URANIUM REDUCTION COMPANY

INTER-OFFICE CORRESPONDENCE

To: L. A. Painter

From: E. B. Winn

Date: March 7, 1960

Subject: RADIATION REPORT FOR OCTOBER, 1959

The following report covers the works completed or "in process" on our radiation control program during the month of October.

EXTERNAL RADIATION PROGRAM

1. The URC film badge program terminated October 20, 1959. Results of the weekly film badge readings and the thirteen week cumulative film badge readings indicate that none of our employees are over the maximum allowable exposure. Paragraph 5, page 5 of our radiation program states as follows: - "The program for all individuals whose film badges show an average exposure of less than 50 mrem for 40 hours, or a total of 650 mrem for the 13 weeks, will be discontinued, and a mean level of exposure for that particular individual assigned. This mean level of exposure will be assigned unless some fault in the film badge reading is apparent, in which case the individual will be rebadged. The mean level of exposure for each job classification will be established and will remain the same as determined unless a process change or the duties of the particular job are changed." The last sentence in this paragraph indicates that a mean level of exposure for each individual has or would be established. Since some of our employees change jobs through the "bidding system", the mean level of exposure for each particular job classification was established as set forth in sentence three. The mean level of exposure was established by grouping all of our employees

URANIUM REDUCTION COMPANY

INTRADEPARTMENTAL CORRESPONDENCE

To L. A. Painter

From : E. B. Winn *Date* : March 7, 1960

Subject : RADIATION REPORT FOR OCTOBER, 1959

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into the particular [illegible] period. The average mrem/hour exposure for this particular job classification was obtained by adding the mrem/hour exposure of all employees in this classification and dividing this sum by the number of employees in the particular classification. This average mrem/hour exposure was multiplied by 40 to obtain the mean level of exposure in mrem/40 hours. The mean exposure level for all job classifications except those of the "Cruster Operator" and the "Moisture Man" have been established and are on file in the radiation file in the Personnel Department. Each of the above mentioned job classifications had employees whose film badges were damaged during the survey and no readings were available. The personnel whose badges were damaged will be rebadged for another 13 week period. A temporary mean level of exposure has been established for these two job classifications until such time as the new readings are available.

The film badge program for all other job classifications has been discontinued as none of the exposures were in excess of 50 mrem/40 hours. The highest mean exposure calculated was 44 mrem/40 hours, this being for the Dryer-Packager job. The lowest mean exposure listed is that of 4.5 mrem/40 hours. Two job classifications had this exposure level, the Heavy Equipment Operators and the Warehouse Personnel.

Since none of our job classifications were above the 50 mrem/40 hour level, paragraphs 6, 7, 8 and 9 of our external radiation policy are automatically eliminated.

2. With the [illegible] carbonate plant [illegible] jobs will be created. These new jobs will be film badged and mean level of exposure for the job classifications created as established.

3. New AEC film badges were received from the Idaho Falls office of the AEC for use during the month of October. These badges were distributed to all employees and the film badges exposed during the month of September were returned to their office. No results of their survey have been made available to date.

4. The fourth quarter, 1959, external radiation survey was started 10-19-59 and completed during the month. This survey was conducted by Mr. T. R. Downard using a Model SBX-11B Scintillator. Mr. Downard's report of this survey is on file in the radiation file in the Personnel Department.

Comparison of the mrem/hour exposure obtained by this survey with the readings obtained by our film badge survey are in fairly good agreement. In nearly all cases the exposures obtained by the Scintillator survey were higher than those recorded by the film badges.

The tailings pond area gives levels of 1.6 and 1.4 mrem/hour exposure, these are below the maximum allowable exposure but if a man were to work in this area continuously for 40 hours a week, we would have to monitor the area for another thirteen week period and establish a mean level of exposure. If this were in excess of 50 mrem/40 hours, we would have to keep permanent records of this man's exposure. As long as we continue our "part time" tailings poundsman, no records need be kept as his exposure would be less than 50 mrem/40 hours on this work schedule.

The URC stockpiles gave high readings but as long as employees are not working on these piles, no action is necessary.

