PDR 40-8746

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U. S. Nuclear Regulatory Commission
NMSS
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APPLICATION FOR RADIOACTIVE

MATERIALS LICENSE

(RENEWAL)

WN-1043-1

POOR ORIGINAL

DAWN MINING COMPANY

31 JULY 1979

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Washington State Department of Social and Health Services
DIVISION OF HEALTH

APPLICATION FOR RADIOACTIVE MATERIAL LICENSE

INSTRUCTIONS—Complete Items 1 through 16 if this is an initial application. If application is for renewal of a license, complete only Items 1 through 7 and indicate new information or changes in the program as requested in Items 8 through 15. Use supplemental sheets where necessary. Item 16 must be completed on all applications. Mail one copy to: Washington State Department of Social and Health Services, Division of Health, Radiation Control Section, P. O. Box 709, Olympia, Washington 98501. Upon approval of this application, the applicant will receive a State of Washington Radioactive Material License issued in accordance with the general requirements contained in Washington State Department of Social and Health Services, Division of Health, Radiation Control Regulations and the Washington Nuclear Energy and Radiation Control Act, Chapter 70.98 RCW.

☐ NEW APPLICATION ☐ AMENDMENT TO LICENSE XX RENEWAL

1. (a) NAME AND STREET ADDRESS OF APPLICANT. (Institution, firm, hospital, person, etc.)

Dawn Mining Co., Office of Secretary
300 Park Avenue
New York, N.Y. 10022

(b) STREET ADDRESS(ES) AT WHICH RADIOACTIVE MATERIAL WILL BE USED. (If different from 1 (a).)

Dawn Mining Company, Mine & Mill
P.O. Box 25
Ford, WA. 99013

2. DEPARTMENT TO USE RADIOACTIVE MATERIAL.

Same as 1 (b)

3. PREVIOUS LICENSE NUMBER(S). (If this is an application for renewal of a license, please indicate and give number.)

AEC License R187
WN 1043-1
WN 1043-2

4. INDIVIDUAL USER(S). (Name and title of individual(s) who will use or directly supervise use of radioactive materials. Give training and experience in Items 8 and 9.)

See Attachment No. 1

5. RADIATION PROTECTION OFFICER (Name of person designated as radiation protection officer if other than individual user. Attach resume of his training and experience as in Items 8 and 9).

See Attachment No. 1

6. (a) RADIOACTIVE MATERIAL. (Elements and mass number of each.)

(A) Natural Uranium plus Daughters

(B) ^{90}SR-Y

(b) CHEMICAL AND/OR PHYSICAL FORM AND MAXIMUM QUANTITY OF EACH CHEMICAL AND/OR PHYSICAL FORM THAT YOU WILL POSSESS AT ANY ONE TIME. (If sealed source(s), also state name of manufacturer, model number, number of sources and maximum activity per source.)

(A) A throughput of approximately 500 tons per day of uranium ore. Uranium oxide, uranium sulfate, uranium nitrate and Uranium Diurnate as solutions and solids, about 3,000 pounds per day. Decay products of uranium 238 in ore residues.

(B) ^{90}SR-Y Sealed Source
Manufacturer - Tracer Lab
Model No. - Fabricated as per Attachment No. 6
No. of Sources - 1
Maximum activity per sources - 350 mCi

7. DESCRIBE PURPOSE FOR WHICH RADIOACTIVE MATERIAL WILL BE USED. (If radioactive material is for "human use," Supplement A (Form RHF-2) must be completed in lieu of this item. If radioactive material is in the form of sealed sources, include the make and model number of the storage container and/or device in which the source will be stored and/or used.) Attach extra sheets if necessary.

(A) This application for License renewal is requested to cover all work connected with the processing of natural uranium ore and the extraction and concentration of natural uranium salts in the form of $(NH_4)_2 U_3O_7$ (Yellowcake).

(B) The ^{90}SR-Y source is used as a secondary calibration for all survey and dose rate instruments.

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DSHS 9-148 (2-73)
HE A-60
RHF-1

TRAINING AND EXPERIENCE OF EACH INDIVIDUAL NAMED IN ITEM 4 (Use supplemental sheets if necessary).

8. TYPE OF TRAINING	WHERE TRAINED	DURATION OF TRAINING	ON THE JOB (Circle answer)	FORMAL COURSE (Circle answer)
a. Principles and practices of radiation protection			Yes No	Yes No
b. Radioactivity measurement standardization and monitoring techniques and instruments	See Attachment No. 1		Yes No	Yes No
c. Mathematics and calculations basic to the use and measurement of radioactivity			Yes No	Yes No
d. Biological effects of radiation			Yes No	Yes No

9. EXPERIENCE WITH RADIATION (Actual use of radioisotopes or equivalent experience).

ISOTOPE	MAXIMUM AMOUNT	WHERE EXPERIENCE WAS GAINED	DURATION OF EXPERIENCE	TYPE OF USE
		See Attachment No. 1		

10. RADIATION DETECTION INSTRUMENTS (Use supplemental sheets if necessary).

TYPE OF INSTRUMENTS (Include make and model number of each)	NUMBER AVAILABLE	RADIATION DETECTED	SENSITIVITY RANGE (mr/hr)	WINDOW THICKNESS (mg/cm²)	USE (Monitoring, Surveying, Measuring)
See Attachment No. 2					

11. METHOD, FREQUENCY, AND STANDARDS USED IN CALIBRATING INSTRUMENTS LISTED ABOVE.
See Attachment No. 2

12. FILM BADGES, DOSIMETERS, AND BIO-ASSAY PROCEDURES USED (For film badges, specify method of calibrating and processing, or name of supplier).
See Attachment No. 4

INFORMATION TO BE SUBMITTED ON ADDITIONAL SHEETS

13. FACILITIES AND EQUIPMENT. Describe laboratory facilities and remote handling equipment, storage containers, shielding, fume hoods, etc. Explanatory sketch of facility is attached (Circle answer). Yes No
See Attachment NO. 3

14. RADIATION PROTECTION PROGRAM. Describe the radiation protection program including control measures. If application covers sealed sources, submit leak testing procedures where applicable, name, training, and experience of person to perform leak tests and arrangements for performing initial radiation survey, servicing, maintenance and repair of the source.
See Attachment No. 4

15. WASTE DISPOSAL. If a commercial waste disposal service is employed, specify name of company. Otherwise, submit detailed description of methods which will be used for disposing of radioactive wastes and estimates of the type and amount of activity involved.
See Attachment No. 5

CERTIFICATE
(This item must be completed by applicant)

16. THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATE ON BEHALF OF THE APPLICANT NAMED IN ITEM 1, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH WASHINGTON STATE DEPARTMENT OF SOCIAL AND HEALTH SERVICES, DIVISION OF HEALTH, RADIATION CONTROL REGULATIONS AND THAT ALL INFORMATION CONTAINED HEREIN, INCLUDING ANY SUPPLEMENTS ATTACHED HERETO, IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF.

DAWN MINING COMPANY
Applicant named in Item 1

Date 27 July 1979

By: Jack E. Thompson
Res. Manager
Title of certifying official authorized to act on behalf of the applicant

DSHS 9-148 (2-73)
HEA-60
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ATTACHMENT No. 1

DAWN MIMING COMPANY

ATTACHMENT NO. 1

Application for radioactive materials license   Items no's 4,5,8,9

As the total mill facilities include natural uranium in either the solid or liquid state, the handling of radioactive materials is handled by the operations and technical staff. The resident manager is ultimately responsible for all aspects of the operation. The radiation protection officer has been delegated the responsibility for radiological and occupational safety.

The attached orginazition chart (attachment 1.1), job descriptions and experience records outline the responsible positions and individuals which are involved in controlling possible radiation hazards.

The job descriptions and experience records cover the following positions:

Resident Manager

Mill Superintendent

Mine Superintendent

Safety Supervisor (Radiation Protection Officer)

Chief Chemist

Mill Foreman

Maintenance Superintendent

In addition Mr. E.M. Craig, past resident manager at Dawn, has been retained as a consultant. His experience record is also included.

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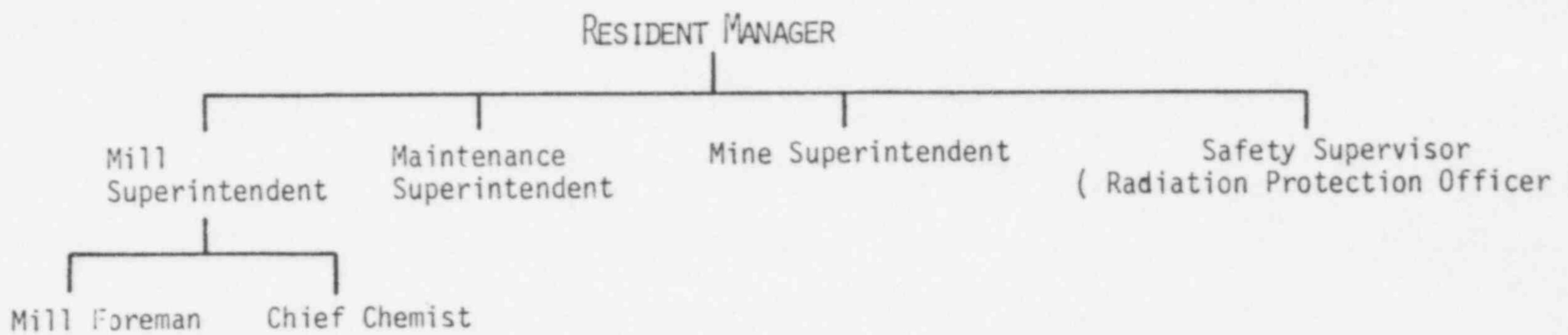
DAWN MINING COMPANY
ORIGANIZATION CHART



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ATTACHMENT 1 CON'T.

JOB DESCRIPTION

Position Title: Resident Manager

Reports to: Vice President - Operations

Newmont Mining Corp.

300 Park Ave.

New York, N.Y. 10022

Positions under direct supervision:

Mill Superintendent

Mine Superintendent

Chief Geologist

Chief Accountant

Chief Chemist

Maintenance Superintendert

Safety Supervisor (Radiation Protection Officer)

Job Summary:

Responsible for the mining and milling of uranium, and all related facilities and activities associated with the Dawn operation.

ATTACHMENT 1. CON'T.

JOB DESCRIPTION

Position Title: Safety Supervisor (Radiation Protection Officer)

Reports To: Resident Manager

Positions under direct supervision: None

Job Summary:

Is responsible for the development and implementation of all safety programs, including emergency procedures. Supervises or personally inspects facilities to verify compliance with all applicable requirements in the areas of radiological health and safety as well as industrial health and safety. Works closely with all supervisory personnel to assure that established programs are maintained. Responsible for the orderly collection and the interpretation of all monitoring data; to include data from industrial safety, radiological safety, and environmental monitoring programs. Recommends measures, as necessary, to improve any and all safety related controls.

JOB DESCRIPTION

Position Title: Chief Chemist

Reports to: Mill Superintendent

Positions under direct supervision: Assigned personnel

Job Summary:

Directly responsible for operation of the analytical laboratory.

ATTACHMENT 1 Con't.

JOB DESCRIPTION

Position Title: Mill Superintendent

Reports To: Resident Manager

Positions under direct supervision:

Mill Foreman

Chief Chemist

Job Summary:

Plans and coordinates activities of personnel engaged in processing of uranium. Has full responsibility for the overall operation of the mill and the analytical laboratory.

JOB DESCRIPTION

Position Title: Mine Superintendent

Reports To: Resident Manager

Positions under direct supervision:

All Mine Personnel

Mine Contractors

Job Summary:

Plans and coordinates activities of personnel and contractors engaged in mining uranium ores. Has full responsibility for the overall operation of the mine.

ATTACHMENT 1 CON'T.

JOB DESCRIPTION

Position Title: Mill Foreman

Reports To: Mill Superintendent

Positions under direct supervision: Hourly personnel

Operating Mill

Job Summary: Responsible for shift operations of mill.

JOB DESCRIPTION

Position Title: Maintenance Superintendent

Reports To: Resident Manager

Positions under direct supervision: All maintenance personnel.

Job Summary: Responsible for the maintenance of all equipment required for mine and mill operation.

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ATTACHMENT 1 CON'T.

EXPERIENCE RECORD

Jack E. Thompson - Resident Manager

Resident Manager - Dawn Mining Company - 7 months

Production Manager - Dawn Mining Company - 5 months

General Superintendent - Newmont Mines LTD.
Granduc Operating Div. - 1-1/2 years

Director Safety & Training - Newmont Mines LTD
Granduc Operating Div. - 1 year

Chief Engineer - Newmont Mines LTD
Granduc Operating Div. - 6 months

Variety of job assigments @ Magma Copper Company

Summarized as follows:

Engineering - 1 year
Management - 2 years
Administration - 1 year

- B.S. Mining Engineering
  Univesity of Arizona 1971
- Short Course - "Extractive Metallurgy of Uranium"
  Toronto, Canada 1978
- Professional Engineer - Accociation Prof. Engineer B.C.
  1976 - Present #10930
- Member S.M.E., A.I.M.E., C.I.M., Northwest Mining
  Association, Arizona Small Mine Operators Association
- B. C. Dept. Mines Shift Boss Certification #874
- B. C. Dept. Mines Mine Rescue Certificate #5673
- St. Johns Ambulance First Aid Certificate #39505
- A.M.A. Supervisory Management Course - 1973
- Red Cross Standard Multimedia First Aid Course - 1974
- M.C.C. Supervisor's Explosives Course - 1975
- M.S.H.A. Course in First Aid #75-1230833

  Self Rescuer #75-1504947

  Mine Emergency Training #75-1504797

  Mine Rescue #1537295

  Dynamics Safety Management #74-0610959

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ATTACHMENT 1 CON'T.

EXPERIENCE RECORD

Walter Lawrence - Mill Superintendent

Mill Superintendent: Dawn Mining Co., 1 year

Assistant Mill Superintendent: Idarado Mining Co., 1 year

Mill Department Foreman: Magma Copper Co., 2 years

Metallurgical Tech. & Mill Operator: Anaconda Copper Co., 10 years

Uranium Tailings Management Course 1978

Industrial First Aid Course

B.S. Mineral Processing Engineer
Montana School of Mines 1976

EXPERIENCE RECORD

Robert Nelson - Radiation Protection Officer

Radiation Protection Officer: Dawn Mining Co., 5 years

Assistant Rad. Protection Officer Dawn Mining Co., 2 years

Lab Technician: Dawn Mining Co., 2 years

Warehouseman: Dawn Mining Co. 1 year

"Radiation Monitoring and Control"
Short Course, Denver Technical Support
Center, 1977

Bio Assay Seminar
N.R.C., 1978

Industrial First Aid Course

Radiation Protection & Environmental
Surveilance Course,
Eberline Instrument Company, 1979

Industrial Respiratory Protection Semminar
Los Alamos Scientific Laboratories, 1979

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ATTACHMENT 1 CON'T.

EXPERIENCE RECORD

Wesley Strong - Chemist

Chemist: Dawn Mining Co., 1 year

Lab Technician: Dawn Mining Co., 7 years

Spokane Falls Comm. College - Organic & Inorg. Chemistry - 5 quarters

Industrial First Aid Course

EXPERIENCE RECORD

Lyle Strong - Maintenance Supertinendent

Maintenance Superintendent: Dawn Mining Co., 11 years

Industrial First Aid Course

EXPERIENCE RECORD

Jack Smith - Mill Foreman

Mill Foreman: Dawn Mining Co., 10 years

Mill Shift Foreman: Carlin Gold Co., 4 years

Metallurgical Clerk & Warehouseman: Dawn Mining Co., 3 years

Industrial First Aid Course

ATTACHMENT 1 CON'T.

EXPERIENCE RECORD

Raymond Addington - Mill Foreman

Mill Foreman: Dawn Mining Co., 10 years

Repairman: Dawn Mining Co., 1 year

Mill Operator: Dawn Mining Co., 8 years

Industrial First Aid Course

EXPERIENCE RECORD

George Kurtzbein - Mill Foreman

Mill Foreman: Dawn Mining Co., 10 years

Mill Shift Foreman: Carlin Gold Co., 3 years

Mill Shift Foreman: Montana Phosphate Co., 1 year

Mill Operator: Dawn Mining Co., 8 years

Mill Operator: American Smelting & Refining , 6 years

Industrial First Aid Course

EXPERIENCE RECORD

Joseph Hentges - Mill Foreman

Mill Foreman: Dawn Mining Co., 9 years

Mill Operator: Dawn Mining Co., 8 years

EXPERIENCE RECORD

Donald Shultz - Mine Superintendent

Mine Superintendent: Dawn Mining Co., 4 years

Mine Foreman: Dawn Mining Co., 2 years

Surveyor: Dawn Mining Co., 5 years

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ATTACHMENT 1 CON'T.

