

**ANNUAL ALARA AUDIT REPORT**  
**May 28, 1990**

**Bluewater Uranium Mill, Grants, New Mexico**

**ARCO Coal Company**

**A Division of Atlantic Richfield Company**

**Prepared By:**

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## SUMMARY

The 1989 Annual "As Low As Is Reasonably Achievable" (ALARA) Audit for ARCO's Bluewater Uranium Mill was conducted on May 9 and 10, 1990.

Employee exposure and radiation protection records, inspections, radiation safety meetings, radiological surveys, environmental monitoring, and standard operating procedures were reviewed and found to be ALARA. All exposures were found to be less than 5 % of the Maximum Permissible Concentration and less than the administrative action level. There were no overexposures reported to the U.S. Nuclear Regulatory Commission.

Actions taken in 1989 to further reduce radiologic exposure to ALARA levels included pumping runoff from the main tailings pond to the evaporation ponds, controlling access to work areas, increasing internal exposure monitoring through the bioassay program and washing of all work areas prior to and during salvage or demolition work for dust control. ALARA had been effectively implemented as evidenced by no increased exposures to workers compared to past years in spite of a significant increase in work activity.

The Radiation Safety Officer successfully implemented a written testing procedure in accordance with the 1988 ALARA Audit recommendation that "...written testing be instituted as part of the radiation safety training program once decommissioning and reclamation work begins."

Recommendations resulting from the audit include:

- 1) radiation procedures that are no longer in use should be removed from the Bluewater Mill Procedures Manual, and
- 2) although ARCO's Radiation Monitoring Procedures are available in the main office, a full copy of the Chem-Nuclear (Contractor) Radiation Procedures should also be made available to ARCO employees at a central location in the main office, in addition to the copy in the Radiation Safety Officer's and contractor's offices.

## INTRODUCTION

On May 9 and 10, 1990, Christopher Sanchez, onsite Project Engineer, and Paul Bergstrom, Environmental Compliance Supervisor from the Denver office, conducted the 1989 Annual ALARA (as low as is reasonably achievable) Audit for the Bluewater Uranium Mill, which is presently being decommissioned. Natver Patel, Radiation Safety Officer (RSO), provided information to the reviewers throughout the audit. The audit was conducted in accordance with the Company's ALARA Policy and the U.S. Nuclear Regulatory Commission Regulatory Guide 8.31, "Information Relevant To Ensuring That Occupational Radiation Exposure At Uranium Mills Will Be As Low As Is Reasonably Achievable." To facilitate the review of information, it was decided that the following items would be covered during the course of the Audit:

- ALARA philosophy.
- Radiation safety staff.
- Procedures for effective radiation protection.
- Discussion with workers regarding their knowledge and contribution to the ALARA philosophy.
- Evaluation of environmental monitoring and health physics survey programs.
- Radiation safety training.
- Inspections.
- Exposure control and reporting.

In addition to the above items, it was agreed that the following procedure would be used for evaluating the effectiveness of the ALARA Policy:

- Data review.
- Determination of unusual trends (for the purpose of the Audit, unusual trends are defined as data, events, or situations that are deviations from normal).
- Discussion for lowering exposure.
- Findings and recommendations.

### ALARA PHILOSOPHY

ARCO's Bluewater Mill has adopted the U.S. Nuclear Regulatory Commission's ALARA philosophy which states that the major purpose of a radiation protection program is to maintain radiation exposure as low as is reasonably achievable for all workers and the general public. This philosophy is in addition to Atlantic Richfield Company's Health, Safety, and Environmental Policy. ARCO believes that the major purpose of the Audit is to determine if Bluewater Mill exposures are as low as is reasonably achievable rather than just a review of compliance with regulatory standards. During the Audit, it was noted that the ALARA philosophy is included routinely in reclamation and decommissioning planning activities. For example, the ALARA philosophy is written into contract requirements for all decommissioning and reclamation work. Implementation of the policy is monitored through radiation safety training, standard operating procedures, control measures for airborne dust, radiation work permits, inspections, and safety meetings.



## RADIATION SAFETY STAFF

### ARCO

Natver M. Patel, Radiation Safety Officer (RSO)  
Christopher E. Sanchez, Alternate RSO

Contractor - Chem-Nuclear Systems, Inc.

- 1 RSO Assistant
- 4 Radiation Technicians

The ARCO radiation safety staff meets the USNRC educational and radiation training requirements necessary to carry out radiation protection programs at the mill. The RSO is scheduled for training in late 1990. The alternate RSO is registered for training from June 4 to 8, 1990. Chem-Nuclear Systems' radiation Safety Staff meets the USNRC educational and radiation training requirements.

