Quivira Mining Company

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January 31, 2000

Certified Mail
Return Receipt Requested (P 268 361 154)

Mr. Thomas Essig, Branch Chief
U.S. Nuclear Regulatory Commission
Uranium Recovery Branch
Division of Waste Management
Mail Stop 7 J8
Rockville MD 20850

Re: **License SUA-1473**
Docket No. 40-8905
1999 ALARA Report

Dear Mr.Essig,

In accordance with license condition #10 of the above referenced source material license and the NRC approved *Health Physics and Environmental Programs Manual*, please find attached the 1999 ALARA Report for the Ambrosia Lake facility. This summary reviews the 1999 employee exposure results and actions taken to maintain occupational exposures as low as reasonably achievable. The report indicates that the 1999 exposures are markedly lower than 1998 exposure levels while maintaining production levels essentially constant.

If you have any questions or need additional information, please do not hesitate to call me at (505) 287-8851, extension 205.

Regards,

Peter Luthiger
Supervisor, Radiation Safety
and Environmental Affairs

Attachment: As Stated

xc: A. Delgado
T. Fletcher
P. Goranson
K. Lovato
NRC-Arlington, TX
file

NMSS01 Public

Quivira Mining Company

Source Material License SUA-1473
Docket Number 40-8905

ALARA REVIEW
1999

January 31, 2000

ALARA SUMMARY
January - December 1999

I. Introduction

The annual ALARA summary for Quivira Mining Company's Ambrosia Lake facility for calendar year 1999 is submitted for NRC's review in accordance with Quivira's Source Material License Condition #10. License condition #10 contains Quivira Mining Company's ALARA Policy as well as the NRC approved health physics and environmental/effluent monitoring programs required to be implemented at the facility as specified within the *Health Physics and Environmental Programs Manual.* The formal management ALARA review was conducted on January 31, 2000 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.* This manual outlines the health physics and environmental/effluent monitoring programs required to be implemented at the facility, as approved by the NRC.

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 forty four (44) routine samples collected from individuals. Analytical results indicated that all sample concentrations were below the laboratory's lower detectable limit of five (5) micrograms per liter (µg/l). All quality assurance spike samples were within the Regulatory Guide 8.22 suggested variance for acceptable spike results.

The reasons for the continued negligible bioassay concentrations are:

1. The process is in slurry form;

2. The operators normally spend approximately ten (10) to fifteen (15) hours per week in the yellowcake area;
3. Airborne concentrations within the area are continually 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 seventy two (72) 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 771 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 when leaving the facility.

C. Surface Contamination Checks

There were 473 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.

D. Radon Daughter Sampling

During 1999, the annual radon daughter exposure for all employees was 0.3 working level months ("wlm"); which corresponds to 7.5% of the annual allowable occupational exposure limit of 4 wlm. It should also be noted that the radon concentrations measured are inclusive of background concentrations.

1. Mill IX Plant

The average radon daughter concentration during 1999 was 0.04 wl. The 1998 average radon concentration also averaged 0.05 wl. There were a total of 130 sample determinations for the area. This represents 12% of the DAC limit of 0.33 wl.

Attached in Appendix A is a graph plotting the radon daughter concentration average within the mill IX plant. The trend line is slightly positive, which indicates the radon concentrations are slightly increasing through time. This slight increase, especially near the end of the year, has been attributed to winterizing the facilities and cold weather creating occasional inversion conditions within the valley.

2. Yellowcake Precipitation Area

During 1999, the yellowcake precipitation area had an average radon daughter concentration of 0.02 wl. This was based on 130 sample determinations. This represents 6% of the DAC limit of 0.33 wl. The 1999 average radon concentration for this area continued their negligible levels; as the 1998 average concentration for the area was also 0.02 wl.

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

3. Chemistry Lab

The 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 52 samples were collected in the area in 1999. The 1998 average concentration for the area was 0.03 wl.

As shown in the Appendix A, the trend line is relatively horizontal indicating that the minimal airborne concentrations are remaining constant through time.

4. Leach Building

The radon daughter concentration average at the leach building was 0.03 wl, which represents 9% of the DAC limit of 0.33 wl.. A total of 57 measurements were made during the year. The 1999 average, which is the same as the 1998 average, indicates that the average concentrations are remaining constant through time.

Attached in Appendix A is a trend line of the concentrations for the leach building. The trend line is slightly positive, which indicates the radon

concentrations are increasing slightly through time. This slight increase, especially near the end of the year, has been attributed to winterizing the facilities and cold weather creating occasional inversion conditions within the valley.

