963

Form AEC-317 (4-58)

UNITED STATES ATOMIC ENERGY COMMISSION

COMPLIANCE INSPECTION REPORT

II A II

1. Name and address of licensee	2. Date of inspection
Petrotomics Company P. O. Box 184 Casper, Wyoming	October 23 - 25, 1962
	3. Type of inspection: Initial
	4. 10 CFR Part(s) applicable: 20, 40

5. License number(s), issue and expiration dates, scope and conditions (including amendments)

SUA-551 **Issued:** 3/8/62 **Expires:** 3/31/63

SCOPE:

"Uranium, Unlimited, USE: For processing uranium ore in accordance with the procedures described in the licensee's application dated October 10, 1961, as supplemented January 12, and February 14, 1962."

CONDITIONS:

" 9. Authorized place of use: The licensee's uranium processing mill located approximately 62 miles south of Casper, Wyoming.

10. Mill operations shall begin only at such time as the licensee has completed installation of all equipment and facilities as described in the application and supplements thereto. However, crushing operations may be conducted at such time as the equipment and facilities described in the application and supplements thereto for this operation have been completed.

11. The licensee is hereby exempt from the requirements of Section 20.203(e)(2) and (Cont.)

6. Inspection findings (and items of noncompliance)

A. The licensee has determined general air concentrations of natural uranium in the restricted area (paragraph 12).

B. The licensee has computed employee's time weighted exposures to general air concentrations of natural uranium (paragraph 13).

C. The licensee determines the quantity of natural uranium in air samples by the flourometric method (paragraph 12).

D. The licensee determines the quantities of radioactive materials in liquid effluents and potable water (paragraph 16).

E. The licensee does not release liquid effluents to the unrestricted area (paragraph 16).

F. The licensee has conducted external radiation surveys in the restricted area (paragraph 17).

G. The licensee maintains a personnel monitoring program (paragraph 18).

(Continued)

7. Date of last previous inspection	8. Is "Company Confidential" information contained in this report? Yes ☐ No ☒ (Specify page(s) and paragraph(s))
None	

DISTRIBUTION:

CO:HQ
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CO:IV

Original signed by George H. Smith

George H. Smith (Inspector) Original sign:

Approved by: Roger T. Woolsey Roger T. Woolsey
Radiation Specialist (Reviewer)
Region IV, Division of Compliance (Operations office)

January 9, 1963 (Date report prepared)

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If additional space is required for any numbered item above, the continuation may be extended to the reverse of this form using foot to head format, leaving sufficient margin at top for binding, identifying each item by number and noting "Continued" on the face of form under appropriate item.

16—73814-2 U. S. GOVERNMENT PRINTING OFFICE

RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

ITEM 5 (Cont.)

20.203(f)(2), 10 CFR 20, for areas and container within the plant, provided all entrances to the mill are conspicuously posted in accordance with Section 20.203(e)(2) and with the words, 'Any area or container within this mill may contain radioactive material.'

12. The licensee shall submit quarterly reports on the results of radiation safety surveys. Reports must be filed no later than June 15, September 15, December 15, 1962, and March 15, 1963.

13. The licensee shall determine concentrations of uranium, thorium 230 and radium 226 in mill water sources used for potable or culinary purposes. These determinations shall be made monthly."

Letter dated June 4, 1962, modifies the source material license by adding the following condition:

"The licensee shall immediately notify the Director, Region IV, Division of Compliance, USAEC, Denver, Colorado, by telephone and telegraph of any failure in an earth dam retention system which results in a release of radioactive material into unrestricted areas. This requirement is in addition to the requirements of 10 CFR 20."

ITEM 6 (Cont.)

H. The entrances to the mill compound are posted as specified (paragraph 19).

I. Form AEC-3 is posted and mill employees are instructed in radiation safety procedures (paragraph 20).

The following items of noncompliance were observed or otherwise noted:

10 CFR 20.103 — Exposure of individuals to concentrations of radioactive material in restricted areas

(a) - in that, during the periods May 9, thru 16, June 20, thru 27, and August 1, thru 8, 1962, five employees (3 in May, one in June and one in August) were exposed to concentrations of airborne natural uranium in excess of the limits specified in Appendix B, Table I, (adjusted in accordance with 20.103(b)). (See paragraph 13.E., page 6)

(b) - in that, during the period April 1, thru October 23, 1962, the licensee adjusted the limits specified in Appendix B, Table I, to correspond to 40 hours exposure in a calendar week (Sunday thru Saturday) rather than 40 hours exposure in any seven consecutive days. (See paragraph 13.B., pages 5 and 6)

10 CFR 20.201 — Surveys

(b) - in that, during the period April 1, to October 23, 1962, the determinations of the exposures to airborne natural uranium of the employees in the yellow cake drying and packaging areas were inadequate because breathing zone samples were not collected and time studies did not reflect specific operations where a potential for excessive exposure to uranium exists. Breathing zone samples collected by AEC during the inspection contained concentrations of natural uranium in excess of concentrations noted in the licensee's general air samples. (See paragraphs 12.3., C. and D., pages 3, 4 and 5 and paragraph 13.C., page 6)

(b) - in that, during the period April 1, to October 23, 1962, the licensee had not determined the concentration of airborne natural uranium released to the unrestricted area. (See paragraph 15, page 7)

10 CFR 20.203 Caution signs, labels and signals

(d)(2) - in that, as of October 23, 1962, the licensee had determined that the average concentrations of airborne natural uranium in the yellow cake drying and packaging enclosures were in excess of the limits specified in Appendix B, Table I, Column I, but had not posted these areas as specified. (See paragraph 19, page 10)

(e)(2) - in that, as of October 23, 1962, the tailings pond which contains in excess of 33 pounds of natural uranium was not posted as specified. (See paragraph 19, page 10)

10 CFR 20.401 Records of surveys, radiation monitoring and disposals

(b) - in that, during the period April 1, thru October 23, 1962, the licensee has maintained records of liquid effluent uranium analyses in units other than those used in this appendicies of Part 20. (See paragraph 16.D., page 8)

10 CFR 20.405 Reports of overexposures and excessive levels and concentrations

(a) & (b) - in that as of October 23, 1962, the AEC and five individuals involved had not been informed as required, of the exposures to concentrations of airborne natural uranium in excess of the specified limits. (AEC informed by letter on October 31, 1962) (See paragraph 14, page 7)

9. Initial Inspection

An announced initial inspection of the subject licensed facility was conducted on October 23, through 25, 1962. The writer was accompanied by Mr. D'Arcy George, Source Material Procurement Division, Grand Junction Office. The following employees of the subject licensee were contacted during the course of the inspection: Mr. Norman A. Grant, Project Manager; Mr. G. K. Coates, Mill Superintendent; Mr. Burt Moulden, Employee Relations and Radiology; Mr. John Crozier, Chemist; and, Mr. Wayne K. Butcher, Administrative Assistant and Office Manager. According to Mr. Grant, Mr. Moulden is responsible for all radiation safety at the mill and reports directly to him.

10. Administrative Structure

Mr. Grant stated that the Petrotomics Company is a partnership consisting of Getty Oil Company, Kerr-McGee Oil Industries, Inc., Skelly Oil Company and Tidewater Oil Company. Grant stated that Kerr-McGee Oil Industries, Inc. owns fifty percent of the partnership and that the ownership of the remaining fifty percent is equally divided between Tidewater, Skelly and Getty Oil Companies. Grant said that the Tidewater Oil Company is the operating partner; that all mill personnel are employees of Tidewater Oil Company and, that the other three partners do not enter into the operation of the mill. Grant outlined the chain of responsibility for administration and radiation safety in the mill; a copy of this outline is attached as Exhibit A.

11. Physical Plant

It was observed that the mill complex consists of a main mill building, a chemistry lab, a crushing plant, two motels, an administration building and a combination mess hall, kitchen and recreation room (see Exhibit B). Grant stated that because of the shift schedule (12 hours/day) and the distance from Casper to the mill, the mill's production employees are housed in the motel during their 3-1/2 day/week tour of duty. The mill complex is enclosed by an eight-foot high chain link fence, however, the administrative building, motels, and eating area are outside of the fence.