AIR SAMPLING

1. The fourth quarter general air sampling and breathing zone air sample survey was started on October 9, 1959. These surveys were started and conducted as outlined in our radiation policy until the last week in October. On October 29 and October 30, Mr. William Johnson and Mr. Richard Kant of the AEC Inspection Division, made a tour of inspection of the mill and our radiation records. On the basis of the past low level exposure levels, they recommended that our sampling rate and/or time be extended to give a larger volume air sample, thus permitting reporting uranium concentration in air at a lower level than had previously been reported. These recommendations were put into practice immediately and the rest of the air sampling survey was conducted in accordance with their recommendations. A detailed report of these changes and an explanation of the effect of these changes on our survey program are on file in the "Airborne Radiation Report" book in the Personnel Department.

EMPLOYEE EDUCATION AND INSTRUCTION

1. Each entrance to the mill building and crushing department buildings was posted with eight by ten signs bearing the words "Caution--Airborne Radioactivity Area". These signs were installed due to a requirement of Title 10, Part 20, which states that any area in which the

airborne radioactivity exceeds 10% of the maximum allowable concentration of $5.0 \times 10^{-}$ [illegible] must be posted.

2. In accordance with our radiation policy, the Personnel Director instructs each new employee in general health precautions, the proper use of a respirator and a short explanation of both external and internal radiation hazards. Since this procedure has been established as a regular part of our new employee indoctrination program, it will not be covered again in future reports.

PRE-PLANNED HOUSEKEEPING PROGRAM

1. Part of the equipment necessary for the installation of the permanent type vacuum producer in the crushing plant was received and is being installed.

2. The Spencer vacuum producer received last month was installed and is being utilized extensively in our regular clean-up program in the product packaging area. This unit does an excellent job and should enable the operating personnel to maintain good housekeeping in this area.

CRASH CLEAN-UP PROGRAM

1. Product Packaging Area: No information has been received as yet from the Sprout-Waldron Company relative to their investigation of the use of a wet digester for disposal of our filter press papers.

2. The maintenance department completed the renovation of the doors on top of the fine ore storage bins. This project should help to lower dust concentrations in this area considerably providing the operators maintain the equipment.

3. The air balancing duct on the No. 1 Syntron vibrator in the Sample Plant is in progress.

4. The installation of a full vacuum hood over the small "Y" blender located in the sample tower lot preparation room was completed and is working very satisfactorily.

5. An evaluation of the air balancing ducts and fog mist sprays that were installed on the discharge chutes of the No. 9 and No. 10 fine ore bins was made but results of this test are not conclusive due to the high moisture content of the ore. Further tests will be conducted in the future to establish the feasibility of installing these units on all bin discharge chutes.

EFFLUENT TREATMENT PLANT

1. The experimental barite treatment plant has not been used to date due to inclement weather.

COLORADO RIVER SAMPLING SCHEDULE

1. Our regular monthly sampling program on the Colorado river was completed. Analytical results of the previous month's river water samples were received and placed in our files.

2. The URC radiation laboratory was completed and is now doing all of the work necessary for our analytical program.

E. E. Winn
Plant Metallurgist

DETERMINATION OF RADIUM BY A DOUBLE CARRIER METHOD

INTRODUCTION

This method is applicable to the determination of radium isotopes in uranium mill effluents. The procedure is based on a method developed by Ames (1) and modified at Argonne National Laboratory (2) The Atomic Energy Research Establishment in Harwell, England (3) and Union Carbide Nuclear Research Laboratory (4).

Radium is carried on lead sulfate and barium chloride. The barium chloride is converted to barium sulfate and counted on a planchet.

APPARATUS

A proportional gas flow counter, Nuclear Measurements Corporation Model PC-3A, a small clinical centrifuge large enough to accomodate a 50 ml centrifuge tube and a millipore filter assembly are required.

REAGENTS

1. Lead carrier, 20 mg ~~Pb +2~~ Pb^{+2} per ml. Dissolve 3.2 gms ~~Pb (No. 3) 2~~ $Pb(NO_3)_2$ in water and dilute to 100 ml.

2. Hydrochloric Acid - Ether Reagent. Mix 600 ml of concentrated HCL with 100 ml of pure ether and store in a closed container.

3. Barium carrier, 10 mg Ba^{+2} per ml. Dissolve 1.9 gm ~~Ba (No. 3) 2~~ $Ba(NO_3)_2$ in water and dilute to 200 ml.

4. H_2SO_4 1:1

5. Aerosol 0.8 solution. Dissolve 5 grams of solid in 100 ml of H_2O.

PROCEDURE

Filter from 100 ml to 1 liter of sample through a Millipore HA filter membrane and transfer into a 1500 ml beaker; immerse a mechanical stirrer in the sample.