## PROCEDURES FOR EFFECTIVE RADIATION PROTECTION

Environmental monitoring, health physics surveys, and standard operating procedures (SOPs) were reviewed. All environmental monitoring procedures and the Radiation Safety Manual were reviewed and/or revised by the RSO on January 16 and March 12, 1990. The respiratory protection program, dosimetry program, environmental airborne monitoring for radionuclides, and controlled area entry requirements were all updated by the RSO.

Standard Operating Procedures were reviewed and revised by the RSO in April 1990, however most of the work performed in the second half of 1989 was done under Radiation Work Permits (RWPs) due to non-routine decommissioning activity.

Mill Emergency Procedures were updated and revised in October 1989. These updates included modification of personnel qualifications and tailings dam failure.

The team recommended that radiation safety procedures no longer in use be removed from the ARCO Procedures manual. The team also recommended that a copy of the Chem-Nuclear (Contractor) Procedures be made available to employees at a central location in the main office building.

## DISCUSSION WITH WORKERS

In reviewing radiation safety training records, it was noted that over 300 workers had been previously trained on ALARA philosophy during the past year. The reviewers met with a randomly selected demolition worker (George Molons with Coronado Wrecking and Salvage) and a technician (Rick Tate with Anderson Engineering). Both were asked if they knew of the ALARA philosophy and if they had contributed to the program. Both workers gave immediate answers which confirmed that they understood ALARA principles and they were able to explain what measures they routinely practice to reduce radiation exposure. The reviewers concluded that the ALARA training program has been effective.

## ENVIRONMENTAL MONITORING

### Water Monitoring

The reviewers examined groundwater monitoring data with the RSO. There were no unusual deviations in radiological concentrations from previous data. The RSO reviewed, evaluated, and documented the data for potential exposures and hazards in a timely manner.

ALARA is being practiced by immediately pumping runoff from the main tailings pond to the evaporation ponds. A Groundwater Corrective Action Program required by the NRC was initiated during 1989 and all groundwater hazardous constituents at the point of compliance were found to be ALARA.

### Air Monitoring

During 1989, the Bluewater Mill activity had increased as a result of the decommissioning of the facility. The number of onsite employees increased from five (5) to just over one hundred (100). The decommissioning work involved dismantling of several major process structures and ore crushing facilities.

The air monitoring program and all data were reviewed with the RSO. There was no significant change in the trend of particulate airborne radionuclides from the previous year at any of the monitoring stations. The highest concentration observed was less than 3% of the maximum permissible concentration (MPC). It was concluded that ALARA practice had been effective, since there was no statistical increase in airborne particulate radionuclide concentrations from 1988 to 1989.

Ambient radon concentrations indicated monthly fluctuations due to weather changes, but there was no unusual trend or deviation from previous data. An anomaly was noted at one of the perimeter sampling stations but was found to be an electronic malfunction of the RGM unit and was documented to the NRC.

In 1987, a soil cap was placed over the dried sand portion of the main tailings impoundment to control airborne radionuclide exposure. The effectiveness of the soil cap had been observed by the reduction in visual airborne sands to negligible amounts during the spring high wind seasons. It was concluded that all reasonable efforts to apply ALARA measures to reduce airborne radionuclide concentrations had been previously accomplished by the placement of the soil cap. Data from downwind environmental monitoring stations confirm ALARA for the reduction of airborne sands from the main tailings.

Review of the direct gamma exposure data from the monitoring station TLDs showed a maximum direct gamma exposure of 37.2 mR per quarter. (The control dosimeter data ranged from 29.0 to 32.0 mR.) This level is considered to be within the upper range of background for the area.

The team reviewed the radiological data for soil and vegetation at the monitoring stations. The highest Radium 226 concentration (3.8 pCi/gm) in the soil was found at the weather station. The Radium-226 background soil concentration for the area was 2.0 pCi/g. The highest Radium-226 concentration (0.098 pCi/gm) in the vegetation was also found at the weather station. It was determined that the radium concentration in soil and vegetation did not deviate substantially from previous years. The team reviewed the current locations of the monitoring stations and concluded that they were adequate.

## HEALTH PHYSICS SURVEYS

### Internal Exposure/Air

There were several major decommissioning projects completed during 1989 which required intensive health physics monitoring. These were:

- SX Dismantlement
- CCD Thickeners Salvage
- CCD Building Dismantlement
- Railroad Track Salvage
- New Leach Tank Salvage
- Phase I Demolition - Ore Handling Facilities
- Sag Mill Salvage and Dismantlement
- Non Process Building Demolition

A review of data for these projects showed that exposures were less than 5% of the maximum permissible intake (MPI) for both exposure to uranium ore dust and radon daughters. This represents a reduction over the previous year (10% MPC), attributable to the effectiveness of ALARA. Review of data for the thickener project showed that exposures were also less than 10% of the MPI.