Grant stated that the mill started processing ore on April 1, 1962; that at the time of the inspection, the mill was processing approximately 500 tons of ore per day; that the ore contained an average of 0.255% U_3O_8; and, that uranium recovery was approximately 95%. Mr. George stated that the Petrotomics Company submits monthly reports to the Source Material Procurement Division, GJ, and that these reports list the quantity of source material received, processed, on hand and transferred.

A mill flow sheet is attached as Exhibit C. A brief chronological description of the recovery process as utilized at the Petrotomics uranium mill follows:

A. The ore enters the mill through a 4" Grizzly. The plus 4" ore passes to a 30" x 40" jaw crusher. The minus 4" ore from the Grizzly and the jaw crusher product is conveyed to a 5' x 12' vibrating screen which is equipped with a 5/8" x 5" slotted screen deck. The process is designed so that the screen oversize passes to an impact crusher, however, Petrotomics Company is required by their source procurement contract to send a certain percentage of their ore to another processor and they have found that if they scalp the ore which should go to the impactor, they fulfill this percentage requirement. Therefore, the impactor is not in use. The vibrating screen undersize is conveyed to two 700 ton fine ore bins. The design capacity of the crushing plant is 125 tons per hour.

B. The fine ore bins are discharged to a 6' x 8' ball mill; this ball mill grinds the ore to minus 28 mesh.

C. The ground ore enters five 14' x 14' leach tanks. Leaching is accomplished by the addition of sulfuric acid and sodium chlorate. Approximately 97% of the contained uranium in the ore is dissolved in the agitators.

D. The discharge from the leaching circuit is delivered to the counter current decantation washing system (thickeners); the washing system consists of six 55' in diameter by 12' deep tanks.

E. The pregnant liquor from the No. 1 thickener is further clarified in a 22' in diameter x 12' deep clarification tank. The pregnant leach solution is pumped to the solvent extractor system. This system consists of four extraction stages and four stripping stages which are accomplished in a compartmented rectangular shaped tank measuring 28' wide x 82' long x 6' high. The stripping is accomplished by contacting the pregnant organic solution with 1.5 normal sodium chloride.

F. The pregnant strip solution is pumped to one of three 10' x 12' precipitation tanks. The precipitation of the uranium is accomplished by the addition of magnesium oxide.

G. The precipitated slurry is then pumped to a filter press where the yellow cake is filtered and water washed.

H. The filtered yellow cake is repulped with water and is pumped to a 6 in diameter x 6 hearth Skinner Roaster. The dryer is exhausted to an AAF Roto-Clone scrubber. (see Exhibit E, photo No. 1)

I. The dryed yellow cake is discharged by gravity through a small hammer mill to three packaging stations (photo No. 2). Barrels are filled through a closed system (photo No. 3), however, it is necessary to change the barrel lid after filling. The barrels are auger sampled and the auger is enclosed in plexiglass (photo No. 3) and the enclosure is vented to the AAF Roto-Clone described in H above.

It should be noted that the Skinner Roaster and the yellow cake barreling mechanisms are completely enclosed and under negative pressure. It was observed that the dust collecting equipment described in the licensee's applications was installed and operating.

12. Airborne Radioactive Materials - Restricted Area

A. Summary
During the period April 1, to September 1, 1962, the licensee collected 111 general air samples in 27 mill areas. Prior to the subject inspection, the licensee had not collected a breathing zone sample. Air samples are analyzed for natural uranium by the flourometric method.

B. Method
1. General Air Samples
Moulden stated that for the purposes of collecting general air samples, the mill had been divided into 27 areas; that a single sample is collected in each area, however, in 17 of the areas, the sample is collected at two locations i.e. the sampler is set up at one location and allowed to run for 10 minutes and is then moved to another locations and allowed to run for 10 minutes; that samples are always collected at the same location; and, that the samples are collected in that portion of an area where employees spend the majority of their time. In a letter dated February 14, 1962, (incorporated by License Condition 8) to AEC, the licensee listed the "Location of Sample Points For Initial Airborne Dust Survey". It was noted that the general air samples were collected in the proposed areas and those areas where the licensee stated samples would be taken at two locations were sampled as described above.

Moulden stated that two "Gast" air pumps are utilized in the collection of general air samples; that samples are collected at a sampling rate of 17.5 l/m and a sampling time of 10 or 20 minutes (those areas where a sample is collected in two locations are sampled for 20 minutes); and, that Whatman No. 41 filter paper is used as the collection media.

2. Breathing Zone Sampler
Moulden stated that he had not collected breathing zone air samples during specific operations because he felt that the short period that an employee occupied the area rendered the results impractical. It should be noted that the licensee's letter of February 14, 1962, states:

"Breathing zone samples will be obtained in areas where the general air samples indicate an atmosphere of near M. P. C. Concentrations."

3. Analysis
John Crozier, Chemist, stated that air samples are analyzed for natural uranium content by the flourometric method; that the analyses are performed in the manner described in IDO-12017; and, that their optimum lower limit of detection is 0.01 ug U_3O_8. Moulden stated that the quantity of U_3O_8 noted in the air samples is converted to microcuries of natural uranium in the following manner:

$$uc - Unat = (\text{grams } U_3O_8) \times (0.333 \text{ uc/gram}) \times (0.35 \frac{Unat}{U_3O_8})$$

C. Results of Sampling
A report dated September 14, 1962, from the licensee to AEC contains a compilation of the licensee's air sampling results for the period April 1, to September 1, 1962, (a copy of this compilation is attached as Exhibit D). Moulden stated that the air samples which were collected in September had not been analyzed at the time of the inspection and that he had not collected the October samples. It should be noted that with the exception of the yellow cake packaging and drying enclosures, the average concentrations of airborne natural uranium in the general air samples collected in the mill areas were less than the limits specified in 10 CFR 20, Appendix B. A transcript of the results of samples collected in the areas frequented by the yellow cake packaging operator follows:

General Air

Location	Natural Uranium x 10^{-11} uc/ml					
	April	May	June	July	August	Mean
Yellow Cake Packaging Enclosure	13.53	12.77	0.093	5.6	discard*	7.5
Yellow Cake Drying Enclosure	6.4	25.4	0.725	1.49	0.172	5.84
Precipitation Area	1.25	0.81	0.032	0.209	0.549	0.57
Reagent Mix	0.384	1.01	0.033	0.475	nil	0.37
Shift Office	0.118	2.01	0.061	0.132	0.134	0.49
Change Room	0.351	3.84	0.008	0.237	0.796	1.05

*Moulden stated that the sample was discarded because the concentration was too low to be representative.

Moulden stated that the yellow cake dryer "burped" on May 12, or 14, 1962; that the general air samples were collected during the period May 12, through 15; and, that he attributed the high airborne natural uranium concentrations during the month of May to the abnormal operation of the dryer. According to Coates, the dryer burping is caused by a faulty adjustment in the dryer feed rate and the dryer burped on the average of once a week during the months of April, May and June.

D. Independent Measurements by AEC
Three general air and three breathing zone samples were obtained on October 24, 1962. The licensee obtained three general air samples simultaneously (AEC's samples and the licensee's samples were placed side by side and turned on and off at the same time). The samples retained by AEC were analyzed by the Analysis Branch, Health & Safety Division, ID, and the samples retained by the licensee were analyzed in their mill laboratory. The results are as follows:

General Air

Location	Natural Uranium x 10^{-11} uc/ml	
	AEC	Licensee
4 feet north of yellow cake dryer @ 5 feet	0.8	0.115
2 feet north of yellow cake dryer @ 15 feet(1)	6.6(2)	0.956(3)
Between yellow cake barrel sampling & weigh station @ 5 feet(4)	4.2(5)	4.75

Breathing Zone

Location	Sampling Rate (l/m)	Sampling Time (min)	Natural Uranium x 10^{-11} uc/ml
Yellow cake barrel sampling	25	6	168.3(6)
Yellow cake barrel lid change and moisture weigh	25	9	10.5(7)

(1) Sample taken opposite top inspection port on dryer - operator inspected and raked dryer while sample being taken (~ 2.5 min).
(2) 1.17 times AEC standard for 56 hours exposure in seven consecutive days and 3.3 times AEC standard for 78 hours exposure in seven consecutive days.
(3) During the time that the dryer was being inspected, the licensee's sampler was shielded by the port door, therefore, the descrepancy.
(4) Sample collected with AEC sampler was analyzed by the licensee and vice versa.
(5) 1.4 times AEC standard for 78 hours exposure in seven consecutive days.
(6) 29.5 times AEC standard for 56 hours exposure in seven consecutive days and 56.1 times AEC standard for 78 hours exposure in seven consecutive days.
(7) 1.9 times AEC standard for 56 hours exposure in seven consecutive days and 3.6 times AEC standard for 78 hours exposure in seven consecutive days.

