



# Rio Algom Mining LLC

February 18, 2004

Certified Mail  
Return Receipt Requested (70011940 0000 5346 3856)

ATTN: Document Control Desk  
Mr. Gar Janosko, Chief  
Fuel Cycle Licensing Branch, NMSS  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

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

Dear Mr. Janosko,

Please find attached the 2003 ALARA Review for the Ambrosia Lake facility. This summary reviews the actions taken to maintain occupational exposures as low as reasonably achievable. This report includes activities associated with the mill demolition project, which was initiated in October 2003.

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

Regards,

  
Peter Luthiger  
Radiation Safety Officer

Attachment: As Stated

xc: J. Caverly (NRC)  
A. Delgado  
T. Fletcher  
P. Goranson  
K. Lovato  
R. Powell  
R. Rodriguez  
file

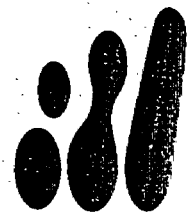
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**RIO ALGOM MINING LLC  
AMBROSIA LAKE FACILITY**

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

**ALARA REVIEW  
CALENDAR YEAR  
2003**

**February 18, 2004**



**bhpbilliton**

**ALARA SUMMARY**  
**January - December 2003**

**INTRODUCTION**

The annual ALARA summary for Rio Algom Mining LLC's Ambrosia Lake facility for calendar year 2003 is submitted for NRC's review in accordance with Quivira's Source Material License Condition #10. License condition #10 contains Rio Algom Mining LLC'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 February 19, 2004 by the facility ALARA audit committee. In attendance were Messrs. Terry Fletcher (General Manager), Peter Luthiger (Radiation Safety Officer), Alberto Delgado (Mill Operations Supervisor), Rudy Rodriguez (Maintenance Foreman), Ron Powell (Reclamation Engineer), and Kathy Lovato (Supervisor, Personnel and Administration). Copies of the review were also sent to corporate management.

The primary focus of activities at the site during calendar year 2003 was preparing the mill for demolition during the first three quarters of the year and initiating demolition activities during the 4<sup>th</sup> quarter. This ALARA Report has been formatted into two sections consisting of a pre-demolition summary and summary specific to the demolition phase. Also included within the report are photographs depicting the demolition project.

**PRE-DEMOLITION PHASE SUMMARY**

I. 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.

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 twenty eight (28) routine samples collected from Rio Algom employees. Analytical results indicated that all sample concentrations were below the laboratory's lower detectable limit of five (5) micrograms per liter (ug/L). All quality assurance spike samples were within the Regulatory Guide 8.22 suggested variance for acceptable spike result.

The reasons for the continued negligible bioassay concentrations are:

1. The site has discontinued yellowcake production and initiated washing and flushing all process equipment associated with yellowcake production;
2. The work activities were performed under radiation work permits to ensure appropriate radiological controls were instituted;
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 pre-demolition phase, there were a total of sixty four (64) 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<sup>2</sup>) guideline contained within NRC Regulatory Guide 8.30.

In addition to the random employee surveys by health physics personnel, there were 1375 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 190 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 2003, the annual radon daughter exposure for all employees was 0.0 working level months (wlm). The annual allowable occupational exposure limit is 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 2003 was 0.03 wl. The 2002 average radon concentration averaged 0.03 wl. The 2003 average area concentration represents 9% of the DAC limit of 0.33 wl.

Attached in Appendix A as Chart 1 is a graph plotting the minimal radon daughter concentration average within the mill IX plant. The trend line indicates that the minimal radon concentrations are decreasing slightly through time.

#### 2. Yellowcake Precipitation Area

During 2003, the yellowcake precipitation area had an average radon daughter concentration of 0.02 wl. This represents 6% of the DAC limit of 0.33 wl. The 2003 average radon concentration for this area continued their negligible levels; as the 2002 average concentration for the area was also 0.02 wl.

Attached in Appendix A as Chart 2 is a graph plotting the radon daughter concentrations average within the yellowcake area. The linear regression line or trend line indicates that the minimal radon daughter concentrations are essentially constant over 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. The 2002 average concentration for the area was also 0.02 wl.

As shown in the Appendix A on Chart 3, the trend line indicates that the minimal airborne concentrations are constant over time.

### 4. Leach Building

The radon daughter concentration average for 2003 at the leach building was 0.03 wl, which represents 6% of the DAC limit of 0.33 wl. The 2002 average for the area was 0.02 wl.

Attached in Appendix A on Chart 4 is a trend line of the concentrations for the leach building. The trend line is relatively flat, which indicates the minimal radon concentrations are remaining constant through time.

## 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 108 routine air samples taken during the first nine months of 2003 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 2003 of  $4.3 \times 10^{-12}$  microcuries per milliliter (uCi/mL), which represents less than 1% of the DAC for soluble natural uranium. The 2002 annual average was also  $4.3 \times 10^{-12}$  uCi/mL, which is less than 0.5% of the DAC for soluble natural uranium.

The airborne concentrations are shown in graphical format within Appendix A on Chart 5. As indicated from the graph, the minimal airborne concentrations for yellowcake dust remain constant over time and are well below the allowable limit of  $5.0 \times 10^{-10}$  uCi/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. Actual occupancy times, and therefore, actual exposure, average around 15 to 20 hours per week.

The intake from soluble uranium, based on continuous occupancy, is presented in Appendix A on Chart 6. During 2003, the average intake of soluble uranium was 0.30 milligrams per week (assuming continuous occupancy); with a maximum intake of 0.59 milligrams per week (assuming continuous occupancy). These results provide confirmation that appropriate radiological controls are implemented and are being followed by employees.

#### **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. 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.

### **II. 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 2003, various jobs required 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 and administrative controls as the primary method to control employee exposures. Respiratory protection was utilized only if an exposure potential still existed after use of these controls or if the employee chose to wear a respirator. 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 the 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 (ug/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.

### III. 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 A 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 2003 was 0.220 Rems. This exposure represents less than 5% of the annual allowable occupational dose limit specified within 10 CFR 20.1201(a). Review of the results indicates that the TEDE is comprised primarily of the deep dose equivalent component.

Appendix A, Chart 7 contains the maximum annual TEDE exposures for the time period covering 1990 to 2003. The chart demonstrates that occupational exposures are being maintained ALARA.

TABLE 1  
2003 TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)

| Exposure (REM)   | 0 -.05 | .051 -.150 | .151 -.250 | > 0.250 |
|------------------|--------|------------|------------|---------|
| No. of Employees | 22     | 1          | 1          | 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 personnel dosimetry 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 2003 employee gamma dose exposures. The highest annual gamma exposure incurred by an employee was 0.217 Rem.

Appendix A Chart 8 contains the maximum annual deep dose equivalent exposures for the time period covering 1990 to 2003. The chart demonstrates that occupational external radiation exposures are being maintained ALARA.

TABLE 2  
2003 DEEP DOSE EXPOSURES

| Exposure (REM)   | < .05 | .051-.150 | .151-.250 | > .250 |
|------------------|-------|-----------|-----------|--------|
| No. of Employees | 22    | 1         | 1         | 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.

All employee radon daughter exposures during 2003 were 0.0 wlm. The annual allowable occupational exposure limit is 4 wlm. These exposures are the result of reduced production within the ion exchange plant. The annual radon daughter exposure results are presented below in Table 3.

TABLE 3  
2003 RADON DAUGHTER EXPOSURES

| Exposure (wlm)   | 0.0 | 0.1-0.5 | 0.6 – 1.0 | > 1.0 |
|------------------|-----|---------|-----------|-------|
| No. of Employees | 24  | 0       | 0         | 0     |

Appendix A Chart 9 contains a chart depicting the maximum annual radon daughter exposures for the time period covering 1990 to 2003. The chart demonstrates that occupational exposures to radon are being maintained ALARA.

**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 2003 employee internal exposures to soluble uranium. The maximum exposure received by an employee during 2003 was 1.4 derived air concentration-hours (DAC-Hr); which corresponds to less than 1% of the annual limit of intake (ALI) for soluble natural uranium of 2000 DAC-Hr.

TABLE 4  
2003 SOLUBLE URANIUM (YELLOWCAKE) EXPOSURES

| Exposure (DAC-Hr) | 0  | 0.1-1.0 | 1.01-2.0 | > 2.0 |
|-------------------|----|---------|----------|-------|
| No. of Employees  | 13 | 8       | 3        | 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.

Appendix A Chart 10 contains a chart depicting the maximum annual exposures to yellowcake dust for the time period covering 1994 to 2003. The chart demonstrates that internal exposures to yellowcake dust are continually being maintained ALARA.

**E. Yellowcake Slurry**

Rio Algom Mining LLC completed two (2) shipments of yellowcake slurry in 2003 to Rio Algom's Smith Ranch facility in Wyoming. As a result of personnel following established standard operating procedures, all employee exposures associated with preparing the shipments were negligible.

**F. Crushed Yellowcake Drums**

During 2003, thirty three (33) shipments of crushed yellowcake drums were received from Honeywell. No problems were encountered during the receipt of the material. Activities were conducted under a standard operating procedure established for receiving byproduct material.

**IV. Miscellaneous ALARA Activities**

**A. Health, Safety, Environment and Community Management System Implementation**

Implementation of the corporate wide Health, Safety, Environment and Community Management environmental management system continued throughout 2003. The management system provides a framework for personal, site and corporate HSEC responsibility and leadership and ensures the continued improvement of HSEC programs and performance.

Integration of the ALARA principle into the site HSEC management system has provided an additional mechanism to monitor progress toward continued improvement in HSEC activities.

Key improvements involved increased employee awareness and incorporating the concept of performing job safety analyses so that potential exposure concerns are identified and addressed prior to initiation of work. This improvement was reflected in the 2003 HSEC audit conducted by off-site personnel, which culminated in overall improvement of the HSEC management system by over 15% from the 2002 audit.

**B. Daily and Weekly Inspections**

During the year, daily inspections did not result in any mill corrective orders being issued. Mill corrective orders (MCO) 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 radiation work permit (RWP).

A total of eight (8) RWPs were issued during 2003 involving various tasks primarily associated with preparing the mill for demolition. Exposures associated with these RWPs were negligible as a result of

the use of appropriate controls designed to minimize employee exposure. Job safety analyses were typically performed prior to initiation of work to identify potential hazards expected to be encountered with appropriate mitigation controls implemented.

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.

#### **C. Safety and Training Activities**

The annual eight (8) hour refresher course was completed for all employees and included the topics as outlined in Rio Algom Mining LLC's "Radiation Safety Training Program". In conjunction with the annual refresher course, all employees completed a respirator fit test. Three newly hired employees were administered a 24 hour training session, which included radiation safety modules.

In addition to the annual refresher course, all employees and the contract security force successfully completed an 8 hour first aid training session during 2003.

All employees receiving physicals were administered a pulmonary function evaluation during 2003. 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 the upcoming implementation of the company HSEC management system, 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.