EXPERIENCE RECORD

E. M. Craig - Consultant

A graduate of the Colorado School of Mines with a degree in Metallurgical Engineering, Mr. Craig has had a long and varied career in mining and milling ores of gold, silver, flourspar, phyrhttite, uranium, vanadium and tungsten. His experience in uranium extends over 16 years having worked at a mill in Grand Junction, Colorado and at Dawn, Mr. Craig received 14 weeks of formal instruction in Radiation Protection at Grand Junction, Colorado. His training included all of the items listed in Section 8 of the License Application.

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ATTACHMENT No. 2

ATTACHMENT 2.

Application for Radioactive Materials License. Item #10.

The following instruments are routinely used in the Dawn Mining Company Radiation Safety Program:

Type of Instrument	Radiation Detected	Sensitivity	Window Thickness	Use
Victoreen Ionization Chamber Survey Instrument, Victoreen Model 74 - Cutie Pie.	Beta Gamma	0-25 R/hr in four ranges	Alpha Shield 7.0 mg/cm^2 Beta Shield 400 mg/cm^2	Monitoring and measuring
Alpha Survey Scintillation Meter. Eberline Instrument Corp. Model PAC-4S.	Alpha	2,000,000 cpm in two ranges	1.5 mg/cm^2	Detecting and Surveying
Geiger Mueller Survey Instrument. Eberline Instrument Corp. Model E-120	Beta Gamma Alpha	0-50 mR.hr in three ranges 0-7000 cpm	30 mg/cm^2 1.4 - 2.4 mg/cm^2	Detecting and Surveying
Gas Proportional Scaler/Timer. Baird Atomic Model 135.	Alpha	Counting rates as high as 10^6 dpm	1.5 mg/cm^2	Measurement
Scaler/Timer. Eberline MS3 Scaler with SAC-R5 Scintillation Detector.	Alpha (Rn)	Counting rates as high as 10^6 dpm		Measurement

Method, Frequency and Standards Used in Calibrating Instruments

Instrument Calibration and Repair services are obtained from Battelle Northwest, through United States Testing Company, 2800 George Washington Way, Richland, Washington. Portable instruments will be calibrated annually at the Hanford Plant Calibration Facility, using NBS calibrated secondary standards.

Calibration of the Baird Atomic, Model 135 Scaler and the Eberline, Model MS3 Scaler will be done semi-annually, on site, by the Mining Safety and Health Administration's, Denver Technical Support Center personnel.

The Sr^{90}-y source referenced in Attachment 2.1, will be used to check the beta-gamma instruments prior to each use. The source, which contains 1/3 MCi Sr^{90}-y, is mounted in a lucite fan as shown.

Alpha calibration sources will be used to check the alpha survey instruments prior to use.

Calibration checks on the Baird Atomic Scaler and the Eberline Scaler will be performed before each use using a 9,400 cpm Thorium Alpha Source, #10310.

Note:

The conversion formula used to convert counts per minute to micro-curies for a given sample analysed by using the Baird Atomic Gas Proportional Scaler/Timer is as follows:

$$\text{micro-curies} = \frac{(\text{counts per minute})\ (\text{machine efficiency factor})^{*}}{(2.22 \times 10^{6}\text{dpm})\ (\text{sample volume in ML})}$$

*machine efficiency factor determined by the M.S.H.A. Denver Technical Support Center presently (4.4)

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ATTACHMENT 2.

Application for Radioactive Materials License. Item #11

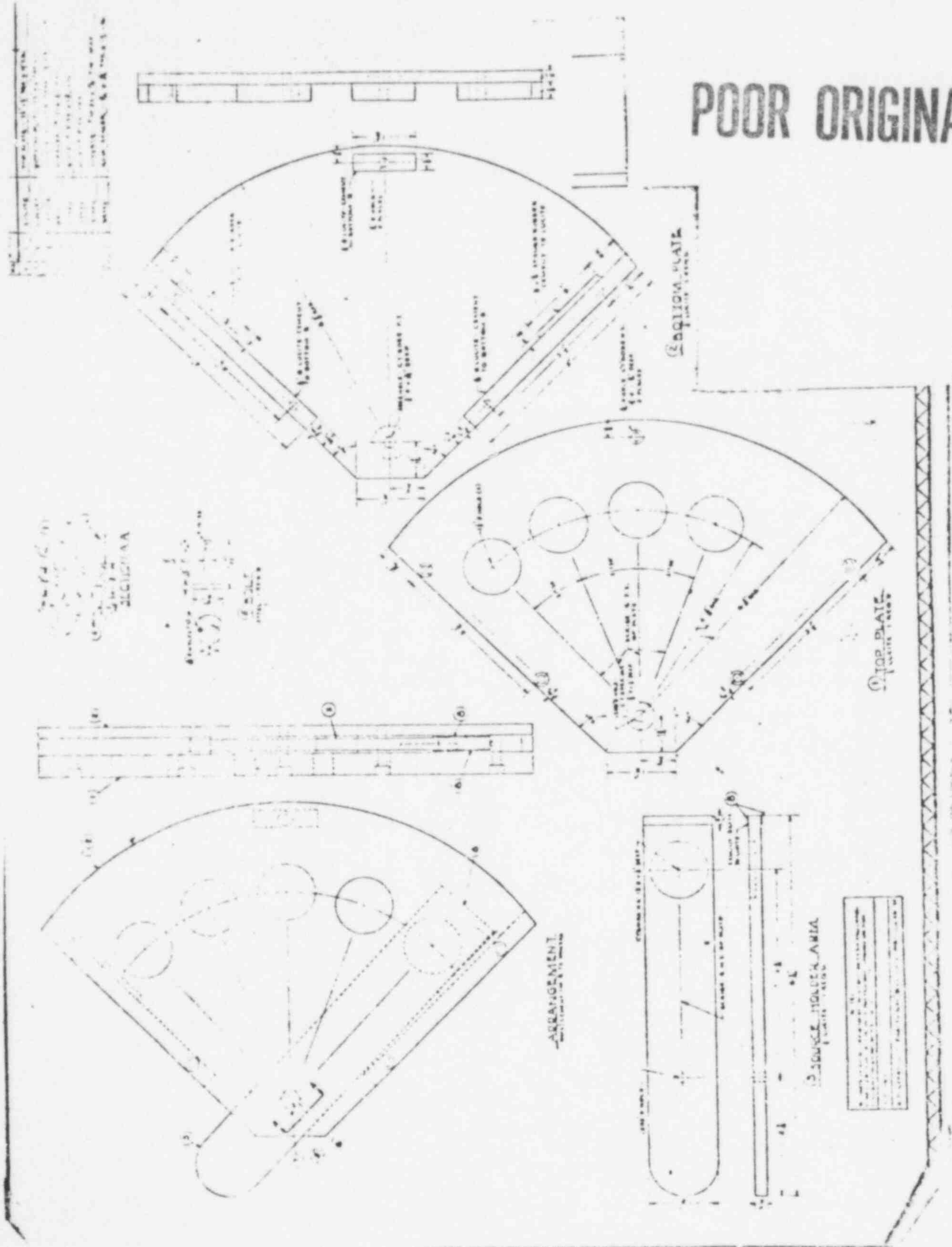
Method, Frequency and Standards Used in Calibrating Instruments.

Instrument Calibration and Repair services are obtained from Battelle Northwest, through United States Testing Company, 2800 George Washington Way, Richland, Washington. Portable instruments will be calibrated annually at the Hanford Plant Calibration Facility, using NBS calibrated secondary standards. Calibration of the Baird Atomic, Model 135 Scaler and the Eberline, Model MS3 Scaler will be done semi-annually, on site, by the Mining Safety and Health Administration's, Denver Technical Support Center personnel. The Sr^{90}-y source referenced in Attachment 2.1, will be used to check the beta-gamma instruments prior to each use. The source, which contains 1/3 mCi Sr^{90}-y, is mounted in a lucite fan as shown.

Alpha calibration sources will be used to check the alpha survey instruments prior to use.

Calibration checks on the Baird Atomic Scaler and the Eberline Scaler will be performed before each use using a 9,400 cpm Thorium Alpha Source, #10310.

ATTACHMENT 2.1



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ATTACHMENT No. 3

FACILITIES AND EQUIPMENT

A. Mill Building

Construction

The mill walls are constructed of plywood with galvanized steel sheet covering on the outside. The roof is composed of wood with built-up composition covering on top. The floor is concrete, covered with acid resistant cement and tar material where necessary.

Ventilation Equipment

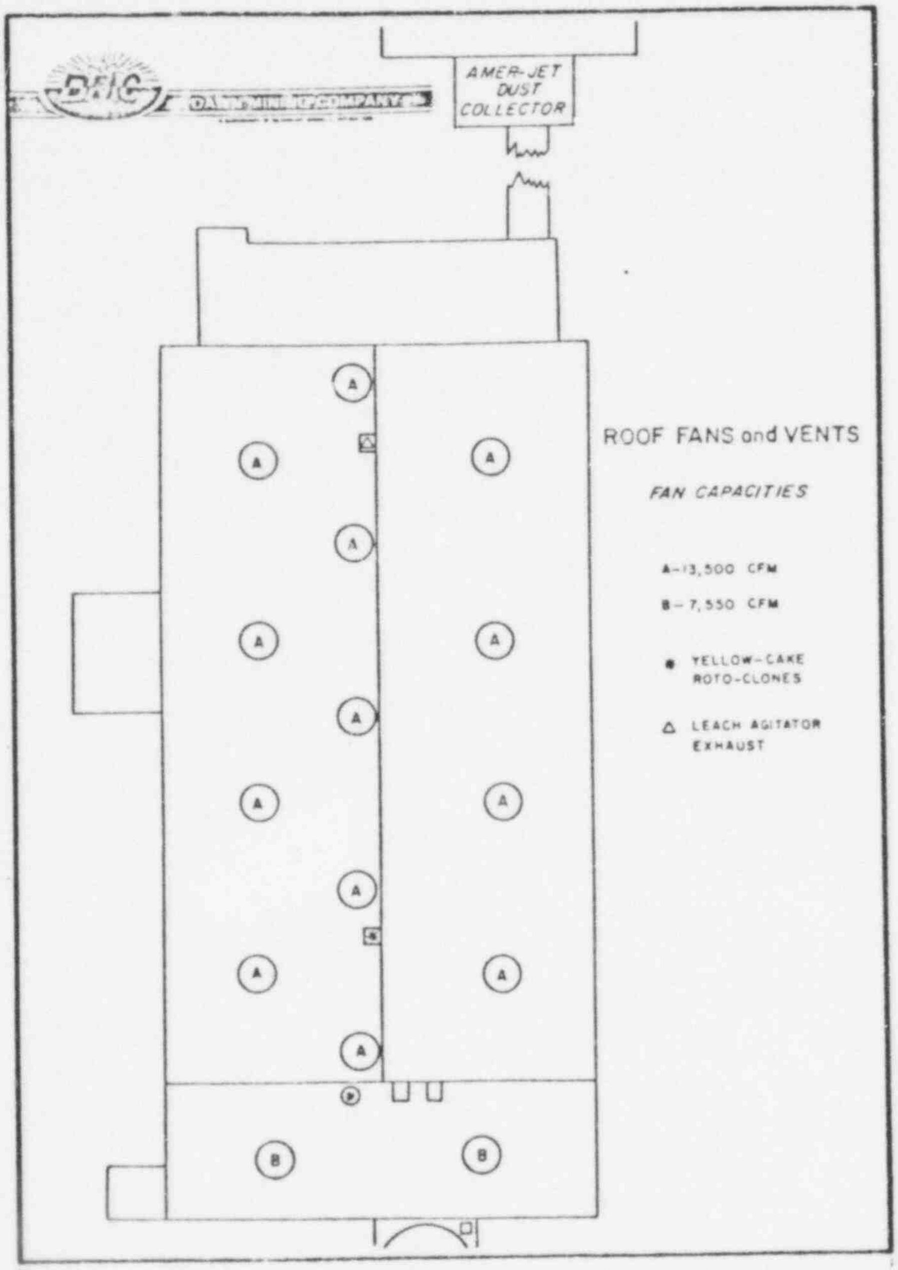
Ventilation is provided for the mill by means of 15 power roof ventilators shown in Attachment 3.1. Thirteen of the ventilators are rated at 13,550 cfm at 1/8" water column total resistance pressure and two are rated at 7,650 cfm at the same resistance pressure. With all of the ventilators in operation there should be a complete air change every 10 minutes.

A special leach agitator exhaust is provided to exhaust moisture from the leach agitation tanks and a special exhaust is provided from the yellow cake drier Roto-Clone.

Process Sumps

Leakage from wooden process tanks is caught in process sumps and returned to the process.

ATTACHMENT 3.1



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ATTACHMENT NO. 3 CON'T.

B. Crusher Building

Construction

The crusher building walls and roof are constructed of galvanized steel sheets covering on the outside. The floor is concrete with steel grating floors utilized for intermediate levels.

Ventilation Equipment

Ventilation is accomplished by exhausting the crusher building using an Amer-Jet dust collector rated at 12,511 cfm. At this rate there should be a complete air change every two minutes. The Amer-Jet exhausts eight specific sections of the building. The dust is caught in a filter bag and returned to the process. This unit is being replaced by a larger Fabripulse unit with approximately twice the bag surface area. This will allow a doubling of pick-up points and increase the ventilation volume of air to 18,000 cfm. Completion of this project is scheduled for late summer.

C. Mill Process (See Attachment 3.2)

Ore, which contains 2 to 6 pounds of U_3O_8 per ton is moved from the stock pile to the crusher. Here it is crushed to minus 2" by a primary jaw crusher and to 1/2 to 5/8" by a Cedar Rapids impact breaker or a Symons Cone Crusher.

Ore is moved by a belt and stored in five round steel bins, capacity 350 tons each. Ore is taken from the bins by belt and fed with water to a Marcy 75 Ball Mill followed by a 5' x 4' Marcy Ball Mill in closed circuit with a wet cyclone classifier. The ground ore then is leached with H_2SO_4 solution, in two stages. The first stage leaching is accomlished in three Devereaux type agitators which receives the cyclone overflow pulp and the #2 thickener overflow solution and discharges to the #1 thickener.