E. Discussion
Mr. Grant stated that breathing zone air samples will be collected during those specific operations where potential dust generation exists.

13. Exposure to Airborne Natural Uranium - Restricted Area

A. Summary
The licensee has conducted time studies and computed employees' time weighted exposures to airborne natural uranium, however, the time studies do not reflect time spent during specific operations and the time weighted exposure calculations are made using only general air concentrations of natural uranium. The licensee has adjusted permissable average concentration of natural uranium to which an employee may be exposed to correspond to 40 hours exposure in a calendar week rather than 40 hours exposure in any seven consecutive days as specified in 10 CFR 20.103(b). Five of the licensee's employees were exposed to average concentrations of natural uranium in excess of AEC standards.

B. Adjusted Permissable Employee Exposure
Moulden stated that the mill employees work, according to their job classifications, the following shift schedules:

1. The mill's administrative and maintenance employees work 8 hours/day, 5 days/week.
2. The crusher operators work 10 hours/day, 4 days/week.
3. The production personnel are divided into 4 crews, each crew works 12 hours/day, 3-1/2 days/week. Copies of the production employee's shift schedule are attached as Exhibit E.

Refer to the production employees' shift schedule (Exhibit E) for the periods May 7, through 17, June 20, through 27, and August 1, through 3, 1962. It should be noted that during the aforementioned periods, the personnel working on the involved crews worked 78 hours in any seven consecutive days. Therefore, in accordance with the instructions contained in 10 CFR 20.103(b), the adjusted permissible average concentrations of natural uranium to which an employee could be exposed during the aforementioned periods, are 3.1×10^{-11} uc/ml (uranium present free from daughters) and 1.28×10^{-11} uc/ml (uranium plus daughters). Moulden stated that because the production employees work 42 hours per calendar week, (Sunday through Saturday), prior to the inspection, he had considered the adjusted permissible average concentrations of natural uranium to be 5.7×10^{-11} uc/ml (uranium present free from daughters) and 2.38×10^{-11} uc/ml (uranium plus daughters).

C. Time Studies

Moulden stated that time studies had been conducted on all mill employees; that, the time studies listed the time spent in each area of the mill (packaging enclosure, drying enclosure, etc.,); but, that the time studies did not list the time spent performing specific operations (sampling yellow cake barrels, checking the yellow cake dryer, etc.). Moulden said that the production employees had recorded their time spent in the various mill areas for a two week period; that the time spent by each employee over the two week period was averaged to obtain an average daily time study; and, that the average daily time studies for all employees in a given job classification were averaged to obtain an average time distribution for any person working in that job classification.

D. Time Weighted Exposure Calculations - Method

Moulden stated that the daily time weighted exposures to airborne natural uranium are computed for each job classification quarterly and that the average concentrations of natural uranium noted in all air samples collected in an area are utilized. The formula which Moulden uses to compute time weighted exposures follows:

$$\text{Job Classification Exposure} = \frac{\sum_{1}^{n} Tn\ Cn}{\sum_{1}^{n} Tn}$$

where Tn = time spent in area n
Cn = average concentration of natural uranium in area n
and n = the areas occupied by a person working in a specific job classification.

A copy of the time weighted exposure calculation for the "Final Product Packaging" employees, for the second quarter, 1962, is attached as Exhibit F. Moulden states that he uses the employees' time cards to relate job classification exposure to individual employee exposure.

E. Records of Time Weighted Exposure Calculations.

A review of the time weighted exposure calculations showed that with the exception of those listed below, all time weighted exposures to airborne natural uranium were less than the applicable AEC standards. The maximum exposures to airborne natural uranium were received by the "Final Product Packaging" and, "Precipitation" employees; a transcript of the time weighted exposures for these employees follows:

Period	Average Exposure To Airborne Natural Uranium $\times 10^{-11}$ uc/ml	
	Final Product Packaging	Precipitation
April & May	N.C.(1)	4.05(2)
April, May & June	5.55(3)	2.74
July & August	4.78(4)	1.83

(1) Not computed by licensee.
(2) 1.3 times AEC standard for 78 hours exposure in seven consecutive days.
(3) 1.8 times AEC standard for 78 hours exposure in seven consecutive days.
(4) 1.5 times AEC standard for 78 hours exposure in seven consecutive days.

At the time of the inspection the above calculations were combined with the individual employee's work schedules and showed that the following employees were exposed to airborne natural uranium in excess of AEC standards:

Employee's Name	Period of Exposure	Daily Exposure natural uranium x 10^{11} uc/ml	No. of times AEC Standard*
F. G. Cole	May 9, through 16, 1962	5.55	1.8
R. C. House	May 9, through 16, 1962	4.05	1.3
R. T. Rorabeck	May 9, through 16, 1962	4.05	1.3
J. R. Ellis	June 20, through 27, 1962	5.55	1.8
A. A. Draper	August 1, through 8, 1962	4.78	1.5

*AEC standard for 78 hours exposure in seven consecutive days is 3.1×10^{-11} uc/ml natural uranium.

It should be noted that the aforementioned time weighted exposures were calculated using general air concentrations of natural uranium and time studies which reflect occupancy in general areas and do not show time spent performing specific operations.

D. Discussion

Grant stated that the following actions would be taken to correct the discrepancies noted in the foregoing paragraph:

1. AEC would be petitioned for a license amendment whereby concentrations of airborne natural uranium could be averaged over 480 hours in any 84 consecutive days rather than 40 hours in any 7 consecutive days.
2. Time studies will be expanded to reflect time spent performing specific operations.
3. Specific duties will be reassigned so that jobs requiring exposure to high concentrations of airborne natural uranium are distributed among a greater number of employees thereby reducing the possibility of any one individual receiving an overexposure.

14. Reports of Overexposures

Grant stated that because prior to the inspection, they did not realize that employees had been exposed to concentrations of airborne natural uranium in excess of AEC standards, the exposures had not been reported to AEC or the persons receiving the exposures. Grant said that the exposures would be immediately reported. It should be noted that the exposures were reported to AEC in a letter dated October 31, 1962.

15. Airborne Radioactive Materials - Unrestricted Area

Moulden stated that air samples to determine the concentration of airborne natural uranium released to the unrestricted area had not been taken. Moulden stated that they were having difficulty devising a plan for taking unrestricted area air samples because the mine is so located that it is up wind from the mill the majority of the time, and they did not know how to determine whether the uranium was coming from the mine or the mill. It should be noted that the licensee's letter of January 12, 1962, states:

> "This stack (Roto-Clone discharge stack) will be sampled weekly by using a venture tube. . ."

and the licensee's letter of February 14, 1962, states:

> "The need for an environmental airborne survey program will be required only if it becomes established that stack concentrations are above MPC."

Grant stated that an unrestricted area survey program would be initiated immediately.

Liquid Effluents

A. Summary

There has not been a direct release of liquid tailings to the unrestricted area. Three test wells have been drilled in order to determine whether tailings liquor is being released to the unrestricted area by seepage; these holes are sampled monthly and the samples analyzed for Radium-226 and Thorium-230 content.

B. Holding Pond and Test Holes

1. A schematic sketch of the tailings pond is attached as Exhibit G. Grant stated that the holding pond has a capacity of 750,000 tons of sand tails or 350 acre feet of liquid and that the pond is capable of holding all tailings which the mill will generate through 1966. According to Grant, the mill has not had a direct release of liquid tailings to the unrestricted area, however, there is a visible seep at the base of the tailings dam. Because of this seep, a second dam immediately below the dam has been constructed. Grant stated that they do not feel the seep is tailings liquor but rather that during the construction of the tailings dam, they uncovered an underground spring. Grant stated that they based this belief on the fact that the pH of the tailings liquor is 1.5 but that the pH of the seepage liquor is 7.5 It was observed that the tailings pond was enclosed by a 3' woven wire plus 2 strand barb wire fence.