#### **D. Performance of Emission Control Equipment**

Due to no yellowcake drying activities occurring in 2003, the facility emission control equipment such as the wet scrubber and the baghouse were not operated.

## **E. 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. Additionally, a fire drill was conducted to test the response actions of employees to real live fire situation.

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

## **DEMOLITION PHASE SUMMARY**

Mill demolition activities were initiated on site in mid-October 2003 with asbestos abatement activities. Actual demolition of structures and equipment commenced in early November 2003. The asbestos abatement phase of the project was completed in mid-December 2003 and by the end of December 2003, all mill structures were demolished and lowered to the ground. Photographs depicting demolition work is provided in Appendix B.

The following review provides a comprehensive summary of all health physics and radiological monitoring performed as part of the demolition project. As a result of the diligent effort undertaken for the contractor selection process along with the pre demolition preparations conducted by Rio Algom employees, the project proceeded without incident and occupational exposures to radioactive materials have been negligible.

### **I. Health Physics Sampling Summary-Demolition Phase**

#### **A. Bioassay-Demolition Phase**

Bioassay samples were collected during the demolition project in accordance with the approved demolition plan, which was consistent with the long standing Bioassay Program established at the site, with the following modifications:

1. Contractor employees associated with demolition activities shall provide a baseline bioassay sample prior to performing any dismantling/demolition activities.

2. Contractor employees associated with demolition activities shall provide a final bioassay sample upon completion of dismantling/demolition activities.
3. Bioassay samples shall be submitted twice a month from employees working on dismantling activities involving the drying/packaging section of the mill, unless a different frequency is established by the facility RSO or required by an RWP.
4. For all other dismantling work involving contaminated materials, bioassay samples shall be submitted monthly.

A total of 173 bioassay samples collected from Contractor and Rio Algom employees in calendar year 2003 associated with demolition activities. Analytical results indicated that all sample concentrations were below the laboratory's lower detectable limit of five (5) micrograms per liter (ug/L) with the exception of two samples associated with employees performing asbestos abatement work. Concentrations reported for these samples were 6.7 and 12.0 ug/L, which is below the base action level of 15 ug/L. All quality assurance spike samples were within the Regulatory Guide 8.22 suggested variance for acceptable spike result.

These bioassay results corroborate the personnel sampling results, which show very low airborne concentrations.

#### **B. Personnel Alpha Contamination Checks – Demolition Phase**

During the demolition phase, there were 1,650 contamination surveys of employees leaving the restricted area. All surveys were below the 1000 disintegrations per minute per 100 square centimeters (dpm/100 cm<sup>2</sup>) guideline contained within NRC Regulatory Guide 8.30. Rio Algom utilized an action level of one half the allowable limit for personnel to ensure ALARA principle is maintained. One individual's orange safety vest registered contamination levels above the action limit; but below the release limit. The vest was removed and washed on site, resurveyed and found to contain negligible contamination levels.

Radiation surveys of contractor vehicles exiting the restricted area were also performed with all results indicating acceptable levels. A total of 195 surveys were performed.

Success in controlling contamination at the site can be attributed to job design, pre-demolition cleaning of mill process equipment, contractor employees utilizing their radiation safety training, following established work procedures including housekeeping, and practicing good personal hygiene.

**C. Surface Contamination Checks – Demolition Phase**

There were 84 surface contamination checks performed at various places associated with the demolition project including offices, lunch rooms, change rooms, storage areas, vehicles, and the guard office. All sample results were below the respective action levels.

**D. Radon Daughter Sampling – Demolition Phase**

During the demolition phase, radon daughter sampling was performed in ancillary buildings/areas associated with the demolition project as safety considerations precluded accessing building interiors once demolition related activities commenced. Historical radon daughter concentrations within the buildings did not indicate potential exposure concerns and with the removal of the building siding, radon daughter concentrations would not be a concern.

The radon daughter exposure for all contractor employees was 0.0 working level months (wlm). The allowable occupational exposure limit is 4 wlm. Areas/buildings sampled included the main changerooms, contractor shower trailer, contractor storage area, and the contractor office trailer. The maximum airborne concentration observed for all these areas was 0.03 wl, which corresponds to 9% of the DAC for radon daughters.

**E. Yellowcake Samples – Demolition Phase**

During the demolition phase, airborne yellowcake dust sampling was performed on a weekly basis in each work area associated with the demolition project. This consisted of collecting high volume air samples from building exteriors as safety considerations precluded accessing building interiors once demolition related activities commenced. However, employee exposure determinations were based on personnel air samples worn daily, as



prescribed by radiation work permits established for each discrete demolition work element.

The samples, which were obtained at random times in the proximity of the active work areas, indicated an average concentration for the demolition project of  $3.0 \times 10^{-12}$  microcuries per milliliter (uCi/mL), which represents less than 1% of the DAC for soluble natural uranium. The maximum concentration observed represented less than 2% of the DAC limit. A total of 35 samples were collected.

#### **F. Personnel Air Samples – Demolition Phase**

Work activities associated with the demolition project that involved the potential for significant exposure to radioactive materials were conducted under a radiation work permit. These RWPs included a requirement to wear a personnel breathing zone air sample unit for the purposes of collecting data associated with potential employee exposures during demolition activities.

One hundred fifty five (155) individual lapel samples were issued on demolition work projects in calendar year 2003. Results indicated an average concentration for the demolition project of  $5.3 \times 10^{-12}$  microcuries per milliliter (uCi/mL), which represents 1% of the DAC for soluble natural uranium. The maximum concentration observed measured 5% of the DAC limit.

Results from these samples were used to calculate contractor employee exposures associated with the demolition project. Contained in Appendix A as Chart 11 is a chart depicting the maximum weekly airborne concentration observed on the demolition project.

#### **G. Soluble Uranium Intake – Demolition Phase**

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 personnel air sampling activities.

The maximum weekly intake from soluble uranium soluble uranium was 0.31 milligrams, or 3.1% of the allowable limit. These results

provide confirmation that appropriate radiological controls are implemented and are being followed by contractor employees. Contained in Appendix A as Chart 12 is a chart depicting the maximum weekly intake over time.

#### H. **Gamma Surveys – Demolition Phase**

Prior to the start of demolition activities, the radiation safety officer conducted a gamma radiation level survey throughout the mill site to ascertain potential exposure levels that contractor employees may encounter during demolition activities. A total of 70 different locations were checked throughout the mill with the maximum gamma radiation level observed within areas scheduled for demolition was 300 microRoentgen per hour (uR/ht). This level was observed within the ore pocket area, between the outdoor thickener tanks, and the outdoor SX tanks.

Since the majority of the work activity will occur through the use of heavy equipment, which results in the effective use of the Time, distance, Shielding Principle to minimize gamma exposure potential, gamma radiation exposure levels were expected to be well below occupational limits. Gamma surveys will be performed following completion of mill demolition work.

### III. Exposure Summary – Demolition Phase

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 A through D below.

#### A. **Total Effective Dose Equivalent – Demolition Phase**

The total effective dose equivalent (TEDE) exposure results for all contractor employees participating in demolition activities 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 2003 was 0.040 Rems. This exposure represents less than 1% of the annual allowable occupational dose limit specified within 10 CFR 20.1201(a). Review of the results indicates that the TEDE is comprised primarily of the deep dose equivalent component.

TABLE 1  
DEMOLITION PROJECT  
2003 TOTAL EFFECTIVE DOSE EQUIVALENT (TEDE)

| Exposure (REM)   | 0 -.05 | .051 -.150 | .151 -.250 | > 0.250 |
|------------------|--------|------------|------------|---------|
| No. of Employees | 30     | 0          | 0          | 0       |

**B. Deep Dose Equivalent (Gamma Exposure) – Demolition Phase**

Gamma exposures are determined by the results of personnel dosimetry worn by all contractor 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 contractor employee gamma dose exposures. The highest deep dose gamma exposure incurred by a contractor employee was 0.032 Rem.

TABLE 2  
DEMOLITION PROJECT  
2003 DEEP DOSE EXPOSURES

| Exposure (REM)   | < .05 | .051-.150 | .151-.250 | > .250 |
|------------------|-------|-----------|-----------|--------|
| No. of Employees | 30    | 0         | 0         | 0      |

**C. Radon Daughter Exposures – Demolition Phase**

All contractor employee radon daughter exposures during 2003 were 0.0 wlm. The annual allowable occupational exposure limit is 4 wlm. The annual radon daughter exposure results for the contractor employees are presented below in Table 3.

TABLE 3  
DEMOLITION PROJECT  
2003 RADON DAUGHTER EXPOSURES

| Exposure (wlm)   | 0.0 | 0.1-0.5 | 0.6 – 1.0 | > 1.0 |
|------------------|-----|---------|-----------|-------|
| No. of Employees | 30  | 0       | 0         | 0     |

**D. Yellowcake and Uranium Ore Dust – Demolition Phase**

Internal exposures to soluble uranium are determined by analyzing the personnel lapel samples for gross alpha activity to obtain an average air concentration for the area. Air samples are obtained from radiation work permits which typically required personnel sampling on most demolition tasks. 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 2003 contractor employee internal exposures to soluble uranium. The maximum exposure received by an employee during 2003 was 4 derived air concentration-hours (DAC-Hr); which corresponds to less than 1% of the annual limit of intake (ALI) for soluble natural uranium of 2000 DAC-Hr.

TABLE 4  
DEMOLITION PROJECT  
2003 SOLUBLE URANIUM (YELLOWCAKE) EXPOSURES

| Exposure (DAC-Hr) | < 1.0 | 1.0 – 2.0 | 2.0-4.0 | > 4.0 |
|-------------------|-------|-----------|---------|-------|
| No. of Employees  | 16    | 4         | 10      | 0     |

**IV. Miscellaneous ALARA Activities – Demolition Phase**

**A. Daily and Weekly Inspections – Demolition Phase**

During the demolition project, daily inspections did not result in any abnormal or unacceptable conditions requiring corrective action.

A total of twenty two (22) RWPs were issued for the demolition project pertaining to asbestos abatement and structural demolition of the mill components. Exposures associated with these RWPs were minimal as a result of the use of appropriate controls designed to minimize employee exposure.

Weekly inspections of pertinent demolition areas by the radiation safety officer were 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.

**C. Safety and Training Activities – Demolition Phase**

All applicable health, safety, and environmental training was administered to contractor employees prior to any employee initiating work on the demolition project. This training consisted of either an 8 or 24 hour course and included the topics as outlined in Rio Algom Mining LLC's "Radiation Safety Training Program", and Mine Safety and Health Administration approved training plan.

Safety meetings were conducted daily with all contractor personnel present. The contractor Health and Safety representative reviewed various topics pertaining to safety, while the site Radiation Safety Officer highlighted radiation safety information such as 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.