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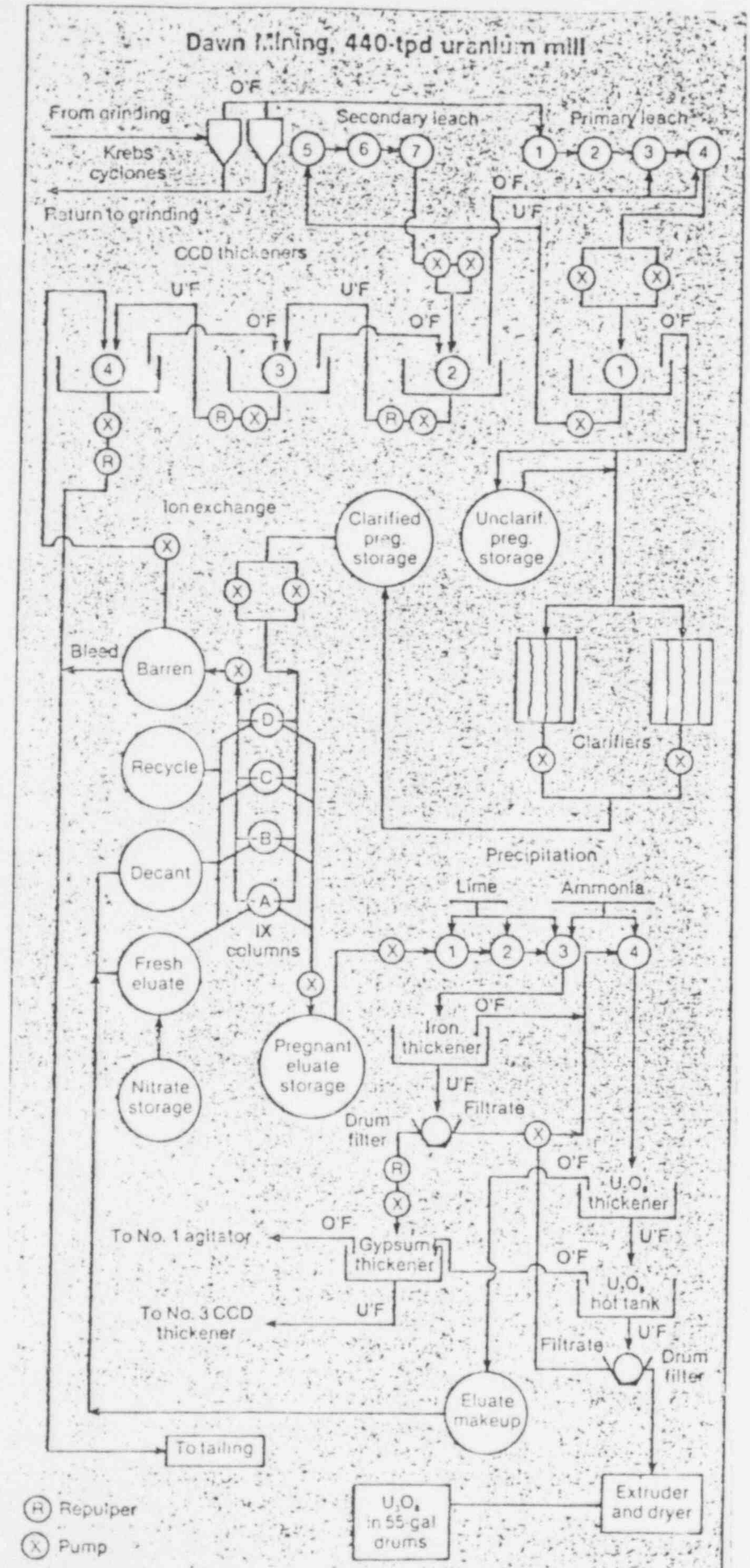
ATTACHMENT 3.2

POOR ORIGINAL



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The second stage is completed in three identical agitators which receive pulp from #1 thickener underflow and concentrated sulfuric acid and discharge to one agitator for pH control. This agitator discharges to the #2 thickener. After leaching, the pulp passes through three thickeners in the counter current decantation step to the tailings agitator where the thick pulp of sand and solution is repulped before being pumped to the tailings pond. Solution from the thickener circuit passes through a filter and ion-exchange columns and into the barren liquor storage. Eighty percent of the ion-exchange barren solution is used as wash to the thickener circuit, eliminating a large volume of solution from being pumped to the tailings pond. The remaining 20% of the barren solution is pumped to the tailings agitator and impounded in the tailings pond.

The uranium ion is released from its site on the resin particle by being replaced by a nitrate ion during the elution step. Precipitation of the eluate solution is accomplished in a two-stage system. Step #1 the pH is raised to 3.5 with milk of lime and gassified ammonia, which precipitates the ferric ion. The resultant calcium sulfate and ferric hydroxide is filtered and retruned to the first stage of leaching.
Precipitation of uranium as ammonium di-uranate is completed in step #2, at a pH of 7.0 with gassified ammonia. Ninety-four percent of the barren eluate is returned to the circuit. The rest is pumped to the tailings agitator and impounded in the tailings pond.
After precipitation, the uranium is filtered on a drum filter, extruded, dried in a Proctor-Swartz drier and packaged in 55 gallon drums for shipment.

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ATTACHMENT NO. 3 CON'T.

Protective Equipment

Respiratory Protection

6 MSA full-face Clearvue filter mask No. 6, with ultra filter which is 99.98% efficient for 0.3μ particles or greater.

2 MSA Flexi-flo air line respirator with Clearvue face piece No. CS-85534.

24 MSA Custom Comfo respirator, type H, with ultra filter which is 99.98% efficient for 0.3μ particles or greater.

Air Samplers

1 Gelman Hurrican Model 16003, 180 cfm line operated.

1 Gelman similar to Model 15003, 20 l/m battery operated.

2 Gelman Model No. unknown, 30 l/m line operated.

3 Gelman Contious Sampler Model 25002, 1 cfm line operated.

1 Gelman Paper Tape Model 23000, 10 l/m line operated.

1 MSA personal air pump 4 L/m capacity.

Calibration of air flow will be accomplished using the following:

Singer American dry test meter. Model DTM200

Calibration of instruments traceable N.B.S.

Clothing

Rubber, plastic, and fabric suits, rubber boots, hard hats and cotton-lined rubber gloves for use in contaminated environments. Each worker is required to furnish coveralls for general use in plant.

Miscellaneous

2 Fume hoods in main plant laboratory.

ATTACHMENT NO. 3 CON'T.

Cleaning Protective Equipment

Coveralls furnished by the Company are stored at the plant. These are surveyed periodically and laundered daily. Normal household laundry procedures will be utilized.

Respiratory protective equipment is assigned to those operators working in areas where it is required. A respirator program has been established for the use and care of the respirators (See attachment 3.3).

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ATTACHMENT 3.3

Respiratory Protection Program

Dawn Mining Co.

Respiratory Protection Program

I. Introduction

The Respiratory Protection Program for Dawn Mining Co. is written to meet the requirements of the State of Washington Department of Social and Health Services' "Standards for Protection Against Radiation", (WAC 402-24), and the Nuclear Regulatory Guide 8.15, "Acceptable Program for Respiratory Protection". These requirements encompass those of the Occupational Safety and Health Administration Standards, 29 CFR Part 1910 and the ANSI standard Z88.2

II. Policy Statement

Dawn Mining Co.'s Respiratory Protection Program is an important part of its operations. The program is designed to minimize the inhalation of airborne radionuclides. This is primarily accomplished by the application of engineering controls. Respirators are used only for the operations where it is not feasible to prevent atmospheric contamination by such controls.

Approved by [signature]
J. F. Thompson
Resident Manager

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ATTACHMENT 3.3

III. Standard Operating Procedures

Procedures have been developed governing the selection, issue, use and maintenance of respirators. They will be followed by all employees to promote an effective respirator program. These procedures can be divided into three categories:

A. Routine operations

B. Non-routine operations

c. Emergencies

A. Routine operations

Employees performing ro ine operations in posted respirator areas are required to wear a spirator with the proper protection factor and cartridge for the particular type of hazard and concentration. These employees are trained and fitted every year with all types of respiratory protection equipment available at Dawn.

The wearer must report to the Safety Department to receive his respirator. He is qualitatively fitted with the respirator by the means of the irriant smoke test. The wearer is responsible for checking the seal before each use by means of the positive and negative pressure tests. The wearer is responsible for seeing that he wears his respirator properly at all times he is in a posted respirator area. The wearer is also responsible for seeing that his respirator is returned to the Safety Department according to the established schedule, or sooner if necessary, for cleaning and maintance. A respirator will be assigned

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ATTACHMENT 3.3

to each individual requiring one one a routine basis.

A bioassay program is in effect at Dawn which monitors the effectivness of the Respiratory Protection Program. In addition air samples are taken continuously throughout the property to monitor dust concentrations in each working place.

B. Non-routine operations

Supervisors who will have an employee perform non-routine operations, such as unusual maintenance in areas that may have high concentrations of airborne radioactive material, must report to the Safety Department prior to beginning such activities.

The Safety Department issues and fits the proper respirator to each worker. Each worker will submit a urine sample on the morning of the second day after performing the non-routine operation.

The Safety Department will take air samples during the non-routine operation and analysis will be done after each sample is taken. In conditions where the average concentration is unknown, a respirator with the highest protection factor will be issued. The non-routine operation will not be considered completed until the area is cleaned up afterwards.

C. Emergencies

Type "N" masks and a Chemox Self Contained Breathing Apparatus are available for use in emergencies such as a severe ammonia leak. Only personnel trained in the use of such equipment will be allowed to wear it. All emergency equipment must be checked at least monthly by the Safety Department and any needed maintenance done immediately. A log will be kept by the Safety Department showing when and what type of inspection was made.

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ATTACHMENT 3.3

Respiratory Protection Program

IV. Selection of Respiratory Devices

Respirators are selected on the basis of the hazards to which the worker is exposed. These hazards are evaluated by periodic surveillance of the work area by air sampling. Only respiratory protection devices approved by NIOSH/MHSA for protection against dust, fumes, mists and radionuclides are used.

V. Training and Fitting

Mill employees and their supervisors are trained by the Safety Department in the hazards associated with airborne natural uranium. This training is performed on their initial hire and yearly thereafter. The employee must demonstrate he understands such training. The employee is advised as to what may happen if the respirator is not worn.

The minimum training program consists of:

A. Discussion of airborne contaminates against which the wearer is protected.

B. Discussion of limitations, construction, and operation of the proper type of respirator for a particular purpose.

C. The discussion of engineering controls and their limitations and the necessity of using respirators. Included in this discussion is the fact that every reasonable effort is being made to eliminate the need for respirators.

D. Any other training deemed necessary by the Safety Department.

E. Each wearer receives fitting instructions, including demonstrations and practice in how to adjust and determine if the respirator fist properly.

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ATTACHMENT 3.3

V. Training and Fitting (continued)

F. Each person wearing a respirator is qualitatively fitted before the respirator is issued.

G. The wearer is instructed in performing the positive and negative pressure test. This test is performed by the wearer before each use.

H. The qualitative fitting is done by means of the irriant smoke tube test.

I. The wearer is instructed as to the application of each cartridge for its proper use.

J. The wearer has the opportunity to handle the respirator and inspect its different parts.

K. The wearer is instructed in procedures to take in case of respirator malfunction. The wearer is also informed that he may leave the area for relief from the respirator due to physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other condition that may require such relief.

L. The wearer is instructed in the proper maintenance of the respirator.

M. No one is fitted with a respirator where conditions prevent a good face seal. These conditions include growth of beard, sideburns, caps, and any other condition preventing a proper seal.

VI. Cleaning and Maintenance

Respirators are cleaned and disinfected as often as necessary to insure

ATTACHMENT 3.3

Respiratory Protection Program

VI. Cleaning and Maintenance (continued)

that proper protection is provided to the wearer. The following schedule will be followed:

A. Crusher personnel, the Crusher Sampler and the Yellow Cake Sampler will bring their respirator to the Safety Department each Friday for cleaning and inspection.

B. The Precip Operators will bring their respirators to the Safety Department once every "day shift".

C. The Laborers and Mechanics, or other intermittant users, will bring their respirators in for inspection after eight cumulative hours of use, or after each use if it has not been checked in the previous month.

Cleaning of the Respirators

1. Remove head and neck straps from facepiece.
2. Remove and discard used cartridges.
3. Remove the exhalation valve cover.
4. Wash facepiece and exhalation valve covers in a basin using a cleaner-sanatizer and b sh.
5. Air dry respirators in clean area after washing.
6. Inspect each respirator after drying for any damage.

Inspection

1. Check each facepiece for cracks, tears, decomposition, stiffening, and distortions.
2. Check halation and exhalation valves for damage and replace if necessary.
3. Check lens for severe scratching that may impair vision.

ATTACHMENT 3.3

VI. Cleaning and Maintenance (continued)

Inspection (continued)

4. Check straps for wear and replace if necessary.
5. Check canister receptacle for gasket.
6. Check for any other missing or worn parts.
7. All defective respirators must be repaired or discarded.
8. After inspection and maintenance, store each respirator in a plastic bag with the initials of inspector and date inspected on it. Seal the plastic bag to insure that the respirator will remain clean until issuance.

Storage

1. Store the respirators in a clean, dry, uncramped area.
2. Respirator issued for more than one use must be kept in the individual's locker in a closed plastic bag.

Cleaning and Maintenance of SCBA's

1. The SCBA is cleaned following same procedures as for other reslirators.
2. Each month a check of SCBA will be done and a log kept.
   a. Check canister to make sure it is operational.
   b. Inspect regulator.
   c. Inspect hose.
   d. Inspect facepiece.
3. Each worn or defective part must be replaced or repaired immediately.

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ATTACHMENT 3.3

Respiratory Protection Program

VII. Surveillance of the Work Area

The work areas where respirators are used must be periodically surveyed by air samples to be certain that air concentrations of hazardous materials are not increasing to the extent that a different type of respirator with higher protection factor would be required. In the event of any changes in the work situation or when unusual maintenance is to be performed, air samples will be taken and analyzed immediately to determine if the respirator type used is adequate.

VIII. Responsibility for Respirator Program

The Respirator Program will be carried out under the direction of the Radiation Safety Officer, with responsibility vested in each of the following:

Each employee is responsible for:

1. Using the respirator issued to him in accordance with instruction and and training provided by the Radiation Safety Department.
2. Informing his supervisor or the doctor of any personal health problem that could be aggravated by the use of respiratory protection equipment.
3. Not disassembling, modifying or in any way altering a respirator other than changing cartridges, if necessary.
4. Reporting any observed or suspected malfunctioning respirator to the Safety Department.
5. Using only those brands and types of equipment for which he has been trained and can obtain a satisfactory fit.

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ATTACHMENT 3.3

VIII. Responsibility for Respirator Program (continued)

6. Being clean-shaven in area of respirator seal.

Supervisors are responsible for:

1. Notifying the Safety Department whenever it is necessary for an employee to enter an area in which airborne radioactive contaminants may exceed acceptable concentrations.
2. Enforcing the use of respirators in situations that require respiratory protection.
3. Consulting with the Safety Department for evaluation of exposure hazards whenever it is suspected that airborne radioactive or toxic contaminants exceed acceptable standards.
4. Notify the Safety Department of any employee known to have an active medical work restriction and obtain Safety Department clearance for such employee prior to assignment of job requiring the use of respirator protection.
5. Periodic checking of employee performing non-routine operations.

The Safety Department is responsible for:

1. Providing necessary respiratory equipment to protect the health of the employees.
2. Maintaining equipment in a serviceable condition.
3. Fitting employees with proper respirators and training them in their use.
4. Evaluating employee exposures and work conditions, including monitoring of the airborne radioactive concentrations during the time

ATTACHMENT 3.3

VIII. Responsibility for Respirator Program (continued)

the employees are working.

5. Random inspections of respirator use.
6. Establishing and keeping records of the medical approval required, training, and fitting.

IX. Medical Approval Program

A medical examination by a licensed physician will be performed on anyone who may wear a respirator, when they are hired. This exam will involve tests and other examinations that the physician feels pertain to the person's ability to work efficiently while wearing a respirator. (Nuclear Regulatory Guide B. 15) The medical status of each respirator user will be reviewed at least annually.

X. Program Evaluation

The program will be continually evaluated and updated to assure that it is the most effective program for the Dawn Mill and that it complies with current laws.

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ATTACHMENT No. 4

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RADIATION PROTECTION PROGRAM

The radiation protection program at Dawn consists of:

(1) Management Controls

(2) Training Programs

(3) Mill Access Controls

(4) Personnel Monitoring

(5) Monitoring the Work Environment

(6) Environmental Monitoring Program

These procedures are designed to assure the existence of and adherence to an in-plant safety program and the implementation of corrective measures if procedures or standards have been violated. The program includes personnel exposure monitoring and monitoring in areas of the plant to assure that exposures are maintained within the established state standards.

(1) Management Program

Dawn's radiation control policy includes the training program conducted for facility personnel, periodic reviews of the Company's radiation protection policy and the incorporation of justifiable operating and maintenance procedures and equipment that reduce exposures of personnel. To assist in accomplishing objectives of the radiation control program the following administrative control and reporting procedures are used:

(A) The appropriate and responsible personnel, including the Resident Manager and the Mill Superintendent, review the monthly summaries of monitoring data to determine whether or not the required limits have been exceeded or if anomalous conditions exist. Anomalous conditions requiring further action are documented in an internal memorandum.

(B) The Mill Superintendent or his designated representative is responsible for determing the corrective actions to be taken and the implementation of such actions if anomalous conditions exist. The effectiveness of the corrective actions may be measured by analysis of subsequent monitoring data. Health physics Consultants from outside the Company are employed when the analysis and correction of the problem are beyond the skills of the plant staff.

(C) All data sheets, records of analysis and correlation and training validation forms are signed and dated by the author, reviewer and supervisor as is required. These records are kept for future reference.