2. Test Holes

Grant stated that three test holes have been drilled on the perimeter of the tailings pond and that the purpose of these holes is to determine the underground flow, if any, of tailings liquor. Exhibit G shows the approximate location of these holes in relation to the tailings dam. Grant stated that the natural underground flow of liquid has been determined and that any underground flow of tailings liquor would be detected in hole No. 2.

C. Drinking Water

Grant stated that the mill's process and drinking water is obtained in the following manner: 1. In the process of mining the uranium ore, a great deal of water is encountered. This water is pumped out of the mine into a series of three settling ponds. 2. The water is then pumped from the settling ponds to a lake where it is held until needed. 3. The lake water is pumped to a large holding tank. 4. From the tank, the water is allowed to flow by gravity into a Zeolite water softener. 5. The treated water is then used for both the mill process and as potable water for the mill complex.

Coates stated that the Zeolite beds are regenerated daily by means of an acid backwash.

D. Results of Sampling

According to Moulden, the mill's drinking water and the three test holes are sampled monthly. Moulden stated that samples are also occasionally taken from the seepage on the tailings dam, the creek below the dam, and the potable water storage lake. Moulden stated that the liquid samples are analyzed for Radium-226, Thorium-230 and U_3O_8 content by Tracerlab, a Division of Laboratory for Electronics, Waltham, Massachusetts, and that prior to August 1, 1962, drinking water samples were also analyzed by Radiation Detection Company, Palo Alto, California. A compilation of the liquid sample analyses results for the period March 1, thru October 1, 1962, follows:

Liquid Analyses

Location	No. of Samples	Ra 226 x 10^{-8} uc/ml			Th-230 x 10^{-8} uc/ml		
		High	Low	Mean	High	Low	Mean
Drinking Water	12	4.00	nil	0.85	0.44	nil	0.04
Test Well No. 1	6	0.15	0.04	0.10		*	
Test Well No. 2	6	0.19	nil	0.09		*	

Liquid Analyses table (Cont.)

Location	No. of Samples	Ra-226 x 10^{-8} uc/ml			Th-230 x 10^{-6} uc/ml		
		High	Low	Mean	High	Low	Mean
Test Well No. 3	6	0.22	nil	0.10		*	
Creek below dam	3	0.70	0.15	0.38		*	
Seepage Liquor	1			0.28		*	

*The maximum of all samples was 0.0072 x 10^{-6} uc/ml and 90% of the samples were reported as <0.005 uc/ml.

The maximum quantity of U_3O_8 noted in the liquid sample was 4.4 micrograms per milliliter (1.2 x 10^{-6} uc/ml natural uranium) which was noted in the seepage liquor. It should be noted that all uranium analyses on the liquid samples were reported as microgram/milliliter U_3O_8. Moulden stated that this method of reporting would be changed and that in the future, uranium content in the liquid samples would be reported in microcuries of U natural/milliliter.

E. Independent Measurements by AEC
Three liquid samples were collected during the course of the inspection; these samples were analyzed by the Analysis Branch, Health and Safety Division, ID. The results of the analyses follow:

Location	Ra-226 x 10^{-8} uc/ml	Th-230 x 10^{-6} uc/ml
Drinking water - from office dringing fountain	0.72	0.27
Seepage liquid	0.84	0.49
Tailings liquor - taken from pond	53.6	179.00

17. External Radiation Surveys

Moulden stated that external radiation surveys were conducted on February 7, April 23, and August 14, 1962; that the survey made in February was utilized to to collect background information. A review of the survey records showed that during each survey approximately 133 readings were taken in 23 areas in the mill proper and surrounding buildings. The maximum external radiation reading recorded was 1.5 mr/hr at contact with a full yellow cake barrel. Approximately 98% of all readings were less than or equal to 0.5 mr/hr. Moulden stated that a Unico Model 166 C Gieger counter, range 0 - 20 mr/hr was utilized in the external radiation survey. According to Moulden, the instrument is calibrated by means of an attached calibration source. The writer used a Frieseke Hoepfner, Model FH-40-T, Gieger counter to obtain the following external radiation readings:

A. The maximum reading of 2 mr/hr beta plus gamma was noted at contact with a full yellow cake storage barrel.

B. The reading at contact with the inside of the shifter's office was 1.5 mr/hr beta plus gamma.

C. All other readings were less than 0.5 mr/hr.

18 Personnel Monitoring

Moulden stated that a film badge program was initiated in the mill on June 4, 1962; that film badges are furnished and processed by Tracerlab, "Twin Film", Richmond, California on a bi-weekly basis; and that 15 employees are badged. Moulden stated that at least one man in each job classification is badged and that the reading from the badged individual in each job classification is utilized as the reading for all men in that job classification. The film badge records were maintained on the processor's reports and on correctly completed Forms AEC 5; Moulden stated that Forms AEC-4 had been completed on all mill personnel who had received occupational exposure prior to their employment with Petrotomics. A review of the film badge records showed the following:

A. The maximum cumulative exposure for the period 6/4/62 to 9/24/62, was 412 mr gamma plus zero beta and 350 mr gamma plus 98 mr beta.

B. The maximum bi-weekly exposure prior to September 10, 1962, was 155 mr gamma plus less than 30 mr beta.

C. All badge exposures for the period September 10 through September 24, 1962, were from 100 to 400 mr gamma.

D. Approximately 80% of all badges for the periods prior to September 10, 1962, were less than 10 mr gamma plus less than 30 mr beta (the film processor's minimum detection limits).

Moulden stated that the high film badge readings for the period September 10, through September 24, 1962, were attributed to the location of the film badge storage rack. According to Moulden, this rack had been placed in the shifter's office in such a location that it was separated from the full yellow cake barrel storage area only by a wall. The external radiation readings inside of the shifter's office at the approximate location of the film badge storage rack are contained in paragraph 17.B. It was observed that at the time of the inspection, the film badge storage rack had been moved to the opposite wall of the shifter's office, and that external radiation readings in this area were essentially background.

19. Posting and Labeling

It was observed that all entrances to the mill compound were posted with signs 6" x 10", magenta on yellow background, bearing the radiation caution symbol and the wording "CAUTION - RADIATION AREA" and with signs 18" x 24", magenta on yellow background, bearing the radiation caution symbol and the wording "ANY AREA OR CONTAINER WITHIN THIS MILL MAY CONTAIN RADIOACTIVE MATERIALS". It was observed that the entrances to the yellow cake packaging room and the yellow cake dryer enclosure were posted with signs 6" x 10", magenta on yellow background, bearing the radiation caution symbol and the wording "CAUTION - RADIOACTIVE MATERIAL". The perimeter of the tailings pond was posted at approximately 50' intervals with signs 6" x 10", magenta on yellow background, bearing the radiation caution symbol and the wording "CAUTION - RADIATION AREA".

It should be noted that the tailings pond area and the mill compound are two separate and distinct areas; that a uranium ore processing mill which processes 500 tons per day of 0.25% ore at a recovery rate of 95%, will deposit approximately 100 pounds of natural uranium in the tailings area per day; and, that the tailings pond area was not posted in accordance with 10 CFR 20.203(e)(2). Mr. Grant stated that signs bearing the wording specified in 10 CFR 20.203(e)(2) would be posted immediately.

The licensee has determined that the average concentrations of airborne natural uranium in the yellow cake drying enclosure and packaging enclosure exceed the concentration listed in 10 CFR 20, Table I, Appendix B (see paragraph 12.C). However, the packaging enclosure and drying enclosure were not posted with signs as specified in 20.203(d)(2). Grant stated that signs bearing the wording specified in 10 CFR 20.203(d)(2) would be posted on these areas as soon as such could be procured.

20. Instruction of Employees

It was observed that Form AEC-3 was posted on the bulletin board located near the mill office entrance and on a bulletin board which was located at the entrance to the mill employee's change room. Moulden stated that he informs each man of proper radiation safety procedures at the time he is employed and that, in addition to verbally discussing radiation safety, each man is given a booklet entitled "Safety Program - Petrotimics Company - Shriley Basin Operation". It should be noted that a copy of this booklet was submitted to AEC at the time the licensee's application for license was filed. It was observed that operating procedures are posted in various areas of the mill; that the procedures contain specific instructions as to proper working procedures for that section of the mill, and, that these procedures state that persons not following proper radiation safety procedure shall be terminated.