APPENDIX A

Time Versus Concentration Plots

&

Historical Exposure Results

CHART 1  
 ION EXCHANGE PLANT  
 wl Concentrations - 2003

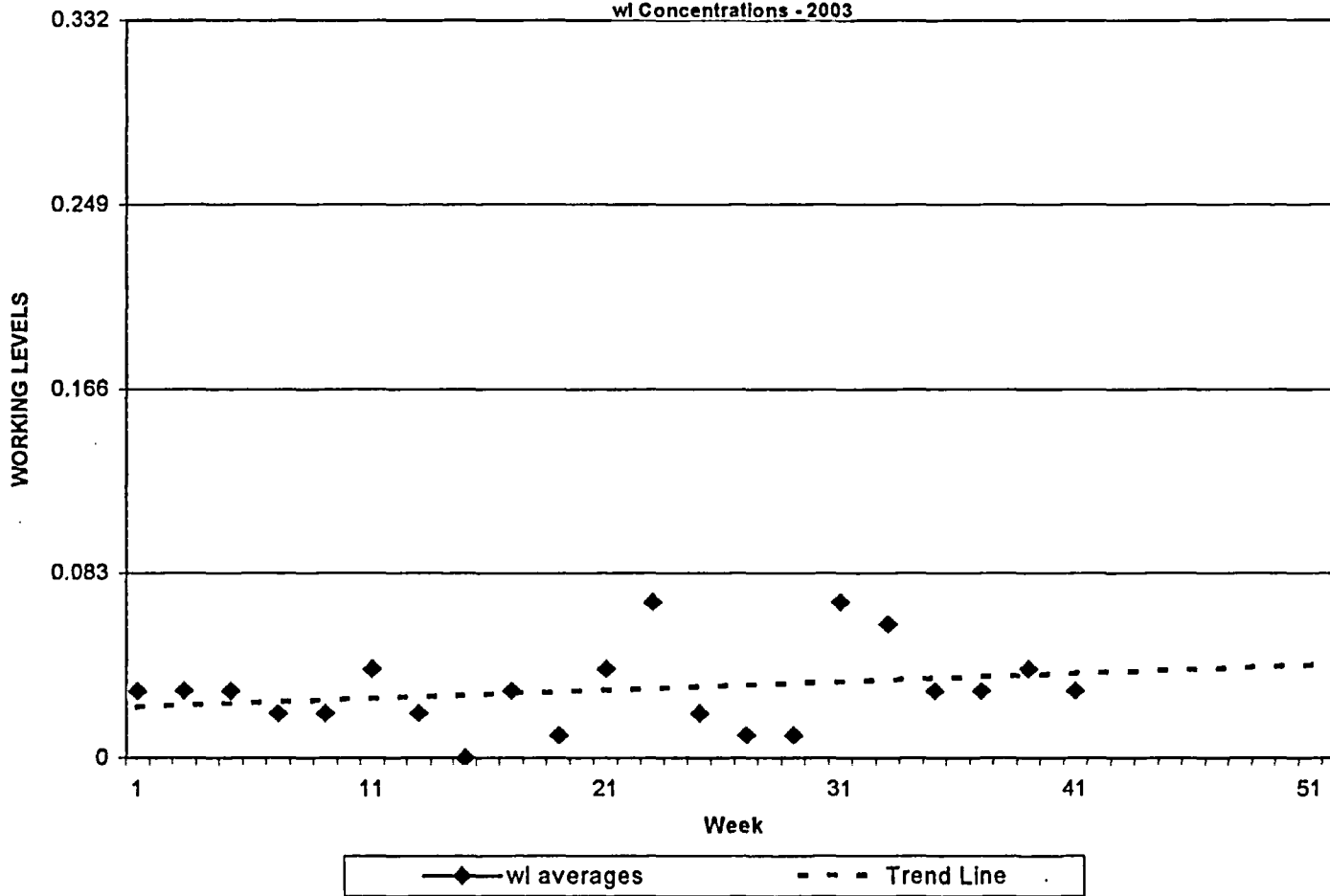


CHART 2  
 YELLOWCAKE PRECIPITATION AREA  
 wl Concentrations - 2003

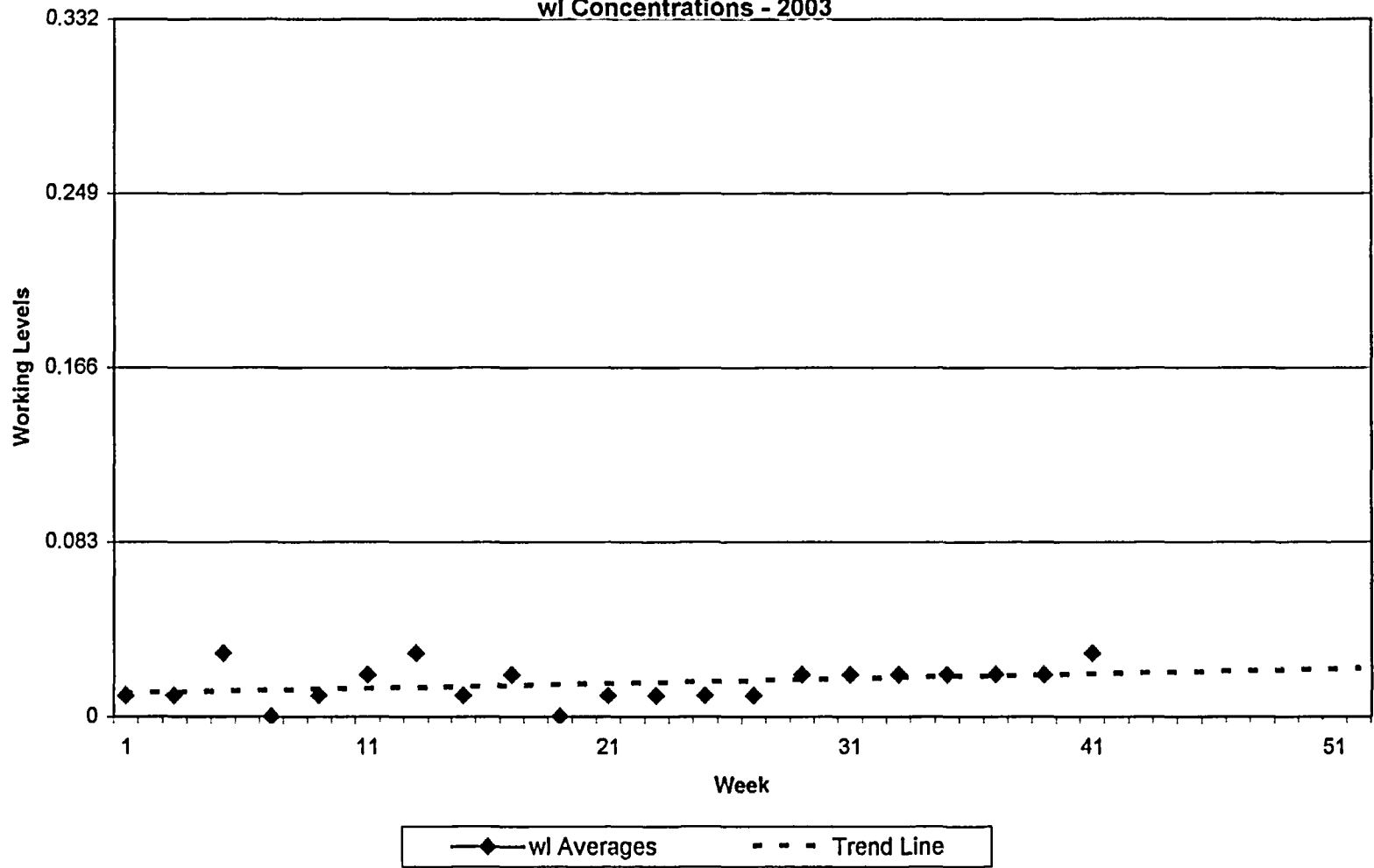