At least once per year, Dawn Mining Company conducts a formal audit to review the adequacy of the plant radiation safety program. Recommendations for modification of the radiation safety program resulting from the audit are documented and submitted to appropriate management including the Mill Superintendent and the Resident Manager.

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(2) Training Program

The purposes of an in-house radiation safety training program are 1) to place in proper perspective for the employee the short and long term radiation hazards associated with the job; 2) to instruct and train employees in the practices instituted by management to keep occupational exposures as low as practicable; 3) to assure that each employee has an understanding (both initially and over the duration of his employment) of the radiation safety procedures which should be followed; 4) to stress that most radiation safety procedures are "common sense" procedures, just as are occupational safety procedures, that have been implemented to protect the employee; and 5) to emphasize the employee's personal responsibility to protect himself by adhering to all safety procedures.
The Dawn training program has been approved by the Mining Safety and Health Administration (M.S.H.A.). It conforms to the new training regulations issued persuant to the Federal Mine Safety and Health act of 1977. All new employees receive a minimum of twenty four hours of instruction before going on the job and all employees receive eight hours of refresher training each year.

Dawn has designed its training program to include radiological safety procedures in almost every topic covered by the training sessions. Radiation safety items covered are summarized in the form titled "Employee Radiation Safety" (Attachment 4.1). In addition female workers and those who may supervise or work with

(2) Training Program cont.

them are given special instruction about prenatal exposure risks to the developing embryo and fetus. This instruction takes the form of the attached U.S. Nuclear Regulatory Commission Appendix to Regulatory Guide 3.13 titled "Possible Health Risks to Children of Women Who Are Exposed to Radiation During Pregnancy". (Attachment 4.2). Each individual is given the opportunity to ask questions and is asked to acknowledge in writing that the instructions has been received. When the instructor is satisfied that the new employee is familiar with the safety procedures, both sign the forms. The new employee must understand and sign the forms prior to commencement of work.

Repeated violations of safety practices will result in disciplinary action, up to and including dismissal.

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ATTACHMENT 4.1

POOR ORIGINAL

EMPLOYEE RADIATION SAFETY

Exposure to radiation can occur from radioactive sources located outside of the body (external) or inside of the body (internal). Radiation presents a hazard to the body in that energy can be transferred to the body; this radiation energy cannot be seen, smelled, heard, or tasted.

Protection from External Radiation

Protection from external radiation exposure may be obtained by the use of two common safety factors--time and distance. Therefore, to protect yourself from radiation, if any area of the mill is identified with a sign worded: "CAUTION-RADIATION AREA" or "RESPIRATOR WITH RADIONUCLIDE CARTRIDGE REQUIRED IN THIS AREA," you should perform your work in the quickest manner possible, and you should keep the source of radiation as far away from your body as possible. This also means working in the cleanest and most efficient manner possible and keeping radioactive materials off your face, arms and clothing.

The above does not necessarily exclude anyone in the mill from minimizing exposures to radiation by using the same procedures in their work.

Protection from Internal Radiation

There are four possible ways to take radioactive materials into your body:

1) by breathing
2) by swallowing
3) through breaks in the skin
4) by adsorption through the skin

In the mill, radioactive materials can be attached to dust particles in the air that you can breathe or to liquids that may splash or spill on you.

To protect yourself from taking radioactive materials into the body, you must observe the following:

1. Maintain a clean work area by using vacuum cleaners and by wetting down dusty areas when necessary.
2. Don't smoke in areas where ore is being processed or handled. Radioactive materials can be transferred from the hands to the cigarette and from the cigarette to the mouth and into the body.
3. Wash face and hands before you eat. Reason: radioactive materials on the hands can get on food and can enter the body when you eat the food.
4. Wear a respirator or gas mask when required. A respirator or mask may be required when working at the jobs listed below:
   a. cleanup of the crushing plant
   b. work in the yellowcake drying and handling section
   c. during unusual dusting conditions as required by the area foreman
5. Shower before leaving work. Personal hygiene is important for your personal safety.

At the present time, it is believed that the body can withstand low dosages of radiation spread over a long period of time without any apparent effect. However, it is to the mutual advantage of everyone to keep exposure to radioactive materials to an absolute minimum. Good common sense and personal hygiene are most effective for protecting your personal safety. However, also follow company procedures and regulations regarding radiation safety; they have been established for your protection.

I, the undersigned, understand that repeated violations of safety practices will result in disciplinary action, up to and including dismissal.

Date ______________ Employee Signature ______________________

Witnessed by:

Date ______________ Supervisor's Signature ______________________

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ATTACHMENT 4.2

POOR ORIGINAL

U.S. NUCLEAR REGULATORY COMMISSION

APPENDIX TO REGULATORY GUIDE 8.13

POSSIBLE HEALTH RISKS TO CHILDREN OF WOMEN WHO ARE EXPOSED TO RADIATION DURING PREGNANCY

Some recent studies have shown that the risk of leukemia and other cancers in children increases if the mother is exposed to a significant amount of radiation during pregnancy. According to a report by the National Academy of Sciences, the incidence of leukemia among children from birth to 10 years of age in the United States could rise from 3.7 cases in 10,000 children to 5.6 cases in 10,000 children if the children were exposed to 1 rem of radiation before birth (a "rem" is a measure of radiation). The Academy has also estimated that an equal number of other types of cancers could result from this level of radiation. Although other scientific studies have shown a much smaller effect from radiation, the Nuclear Regulatory Commission wants women employees of its licensees to be aware of any possible risk so that the women can take steps they think appropriate to protect their offspring.

As an employee of a Nuclear Regulatory Commission licensee, you may be exposed to more radiation than the general public. However, the Nuclear Regulatory Commission has established a basic exposure limit for all occupationally exposed adults of 1.25 rems per calendar quarter, or 5 rems per year. No clinical evidence of harm would be expected in an adult working within these levels for a lifetime. Because the risks of undesirable effects may be greater for young people, individuals under 18 years of age are permitted to be exposed to only 10 percent of the adult occupational limits. (This lower limit is also applied to members of the general public.)

The scientific organization called the National Council on Radiation Protection and Measurements has recommended that because unborn babies may be more sensitive to radiation than adults, their radiation dose as a result of occupational exposure of the mother should not exceed 0.5 rem. Other scientific groups, including the International Commission on Radiation Protection, have also stressed the need to keep radiation doses to unborn children as low as is reasonably achievable.

All Nuclear Regulatory Commission licensees are now required* to inform all individuals who work in a restricted area of the health protection problems associated with radiation exposure. This instruction would in many cases include information on the possible risks to unborn babies. The regulations also state** that licensees should keep radiation exposures as low as is reasonably achievable. According to the National Council on Radiation Protection and Measurements, vigorous efforts should be made to keep the radiation exposure of an embryo or fetus at the very lowest practicable level during the entire period of pregnancy.

Thus it is the responsibility of your employer to take all practicable steps to reduce your radiation exposure. Then it is your responsibility to decide whether the exposure you are receiving is sufficiently low to protect your unborn child. The advice of your employer's health physicist or radiation protection officer should be obtained to determine whether radiation levels in your working areas are high enough that a baby could receive 0.5 rem or more before birth. If so, the alternatives that you might want to consider are:

(a) If you are now pregnant or expect to be soon, you could decide not to accept or continue assignments in these areas.

(b) You could reduce your exposure, where possible, by decreasing the amount of time you spend in the radiation area, increasing your distance from the radiation source, and using shielding.

(c) If you do become pregnant, you could ask your employer to reassign you to areas involving less exposure to radiation. If this is not possible, you might consider

* By Title 10, Part 19, of the Code of Federal Regulations.

**In Title 10, Part 20.

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ATTACHMENT 4.2

leaving your job. If you decide to take such steps, do so without delay. The unborn child is most sensitive to radiation during the first three months of your pregnancy.

(d) You could delay having children until you are no longer working in an area where the radiation dose to your unborn baby could exceed 0.5 rem.

You may also, of course, choose to:

(e) Continue working in the higher radiation areas, but with full awareness that you are doing so at some small increased risk for your unborn child.

The following facts should be noted to help you make a decision:

1. The first three months of pregnancy are the most important, so you should make your decision quickly.

2. In most cases of occupational exposure, the actual dose received by the unborn baby is less than the dose received by the mother because some of the dose is absorbed by the mother's body.

3. At the present occupational exposure limit, the actual risk to the unborn baby is small, but experts disagree on the exact amount of risk.

4. There is no need to be concerned about sterility or loss of your ability to bear children. The radiation dose required to produce such effects is more than 100 times larger than the Nuclear Regulatory Commission's dose limits for adults.

5. Even if you work in an area where you receive only 0.5 rem per three-month period, in nine months you could receive 1.5 rems, and the unborn baby could receive more than 0.5 rem, the full-term limit suggested by the NCRP. Therefore, if you decide to restrict your unborn baby's exposure as recommended by the NCRP, be aware that the 0.5 rem limit to the unborn baby applies to the full nine-month pregnancy.

The remainder of this document contains a brief explanation of radiation and its effects on humans. As you will see, some radiation is present everywhere and the levels of radiation most employees of Nuclear Regulatory Commission licensees receive are not much larger than these natural levels. Because the radiation levels in the facility where you will be working are required by [illegible] to be kept quite low, there is not considered to be a significant health risk to individual adult employees.

Discussion of Radiation

The amount of radiation an individual receives is called the "dose" and is measured in "rems." The average individual in the United States accumulates a dose of one rem from natural sources every 12 years. The dose from natural radiation is higher in some states, such as Colorado, Wyoming, and South Dakota, primarily because of cosmic radiation. There the average individual gets one rem every 8 years.

Natural background radiation levels are also much higher in certain local areas. A dose of one rem may be received in some areas on the beach at Guarapari, Brazil, in only about 9 days, and some people in Kerala, India, get a dose of one rem every 5 months.

Many people receive additional radiation for medical reasons. In 1970, an estimated 212 million X-ray examinations were performed in the United States. The estimated average surface skin dose from one radiographic chest X-ray is 0.027 rem. The estimated average surface skin dose per abdominal X-ray is 0.62 rem.*

Radiation can also be received from natural sources such as rock or brick structures, from consumer products such as television and glow-in-the-dark watches, and from air travel. The possible annual dose from working 8 hours a day near a granite wall at the Redcap Stand in Grand Central Station, New York City, is 0.2 rem, and the average annual dose in the United States from TV, consumer products, and air travel is 0.0026 rem.

Radiation, like many things, can be harmful. A large dose to the whole body (such as 600 rems in one day) would probably cause death in about 30 days, but such large doses result only from rare accidents. Control of exposure to radiation is based on the assumption that any exposure, no matter how small, involves some risk. The occupational exposure limits are set so low, however, that medical evidence gathered over the past 50 years indicates no clinically observable injuries to individuals due to radiation exposure when the established radiation limits are not exceeded. This was true even for exposures received under the early occupational exposure limits, which were many times higher than the present limits. Thus the risk to individuals at the occupational exposure levels is considered to be very low. However, it is impossible to say that the risk is zero. To decrease the risk still further, licensees are expected to keep actual exposures as far below the limits as is reasonably achievable.

*"Pre-Release Report, X-Ray Exposure Study (XES) Revised Estimates of 1964 and 1970 [illegible]," February 4, 1972, U.S. Department of Health, Education, and Welfare, Public Health Service, Federal Drug Administration, Bureau of Radiological Health.

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POOR ORIGINAL

ATTACHMENT 4.2

The current exposure limits for people working with radiation have been developed and carefully reviewed by nationally and internationally recognized groups of scientists. It must be remembered, however, that these limits are for adults. Special consideration is appropriate when the individual being exposed is, or may be, an expectant mother, because the exposure of an unborn child may also be involved.

Prenatal Irradiation

The prediction that an unborn child would be more sensitive to radiation than an adult is supported by observations for relatively large doses. Large doses delivered before birth alter both physical development and behavior in experimentally exposed animals. A report of the National Academy of Sciences states that short-term doses in the range of 10 to 20 rems cause subtle changes in the nerve cells of unborn and infant rats. The report also states, however, that no radiation induced changes in development have been demonstrated to result in experimental animals from doses up to about 1 rem per day extended over a large part of the period before birth.

The National Academy of Sciences also noted that doses of 25 to 50 rems to a pregnant human may cause growth disturbances in her offspring. Such doses substantially exceed, of course, the maximum permissible occupational exposure limits.

Concern about prenatal exposure (i.e., exposure of a child while in its mother's uterus) at the permissible occupational levels is primarily based on the possibility that cancer (especially leukemia) may develop during the first 10 years of the child's life. Several studies have been performed to evaluate this risk. One study involved the followup of 77,000 children exposed to radiation before birth (because of diagnostic abdominal X-rays made for medical purposes during their mother's pregnancy). Another study involved the followup of 20,000 such children. In addition, 1292 children who received prenatal exposure during the bombing of Hiroshima and Nagasaki were studied. Although contradictory results have been obtained, most of the evidence suggests a relationship between prenatal exposure and an increased risk of childhood cancer.

Summary

Occupational exposures to radiation are [illegible] kept low. However, qualified scientists have recommended that the radiation dose to an embryo or fetus as a result of occupational exposure of the expectant mother should not exceed 0.5 rem because of the small increased risk of childhood leukemia and cancer. Since this 0.5 rem is lower than the dose generally permitted to other workers, women may want to take special actions to avoid receiving higher exposures, just as they might stop smoking during pregnancy or might climb stairs more carefully to reduce possible risks to their unborn children.

Bibliography

1. Donald G. Pizzarello and Richard L. Witcofski, *Basic Radiation Biology*, Philadelphia, Lea and Febiger, 1967.

2. National Academy of Sciences – National Research Council, *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation*, Washington, D.C., November 1972.

3. National Council on Radiation Protection and Measurements, *Basic Radiation Protection Criteria*, NRCP Report No. 39, Washington, D.C., January 15, 1971.

4. United Nations, *Ionizing Radiation: Levels and Effects*, 2 vols., Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, Report No. A 8725, United Nations, New York, 1972.

5. U.S. Atomic Energy Commission, Division of Technical Information, Understanding the Atom Series

   Atoms, Nature and Man

   The Genetic Effects of Radiation

   The Natural Radiation Environment

   Your Body and Radiation

8.13-5

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ATTACHMENT NO. 4 CON'T.

In addition periodic meetings are held with operators and management to discuss all aspects of the safety program and violations of radiation safety procedures. These meetings are used to discuss the results of monthly safety inspections which are conducted by a team made up of representatives of management and operations. Membership on this team is rotated to obtain new insight on the safety program.

Records of attendance are maintained.

(3) Mill Access Controls

The mill area is enclosed by an eight foot chain link fence topped with 3-strand barbed wire, providing complete control of access to the mill area. The tailings disposal area is enclosed by a four-strand barbed wire fence. Metal gates kept closed and locked are provided to control access. All visitors are required to register at the reception desk. No visitors will be permitted to enter the crusher or mill buildings unless escorted by Dawn Mining Company personnel.

All entrances to the mill site are posted in ac[illegible]ce with WAC 402-24-090.

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All signs indicating potential radiation hazards use the conventional radiation caution colors (magenta or purple on yellow background) and the conventional three-blade design radiation symbol. Signs posted along the restricted area fence are:

1) CAUTION - RADIOACTIVE MATERIAL

All restricted area entrances are posted with the following signs:

1) RESTRICTED AREA - NO ADMITTANCE APPLY AT OFFICE

2) CAUTION - ANY AREA OR CONTAINER WITHIN THIS AREA MAY CONTAIN RADIOACTIVE MATERIALS

The crusher building entrances are posted with the following signs:

1) CAUTION - RADIOACTIVE MATERIAL

2) CAUTION - AIRBORNE RADIOACTIVITY AREA

3) CAUTION - RESPIRATOR REQUIRED IN THIS AREA

The yellowcake storage area posted with the following signs:

1) CAUTION - RADIOACTIVE MATERIALS

The yellowcake drying and packaging area is posted with the following signs:

1) CAUTION - RADIOACITVE MATERIALS

2) DANGER - RESTRICTED AREA

3) CAUTION - AIRBORNE RADIOACTIVITY AREA

4) CAUTION - RESPIRATOR REQUIRED IN THIS AREA

5) NO BEVERAGES OR FOOD ALLOWED IN THIS AREA

Exemption is requested from the requirement of WAC 402-24-090 (1) (g) (ii) and (1) (h) for areas and containers within the mill since all entrances to the property will be conspicuously posted with the words:

"CAUTION - ANY AREA OR CONTAINER WITHIN THIS AREA MAY CONTAIN RADIOACTIVE MATERIAL".