E. Yellowcake Samples

As an integral component of the health physics monitoring program outlined within License Condition #10, air sampling is performed to assess potential employee exposure to airborne yellowcake. There were 492 routine air samples taken during 1999 for airborne yellowcake activity within the yellowcake precipitation area. The samples; which were obtained at random times at twelve locations within the precipitation area, indicated an annual average concentration for 1999 of 3.6×10^{-12} microcuries per milliliter (μCi/ml), which represents less than 1% of the DAC for soluble natural uranium. In comparison, the 1998 annual average was 4.9×10^{-12} μCi/ml, which is 1% of the DAC for soluble natural uranium.

The airborne concentrations are shown in graphical format within Appendix A. As indicated from the graph, the line is horizontal indicating that the minimal airborne concentrations for yellowcake dust remain constant over time and are well below the allowable limit of 5.0×10^{-10} μCi/ml for soluble uranium.

F. Soluble Uranium Intake

To demonstrate compliance with 10 CFR § 20.1201(e), which limits soluble uranium intake to 10 milligrams per week, intake values were determined for the yellowcake area by utilizing data obtained from the air sampling program. For conservatism, the intake values assume continuous occupancy (40 hours) within the area.

The intake from soluble uranium, based on continuous occupancy, is presented in Appendix A. During 1999, the average intake of soluble uranium was 0.24 milligrams per week (assuming continuous occupancy); with a maximum intake for one week of 0.66 milligrams per week (assuming continuous occupancy). This represents a 33% decrease from the 1998 average intake of soluble uranium, which was 0.36 milligrams per week.

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**

Four (4) quarterly removable alpha contamination surveys were conducted during the year with a total of 80 samples collected. These samples are taken to ensure that contamination has not accidentally been spread to other areas of the facility. The results indicated that all samples were below the specified limits.

I. **Gamma Surveys**

There were two semiannual gamma surveys conducted during the year as suggested by Regulatory Guide 8.30. A total of 42 different locations were checked throughout the mill and all areas surveyed were properly posted in accordance with 10 CFR § 20.1902.

III. Respiratory Protection Program

The facility *Respiratory Protection Program* was reviewed to evaluate the effectiveness of the program in limiting exposures to individuals. This review included evaluating air sampling data, use of engineering controls, bioassay results, and employee acceptance of the using the equipment. The review determined that, when required, respirators were effective in minimizing employee exposure to radioactive materials.

All employees received refresher training on respiratory protection program including a fit test to determine the best respirator size for each employee. Spirometry testing by a physician indicated that all employees have been deemed physically fit to use respiratory protection equipment. No complaints or comments were received by employees regarding problems with equipment.

During 1999, various jobs required to placement of special controls on the work procedures to ensure employee exposures were minimized. These jobs, which were issued as radiation work permits, utilized engineering controls (ventilation, enclosures, and additional accesses) as the primary method to control employee exposures. Respiratory protection was utilized if needed if an exposure potential still existed. Results of air sampling results indicated that exposures on these jobs were negligible.

Air sampling data continues to indicate that airborne concentrations are well below the DAC for soluble natural uranium. The airborne concentrations, which are shown in graphical format within Appendix A, indicate that the minimal airborne concentrations for yellowcake dust remain constant over time. This is attributable to maintaining the process in slurry form,

following established procedures, and the use of proper controls on special jobs where employee exposure may occur.

Bioassay results were reviewed to evaluate how effectiveness of the air sampling program presently in place at the facility. Analytical results, all of which were below the laboratory's lower detectable limit of five (5) micrograms per liter (μg/l), reinforce that the air sampling program is effective in evaluating the airborne concentrations in the work areas and that employees are following established procedures, adhering to special work requirements.

IV. Exposure Summary

All licensees are required to ensure compliance with the occupational dose limits specified within 10 CFR § 20.1201(a). This regulation establishes 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 highest employee TEDE exposure for 1999 was 0.335 Rems. This exposure represents 7% of the annual allowable occupational dose limit specified within 10 CFR § 20.1201(a). The 1999 maximum represents a 29% decrease from the maximum annual TEDE exposure received by any employee in 1998.

TABLE 1
1999 TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)

Exposure (REM)	**0 -.05**	**.05 -.10**	**.10 -.50**	**.50-1.0**	**1.0-5.0**	**> 5.0**
No. of Employees	**23**	**3**	**5**	**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 1999 employee gamma dose exposures. The highest annual gamma exposure incurred by an employee was 0.203 Rem.