CHART 3  
CHEMISTRY LABORATORY  
wl Concentrations - 2003

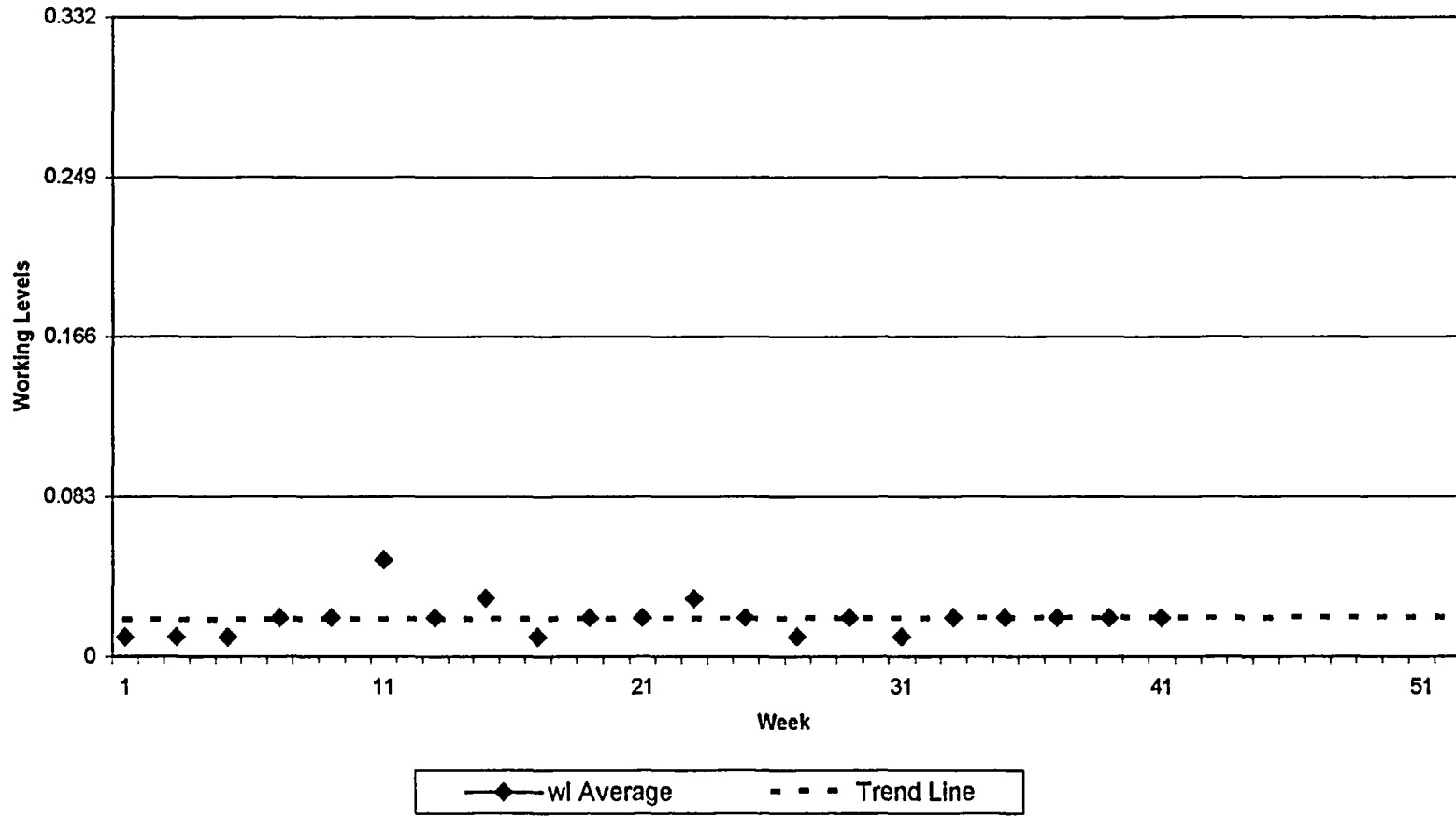


CHART 4  
LEACH BUILDING  
wl Concentrations - 2003

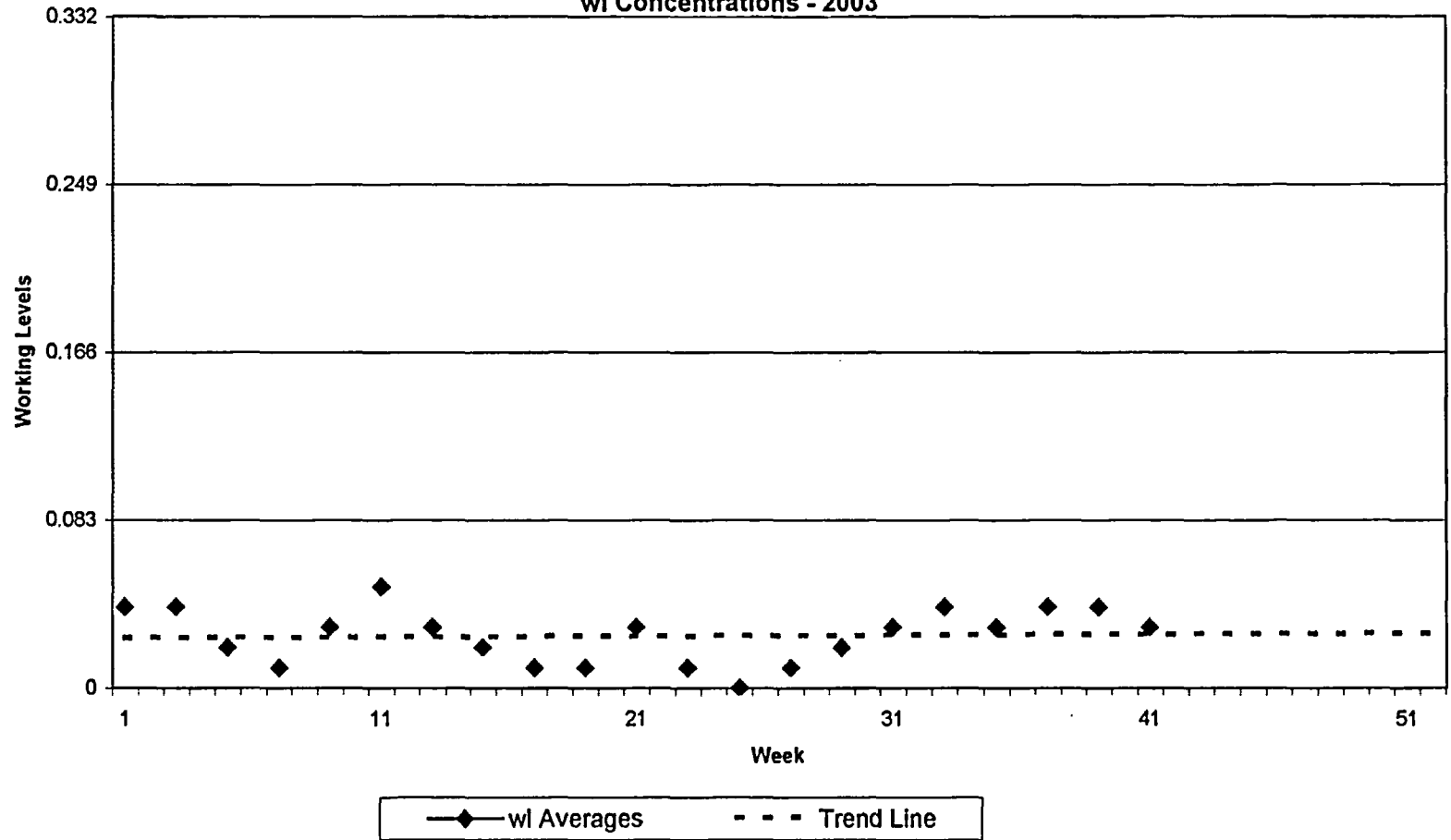
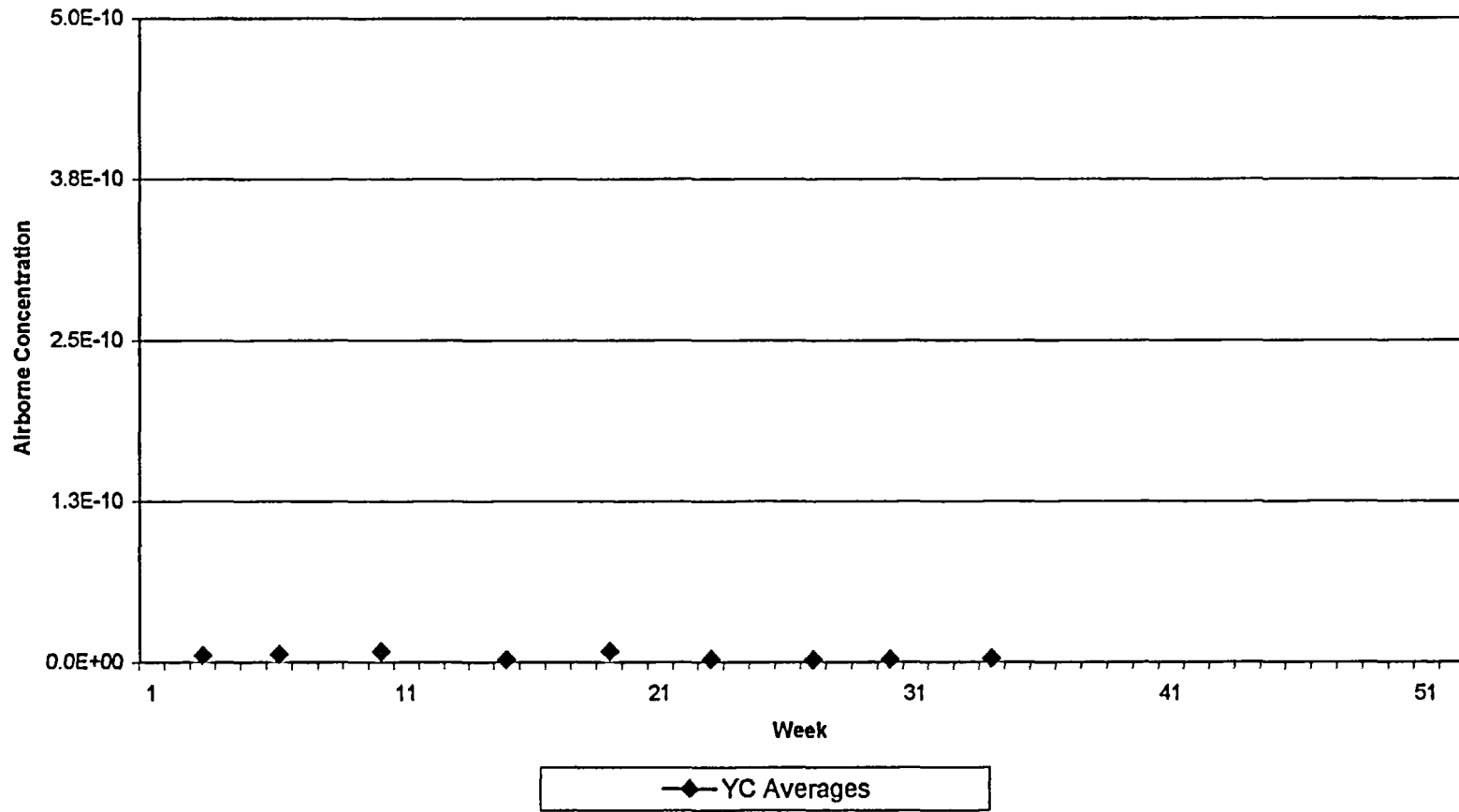
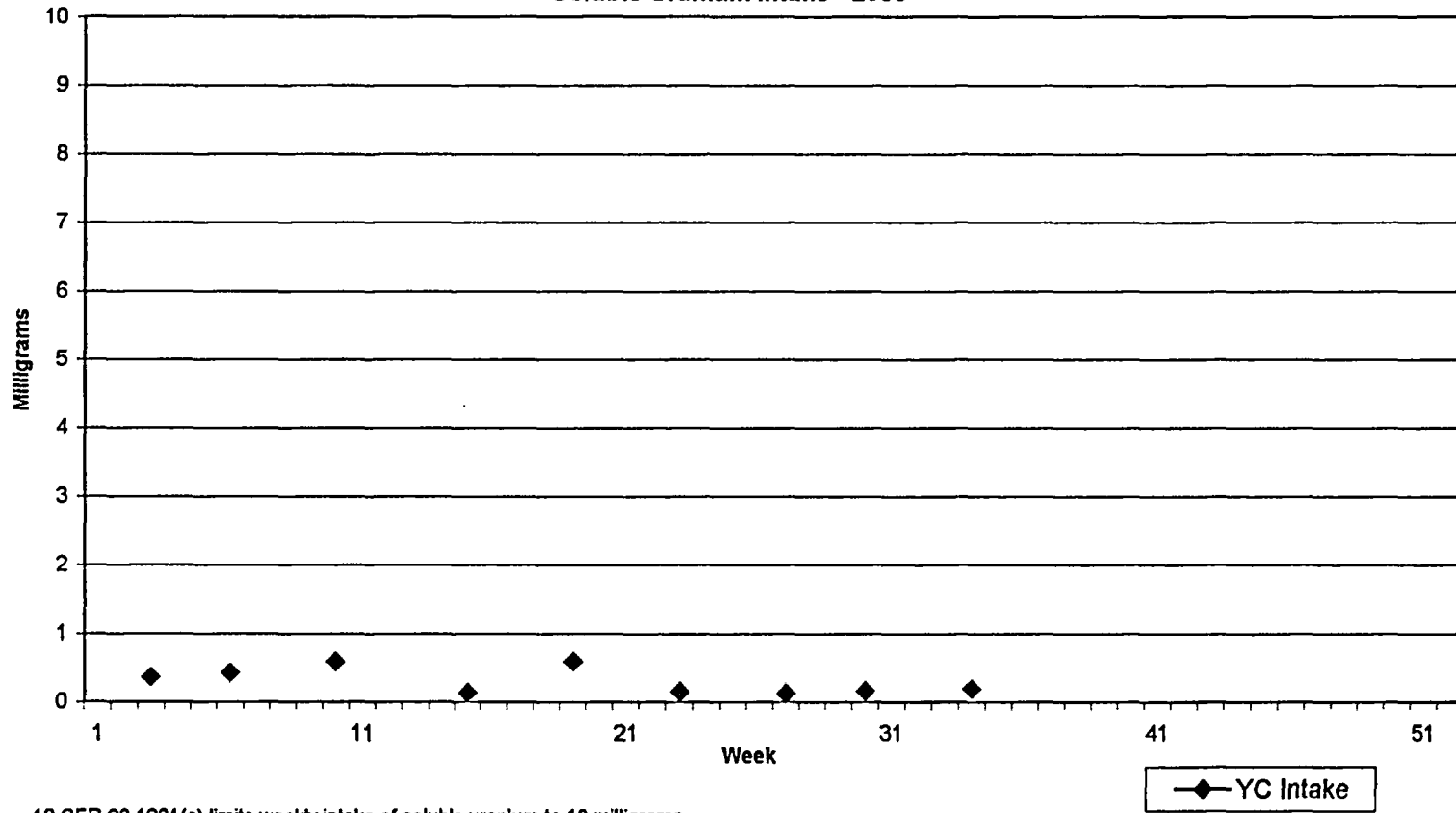


