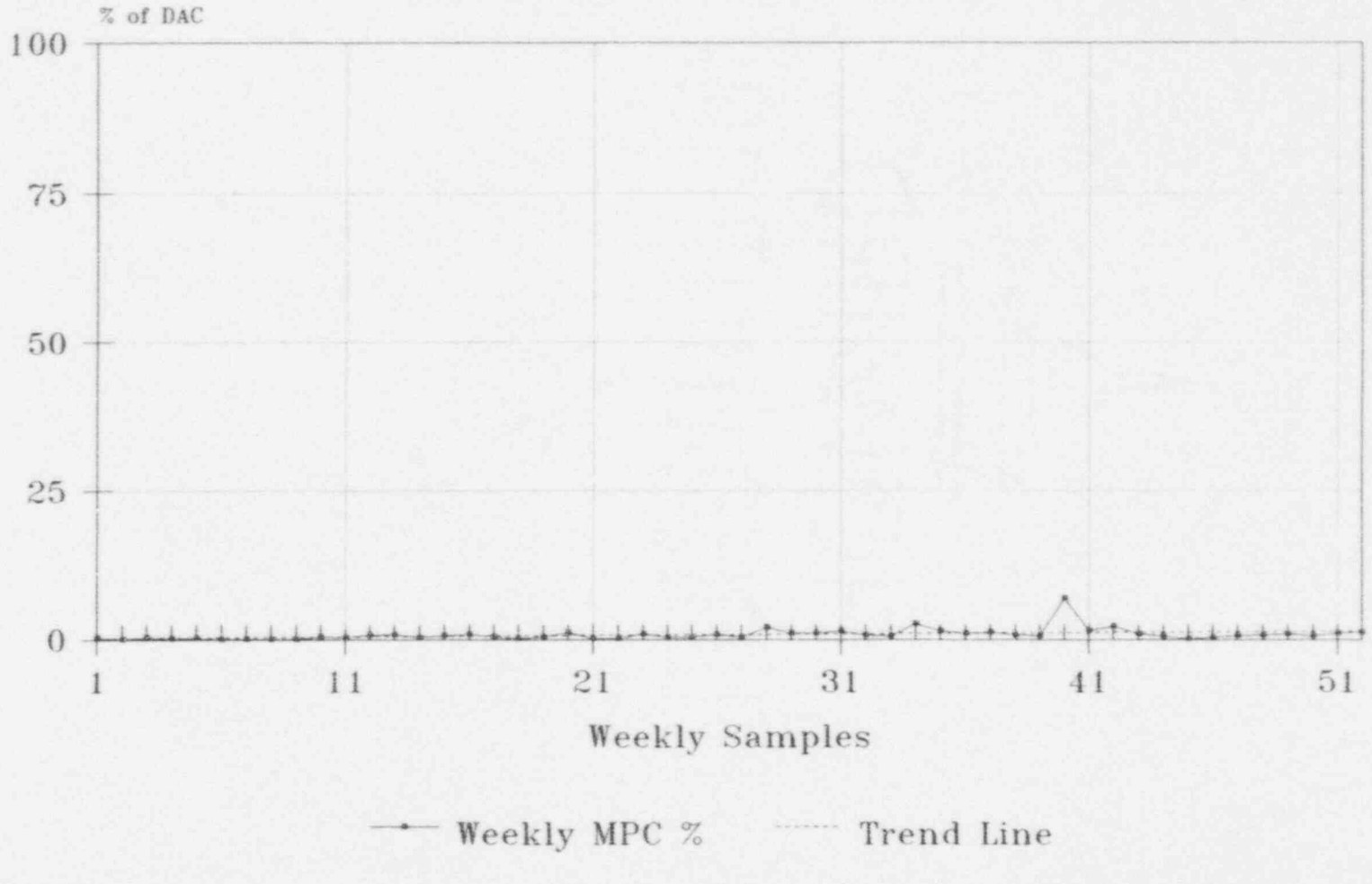
LEACH BUILDING
WL Concentrations - 1994



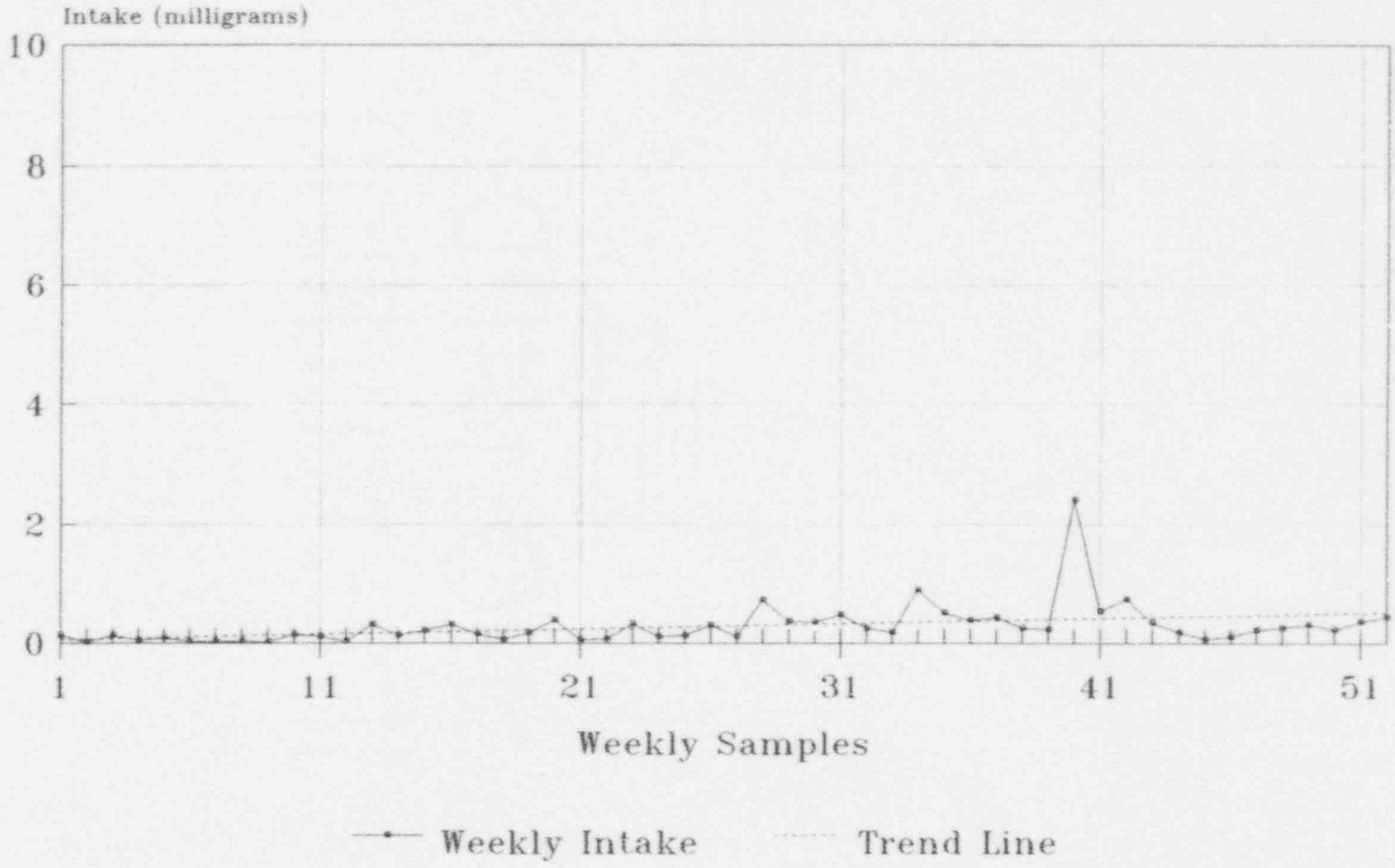
SLURRY LOADING STATION
WL Concentrations - 1994



YELLOWCAKE PRECIPITATION AREA
YC Concentrations - 1994



YELLOWCAKE AREA
Soluble Uranium Intake - 1994



* 10 CFR 20.1201(e) limits weekly intake of soluble yellowcake to 10 milligrams