TABLE 2
1999 DEEP DOSE EXPOSURES

Exposure (REM)	< .05	.05-.10	.10-.20	.20-.50	.50-.75	> .75
No. of Employees	23	3	4	1	0	0

C. **Radon Daughter 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 outlined within the NRC approved Health Physics and Environmental Programs Manual 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 highest annual radon daughter exposure incurred by an employee was 0.3 wlm. This represents 7.5% of the annual allowable occupational exposure limit of 4 wlm. The 1999 maximum represents a 40% decrease from the maximum radon daughter exposure received by any employee in 1998. The annual radon daughter exposure results are presented below in Table 3.

TABLE 3
1999 RADON DAUGHTER EXPOSURES

Exposure (wlm)	0.0	0.1-0.3	0.3-0.6	0.6-0.8	0.8-1.0	> 1.0
No. of Employees	26	5	0	0	0	0

D. **Yellowcake and Uranium Ore Dust**

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 1999 employee internal exposures to soluble uranium. The maximum exposure received by an employee during 1999 was 3.3 derived air concentration-hour (DAC-Hr); which corresponds to less than 1% of the annual limit of intake (ALI) for soluble natural uranium of 2000 DAC-Hr. The 1999 maximum represents a 75% decrease from the maximum soluble uranium exposure received by any employee in 1998.

TABLE 4
1999 SOLUBLE URANIUM (YELLOWCAKE) EXPOSURES

Exposure (DAC-Hr)	< 0.1	0.1-1.0	1.0-2.5	2.5-5.0	5.0-10.0	> 10.0
No. of Employees	10	11	6	4	0	0

Due to the minimal airborne concentrations, all exposures to internal radionuclides are significantly below 25% of the DAC limit. The average yellowcake airborne concentration during the year was 1% of the DAC limit.

E. **Yellowcake Slurry**

Quivira conducted eight (8) shipments of yellowcake slurry during 1999. As a result of personnel following established standard operating procedures, all employee exposures associated with the shipments were negligible.

F. **Crushed Yellowcake Drums**

During 1999, Quivira received a total of twenty eight (28) shipments of crushed damaged yellowcake drums. No problems or concerns were encountered during the receipt and disposal of the material.

IV. Miscellaneous ALARA Activities

A. **Daily and Weekly Inspections**

During the year, daily inspections resulted in one 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 order involved wiping down some visible yellowcake contamination on the lab bench within the yellowcake assay room. The orders have been filed for future reference and inspection.

Weekly inspections of pertinent mill areas by the radiation safety officer are performed to observe and ensure that general radiological control practices are being used. The weekly inspections did not identify any unusual conditions or situation that required corrective action.

B. **Safety and Training Activities**

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 a respirator fit test.

In addition to the annual refresher course, all employees and the contract security force successfully completed an 8 hour first aid training session during 1999.

All employees receiving physicals were administered a pulmonary function evaluation during 1999. Results from these spirometry tests indicated that all current employees are medically qualified to wear respiratory protection equipment.

Safety meetings, conducted throughout the year, reviewed various topics pertaining to radiation safety including contamination control, personnel dosimetry, the importance of reporting radiological hazards, personnel survey procedures, bioassay procedures, and the importance of practicing good personal hygiene and housekeeping while working in the mill area to ensure exposures remain ALARA.

C. Performance of Emission Control Equipment

Due to no yellowcake drying activities occurring in 1999, the facility emission control equipment such as the wet scrubber and the baghouse were not operated.