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(4) Personnel Monitoring

The purpose of the monitoring program is to provide timely measurements of personnel exposures. This program provides a means of assuring that employees are not exposed to radiation in excess of applicable limits. Employees in high exposure areas will be re-scheduled to work in low exposure areas if and when applicable limits are obtained. The accumulated monitoring data aids management in the placement of personnel and in the detection of anomolous conditions within the plant environs.

Film Badges

Film badges are used to monitor external exposures of personnel to beta and gamma radiation. All employees wear film badges during working hours. The total cumulative exposure for each employee in the film badge program is maintained in accordance with applicable state requirements.

An example of this data is included as attachment 4.3.

Bio Assays

A Bio assay program consisting of urinalysis for uranium is used to supplement the airborne dust sampling program. Procedures used in this urinalysis program conform with the NRC Regulatory Guide 8.22 "Bio Assay at Uranium Mills." An example of data generated under the program is included as Attachment 4.4

ATTACHMENT 4.3

POOR ORIGINAL

CURRENT RADIATION EXPOSURE REPORT

UNITED STATES TESTING COMPANY, INC.
ESTABLISHED 1880
RICHLAND DIVISION

COMPANY: DAWN MINING CO
ADDRESS: PO BOX 25
CITY: FORD WA 99013

ATTENTION: RAD. OFFICER
DEPT/BLDG: MR R NELSON
DMC- 14/79 14E

04-Jan-79
10-Jan-79
330 5 FILM--

SEE REVERSE SIDE FOR EXPLANATION

I.D. NO.	PARTICIPANT'S NAME		SEX	WEAR PERIOD (FROM / TO)	TYPE	DOSE FOR WEAR PERIOD (REM) NEUTRON	SKIN	WHOLE BODY	CALENDAR QUARTER SKIN	CALENDAR QUARTER WHOLE BODY	CALENDAR YEAR SKIN	CALENDAR YEAR WHOLE BODY	NO. OF EPS	LIFE TIME SKIN	LIFE TIME WHOLE BODY	START OF SERVICE MO/YR	LPD (REM)	BIRTH	SS#
00136	MC AHAHY	R	M	1201 1231	3		Min.	Min.	Min.	Min.	0.03	0.03	11		0.03	0178	50	03-51	526-02-4919
00137	LAWRENCE		M	1201 1231	3		0.02	0.02	0.06	0.06	0.16	0.16	11		0.16	0278			
00139	WHITESELL	A	M	1201 1231	3		0.06	0.06	0.17	0.17	1.00	0.90	9		0.98	0476	55	06-50	533-52-9076
00141	PARSON	P	M	1201 1231	3		0.11	0.11	0.32	0.32	1.00	1.00	9		1.00	0478	60	10-49	536-48-5472
00142	SULLIVAN	J	M	1201 1231	3		0.09	0.09	0.21	0.21	0.74	0.69	6		0.69	0478	145	10-32	53[illegible]-23-4729
00144	THOMPSON	J	M	[illegible]	3		0.10	0.06	0.30	0.22	0.74	0.61	7		0.51	[illegible]	10	09-59	531-70-2293
00146	[illegible]R	R	M	[illegible]	3		0.06	0.06	0.16	0.16	0.79	0.39	6		0.39	0576	115	05-38	369-39-4717
00147	THOMPSON	J	M	[illegible]	3		0.02	0.02	0.02	0.02	0.04	0.04	5		0.04	0770	55	03-50	127-38-0406
00148	NAVE	B	M	1201 1231	3		0.05	0.05	0.15	0.15	0.26	0.26	5		0.26	0778	55	12-50	399-48-3021
00149	COLLINS		M	1201 1231	3		0.03	0.03	0.10	0.10	0.15	0.15	5		0.15	0678			
00150	STOUT	D	M	1201 1231	3		0.10	0.10	0.21	0.21	0.27	0.27	5		0.27	0676	130	02-35	505-38-3868
00151	HENDRIKS	R	M	1201 1231	3		0.03	0.03	0.11	0.11	0.16	0.16	5		0.16	0378	80	03-45	510-50-2231
00152	LOGAN	S	M	1201 1231	3		0.03	0.03	0.09	0.09	0.11	0.11	4		0.11	0478	30	04-35	531-62-9232
00154	HENTGES	T	M	1201 1231	3		0.02	0.02	0.02	0.02	0.02	0.02	2		0.02	[illegible]			
00155	FRAGA	C	M	1201 1231	3		0.08	0.08	0.22	0.22	0.22	0.22	3		0.22	0977	130	11-35	558-27-9396
00156	KOEHLER	J	M	1201 1231	3		0.07	0.07	0.22	0.22	0.22	0.22	3		0.22	0978	5	08-60	532-48-4270

CALIBRATIONS: GAMMA = CESIUM-137, BETA = STRONTIUM-90, X-RAY = 16-117KEV, NEUTRON = PLUTONIUM-BERYLLIUM

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ATTACHMENT 4.4

DAWN MINING COMPANY
Ford, Washington

BIO-ASSAYS

Period 2/27/78 - 5/8/78

Name	Job Classification	Spec. Date	Since last Bio-assay:	Readings: less blank + blank Sample	Standard	Micro-grams U/ltr.
Inzer, S	YC Packaging	2/27	45 days	2.500	33.75	6.28
Pierce, R	Precip Oper.	3/2	49 days	.250	31.00	.34
Nilsson, F	Precip Oper.	3/9	53 days	4.875	41.75	9.90
LeBret, C	Precip Oper.	3/16	64 days	2.250	31.50	6.05
Inzer, S	YC Packaging	3/20	24 days	1.750	34.00	4.37
Koehler, A	Precip Oper.	3/23	39 days	1.875	34.50	4.60
Pierce, R	Precip Oper.	3/30	28 days	1.500	35.50	3.59
Inzer, S	YC Packaging	4/3	14 days	2.250	39.00	4.89
Abrahamson, M	Crusher	4/3	77 days	1.750	39.00	3.81
Dituri, E	Crusher	4/3	81 days	1.000	40.00	2.12
Corral, C	Crusher (SP)	4/3	77 days	.250	40.00	.53
Douglas, E	Precip Oper.	4/6	84 days	1.500	35.00	3.64
LeBret, C	Precip Oper.	4/13	28 days	1.250	41.50	3.01
Inzer, S	YC Packaging	4/18	15 days	1.875	35.50	4.48
Campbell, J	Precip Oper.	4/21	95 days	4.150	38.00	9.26
Schuler, J	YC Packaging	4/24	98 days	2.600	35.00	6.28
Douglas, E	Precip Oper.	5/4	28 days	2.200	41.00	6.21
Schuler, J	YC Packageing	5/8	14 days	2.250	43.00	6.41

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Personnel Contamination Control

A changeroom is provided with showers and facilities for clothing storage. The company encourages all operations personnel to shower and change to street clothing prior to departure from property.

Operators in the yellowcake precipitation and drying area and all maintenance personnel are issued work clothing. Two sets of clothing are issued, one to be worn on shift while the other set is laundered in the company facilities. By this method, clean work clothing is available each day. No residual radioactive contamination is anticipated on the laundered clothing.

(5) Monitoring The Work Environment

Airborne Particulate Controls

Radioactive material may enter the body by a means of inhalation, ingestions, absorption or transpiration through the skin. To provide information concerning the amounts and types of radioactive materials workers are exposed to, air sampling and other radiation survey programs are used to monitor the work enviroment. The mill building is hosed down each night for fire protection purposes,and to remove minor ore residues which might be present, minimizing airborne contamination.

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The air sample program includes spot samples taken periodically throughout the building, and three continuous air samplers. Two of these continuous samplers are located at the two points having the highest potential for airborne contamination, the crusher building and the yellow cake barreling area. The third continuous sampler is located at the yellow cake drier Roto-Cone exhaust, expected to represent the highest potential for release of uranium from the building. All air sampie results are recorded. (Attachment 4.5). Custom Comfo respirators are required for personnel working at the yellow cake barrel loading station and the crusher building.

Any openings of closed, dry, process lines which have been used for transferring process solutions containing radioactive material will be accomplished with local ventilation and supplied respirators.

Entry of personnel into normally closed process vessels will be minimized to the extent practical: Whenever such entry is required, protective clothing, respiratory protection and mechanical ventilation will be provided.

Yellow cake shipping drums are examined with an Alpha Survey instrument for Beta/Gamma and gross Alpha before shipment. Sampling frequency is every 10th drum.

Radon Monitoring

Radon gas monitoring is accomplished by the sampling of air for radon daughter products as outlined by the Bureau of Mines publication Controlling Employee Exposure to Alpha Radiation in Underground Uranium Mines, Bolume 2, published in 1971. (See Attachment 4.6 for the modified Kusnetz method.) Radon monitoring is performed at each monitoring location itemized in Table 4.1 once per month.

ATTACHMENT 4.5

AIRBORNE RADIOACTIVE DUST SAMPLES

FOR May 1978

(Typical Report)

CRUSHER Date Sample Counted	Short Decay (30 min) MPC-7.2X10^{-8} µCi/ml	Long Decay MPC-2.5X10^{-11} µCi/ml	Long Decay (hours)
May 2	6.3×10^{-11}	2.5×10^{-12}	24
May 3	9.4×10^{-11}	1.7×10^{-12}	24
May 4	5.1×10^{-11}	2.2×10^{-12}	24
May 8	1.2×10^{-10}	3.0×10^{-12}	24
May 9	3.8×10^{-11}	2.9×10^{-12}	24
May 10	3.9×10^{-11}	2.0×10^{-12}	24
May 11	5.4×10^{-11}	2.9×10^{-12}	24
May 15	5.2×10^{-11}	3.6×10^{-12}	24
May 16	6.8×10^{-11}	2.5×10^{-12}	24
May 17	5.0×10^{-11}	3.6×10^{-12}	24
May 18	6.3×10^{-11}	1.8×10^{-12}	24
May 19	4.6×10^{-11}	1.6×10^{-12}	72
May 22	5.4×10^{-11}	1.9×10^{-12}	24
May 23	9.4×10^{-11}	1.4×10^{-12}	24
May 24	9.7×10^{-11}	1.5×10^{-12}	24
May 25	6.0×10^{-11}	1.8×10^{-12}	24
May 26	4.7×10^{-11}	1.1×10^{-12}	96
May 30	9.0×10^{-11}	1.6×10^{-12}	24
May 31	2.1×10^{-11}	3.3×10^{-12}	24

Mill Area Grab Samples (Location/Date)	Short Decay MPC-7.[illegible]X10^{-8} µCi/ml	Long Decay MPC-2.[illegible]X10^{-11} µCi/ml	Decay (hours)
Above Agitator Tanks 5/30	[illegible].8X10^{-10}	5.0×10^{-12}	46
Above Clarifier Tanks 5/30	2.4×10^{-10}	3.3×10^{-12}	45
Above IX Columns 5/30	3.1×10^{-10}	4.7×10^{-12}	47
Ball Mill Station 5/30	4.0×10^{-10}	3.6×10^{-12}	46

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ATTACHMENT 4.5

AIRBORNE RADIOACTIVE DUST SAMPLES

FOR November 1978

(Typical Report)

Unconfined Date Sample Counted	Short Decay (30 min) MPC-$7.2X10^{-8}$ μCi/ml	Long Decay MPC-$8X10^{-13}$ μCi/ml	Long Decay (hours)
Roof			
November 1	$1.2X10^{-11}$	$2.2X10^{-13}$	49
November 3	$3.6X10^{-11}$	$1.3X10^{-13}$	73
November 7	$2.7X10^{-11}$	$4.5X10^{-13}$	25
November 10	$5.5X10^{-12}$	$1.3X10^{-13}$	73
November 15	$9.3X10^{-11}$	$5.8X10^{-13}$	49
November 17	$2.5X10^{-11}$	1.[illegible] 10^{-13}	97
November 22	$3.3X10^{-11}$	$2.7X10^{-14}$	121
November 29	$2.4X10^{-11}$	$6.6X10^{-13}$	25
Roof Grab	$6.7X10^{-12}$	$3.6X10^{-13}$	48
Crusher Grab	$3.3X10^{-12}$	$4.9X10^{-13}$	48
	MPC-$7.2X10^{-8}$ uCi/ml	MPC-$6X10^{-13}$ uCi/ml	
Trailer Area Grab	$8.1X10^{-12}$	$7.2X10^{-15}$	46
Radon Daughter Samples	MPC- .3 Working Level		
Ball Mill Station	.072 WL		
Above Agitator Tanks	.077 WL		
Above Clarifier Tanks	.059 WL		
Above IX Columns	.047 WL		
Basement of Crusher	.045 WL		

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POOR ORIGINAL

ATTACHMENT 4.5

AIRBORNE RADIOACTIVE DUST SAMPLES

FOR November 1978

(Typical)

Yellow Cake Area Date Sample Counted	Short Decay (30 min) MPC-7.2×10^{-8} µCi/ml	Long Decay MPC-7×10^{-11} µCi/ml	Long Decay (hours)
November 1	1.6×10^{-10}	8.0×10^{-12}	25
November 2	2.6×10^{-10}	1.0×10^{-11}	25
November 3	1.5×10^{-10}	1.2×10^{-12}	72
November 7	4.8×10^{-12}	4.7×10^{-12}	25
November 8	6.1×10^{-11}	9.6×10^{-12}	25
November 9	1.1×10^{-10}	3.9×10^{-12}	24
November 10	3.9×10^{-11}	1.3×10^{-12}	73
November 14	1.3×10^{-10}	1.0×10^{-11}	24
November 15	1.9×10^{-10}	1.5×10^{-11}	25
November 16	2.5×10^{-10}	1.5×10^{-11}	25
November 17	2.0×10^{-10}	9.9×10^{-12}	73
November 21	1.8×10^{-10}	9.7×10^{-12}	25
November 22	1.8×10^{-10}	4.9×10^{-12}	121
November 28	2.2×10^{-11}	7.2×10^{-12}	25
November 29	1.3×10^{-10}	9.6×10^{-12}	25
November 30	2.2×10^{-10}	1.2×10^{-12}	27
Y.C. Filter Area Grab	1.9×10^{-9}	9.4×10^{-12}	46

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ATTACHMENT 4.6

POOR ORIGINAL

Modified Kusnetz Method

Excerpt from Bureau of Mines Publication Controlling Employee Exposure to Alpha Radiation in Underground Uranium Mines Volume 2, published in 1971

STANDARD SAMPLING METHOD

GENERAL DESCRIPTION

Radon-daughter concentrations are most commonly determined by drawing 10 to 15 liters of mine air through a suitable filter. Filters should be checked for self-absorption, at least initially. If self-absorption is found to be significant, each lot of filters should be tested, and the necessary correction factors should be applied to alpha readings obtained.

Filter self-absorption can be determined by counting alpha activity on the filter face (C_1), counting the back side (C_2), covering the face with an unused filter of the same type, and recounting the front side (C_3). These readings are then used in the following formula to determine the percent of self-absorption:

$$\frac{C_2 - C_3}{2C_1 + C_2 - C_3} \times 100 = \text{percent self-absorption.} \qquad (1)$$

Sample time has been standardized at 5 minutes. Sampling times of more or less than 5 minutes introduce unnecessary error because the standard time factor curve was calculated on the basis of 5-minute samples. The degree of error introduced is dependent upon equilibrium conditions between the daughters while the sample is being taken. With considerable effort, special factors can be prepared for other sample times.

Samples should be counted between 40 and 90 minutes after end of sampling. This elapsed time interval should minimize the error introduced by variable equilibrium conditions at time of sampling. High disequilibrium magnifies the percentage of error introduced if the samples are counted before 40 minutes have elapsed.