21. Discussion with Management

The discrepancies noted during the course of the inspection were discussed with Grant, Coates and Moulden at the termination of the inspection. Their comments regarding these discrepancies appear where applicable in the body of this report.

ORGANIZATION CHART

Tidewater Oil Company
4201 Wilshire Blvd.
Los Angeles 5, California

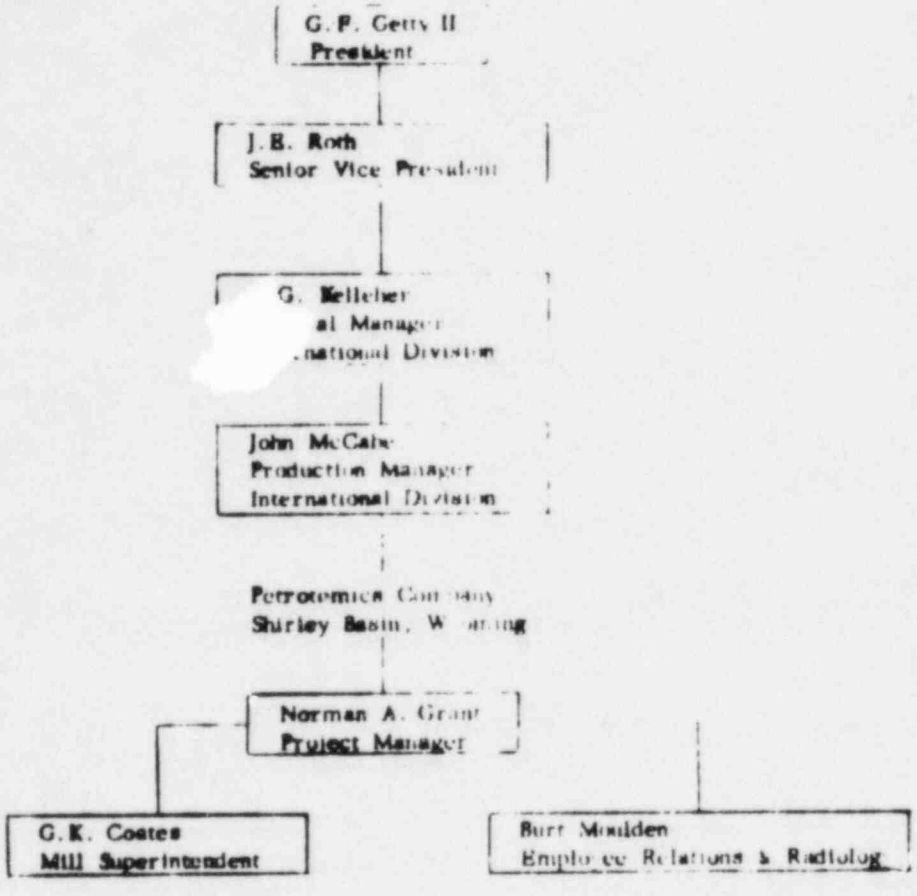
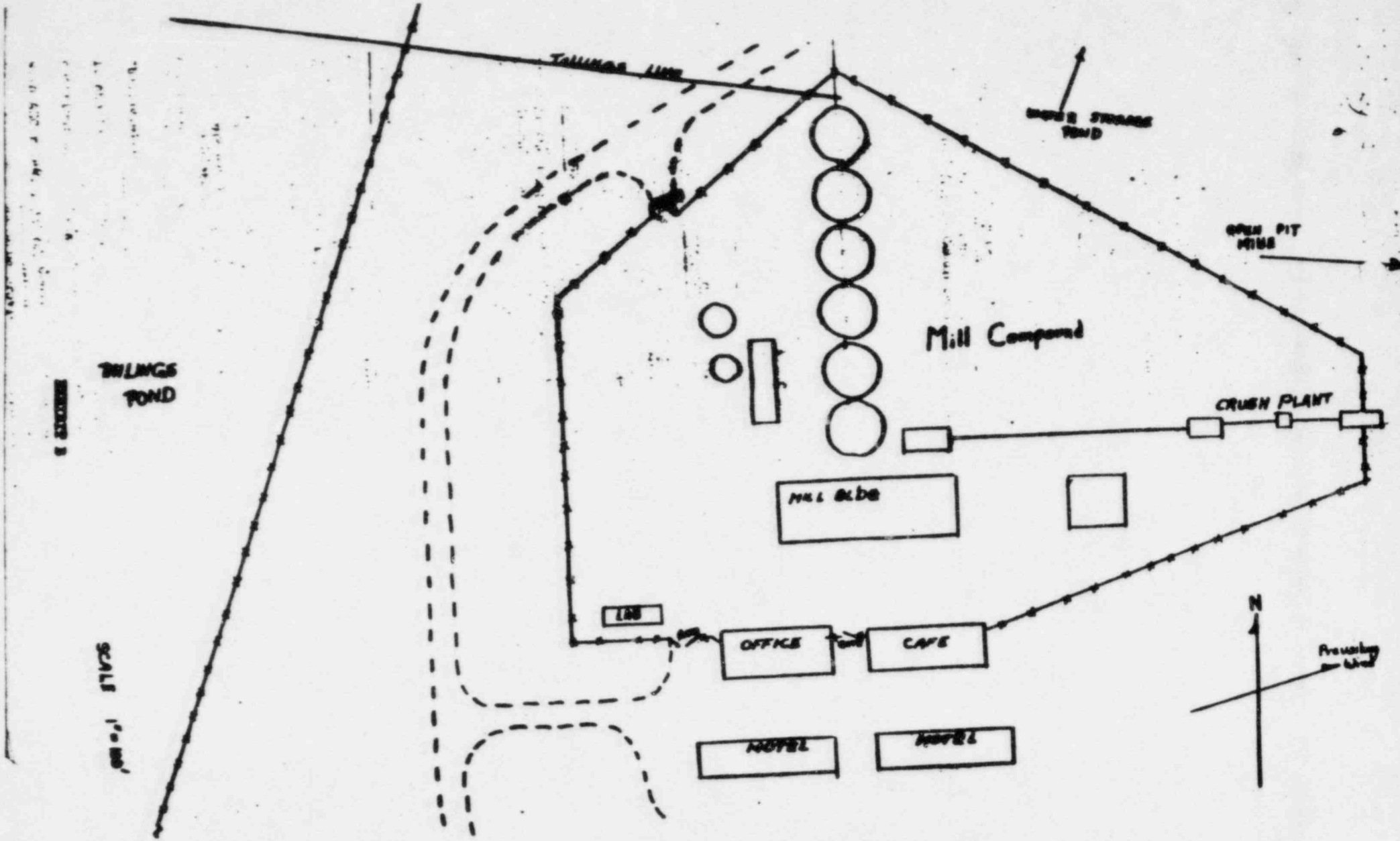