D. Operational Procedures & Emergency Response Actions

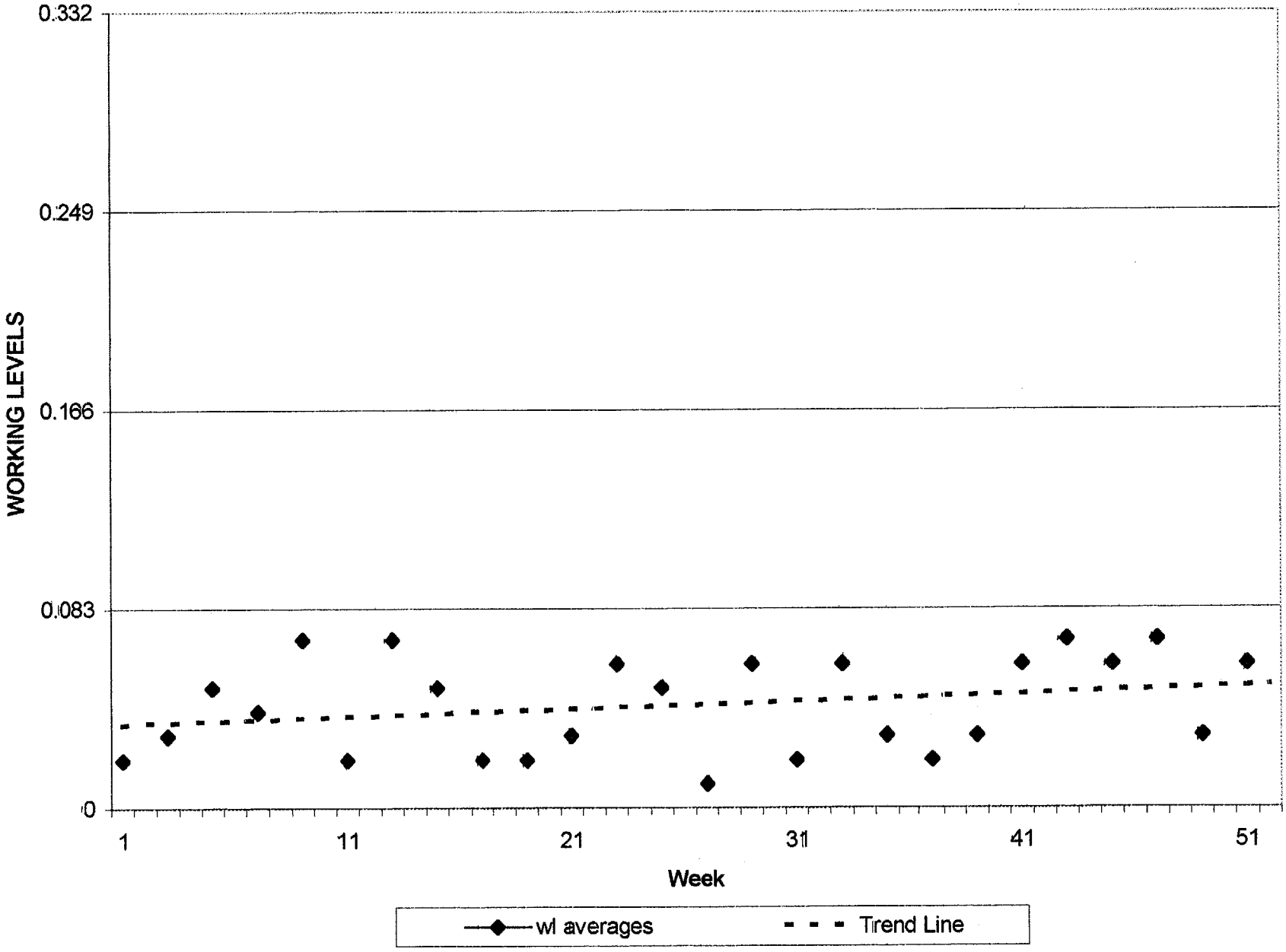
During the year, all Standard Operating Procedures (SOP) and Emergency Response Procedures were reviewed and updated, if necessary, to ensure that proper radiation protection principles are applied. As part of this review, emergency telephone numbers were verified to ensure accurate and prompt notification channels are in place.