Add 3 drops Aerosol solution. Slowly add 80 ml 1:1 H_2SO_4 and if sample volume less than 1 liter dilute to this volume. Add 5 ml of lead carrier solution. (a) Mix for 5 minutes and place in an ice bath for 10 minutes.

Filter through an HA Millipore filter and wash residue with four 5 ml washes of ice water. Transfer residue and filter membrane to a 50 ml centrifuge tube, add 10 ml HCl, stopper the tube and shake. Remove the membrane and wash with a minimum amount of HCl. The final volume of HCl should be 24 ml. Add 4 ml of ether and immerse the centrifuge tube in an ice bath for 10 minutes. Add 1 ml of barium carrier solution while stirring and let stand for 15 minutes.

Centrifuge for 3 minutes and discard the supernatant liquid. Add 5 ml of acid - ether reagent, shake to wash residue and again centrifuge and discard supernatant liquid.

DETERMINATION OF RADIUM BY A DOUBLE CARRIER METHOD (CONTINUED)

Add 10 ml H_2O to dissolve residue. Add 2 drops 1:1 H_2SO_4, allow 5 minutes for precipitation to form. (Record time when this precipitation is made)

Filter through a Millipore HA 1 inch filter membrane, dry for 30 minutes at 60° C and place filter on a stainless steel planchet and count in a proportional gas flow counter.

CALCULATIONS

Three standard samples containing 2, 4 and 50 grams of radium respectively and one blank sample are carried through with each group of radium samples and calculated as follows:

$$\frac{\text{Curie in standard}}{\text{C P M Standard - C P M Blank}} = \text{Curie / C P M}$$

$$\frac{(\text{C P M})(\text{Curie / C P M})}{\text{Sample Vol Ml}}\ 1000 = \text{Curie / liter}$$

(a) If this method is applied to solutions containing more than 100 ppm phosphate or sulfate a permanent precipitate will form on adding the lead. In such cases the order of addition of carrier and reagent should be reversed, and very efficient stirring employed.

(1) Ames, D. P. "Rapid Radiometric Assay for Radium..." A.E.C.D. - 2696 (Declassified September, 1949) and paper 22.70 In "The Transuranium Elements", National Nuclear Energy Service, Div. IV, Vol. 14B Part II, P. 1700.

(2) Russell, E. R., et al, "Determining Radium in Exposed Humans", Nucleonics 7, (No. 1) 60 (1950).

(3) Jenkins, E. N., and Sneddon, G. W., "The Monitoring of Effluent for Alpha Emitters," AERE C/R 2385 (1958)

(4) Union Carbide Nuclear Research Laboratory - (To date, the modifications to this procedure, by Union Carbide, have not been published and further development work is presently being carried out.

RADIUM ANALYSIS DATA *

*All samples submitted were filtered through a Whatman #42 filter paper.

Sample No.	Date Taken	Time Sample Taken	Date Submitted for Assay	Sample Location	River level on Sampling date	Estimated dpm/l	Combustion Engineering Lab Assay in dpm/l	UC/ml Ra-226
1	2-27-59	1:10 pm	6-30-59	one mile above mill	19.5 ft.	15	10.2	4.6×10^{-9}
2	2-27-59	2:00 pm	6-30-59	five miles below mill	19.5	15	23.9	10.8×10^{-9}
3	2-27-59	2:50 pm	6-30-59	Ten miles below mill	19.5	15	18.0	8.1×10^{-9}
4	3-26-59	12:50 pm	6-30-59	One mile above mill	19.5	15	28.0	12.6×10^{-9}
5	3-26-59	1:15 pm	6-30-59	Five miles below mill	19.5	15	35.5	16.0×10^{-9}
6	3-26-59	2:00 pm	6-30-59	Ten miles below mill	19.5	15	39.0	17.6×10^{-9}
7	3-26-59	3:00 pm	6-30-59	Mill tailing effluent	-	15,000	1,771	797.7×10^{-9}
8	5-1-59	1:00 pm	6-30-59	One mile above mill	18.5	15	4.5	2.0×10^{-9}
9	5-1-59	1:35 pm	6-30-59	Five miles below mill	18.5	15	36.3	16.4×10^{-9}
10	5-1-59	2:20 pm	6-30-59	Ten miles below mill	18.5	15	19.7	8.9×10^{-9}
11	5-1-59	3:00 pm	6-30-59	Tailing pond effluent	-	15,000	1,288	580.2×10^{-9}
12	5-27-59	12:45 pm	6-30-59	One mile above mill	16.5	15	9.8	4.4×10^{-9}
13	5-27-59	1:30 pm	6-30-59	Five miles below mill	16.5	15	35.0	15.8×10^{-9}
14	5-27-59	2:30 pm	6-30-59	Ten miles below mill	16.5	15	25.0	11.3×10^{-9}
15	5-27-59	3:30 pm	6-30-59	Tailings pond effluent	-	15,000	3,238	1458.6×10^{-9}