The multiple of a working level can be calculated from the sample volume, alpha count rate, and elapsed time after sampling. Meter reading in counts per minute (cpm) is converted to disintegrations per minute (dpm) using the previously established field meter calibration curve. Divide

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ATTACHMENT 4.6

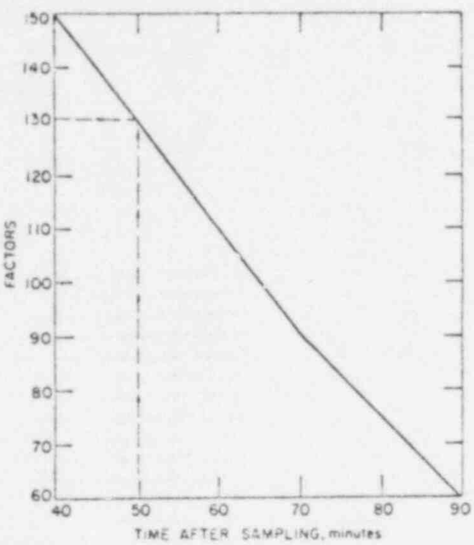

Figure B-4.—Factors for converting disintegrations per minute per liter of air sampled to working levels, 40 to 90 minutes after sampling.

alpha dpm by sa... volume to obtain dpm per liter. Divide dpm per liter by the factor obtained from the time-factor graph (fig. B-4) corresponding to the time elapsed between end of sampling and counting. The result is the radon daughter concentration in multiples of a working level at time of sampling (*4*).

Sample calculations:

Total sample volume .... liters	10
Elapsed time .... minutes	50
Time factor for 50 minutes (from time factor graph, fig. B-4)	130
Alpha meter reading .... cpm	2,500
Meter reading for 2,500 cpm (from calibration graph, fig. B-3) .... dpm	5,000

dpm/liter ÷ time factor =

$$\frac{5{,}000}{10} \div 130 = \frac{5{,}000}{1{,}300} = 3.85 \text{ WL}$$

INHERENT ERRORS

The time-factor graph is a plot of the numerical factors that must be divided into disintegrations per minute per liter of air sampled for any elapsed time from 40 to 90 minutes to obtain radon daughter concentrations in terms of working levels. These factors were determined by solving Bateman-type[1] equations for the decay of various equilibrium and nonequilibrium mixtures. Errors in estimating the alpha energy per liter are listed in table B-2. Maximum error shown is 12 percent, which may be small compared with other variables in the method. The error is generally on the side of safety, because potential alpha energy is overestimated except in three instances as noted (*4*). Later calculations by Shroeder (*3*) have indicated different percentages of error are involved than those reported by Kusnetz. Shroeder's calculations indicated the Kusnetz time factors slightly underestimate working levels at usual equilibrium conditions.

PROCEDURAL ERRORS

Common errors in sampling procedure are due principally to lack of or inadequate training.

[1] Bateman equations: a general solution of the distribution of nuclides among the members of a radioactive decay chain, based on the assumption that only the parent atoms exist at time zero.

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ATTACHMENT 4.6

Table B-2.—*Percent error of working level estimation with adjusted factors for different times and equilibrium ratios* [1]

Time after samplings, minutes	Factor	Percent error at equilibrium ratio of—			
		1:1:1	1:0.9:0.8	1: 0.45: 0.35	1: 0.15: 0.06
40	150	7	8	2	[2]7
50	130	3	4	2	[2]7
60	110	3	3	2	[2]2
70	90	[illegible]	12	4	[2]3
80	75	[illegible]	3	11	12
90	60	2	4	6	7

[1] Data taken from reference 4, p. 42.
[2] Percent underestimated.

Pumps are not always calibrated accurately and some have never been calibrated. Often pumps which were initially calibrated are not rechecked frequently enough to assure accurate sample volumes. Care must be taken to adjust, if necessary, the flowmeter while sampling, particularly as the sampling day progresses and the battery voltage decreases.

An accurate stopwatch should be used to time the period of sampling. The use of ordinary wristwatches or automatic buzzer-type timers has not proven dependable. Errors in timing are reflected directly in radon-daughter determinations. The timepiece used should be checked frequently to assure continued accurate operation.

Cracked or punctured filters, leaks around the filter, and kinked sampling hoses are common causes of erroneous measurements. Membrane filters may deteriorate and become brittle with age. Only fresh stock should be used. Filters should be handled carefully to avoid damage before and after sampling. When the filter paper is placed under the counting window or in the probe, the filter must be flat to assure that distance does not become a variable which will influence the accuracy of the count.

Alpha survey instruments are delicate and must be protected in transit as well as during use. When subjected to severe temperature change, instruments may behave erratically; counting of alpha standards will reveal erratic behavior. Instruments should be checked for proper operation with the field-check standard before each group of samples is counted. Any unexplained changes in meter behavior should be evaluated thoroughly by a trained instrument technician. Most samplers would be well advised to have internal instrument adjustments made only by the manufacturer's representative.

Poor meter observations occasionally result from a failure to consider instrument design capabilities. If the meter reads near the beginning of one of the less sensitive scales, it may be possible to achieve more accuracy by allowing the sample to decay so that the meter needle is near the high end of the next more sensitive scale. Normal needle fluctuation should not then introduce so high a percentage of uncertainty. Some instruments lose linearity near the beginning and end of their scales. This can be determined through the laboratory calibration procedure. If the problem is found to exist and it cannot be cured by adjusting the instrument, it may be possible to use a more favorable location on the scale by allowing the sample more time for decay.

Other common mistakes are made in the selection of sampling sites. Low concentrations can usually be recorded by sampling the vent tubing discharge, but such samples may have little bearing on actual exposure levels in the work place. The same is true if samples are taken in dead air spaces where men are not exposed. Every effort must be made to sample air which is representative of the condition to be defined. A chemical smoke cloud can be used to observe air flow patterns and lessen the possibility that invisible air interfaces will confuse sample results.

REFERENCES

1. American Standards Association (now American National Standards Institute, Inc.). Radiation Protection in Uranium Mines and Mills (concentrators). N7.1, 1960, 31 pp.

4M-546 O - 71 - 11

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ATTACHMENT NO. 4 CON'T.

Table 4.1

Radon Monitoring

Sampling Stations

Station No.	Location
1	Above Agitator Tanks
2	Ball Mill Station
3	Above Clarifier Tanks
4	Above IX Columns
5	Y. C. Filter Area
6	Basement of Crusher
7	Trailer Park
8	Precip Operator's Station

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ATTACHMENT NO. 4. CON'T.

GAMMA RADIATION SURVEY

A routine survey program is carried out in the mill buildings, similar to that shown in Attachment 4.7. The results of these surveys, are used to identify radiation areas. Pocket ionization chamber dosimeters are used within Radiation Areas for exposure control purposes.

ATTACHMENT 4.7

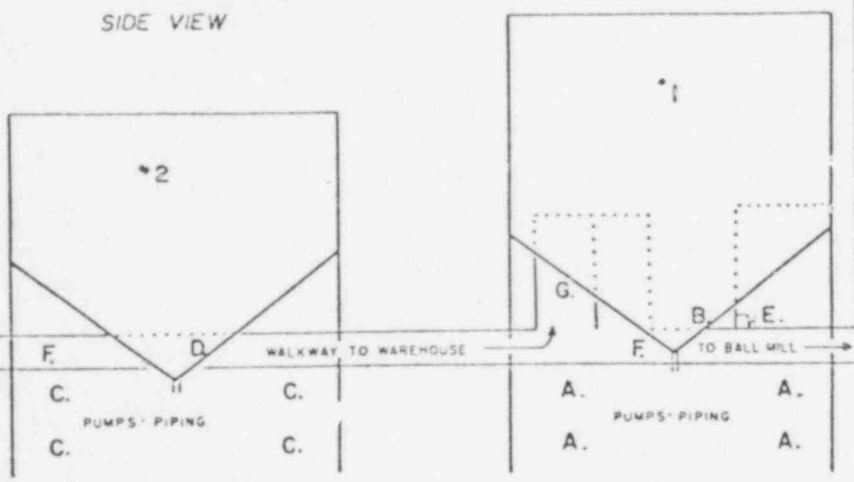
DAWN MINING COMPANY

CLARIFIER SURVEYS

DATE ______________

	READINGS MR/HR
A. Area around pump and pipes #1 clarifier	
B. 2" from #1 clarifier	
C. Area around pump and pipes #2 clarifier	
D. 2" from #2 clarifier	
E. Area of purchasing agents desk	
F. Walkway	
G. Entrance to warehouse	

SIDE VIEW



INSTRUMENT USED ______________

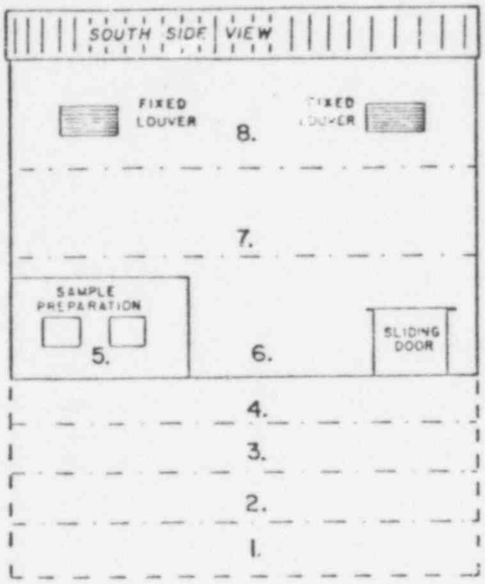
SIGNATURE ______________

1076 267

ATTACHMENT 4.7

CRUSHER BUILDING

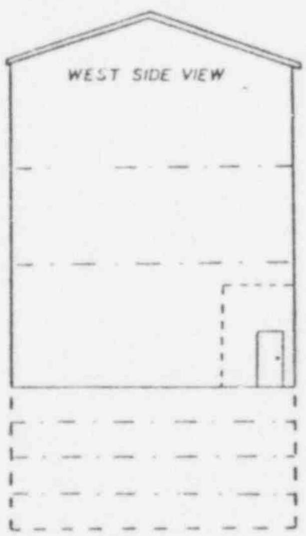
____
DATE



MONTHLY SURVEY

DOSE RATE MR/HR

1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______



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INSTRUMENT USED

____
SIGNATURE

1076 268

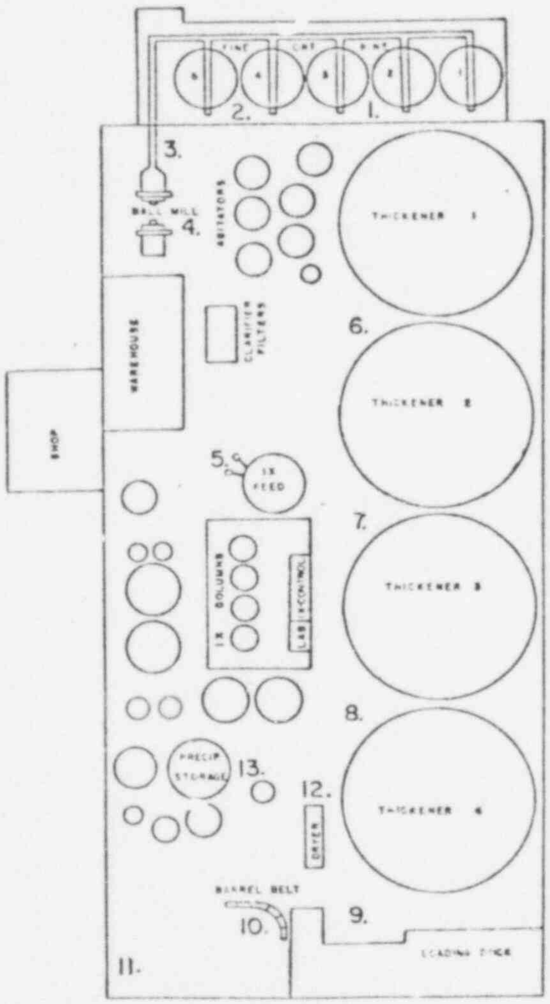
ATTACHMENT 4.7

DAWN MINING COMPANY

MILL BUILDING (floor plan)

LOWER LEVEL

DATE ________



MONTHLY SURVEY

DOSE RATE MR/HR

1 ________
2 ________
3 ________
4 ________
5 ________
6 ________
7 ________
8 ________
9 ________
10 ________
11 ________
12 ________
13 ________

☐ AREAS SAMPLED ON SEPARATE SHEET

____
INSTRUMENT USED

____
SIGNATURE

1076 269

ATTACHMENT 4.7

DAWN MINING COMPANY

INSTRUMENT USED

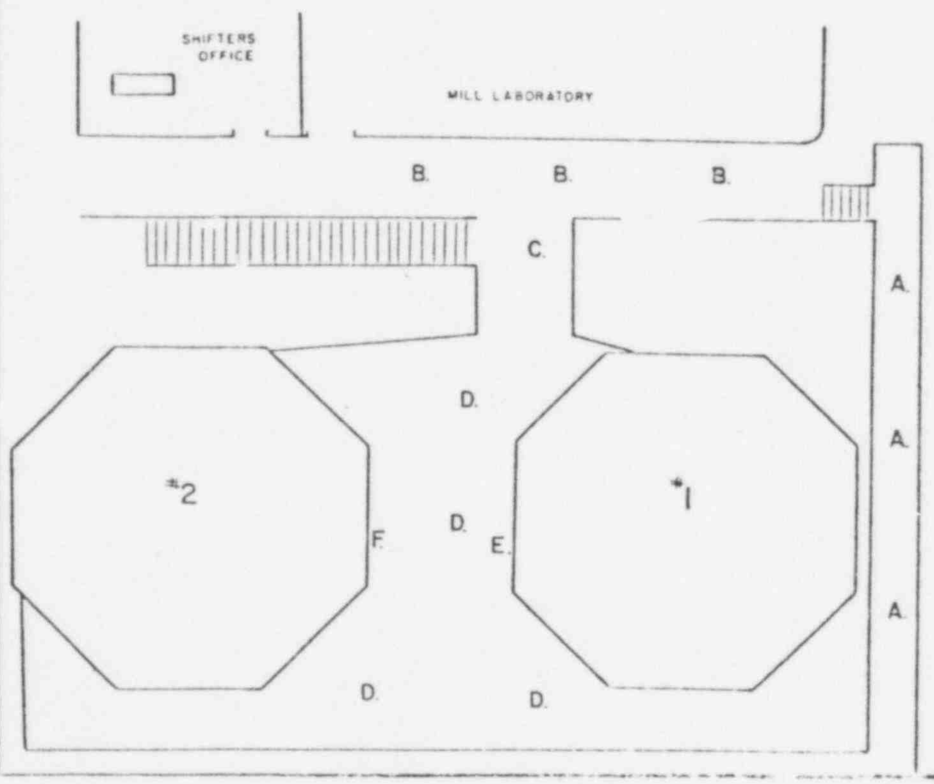
DATE

SIGNATURE

CLARIFIER SURVEYS

	READINGS MR/HR
A. Control panel walkway	
B. Bulletin board area	
C. Top of stairs	
D. Area between clarifiers	
E. 6" from #1 clarifier	
F. 6" from #2 clarifier	

TOP VIEW



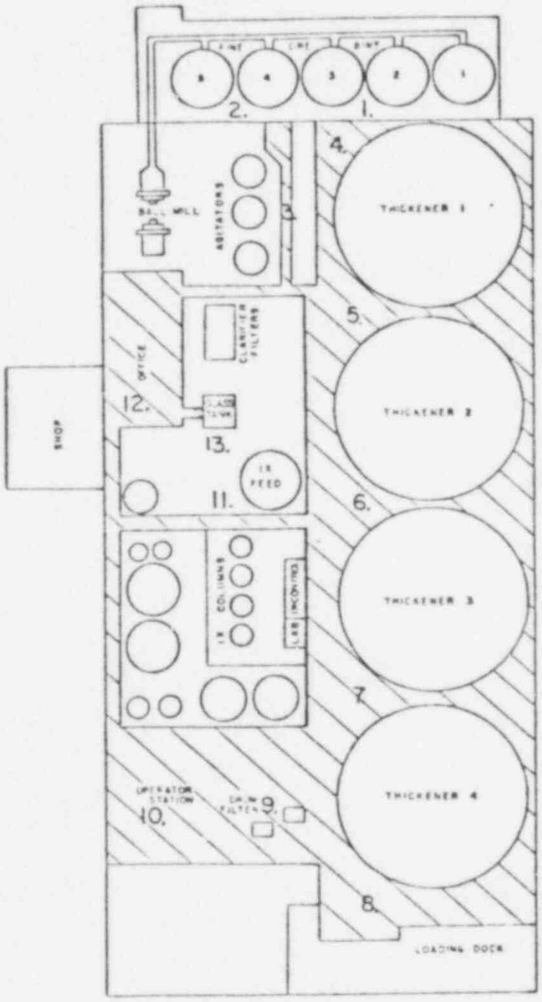
1076 270

ATTACHMENT 4.7

DAWN MINING COMPANY

MILL BUILDING (floor plan)