EXHIBIT A


TAILINGS LINE
TAILINGS POND
Mill Compound
CRUSH PLANT
OFFICE
CAFE
HOTEL
HOTEL
N

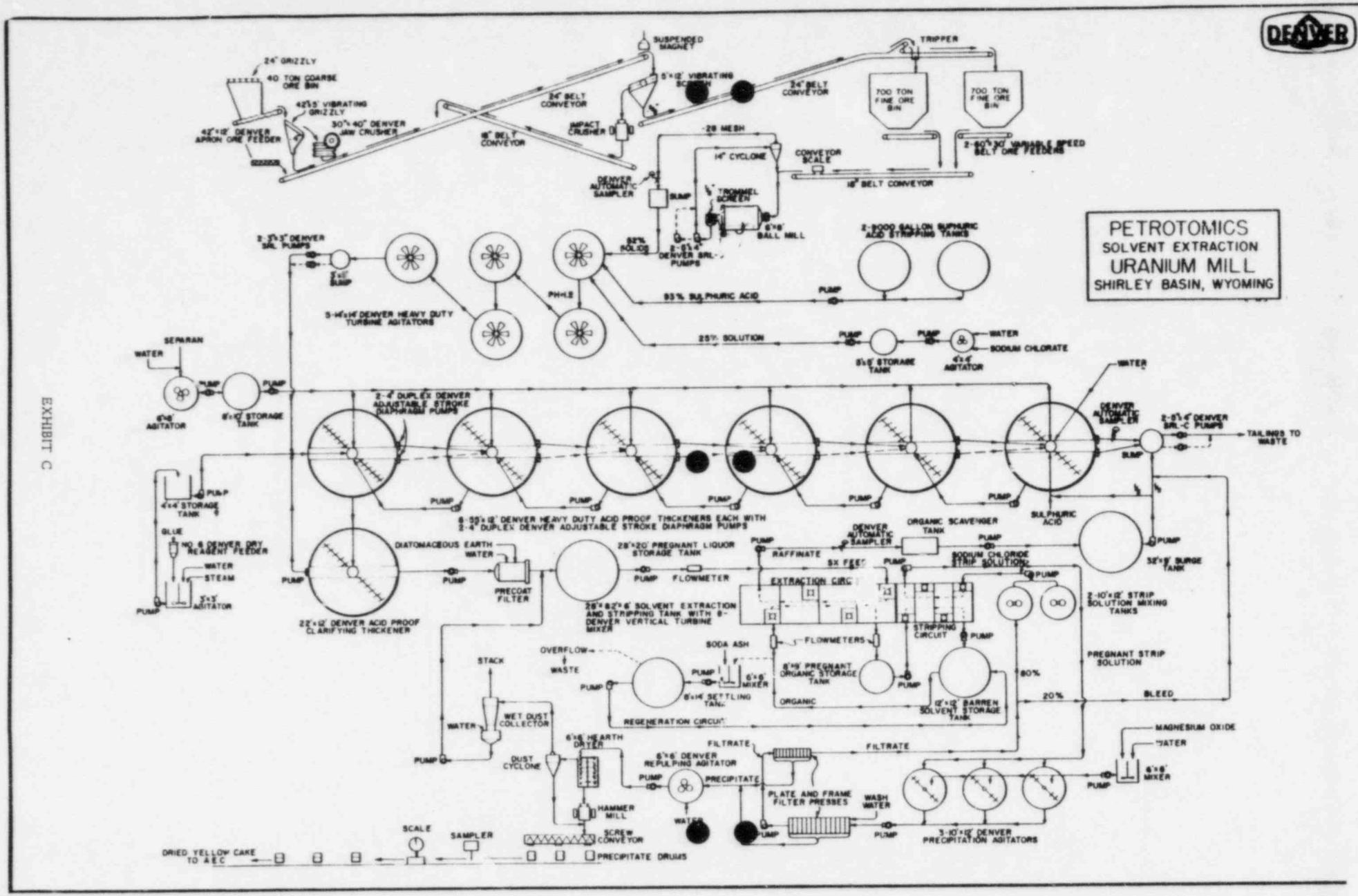

PETROTOMICS
SOLVENT EXTRACTION
URANIUM MILL
SHIRLEY BASIN, WYOMING
DENVER
24' GRIZZLY
40 TON COARSE ORE BIN
42"x5' VIBRATING GRIZZLY
42"x12' DENVER APRON ORE FEEDER
30"x40" DENVER JAW CRUSHER
36" BELT CONVEYOR
SUSPENDED MAGNET
5'x12' VIBRATING SCREEN
IMPACT CRUSHER
TRIPPER
700 TON FINE ORE BIN
700 TON FINE ORE BIN
2-60"x20' VARIABLE SPEED BELT ORE FEEDERS
-28 MESH
14" CYCLONE
CONVEYOR SCALE
18" BELT CONVEYOR
DENVER AUTOMATIC SAMPLER
SUMP
5' TROMMEL SCREEN
6'x8' BALL MILL
52% SOLIDS
2-8"x6" DENVER SRL PUMPS
2-3"x3" DENVER SRL PUMPS
2-8000 GALLON SULPHURIC ACID STRIPPING TANKS
93% SULPHURIC ACID
PUMP
PH=1.2
5-14'x14' DENVER HEAVY DUTY TURBINE AGITATORS
25% SOLUTION
8'x8' STORAGE TANK
4'x4' AGITATOR
WATER
SODIUM CHLORATE
SEAWAN
WATER
6'x6' AGITATOR
8'x12' STORAGE TANK
2-4" DUPLEX DENVER ADJUSTABLE STROKE DIAPHRAGM PUMPS
DENVER AUTOMATIC SAMPLER
2-3"x4" DENVER SRL-C PUMPS
TAILINGS TO WASTE
4'x4' STORAGE TANK
GLUE
NO. 6 DENVER DRY REAGENT FEEDER
WATER
STEAM
3'x3' AGITATOR
6-30'x12' DENVER HEAVY DUTY ACID PROOF THICKENERS EACH WITH 2-4" DUPLEX DENVER ADJUSTABLE STROKE DIAPHRAGM PUMPS
SULPHURIC ACID
ORGANIC SCAVENGER TANK
32'x9' SURGE TANK
DIATOMACEOUS EARTH
WATER
PRECOAT FILTER
22'x12' DENVER ACID PROOF CLARIFYING THICKENER
28'x20' PREGNANT LIQUOR STORAGE TANK
FLOWMETER
28'x8'2"x6' SOLVENT EXTRACTION AND STRIPPING TANK WITH 8-DENVER VERTICAL TURBINE MIXER
RAFFINATE
5% FEED
EXTRACTION CIRC.
SODIUM CHLORIDE STRIP SOLUTION
STRIPPING CIRCUIT
2-10'x12' STRIP SOLUTION MIXING TANKS
PREGNANT STRIP SOLUTION
80%
20%
BLEED
FLOWMETERS
6'x9' PREGNANT ORGANIC STORAGE TANK
ORGANIC
12'x12' BARREN SOLVENT STORAGE TANK
OVERFLOW
WASTE
SODA ASH
6'x6' MIXER
6'x14' SETTLING TANK
REGENERATION CIRCUIT
STACK
WET DUST COLLECTOR
WATER
6'x6' HEARTH DRYER
DUST CYCLONE
6'x6' DENVER REPULPING AGITATOR
PRECIPITATE
FILTRATE
FILTRATE
PLATE AND FRAME FILTER PRESSES
WASH WATER
MAGNESIUM OXIDE
WATER
6'x6' MIXER
HAMMER MILL
SCREW CONVEYOR
3-10'x12' DENVER PRECIPITATION AGITATORS
SCALE
SAMPLER
DRIED YELLOW CAKE TO AEC
PRECIPITATE DRUMS