Sample No.	Date Taken	Time Sample Taken	Date Submitted for Assay	Sample Location	River level on Sampling date	Estimated dpm/l	Combustion Engineering Lab Assay in dpm/l	UC/ml Ra-226
16	6-23-59	1:05 pm	6-30-59	One mile above mill	14.5	15	14.9	6.7×10^{-9}
17	6-23-59	1:15 pm	6-30-59	Five miles below mill	14.5	15	8.4	3.8×10^{-9}
18	6-23-59	2:00 pm	6-30-59	Ten miles below mill	14.5	15	5.0	2.3×10^{-9}
19	6-23-59	2:30 pm	6-30-59	Tailings Pond effluent	-	15,000	4,582	2064×10^{-9}
20	7-28-59	1:45 pm	8-19-59	One mile above mill	19.5	15	8.9	illegible
21	7-28-59	2:10 pm	8-19-59	Five miles below mill	19.5	15	11.2	illegible
22	7-28-59	2:30 pm	8-19-59	Ten miles below mill	19.5	15	16.6	illegible
23	7-28-59	3:20 pm	8-19-59	Tailings pond effluent		15,000	10770	illegible
24 (1)	8-12-59		8-19-59	1 Colo. River above junction with Dolores River		15	3.5	illegible
25 (3)	8-12-59		8-19-59	2 Colo. River at Dewey Bridge		15	9.4	illegible
26 (11)	8-12-59		8-19-59	3 Colo. River 1/2 mile below mill		15	7.2	illegible
27 (14)	8-12-59		8-19-59	4 Colo. River one mile below mill		15	illegible	illegible
28 (17)	8-12-59		8-19-59	5 Colo. River at Ralph Miller farm		15	illegible	illegible
29 (18)	8-12-59		8-19-59	6 Colo. River five miles below mill		15	illegible	illegible
30 (21)	8-12-59		8-19-59	7 Colo. River ten miles below mill		15	illegible	illegible
31 (24)	8-12-59		8-19-89	8 Colo. River 20 miles below mill		15	illegible	illegible
32 (26)	8-11-59		8-19-59	9 Colo. River 20 mi above confluence with Green		15	illegible	illegible
(28)	8-11-59		8-19-59	10 Colo. River 10 mi. above confluence with Green		15	illegible	illegible

Radium analysis cont'd

Sample No.	Date Taken	Time Sample Taken	Date Submitted for Assay	Sample Location	River level on Sampling date	Estimated dpm/l	Combustion Engineering Lab Assay in dpm/l	UC/ml Ra-226
34 (30)	8-11-59		8-19-59 11	Colo. River one mile above confluence with Green		15	12.2	5.5×10^{-9}
35 (32)	8-11-59		8-19-59 12	Green River one mile above confluence with Colo.		15	21.5	9.7×10^{-9}
36 (34)	8-11-59		8-19-59 13	Colo R. one mile below confluence of Green		15	18.6	8.4×10^{-9}
37 (7)	8-12-59		8-19-59 14	Tailings pond effluent		15,000	9017.0	4.06×10^{-6}
38 (8)	8-12-59		8-19-59 15	Colo. R 1/4 mi below mill		15	6.4	2.9×10^{-9}
39 (5)	8-12-59		8-19-59 16	Colo. R. at Bridge above mill		15	6.1	2.7×10^{-9}
40	1-2-59	Late morning	1-11-59	1 mi above mill	17.9 ft	15	11.9	5.4×10^{-9}
41				5 mi below mill	19.4 ft	15	85.5	37.0×10^{-9}
42				some below mill	11.4 ft	15	45.5	14.5×10^{-9}
43				Tailings Pond effluent		15,000	20,574	9268.2×10^{-9}