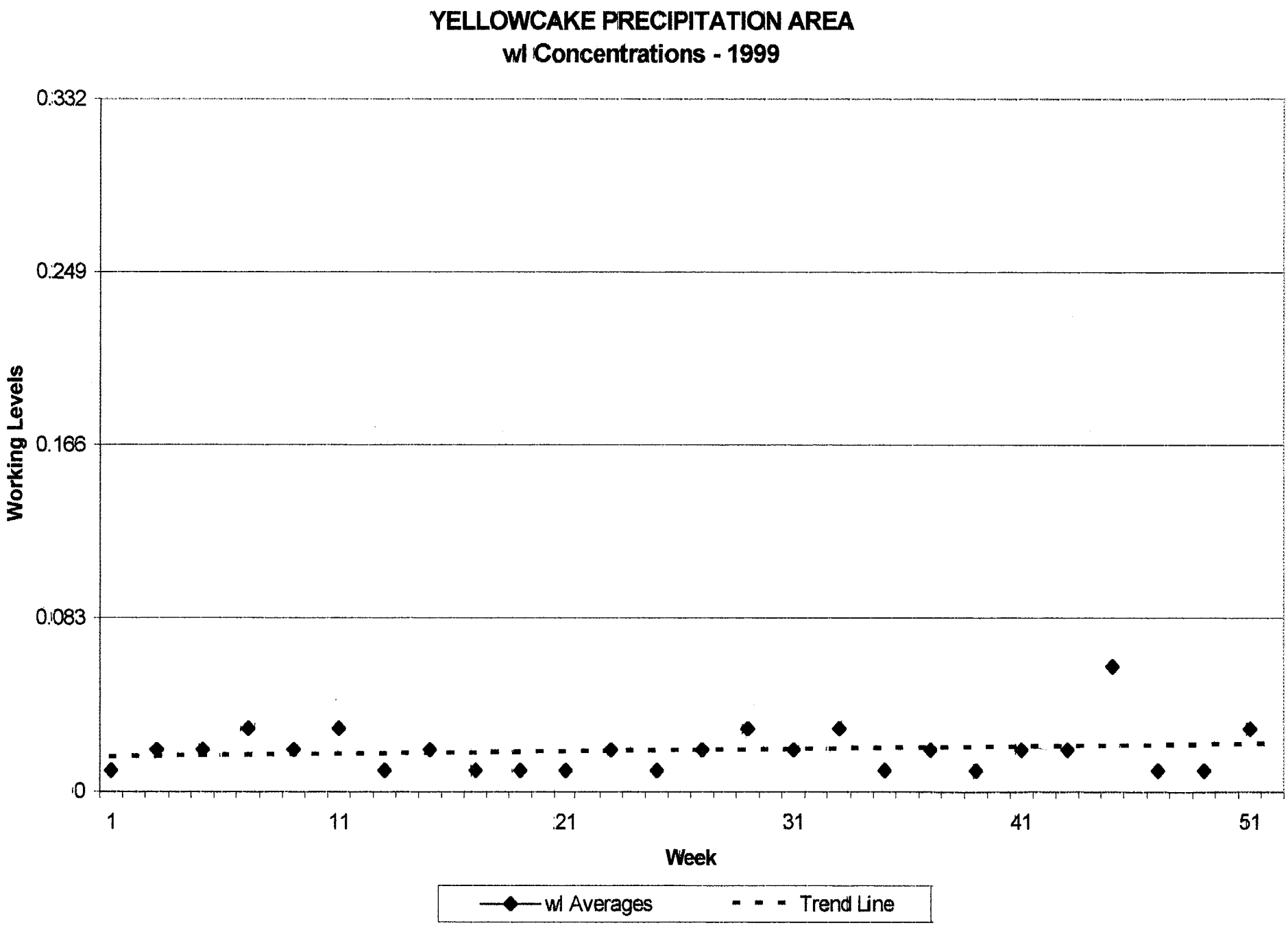
In addition, all procedures utilized within the radiation safety program were reviewed and updated, as necessary.