CHART 5  
YELLOWCAKE PRECIPITATION AREA  
Airborne Yellowcake Concentrations - 2003

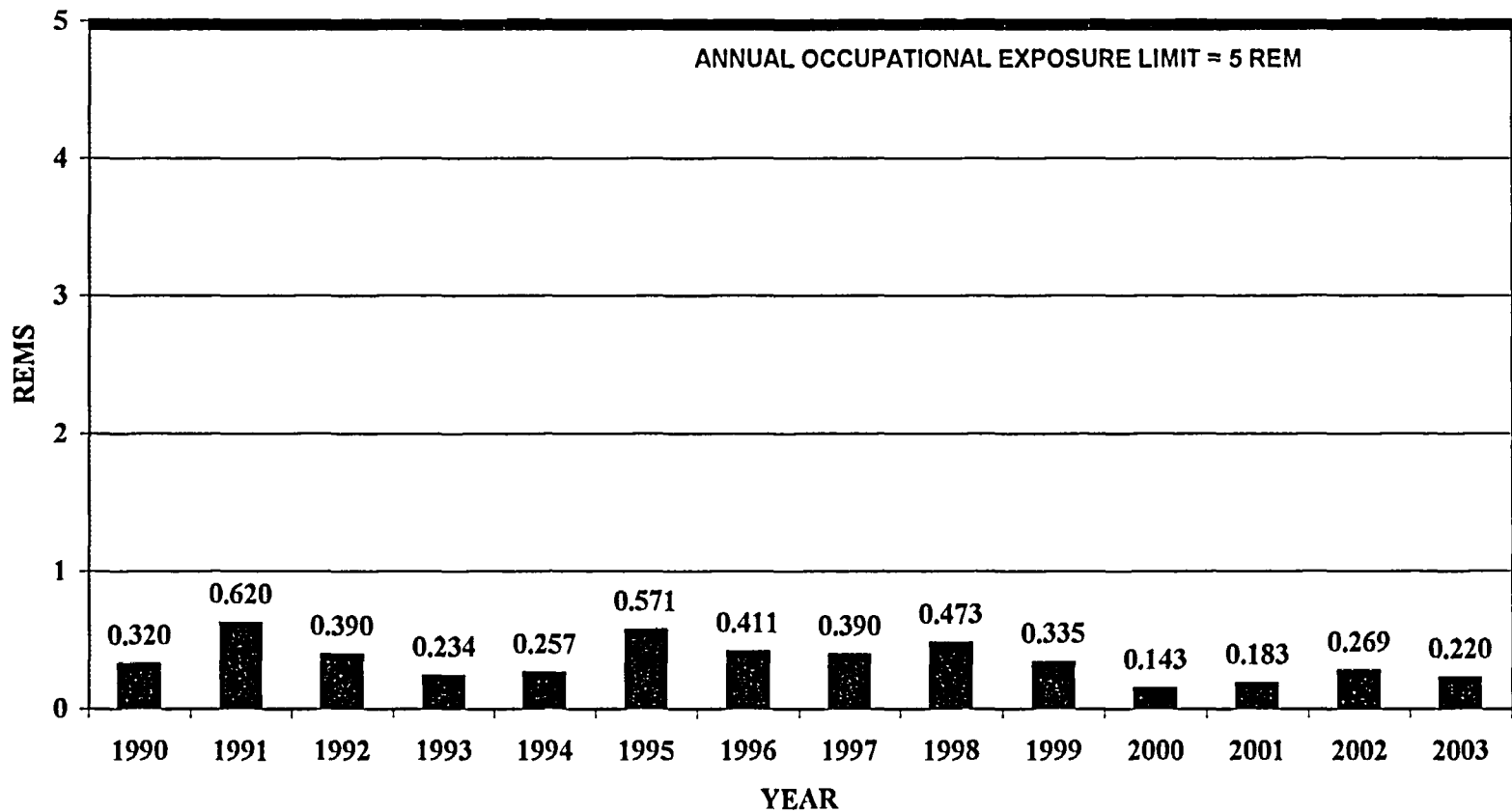


**CHART 6  
YELLOWCAKE PRECIPITATION AREA  
Soluble Uranium Intake - 2003**

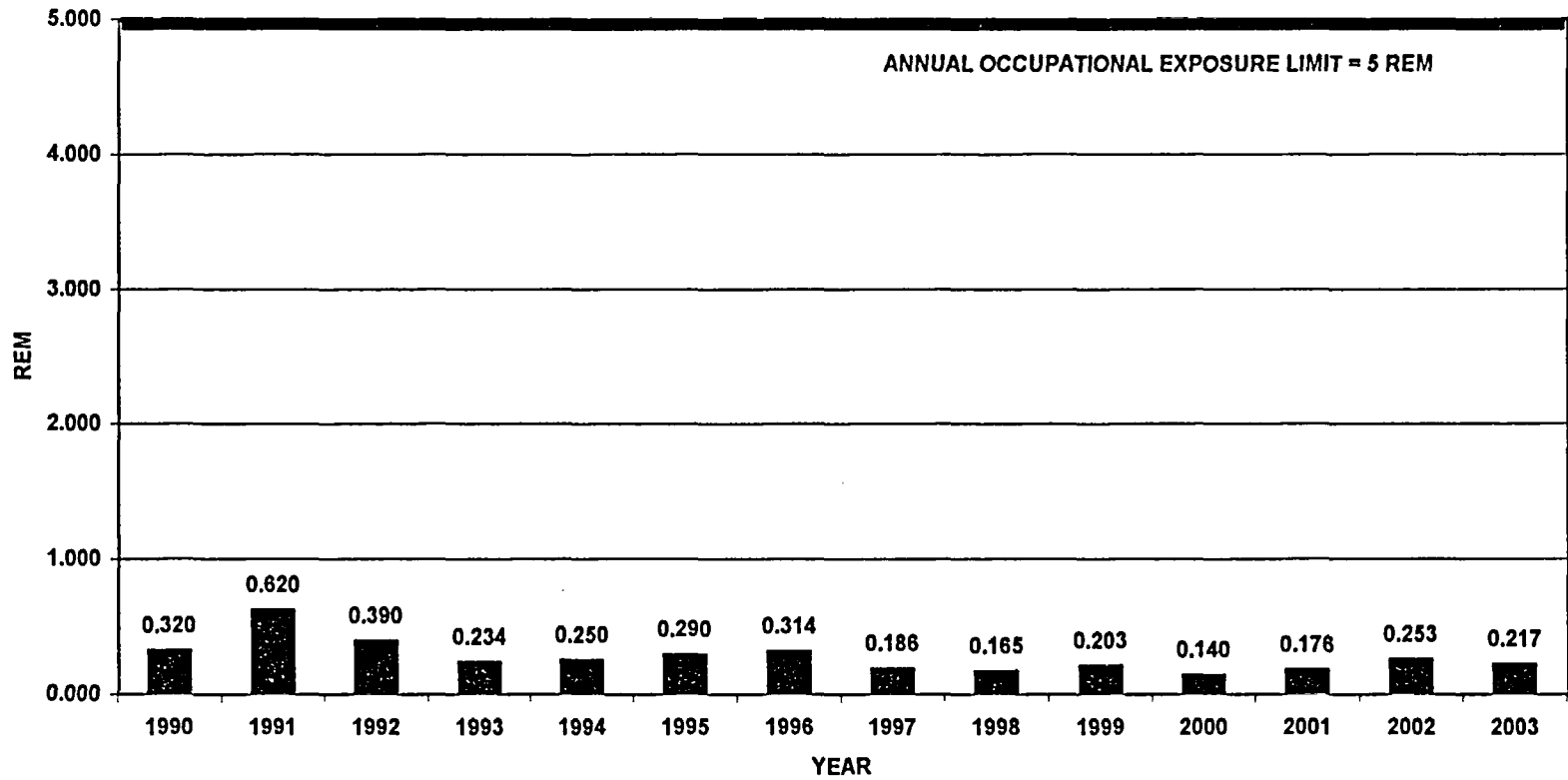


10 CFR 20.1201(e) limits weekly intake of soluble uranium to 10 milligrams.  
 Values based on continuous occupancy. Actual occupancy times are approximately half of continuous occupancy.