UPPER LEVEL



____
DATE

MONTHLY SURVEY

DOSE RATE MR/HR

1. ______________
2. ______________
3. ______________
4. ______________
5. ______________
6. ______________
7. ______________
8. ______________
9. ______________
10. ______________
11. ______________
12. ______________
13. ______________

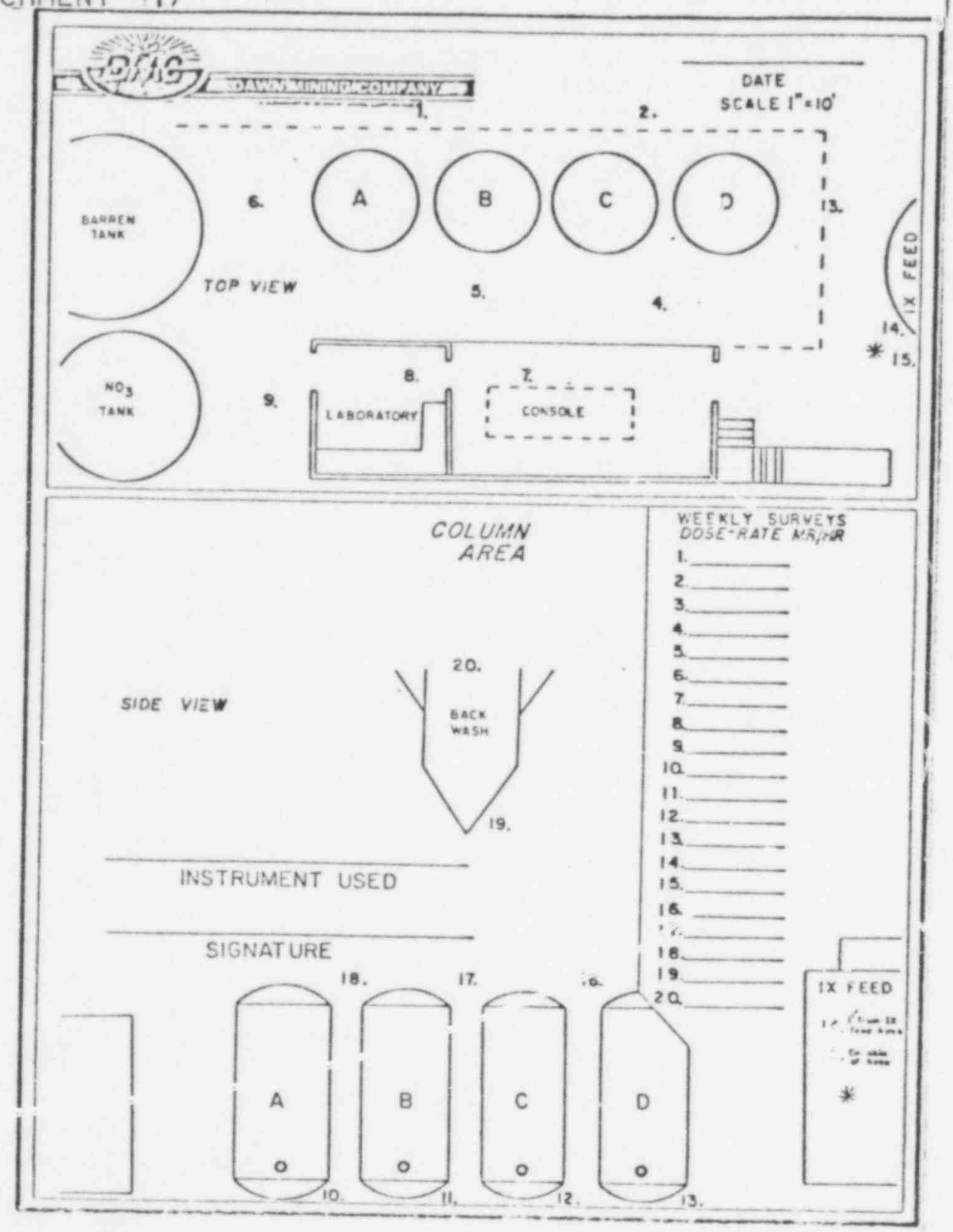
☐ AREAS SAMPLED ON SEPARATE SHEET

____
INSTRUMENT USED

____
SIGNATURE

1076 271

ATTACHMENT 4.7



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(6) Environmental Monitoring Program

Procedures for controlling effluent release, for performing radiological monitoring and surveys, and for recording and reporting results will conform to applicable regulations. The monitoring program is designed to provide data that may be compared with applicable standards for concentrations of individual radionuclides. The program outlined here reflects an expansion of the monitoring carried out under the old license.

Analyses of environmental monitoring data will be available for review by the Radiation Control Unit of the Washington State Department of Social and Health Services. Data in the report will be tabulated quarterly.

Air-Particulates

As outlined earlier under monitoring the work environment a continous air sampling unit monitors the exhaust from the yellow cake dryer Roto-Clone.

In addition grab samples are taken on the roof at the exhaust from the leach circuit and at the crusher dust collector exhaust on a monthly basis.

To allow assessment of the potential exposure of the public to plant releases a series of sampling sites has been selected as shown in Attachment 4.8. These sites are located at three of the property boundaries, the nearest residence and a background site located at Tum Tum, WA. These locations and types of sampling have been chosen on the basis of an analysis of the potential exposure pathways to Biota and man, computation of the anticipated releases from the plant, local meteorology andevaluation of results from the existing monitoring program.

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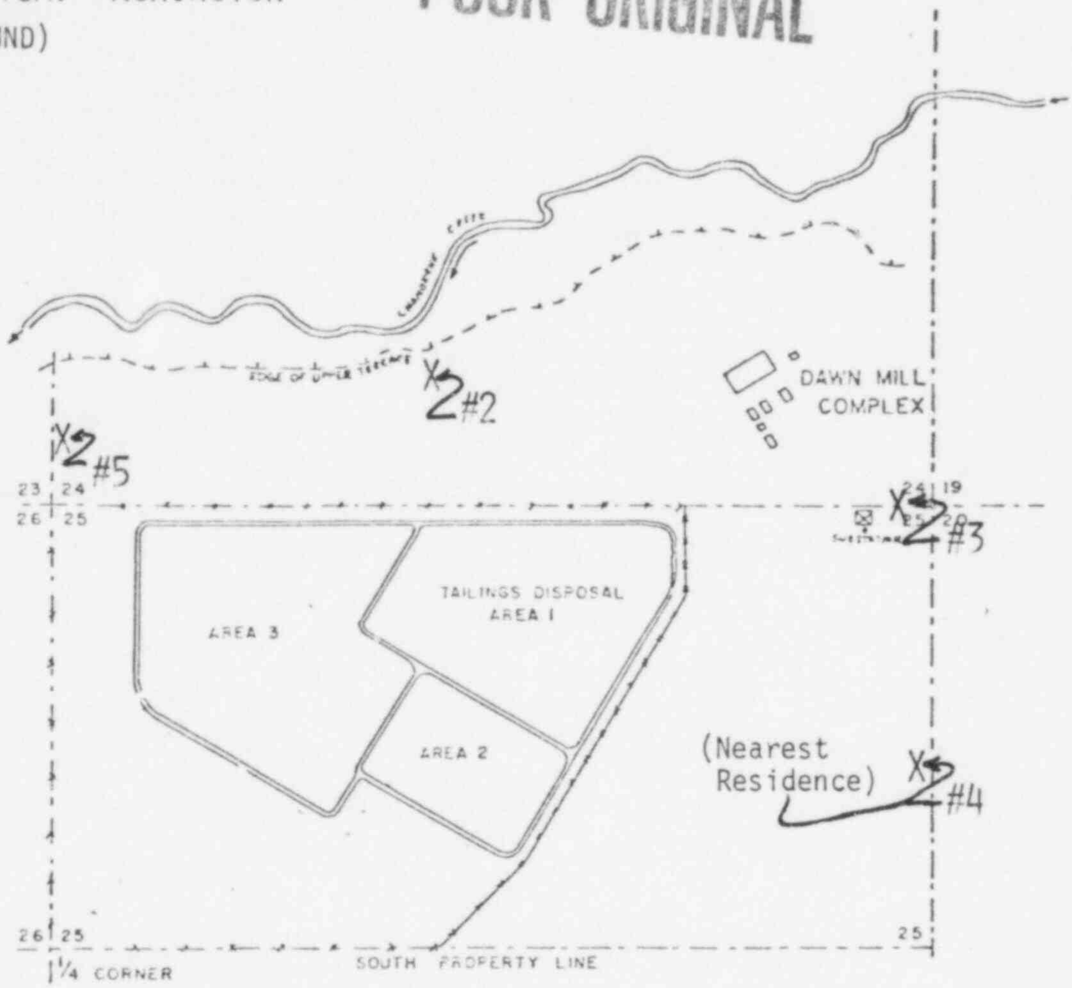
ATTACHMENT 4.8

STATION NO. 1 LOCATED
AT TUM TUM, WASHINGTON
(BACKGROUND)



AIR SAMPLING LOCATIONS

PLAN MAP

DAWN MINING COMPANY

MILL & TAILINGS POND AREA

FORD, WA.

1" = 1200'

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Air-Particulates cont.

Continuous low volume air samplers will be placed at these sites and measurements taken as summarized in Table 4.2.

Air-Radon Gas

Radon gas samplers will be placed at the locations shown in Attachment 4.8. Sampling regime is outlined in Table 4.2.

Water-Groundwater

To validate the integrity of the tailings retention system and to document any migration of radionuclides due to accidental seepage from the tailings pond, grab samples (about 6 liters) are collected from five monitoring wells (see Attachment 4.9) and analyzed as outlined in Table 4.2. Sensitivities of analysis of about one picocurie per liter are anticipated.

There are approximately 30 wells within a 2 KM distance of the tailings pond that are used for drinking water or watering of livestock or crops. Due to this large number, four wells have been chosen as representative and are shown in Attachment 4.10. These wells will be sampled as outlined in Table 4.2.

If analysis of sample data from the water surveillance program in the vicinity of the site indicates an excessive presence of radionuclides, corrective measures will be selected, appropriate to the evolving situation, and may possibly include the installation of collection wells downstream of the tailings pond to collect and to pump seepage water back into the tailings pond.

Domestic water for workers will be sampled and analyzed as specified by the Department of Social and Health Services.

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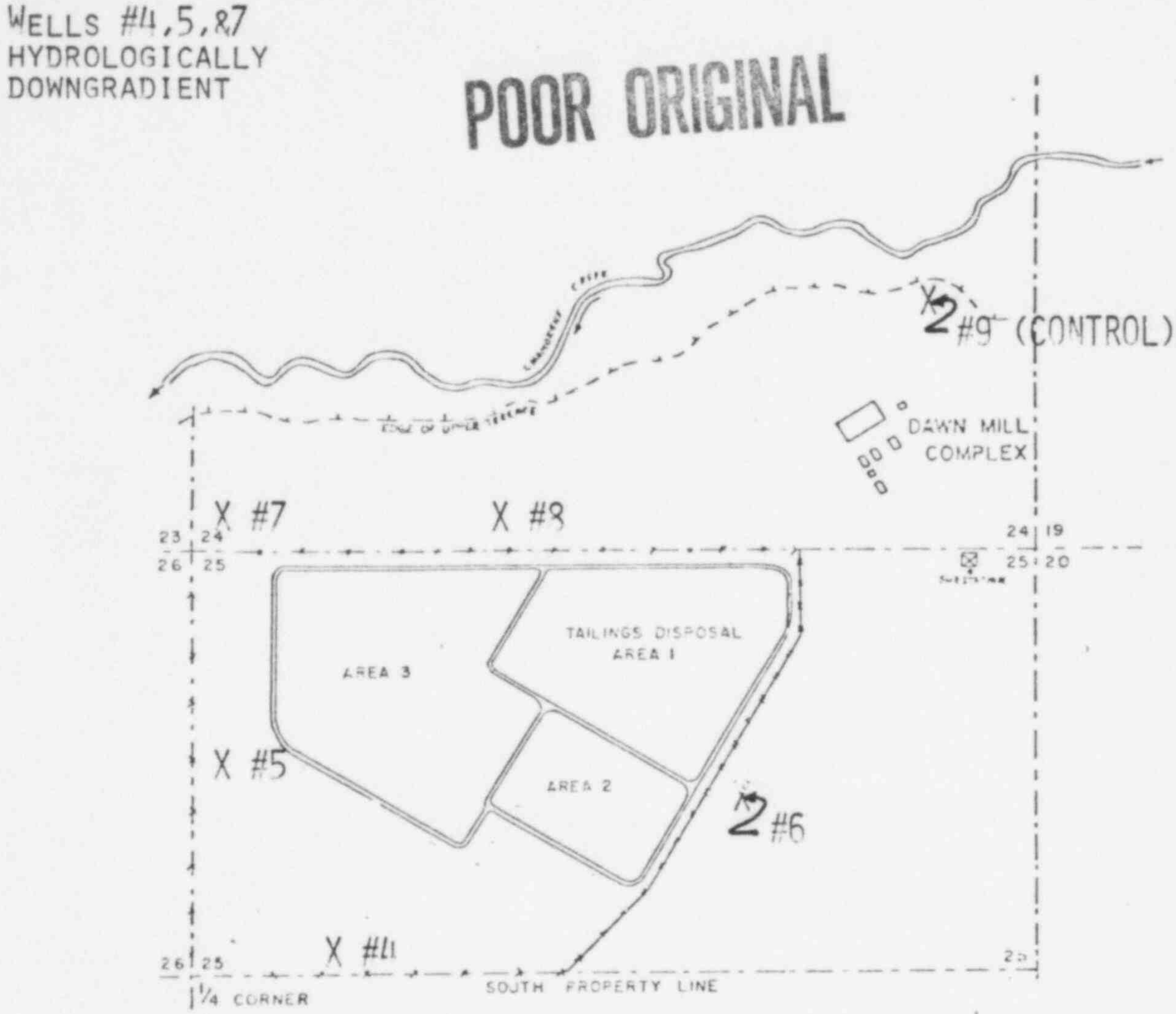
Table 4.2

ENVIRONMENTAL MONITORING PROGRAM
DAWN MINING COMPANY

Type of Sample	Sample Location: Number	Location	Type	Frequency	Sample Measurement: Frequency	Type of Measurement
Air - Particulates	Five	As shown in Attachment 4.8	Low Volume continuous	Weekly filter change or more frequently as required by dust loading	Quarterly composite, by location, of weekly samples	Natural uranium, Ra 226, Th 230, Pb 210
	One	Yellowcake dryer and packaging stack	Low Volume continous	Every 2 days	Every 2 days	Long and short decay Alpha counts
	Two	Exhaust from leach circuit and crusher dust collector	Grab	Monthly	Monthly	Long and short decay Alpha counts
Air - Radon Gas	Five	As shown in Attachment 4.8	Continuous for one week	One week per calendar month representing approximately the same period each month	Monthly	Rn 222
Water - Groundwater	Five	As shown in Attachment 4.9	Grab	Monthly (first year)	Monthly (first year)	Natural uranium, Th 230
				Quarterly (after first year)	Quarterly (after first year)	Ra 226
					Annually	Pb 210, Po 210
	One	Well #9 as shown in Attachment 4.9 (for background)	Grab	Quarterly	Quarterly	Natural uranium, Ra 226, Th 230
					Semi Annually	Pb 210, Po 210
	Four	Drinking wells as shown on Attachment 4.10	Grab	Quarterly	Quarterly	Natural uranium, Ra 226, Th 230
Water - Surface Water	Three	As shown in Attachment 4.10	Grab	Quarterly	Quarterly	pH, Natural uranium, Ra 226, Th 230
					Semi annually	Pb 210, Po 210
Direct Radiation	Five	Same stations shown in Attachment 4.8	Continuous passive integrating device (TLD's)	Quarterly change of passive dosimeters	Quarterly	Quarterly measurement of X + Gamma ray exposure rates
Surface Soil	Five	Same stations shown in Attachment 4.8	Grab-Approx. 2 lbs. from top 2 in. by three feet	Annually	Annually	Natural uranium, Ra 226, Pb 210
Vegetation (forage)	Three	From animal grazing areas down wind from mill complex	Grab-Approx. 2 lbs. dry weight	Annually (to be discontinued if no positive found in initial sampling period)	Each sample	Ra 226, Pb 210
Fauna - Terrestial	Five	Same stations shown in Attachment 4.8	Less than 10 individuals - Rodents, Hares	Annually	Total sample	Ra 226, Th 230
Fauna - Aquatic	-	-	-	To be sampled only if results of water samples indicate contaminants exceeding 80% allowable limits		

1075 276

ATTACHMENT 4.9



MONITOR WELLS
PLAN MAP
DAWN MINING COMPANY
MILL & TAILINGS POND AREA
FORD, WA.