APPENDIX A

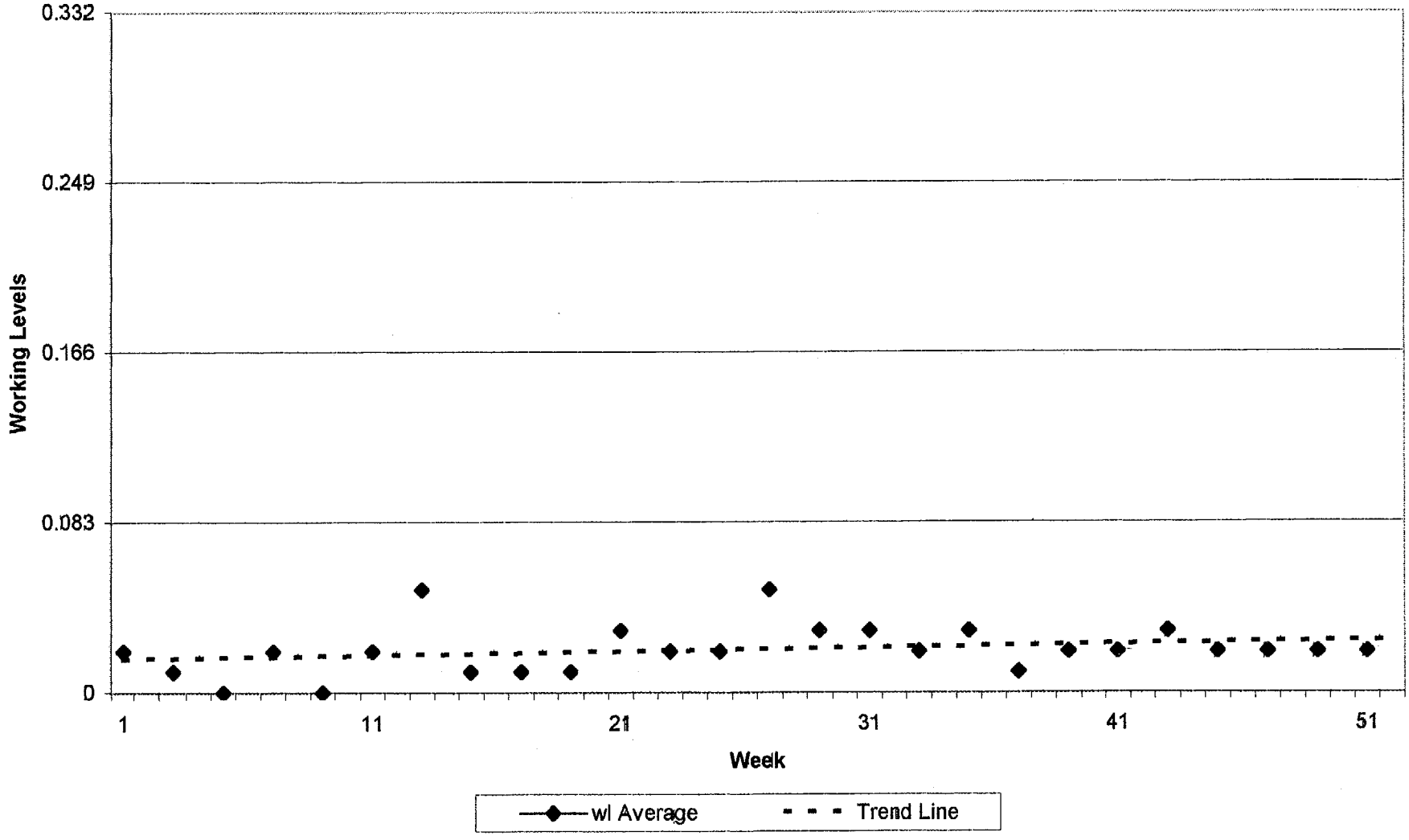
Time Versus Concentration Plots

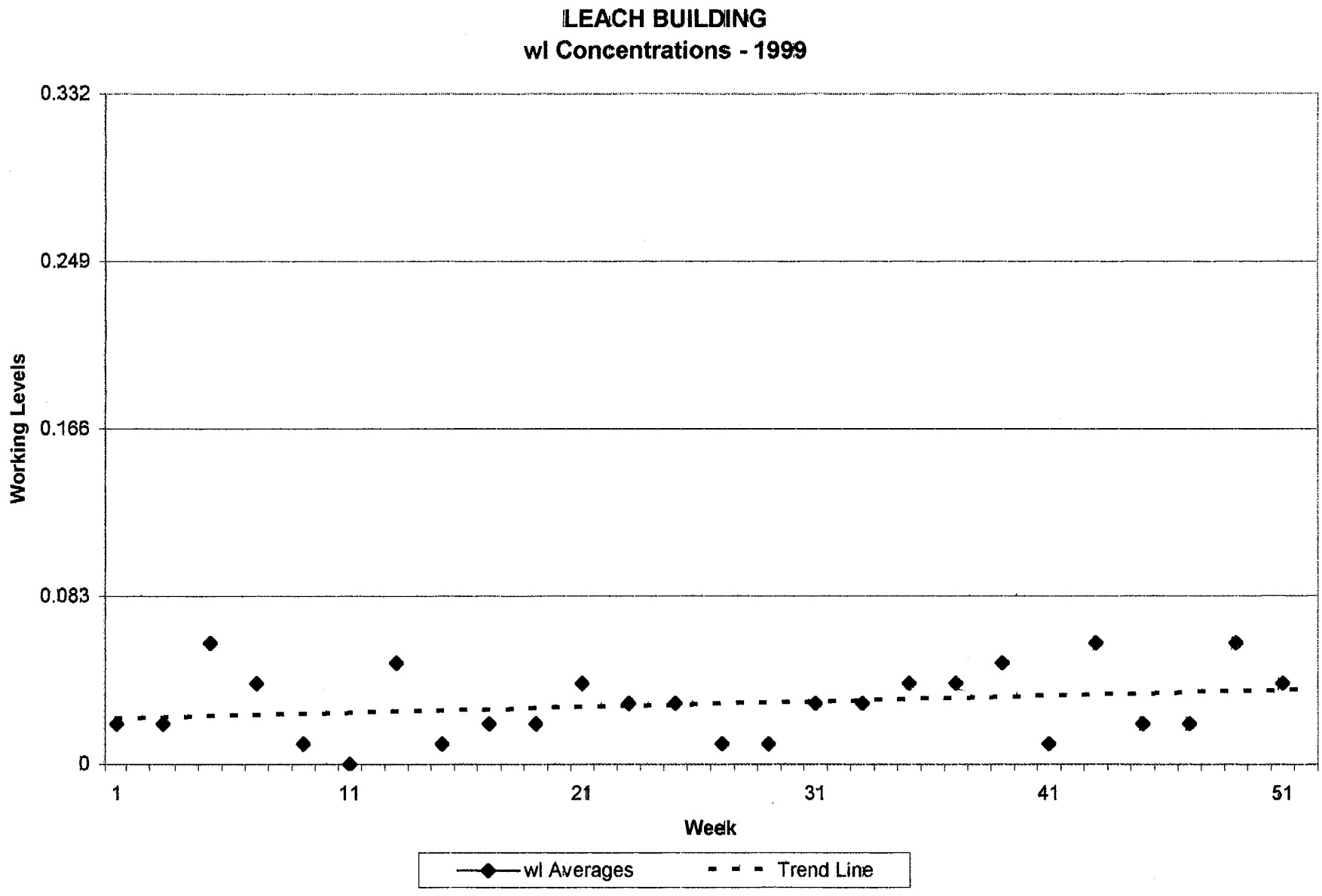
ION EXCHANGE PLANT
wl Concentrations - 1999