Thirty-eight (38) radiation work permits (RWPs) were prepared during 1989 to control exposure during all non-routine work associated with the above projects. A review of the exposure data under the RWPs indicated that measures taken to reduce exposures during completion of the projects were effective in meeting ARCO's ALARA policy.

### Internal Exposure/Radon Progeny

The reviewers examined the working level (WL) data for all decommissioning activities.

The data showed that exposures ranged from <0.01 to 0.04 WL with an average of 0.013 WL (the MPC for radon daughters is 0.3 WL.) The current procedure is to monitor working levels on an as needed basis consistent with RWPs for the specific work area and ARCO's Policy.

In addition, the reviewers found that the following have been implemented to further reduce internal exposure:



- Access control to work areas.
- Exposure time is being recorded in all mill circuit buildings.
- Mill decommissioning is conducted under RWPs.

#### Internal Exposure/Bioassay

The reviewers examined the urinalysis data for U<sup>238</sup> concentrations with the RSO. The bioassay program has been modified for the decommissioning activity to include:

- Implementing of entrance and exit sampling.
- Bi-weekly sampling for yellowcake workers.
- Semi-annual sampling for all other workers.

The data indicated that U<sup>238</sup> concentrations were below the action level of 15 ug/l for all employees and contract workers.

Personal and material contamination survey data were reviewed. The clean area (office, desk, and eating area) contamination survey was found to be less than 7% of the MPC for total alpha contamination. Removable alpha contamination was found to be less than 15% of the MPC. The reviewers concluded the above levels were ALARA.

All materials and equipment released to the unrestricted area were well below the release criteria. The removable surface alpha contamination was less than 10% of the MPC. All reasonable efforts were made to keep surface contamination ALARA. For example, all items to be released were either washed, wet sandblasted, or steam cleaned even though initial surveys were below the release criteria.

#### External Exposure/Gamma and Beta Survey

The gamma exposure rate survey was reviewed with the RSO. The reviewers noted that the RSO is performing annual gamma surveys of general mill areas and surveys required by RWPs. Also, a personal dosimetry program is being implemented. A routine gamma exposure rate survey is also conducted in the mill circuit area.

The data from the most commonly entered areas in the mill showed an exposure rate of 8-300 uR/hr. Some mill process circuit areas (Old Acid Leach, New Yellowcake) ranged up to 1800 uR/hr, but occupancy in these areas was minimal as verified by the annual TLD exposure of <60 mrem/yr. It was concluded that the exposures were ALARA at less than 5% of the MPC.

The semi-annual source leakage survey for a calibration Cs-137 source was reviewed and the results were negative, (no leakage) less than  $8.0 \times 10^{-4}$  uCi.

The reviewers examined the annual thermal luminescent dosimetry (TLD) data. The results were less than 5% of the maximum permissible dose (MPD) for gamma and beta (whole body) for the ARCO staff and permanent contract workers.

### RADIATION SAFETY TRAINING

Radiation safety training records and topics were reviewed with the RSO. The training record indicated that one radiation safety training session with written testing was conducted in 1989 for ARCO employees.

It was found that the 1988 ALARA Audit recommendation that "written testing be instituted as part of the radiation safety training program once decommissioning and reclamation work begins," was implemented by the RSO. Special efforts were used to train bilingual workers for understanding the training information and written testing. Over 300 contract personnel were trained and tested in about 35 separate radiation safety training sessions prior to conducting work in restricted areas. Visitors were also informed in writing of radiological and general safety policies to minimize potential exposure.

### INSPECTIONS

The reviewers found that inspections of the mill were conducted monthly during 1989. All non-routine inspections were completed and documented as a part of radiation work permits (RWPs). During decommissioning activities, more frequent inspections were made by the RSO and radiation safety staff.

The review of inspection records and daily activity logs from the tailings pond, evaporation ponds, secondary containment, and diversion systems showed no unusual events. Maintenance was performed as needed on the soil cap to prevent exposure of the tailings sands.

### EXPOSURE CONTROL EQUIPMENT

The reviewers examined the exposure control method used to control airborne radioactive dust. Water spraying is used during all decommissioning work to minimize airborne radionuclide concentrations. The review of airborne concentration data and bioassay results verified that the controls were effective. Personal protective equipment (safety gear, overalls, gloves) were used by all workers to further reduce exposures. The fume hoods in the laboratory were found to be properly maintained.

In 1989, chain link gates were installed to avoid unauthorized entry into the process buildings and at the same time, allow for ventilation to minimize radon daughter exposures.



REPORTS OF OVEREXPOSURE

There were no overexposures at the Bluewater Mill in 1989 and therefore none were reported to the U.S. Nuclear Regulatory Commission.

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6-20-90  
Date

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