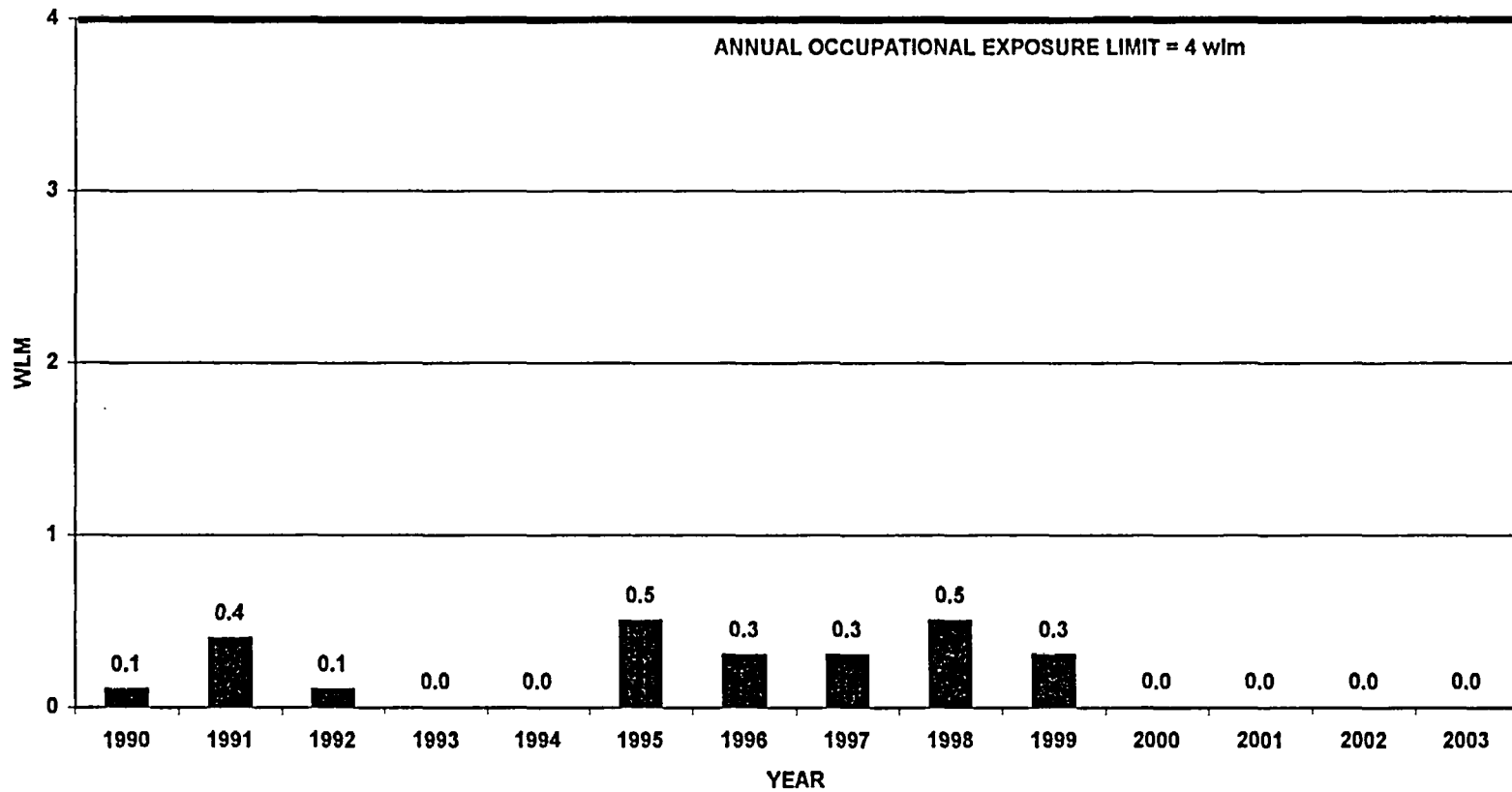
**CHART 7**  
**ANNUAL TEDE EXPOSURE**  
**MAXIMUM EXPOSURE FOR ANY EMPLOYEE**



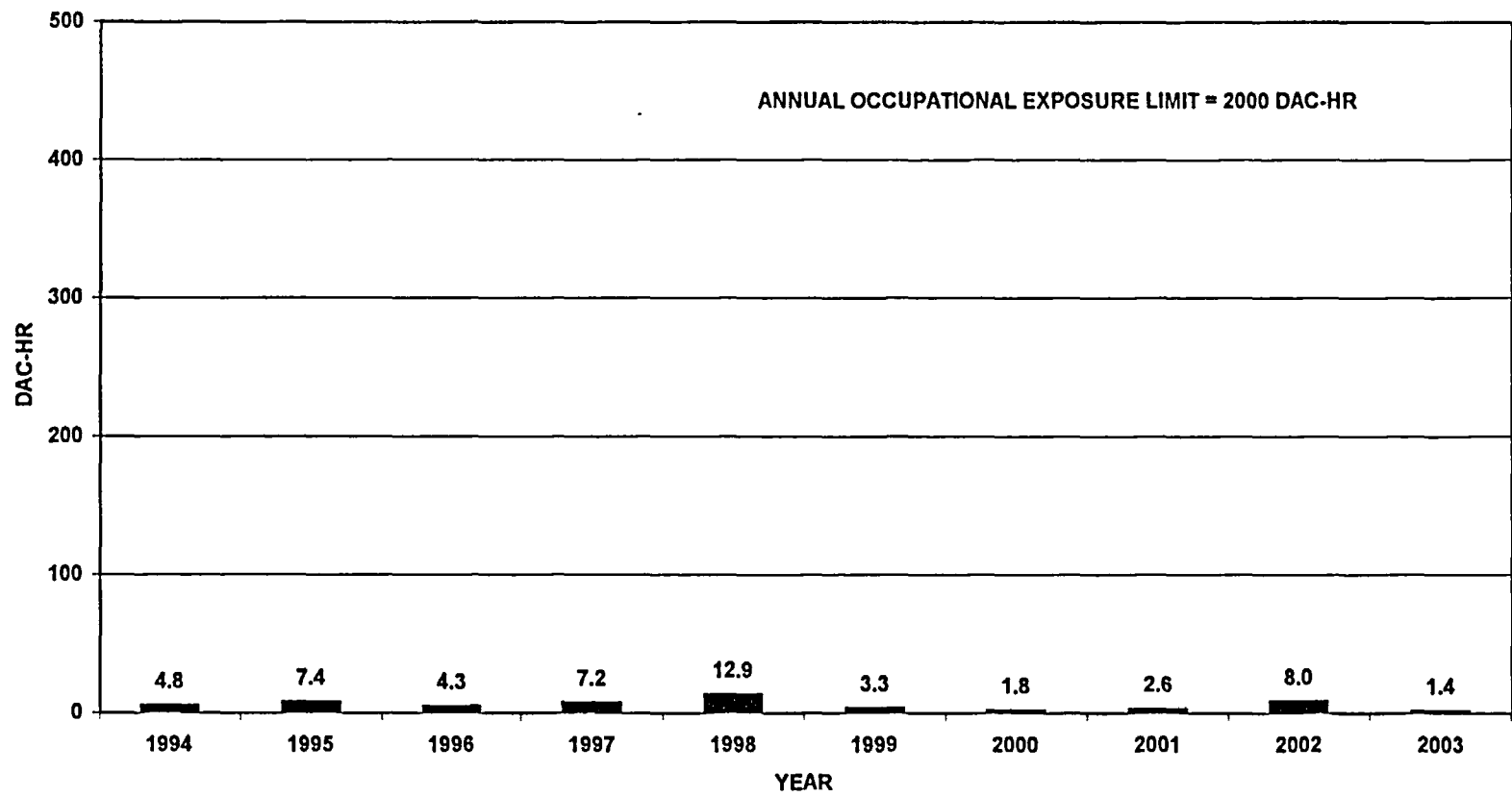
**CHART 8**  
**ANNUAL EXTERNAL RADIATION EXPOSURE**  
**MAXIMUM DEEP DOSE EXPOSURE LEVEL FOR ANY EMPLOYEE**