EXHIBIT C

AREA DUST SURVEY RESULTS

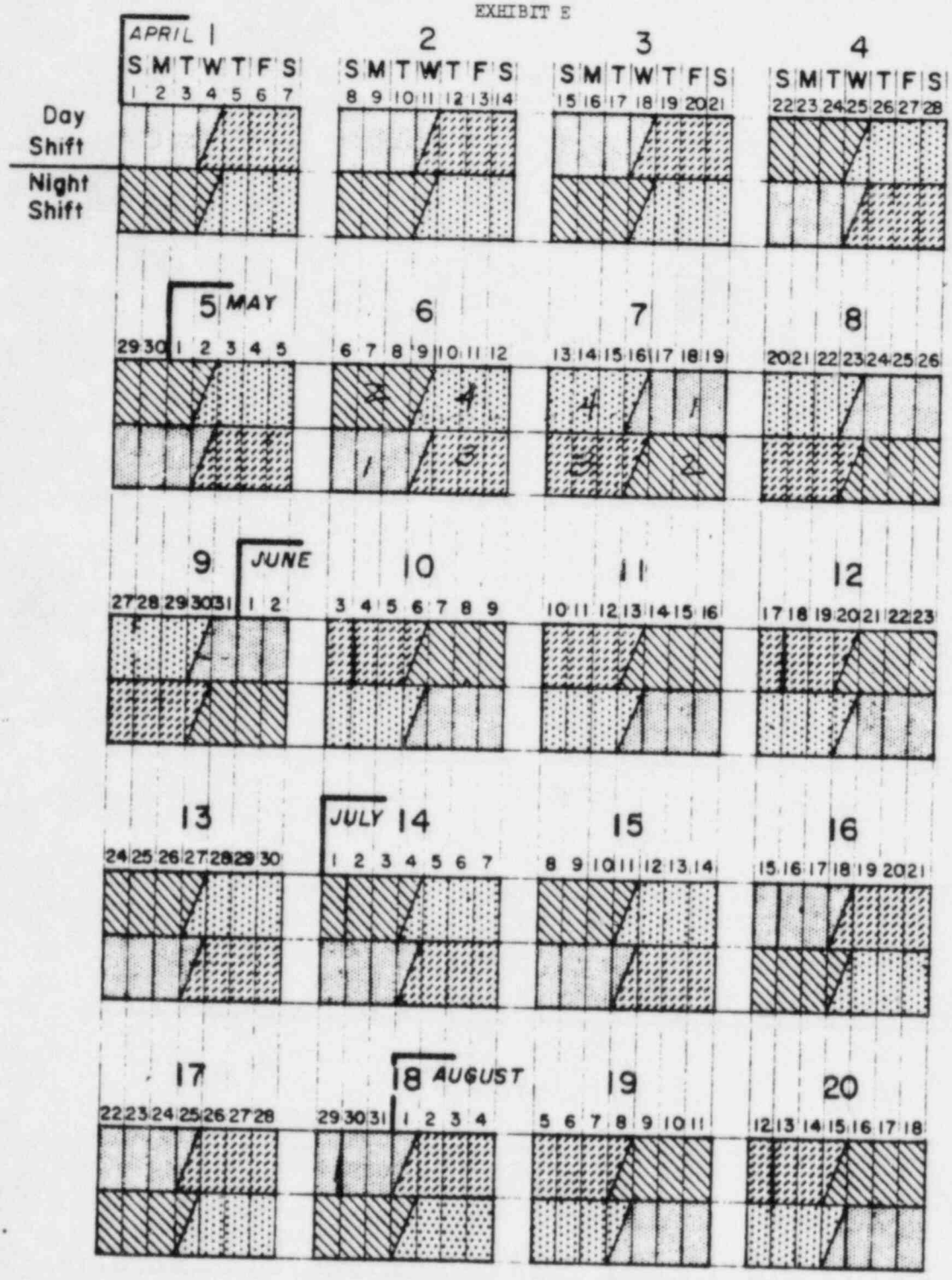
AREA	BUILDING	NUMBER SURVEYS	SIZE	GAS	AVG	MPC x/ml x 10^{-11}	RMPC
Grizzly	Primary	1	[illegible]	[illegible]	[illegible]	2.5	.07
Feeder Floor		4	[illegible]	[illegible]	[illegible]	2.5	.08
Crusher Floor		3	[illegible]	[illegible]	[illegible]	2.5	.17
Pit		3	[illegible]	[illegible]	[illegible]	2.5	.35
Screen Floor	Secondary	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.05
Inspection Floor		4	[illegible]	[illegible]	[illegible]	2.5	.04
Ground Floor		4	[illegible]	[illegible]	[illegible]	2.5	.08
Tripper Floor	Fine Ore	[illegible]	[illegible]	[illegible]	[illegible]	2.5	.03
Sample Prep		3	[illegible]	[illegible]	[illegible]	2.4	<.01
Feeder Floor		[illegible]	[illegible]	[illegible]	[illegible]	2.4	.03
Grind	Mill	5	[illegible]	[illegible]	[illegible]	5.7	.04
Leach		[illegible]	[illegible]	[illegible]	[illegible]	5.7	.02
Precipitation	(Mezzanine)	5	[illegible]	[illegible]	[illegible]	5.7	.11
Precipitation	(Main Floor)	5	[illegible]	[illegible]	[illegible]	5.7	.07
Packaging Room		4	[illegible]	[illegible]	[illegible]	5.7	1.40
Drying Room		5	[illegible]	[illegible]	[illegible]	5.7	.30
CCD Mill		4	[illegible]	[illegible]	[illegible]	5.7	<.01
CCD Tunnel		3	[illegible]	[illegible]	[illegible]	5.7	.08
Tails Pump House		3	[illegible]	[illegible]	[illegible]	5.7	<.01
SX Lab		4	[illegible]	[illegible]	[illegible]	5.7	<.01
SX Deck		[illegible]	[illegible]	[illegible]	[illegible]	5.7	<.01
Shift Office		5	[illegible]	[illegible]	[illegible]	5.7	.09
Change Room		5	[illegible]	[illegible]	[illegible]	5.7	.05
Supt. Office		5	[illegible]	[illegible]	[illegible]	5.7	.29
Met. Office		3	[illegible]	[illegible]	[illegible]	5.7	.0[illegible]
Met. Lab		[illegible]	[illegible]	[illegible]	[illegible]	5.7	[illegible]
Cafeteria		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.01

EXHIBIT D

MILL OPERATING SHIFT SCHEDULE

APRIL 1, 1962 to AUGUST 18, 1962

EXHIBIT E



No. 1 SHIFT CREW

No. 2 SHIFT CREW

No. 3 SHIFT CREW

No. 4 SHIFT CREW

- 3 Week Night - Day Rotation -
- 6 Week Front - Back Rotation -
- 24 Week Complete Cycle -

DAY SHIFT HOURS	NIGHT SHIFT HOURS
7:00 A.M. to 7:00 P.M.	7:00 P.M. to 7:00 A.M.
WED. HOURS - 7:00 A.M. to 1:00 P.M.	7:00 P.M. to 1:00 A.M.
1:00 P.M. to 7:00 P.M.	1:00 A.M. to 7:00 A.M.

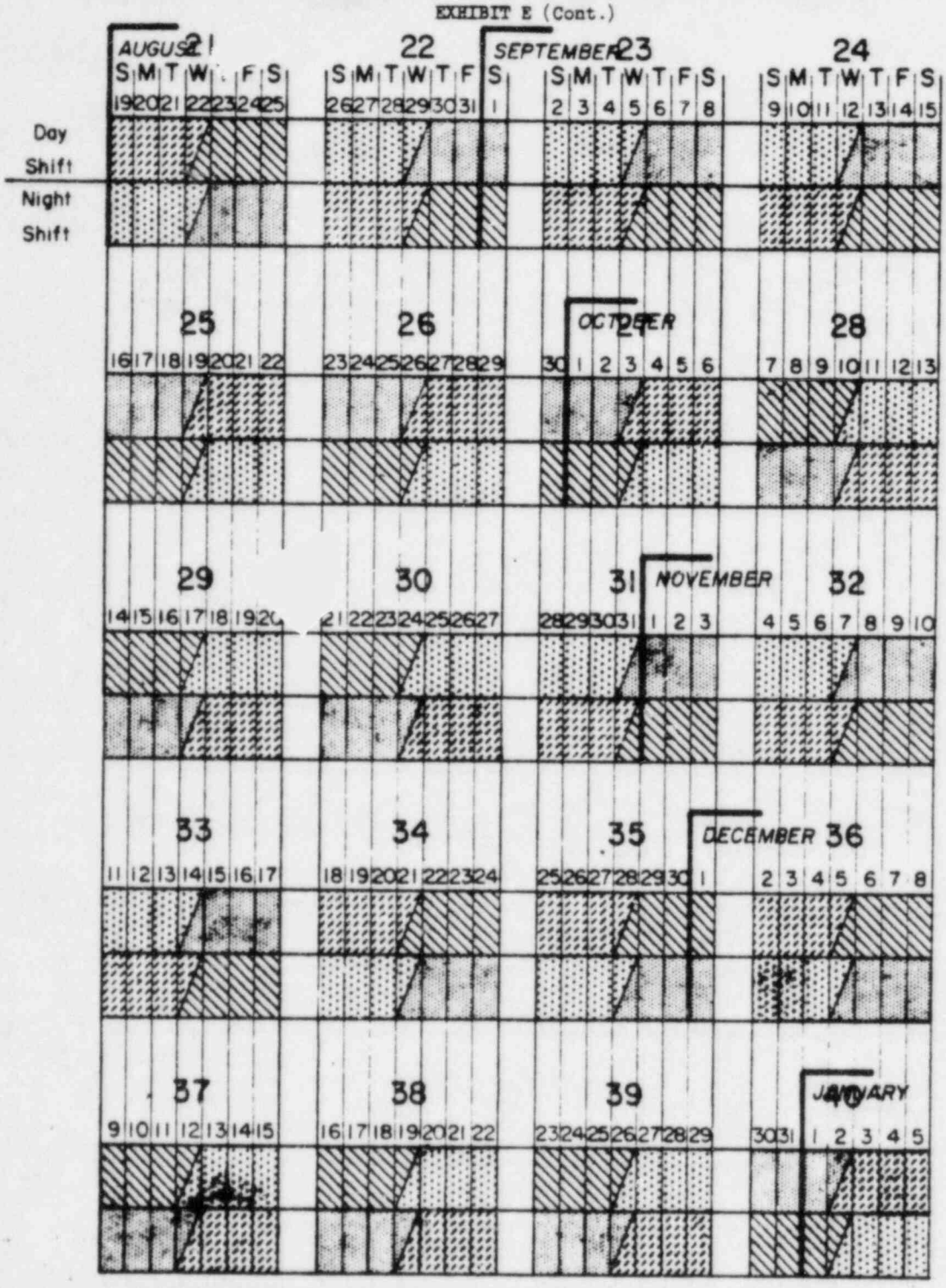
No. 112

Pe..otomics Company

MILL OPERATING SHIFT SCHEDULE

AUGUST 19, 1962 to JANUARY 5, 1963

EXHIBIT E (Cont.)