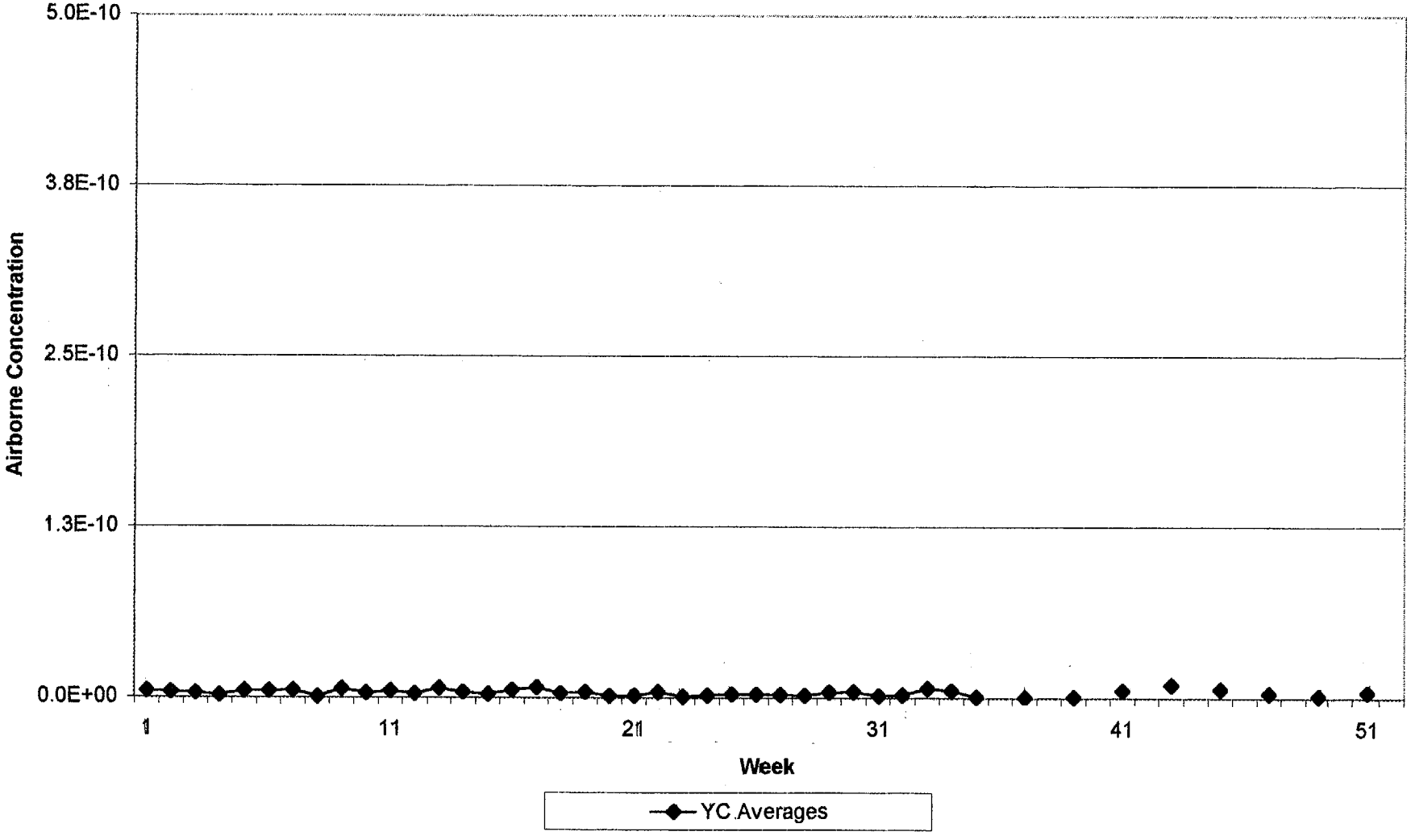

YELLOWCAKE PRECIPITATION AREA
wl Concentrations - 1999
0.332
0.249
0.166
0.083
0
Working Levels
1
11
21
31
41
51
Week
wl Averages
Trend Line