**CHART 9  
RADON DAUGHTER EXPOSURES  
MAXIMUM EXPOSURE FOR ANY EMPLOYEE**

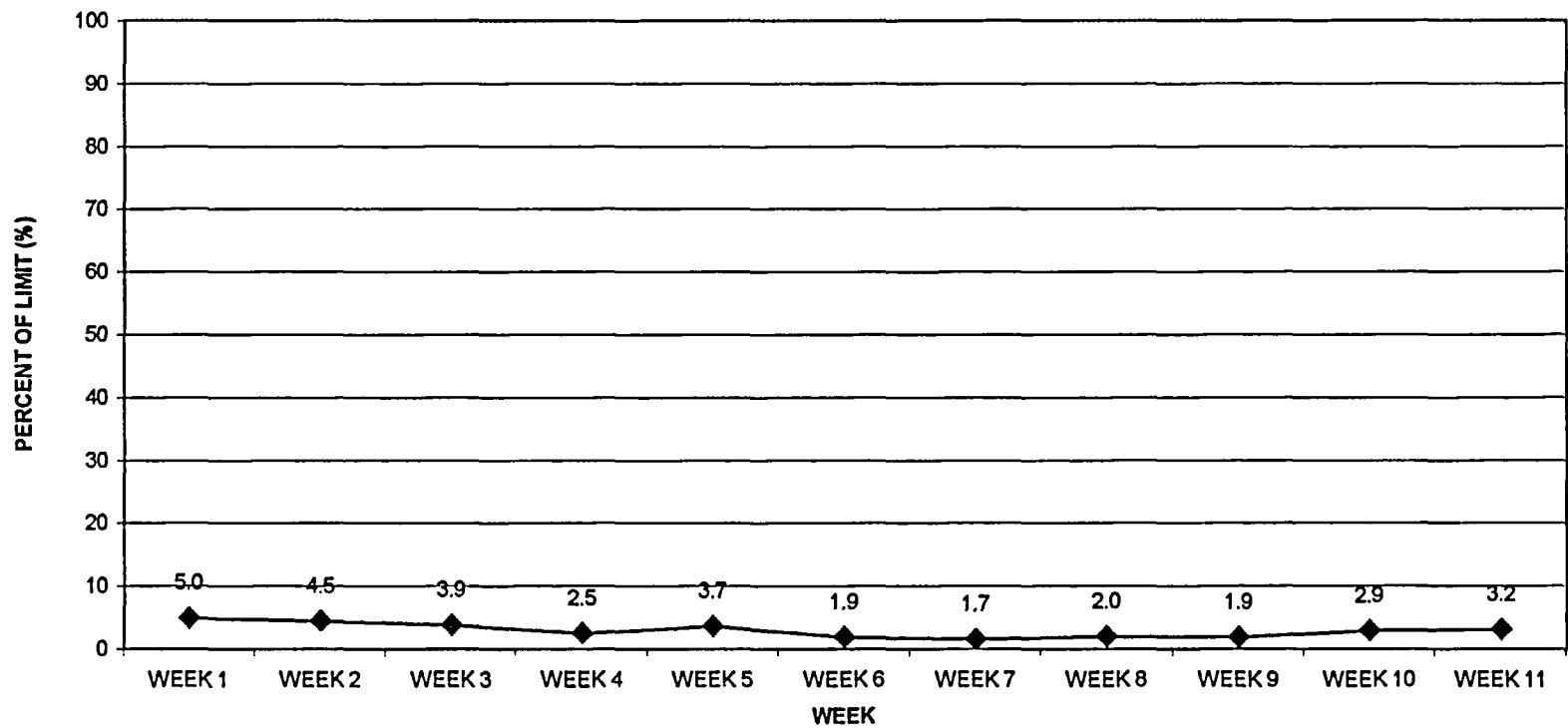


**CHART 10**  
**ANNUAL INTERNAL YELLOWCAKE DUST EXPOSURE LEVELS**  
**MAXIMUM EXPOSURE FOR ANY EMPLOYEE**

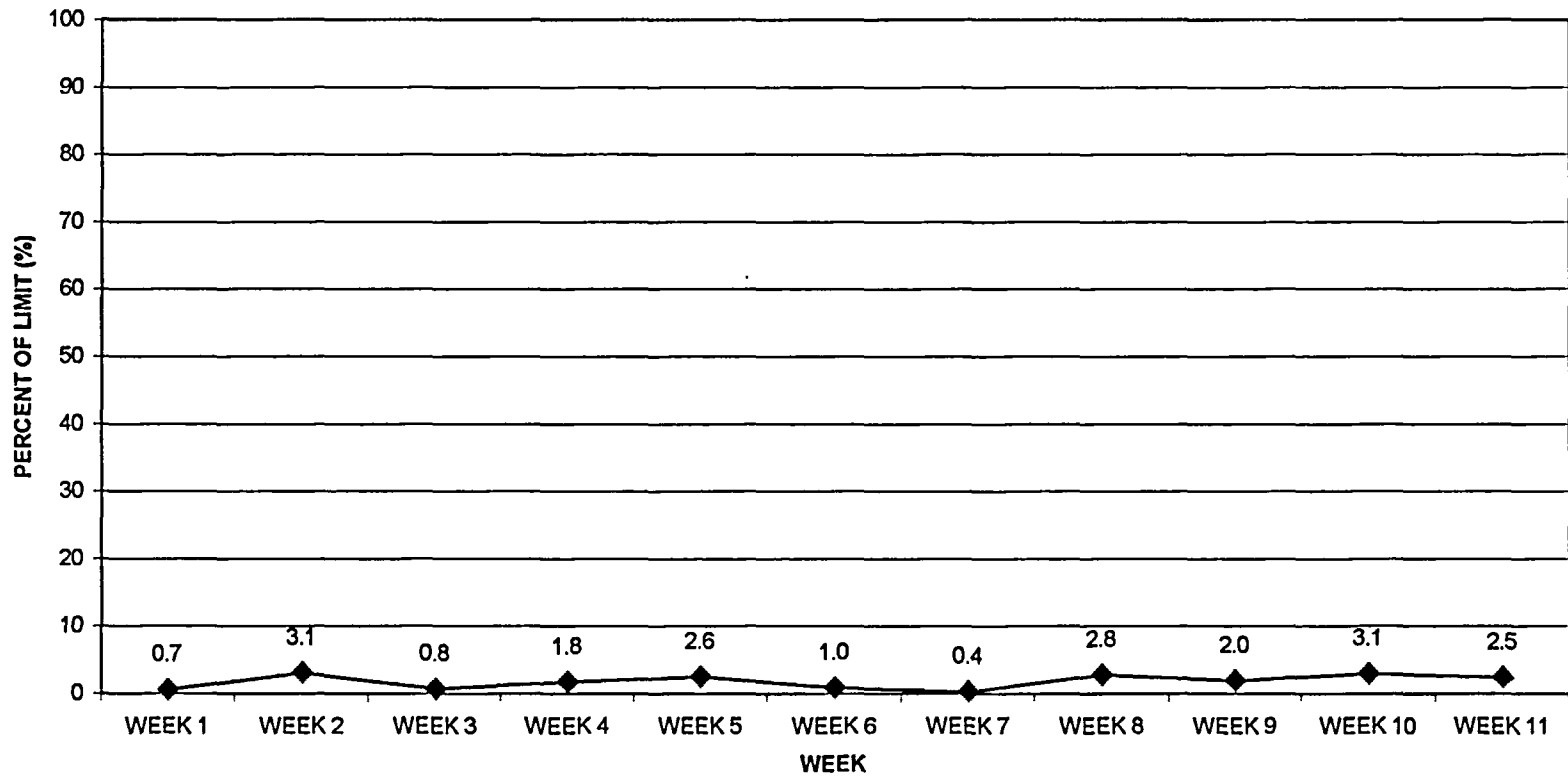




**CHART 11**  
**RIO ALGOM MINING LLC - MILL DEMOLITION PROJECT**  
**PERCENT OF AIRBORNE CONCENTRATION LIMIT**  
**SOLUBLE URANIUM DAC = 5.0E-10 uCi/mL**



**CHART 12**  
**RIO ALGOM MINING LLC - MILL DEMOLITION PROJECT**  
**PERCENT OF SOLUBLE URANIUM INTAKE LIMIT**  
**LIMIT = 10 MILLIGRAMS PER WEEK [10 CFR 20.1201(e)]**



APPENDIX B  
MILL DEMOLITION PROJECT  
PHOTOGRAPHS

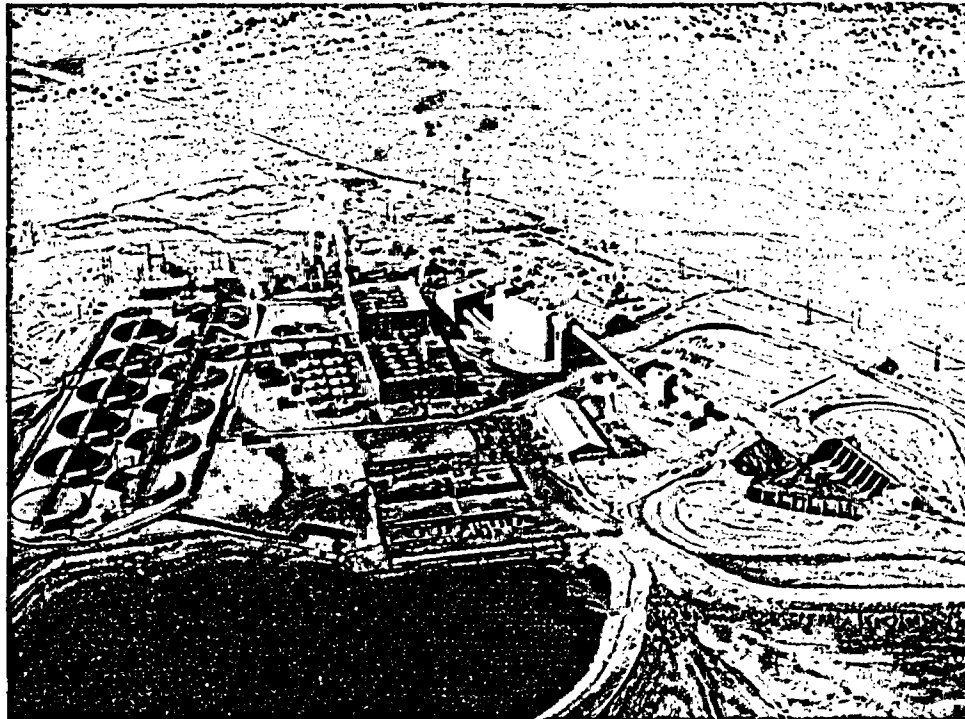


Photo 1 – Ambrosia Lake Mill (1958)