No. 1 SHIFT CREW
No. 2 SHIFT CREW
No. 3 SHIFT CREW
No. 4 SHIFT CREW

– 3 Week Night - Day Rotation –
– 6 Week Front - Back Rotation –
– 24 Week Complete Cycle –

	DAY SHIFT HOURS	NIGHT SHIFT HOURS
	7:00 A.M. to 7:00 P.M.	7:00 P.M. to 7:00 A.M.
Wed. Hours	7:00 A.M. to 1:00 P.M.	7:00 P.M. to 1:00 A.M.
	1:00 P.M. to 7:00 P.M.	1:00 A.M. to 7:00 A.M.

PETROTOMICS COMPANY

JOB EXPOSURE EVALUATION

Survey Period 2nd Qtr. July-Aug. '62

BUILDING Mill Building PROCESS AREA Final Product Packaging

OPERATOR Packaging 1 men/shift 1 shift/day 1 men/day

Operation or Operating Area	Time Per Oper.	Oper. Per Shift	Time Per Shift (T)	Sample No.	Concentration uc/ml x 10^{-11} High	Low	Avg. (C)	TXC
Packaging Room			360		13.54	.09	8.00	2880.00
Drying Room			160		25.46	.19	6.84	410.40
Precip Area			150		1.25	.03	.61	91.50
Reagent Mix*			120		1.02	Nil	.37	44.40
Shift Office			20		2.01	.06	.49	9.80
Change Room			10		3.85	.01	.29	2.90

Σ (T) 720 Σ (TXC) 3439.00

$\frac{\Sigma (TxC)}{\Sigma(T)}$ = 4.78 uc/ml x 10^{-11} = .84 MPC

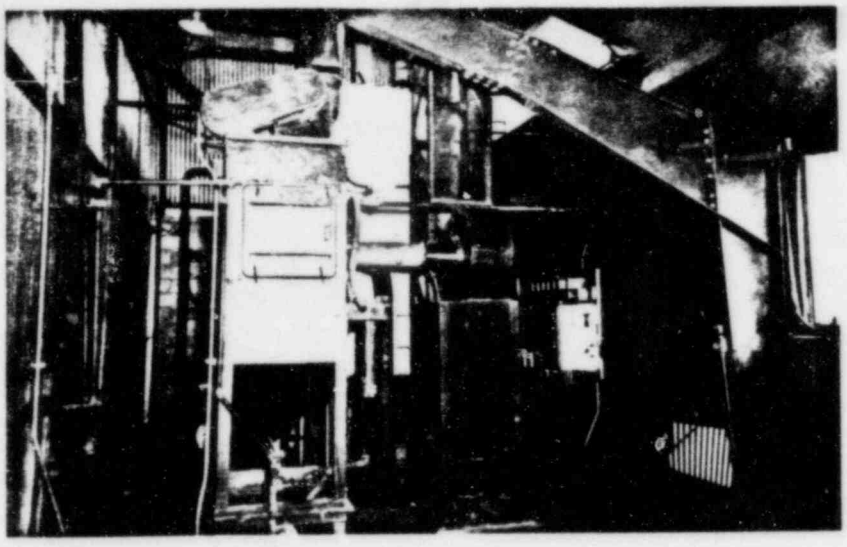
*No samples collected in Reagent Mixing area; assume average concentration to be same as other open areas of mill floor nearby

MPC = 5.7×10^{-11} uc/ml (48 hr/wk)

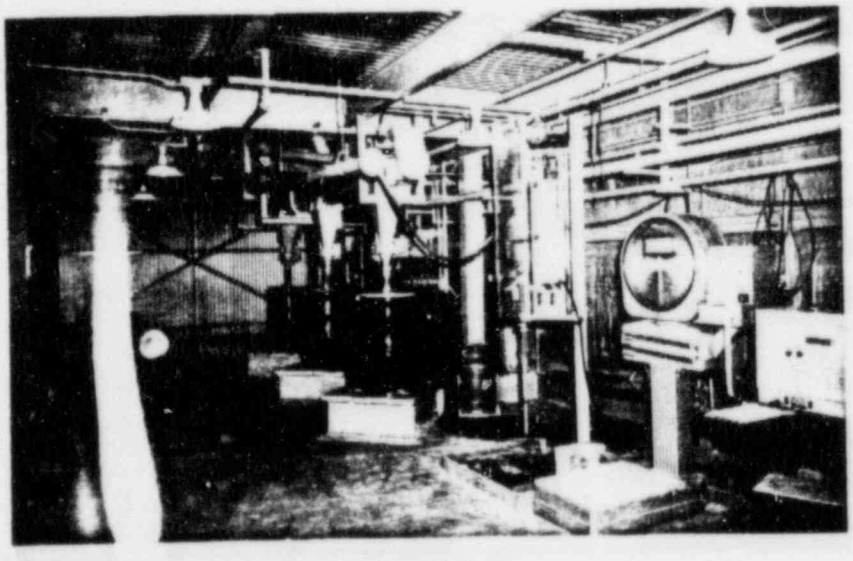
EXHIBIT P

40-6457

RECEIVED SEP 17 1962 USC

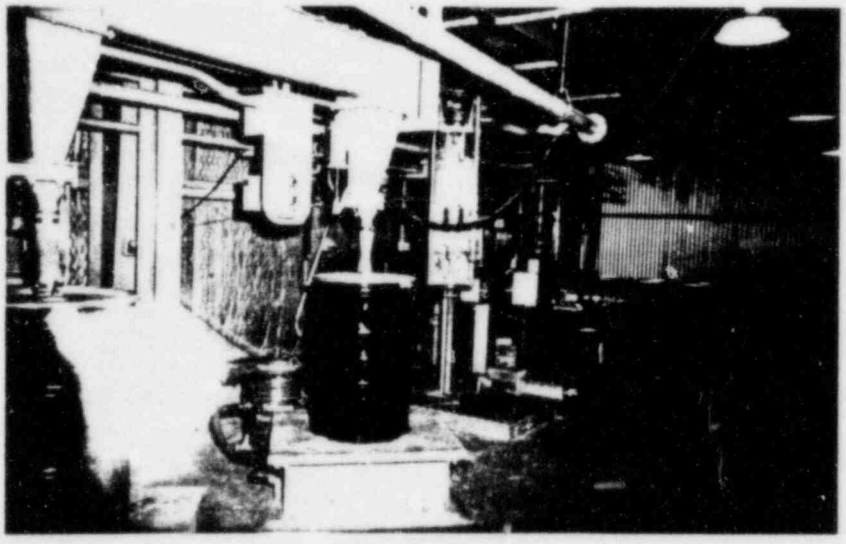


Yellow cake drying enclosure. Note the dust collection equipment in the foreground and the Skinner Roaster in the background



Yellow cake barreling enclosure.

EXHIBIT H



a. Yellow cake barreling mechanism. Note that the process is closed. The mechanism automatically shuts off when the barrel is full.

b. Yellow cake barrel sampling auger. Note the plexiglass enclosure.

c. Negative pressure line which is attached to plexiglass enclosure during barrel sampling.