CHEMISTRY LABORATORY
wl Concentrations - 1999

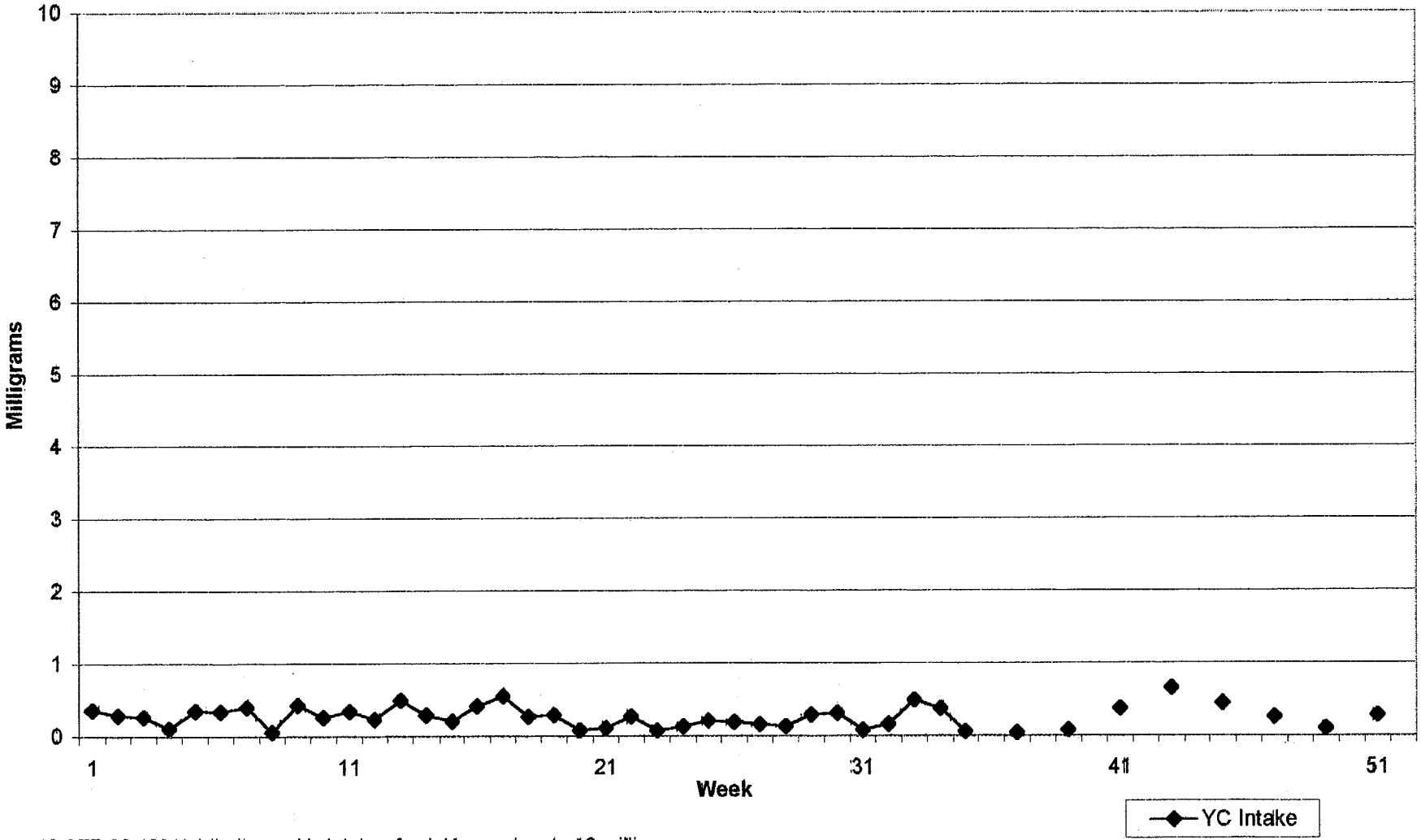



LEACH BUILDING
wl Concentrations - 1999
0.332
0.249
0.166
0.083
0
Working Levels
1
11
21
31
41
51
Week
wl Averages
Trend Line

YELLOWCAKE PRECIPITATION AREA
Airborne Yellowcake Concentrations - 1999



YELLOWCAKE PRECIPITATION AREA
Soluble Uranium Intake - 1999



10 CFR 20.1201(e) limits weekly intake of soluble uranium to 10 milligrams.
Values are based on continuous occupancy. Actual occupancy times are approximately half of continuous occupancy.