Photo 2 – Daily morning safety meeting

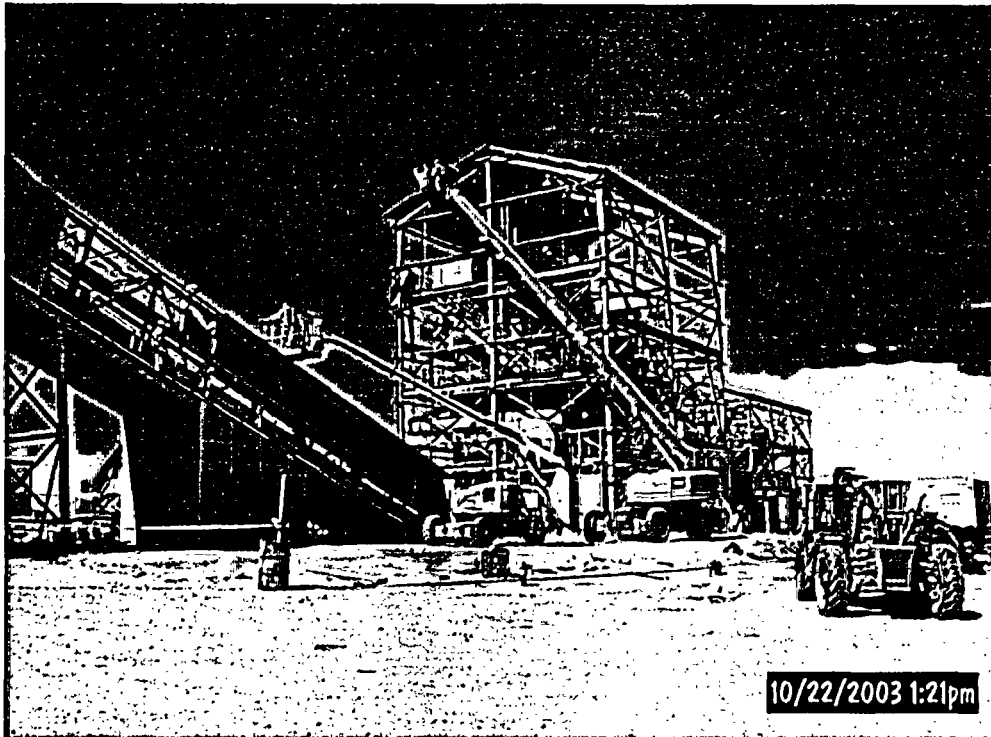


Photo 3 - Asbestos Abatement Activities

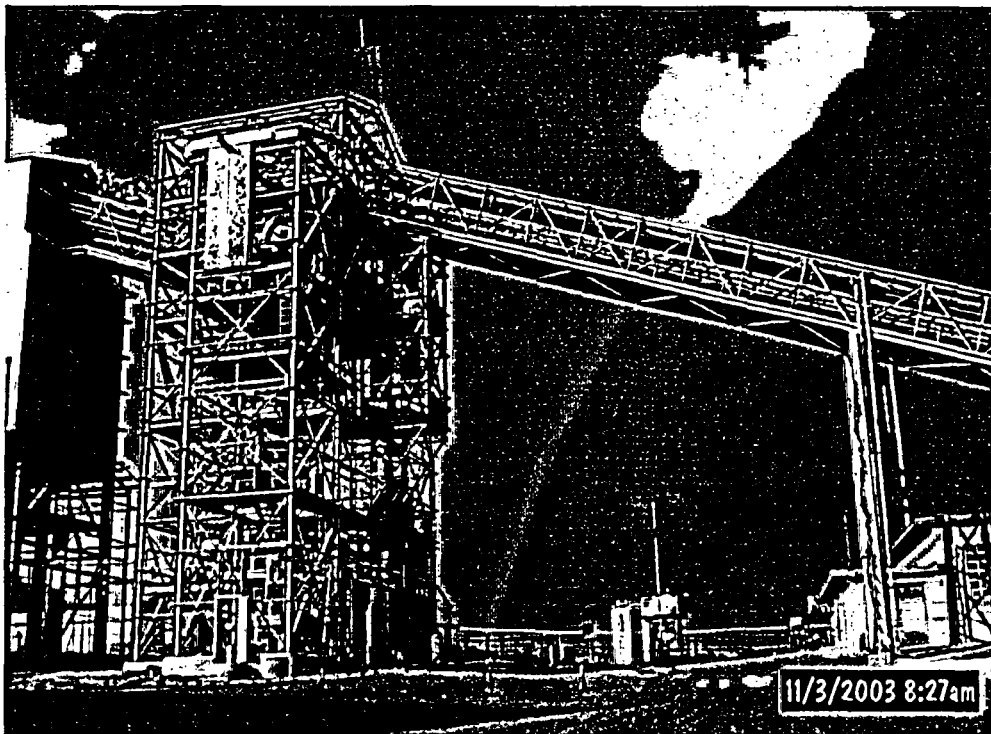


Photo 4 – Abated mill structure prior to demolition



Photo 5 - Demolition of secondary crusher



Photo 6 - Demolition of Sample Tower

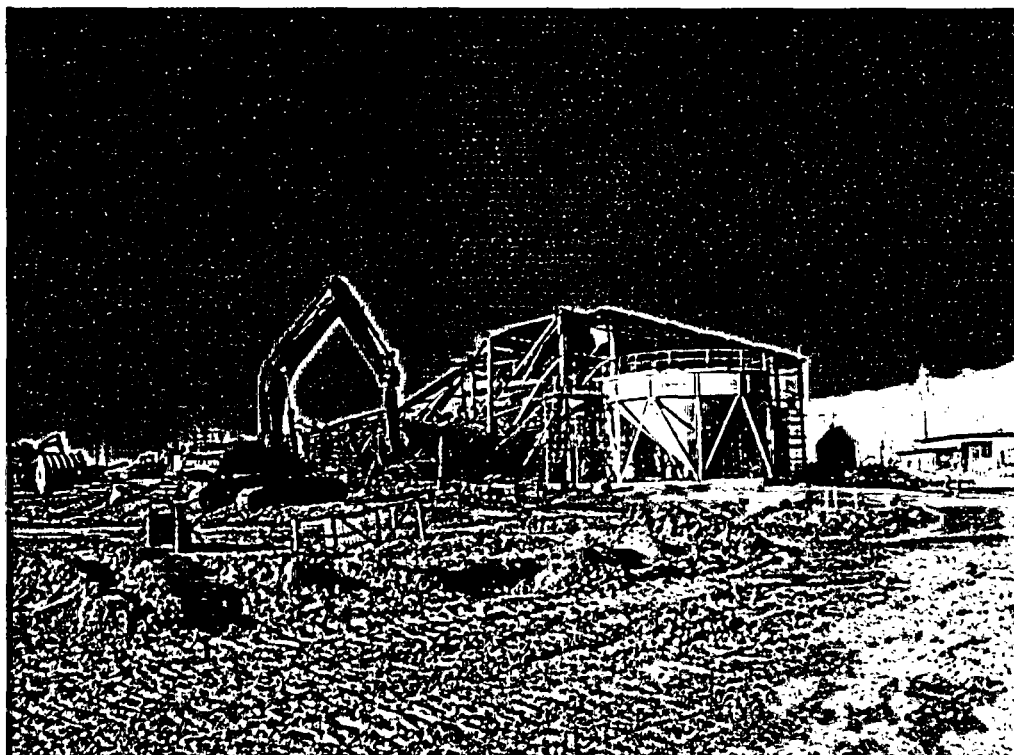


Photo 7 – Demolition of Yellowcake Area



Photo 8 – Primary mill processing area following building demolition

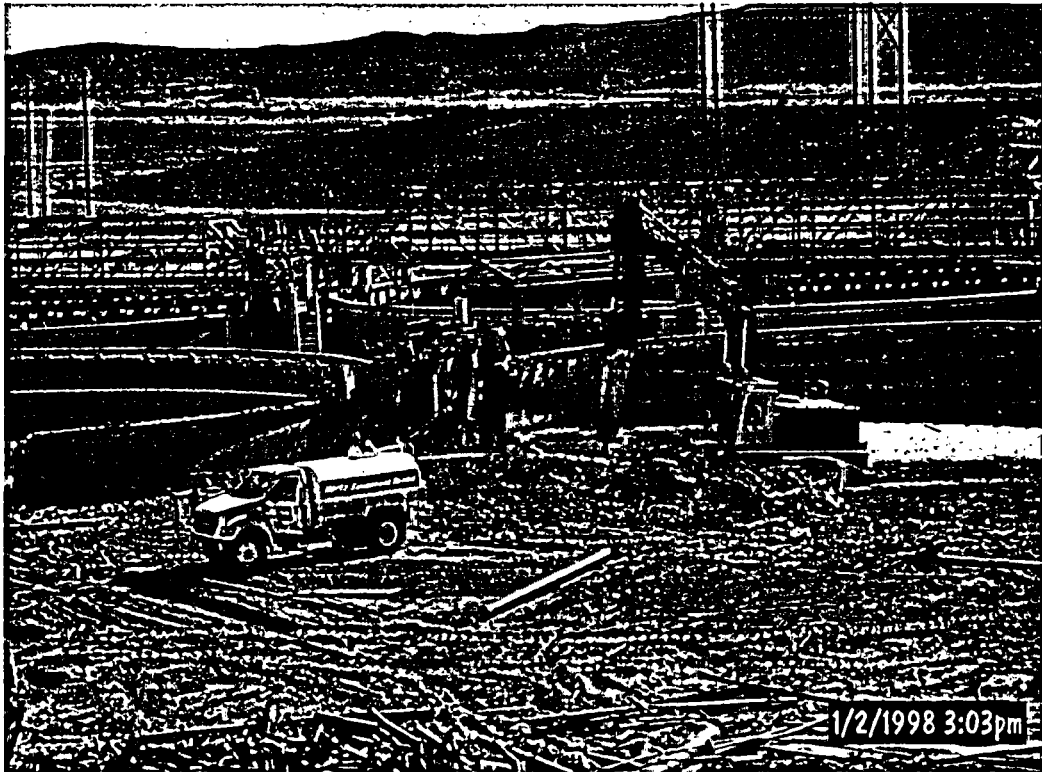


Photo 9 – Concrete excavation from thickener circuit

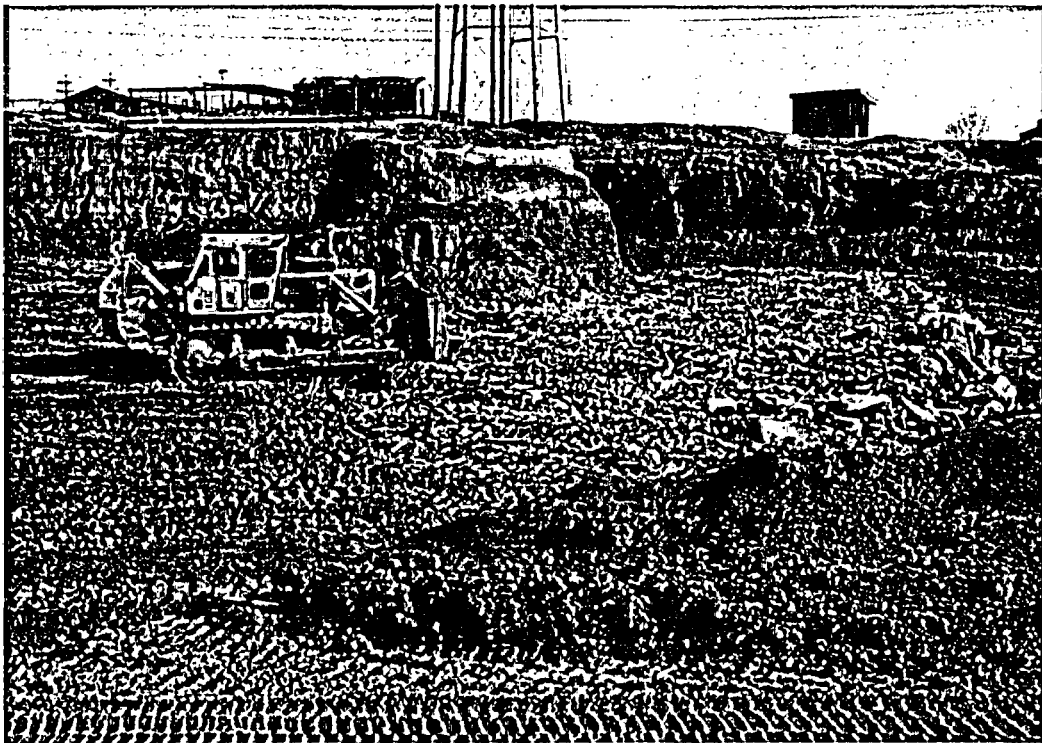


Photo 10 – Waste consolidation in disposal cell



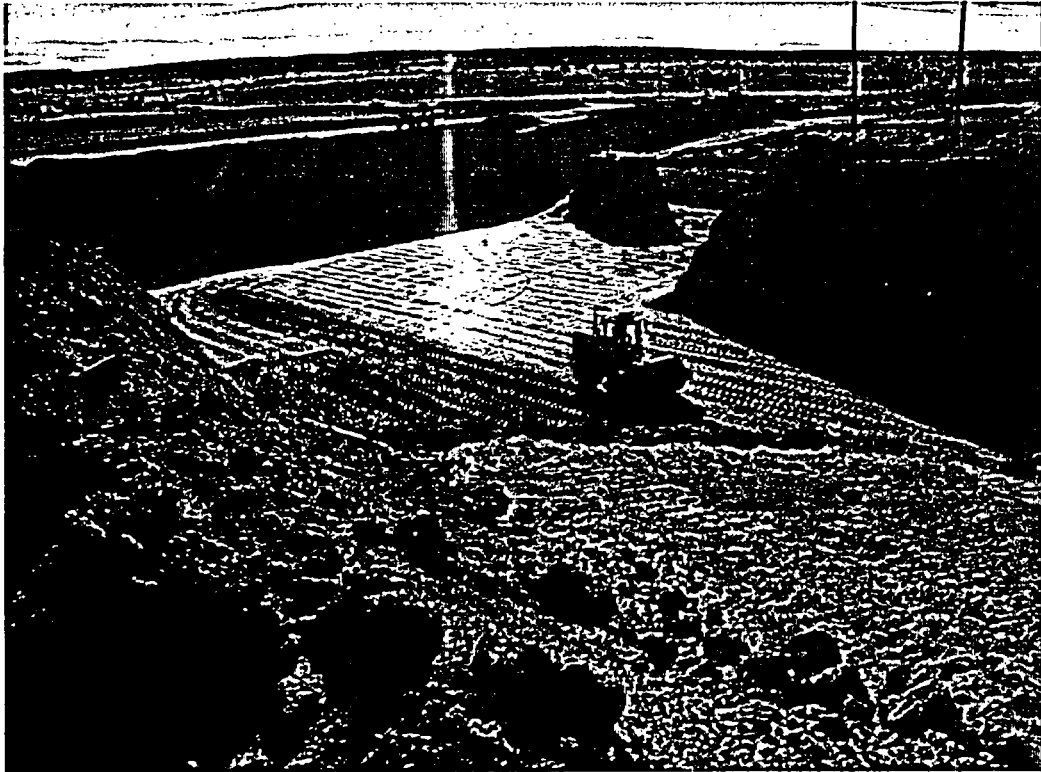


Photo 11 –Clay layer between successive waste layers



Photo 12 – Distributing Certificates for a demolition project completed safely