1" = 1200'

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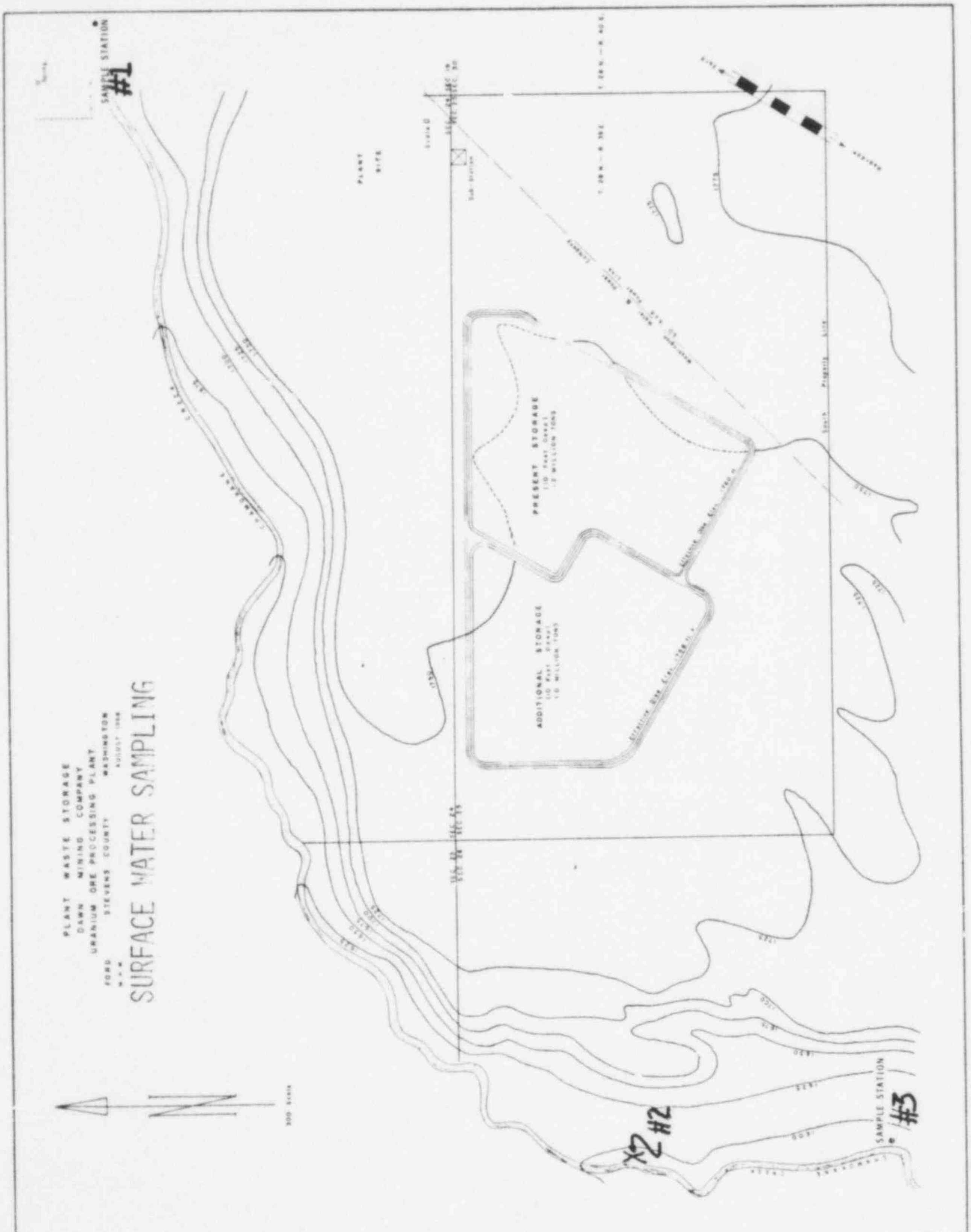
ATTACHMENT 4.10

SAMPLE WELLS USED FOR DRINKING WATER
OR WATERING OF LIVESTOCK OR CROPS

DAWN MINING COMPANY

ATTACHMENT 4.11



1076 279

ATTACHMENT 4 CON'T

Water - Surface Waters

Surface water samples have been routinely taken since 1958 from Chamokane Creek at established monituring stations above and below the mill site area. (Stations 1 and 3 Attachment 4.11) An additional monitoring stations will be established (Station 2) at a point coinciding with the surface outcrop of the impervious thick layer of clay underlying the mill area. This clay layer dips towards the west and any tailings pond seepage is channeled towards this new monitoring station. In the past pH, Ra 226, and Th 230 were the parameters analysed. In addition to the above, natural uranium will be checked.

Direct Radiation

Continous passive intergrating devices (TLD's) will be placed at the sampling stations outlined in Attachment 4.8.

Soil

Soil samples will be collected once per year at the unrestricted area air sampling stations (specified in Attachment 4.8). The samples will be analysed for uranium, Lead 210 and radium-226. Each sample will be approximately two pounds composited from the top one-two inches of soil in an area of approximately three square feet.

Vegetation

Samples of native vegetation, about 2 pounds dry weight, primarily grasses and other herbaceous species grazed by indigenous animals will be collected once per year at livestock grazing areas downwind from the mill complex. The samples will be analyzed for Lead 210 and radium-226.

1076 280

Fauna - Terrestial

Samples of native fauna, primarily rodents and hares, will also be collected in the same areas and analyzed for thorium-230 and radium-226. These samples will be obtained at approximately the same time as the vegetation samples are collected. The number of individuals will not exceed ten. Depending on the analytical techniques to be employed, the specimens will be collected by either live or kill-trapping.

Fauna - Aquatic

There is no evidence that toxic substances have reached Chamokane Creek. Thus an aquatic fauna sampling program has not been proposed. However, if the surface water monitoring program indicates any possibility of surface water contamination, a program designed to monitor the effects of such contaminants on the aquatic fauna will be implemented. (This program would be implemented only if water samples indicate contaminants exceeding 80% allowable limits.)

1076 281

ATTACHMENT No. 5

1076 282

ATTACHMENT NO.5

Application for Radioactive Materials License Item #15

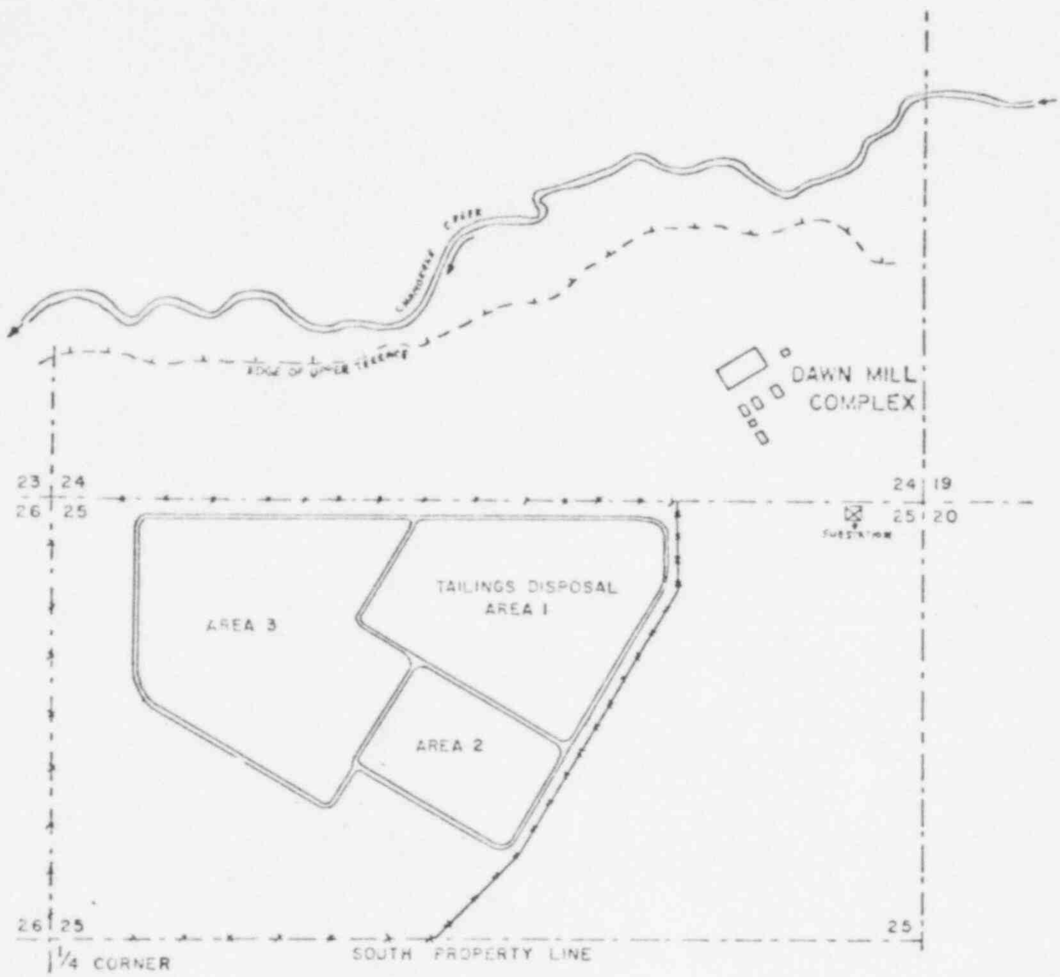
Waste Disposal

Attachment 5.1 illustrates the layout of the tailings facilities presently in use. Area #3 dike was raised in March 1979 as per design submitted to and approved by D.S.H.S. It has a capacity of 200,000 dry tons of tailings. This represents only 15 months of production. By July 1980, additional tailings capacity will have to be provided for the continued operation of the plant. This discussion will first focus on present practice and the turn to the new proposed long-term tailings disposal plant.

Walkers Prairie, the site of the Dawn mill complex, is a northeast trending valley about two miles wide and 15 miles long. It is bordered along the northwest by rimrock cliffs of plateau basalts and along the southeast by rounded granitic hills. A few erosional remnants of basalt veneer the flanks of the granitic terrain.

The valley floor is a flat plain of glacial outwash and flood deposits cut by the meandering channel of Chamokane Creek. At the millsite, valley floor elevations range from 1740 to 1760 feet above sea level, while Chamokane Creek has incised its channel to an elevation about 100 feet below the Dawn mill level. Intervening cut banks between stream level and the main valley floor terrace above are very steep but in most areas are stabilized by fir/pine vegetation.

ATTACHMENT 5.1



EXISTING FACILITIES
PLAN MAP
DAWN MINING COMPANY
MILL & TAILINGS POND AREA
FORD, WA.

1" = 1200'

1076 284

ATTACHMENT NO. 5 CON'T

Sub-Surface Conditions

The tailings disposal area is underlain by a granite basement buried beneath thin remnants of Columbia River Basalt and a thick accumulation of glacioflurial clays, sands, and bouldery gravels. Attachment 5.2 shows an interpretive geologic profile of the material underlying and adjacent to the millsite. A detailed measured section of the glaciofluvial deposits which underlie the tailings disposal area is presented in Attachment 5.3.

Present Tailings Disposal

The present tailings disposal system is described in greater detail in the existing license and amendments. What follows is a brief summary of present practice.

Liquid and solid process wastes are discharged to the tailings pond by means of a PVC pipe. The following amounts are typical:

Solids	500 ton/day
Solution	600 ton/day

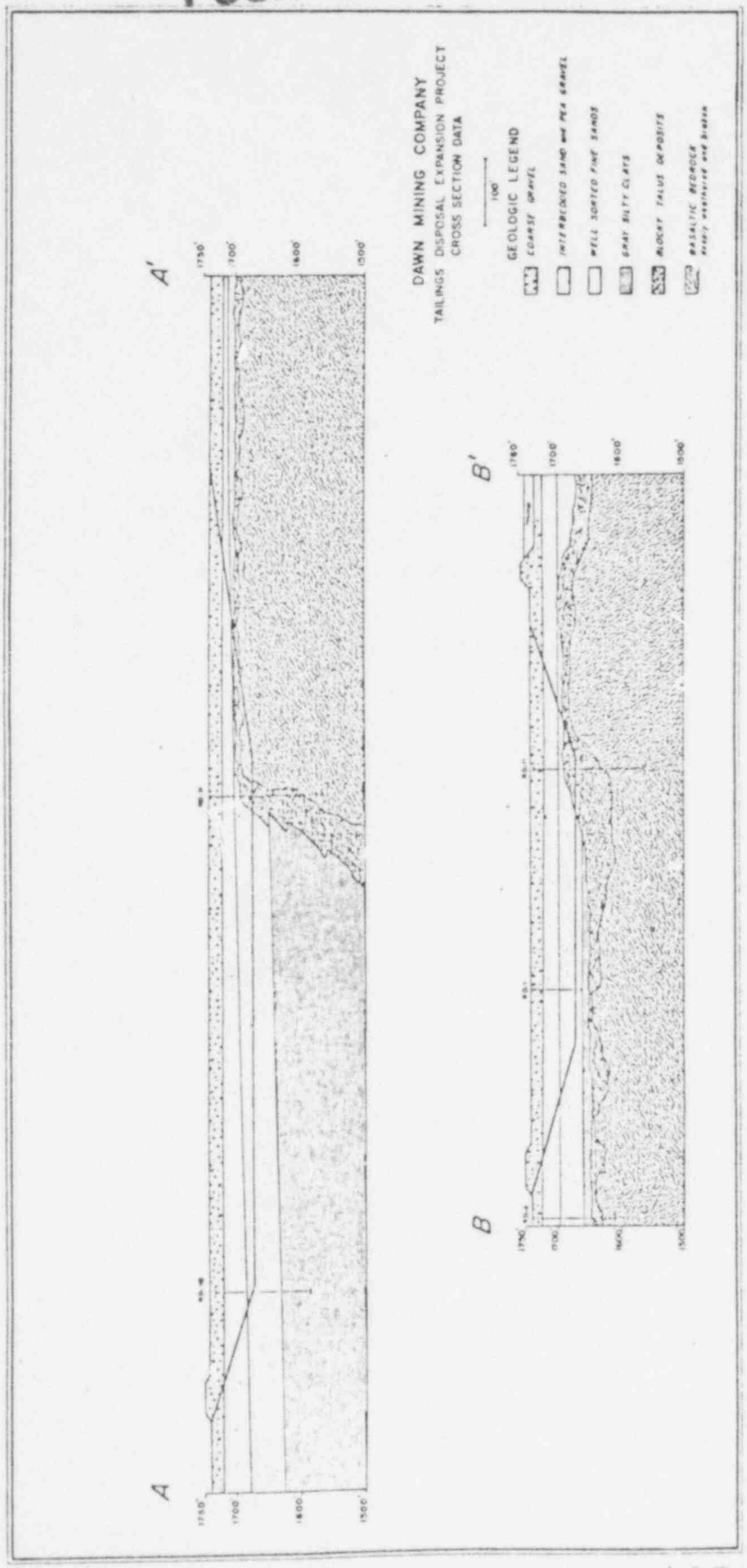
The solids contain radium daughters at near the quantities found in the original ore and less than .01% U_3O_8. The solution has been analysed as follows:

Total Suspended Solids	27810 mg/L	Uranium	30.15 mg/L
Arsenic	1.24 mg/L	pH	1.6
Zinc	15.9 mg/L	Radium	530 pCi/L
NH_3	205 mg/L		

The existing pond contains approximately 2.0 million tons of tailings at 70% solids. Attachment 5.4 shows a typical section through the present dike.

ATTACHMENT 5.2

POOR ORIGINAL



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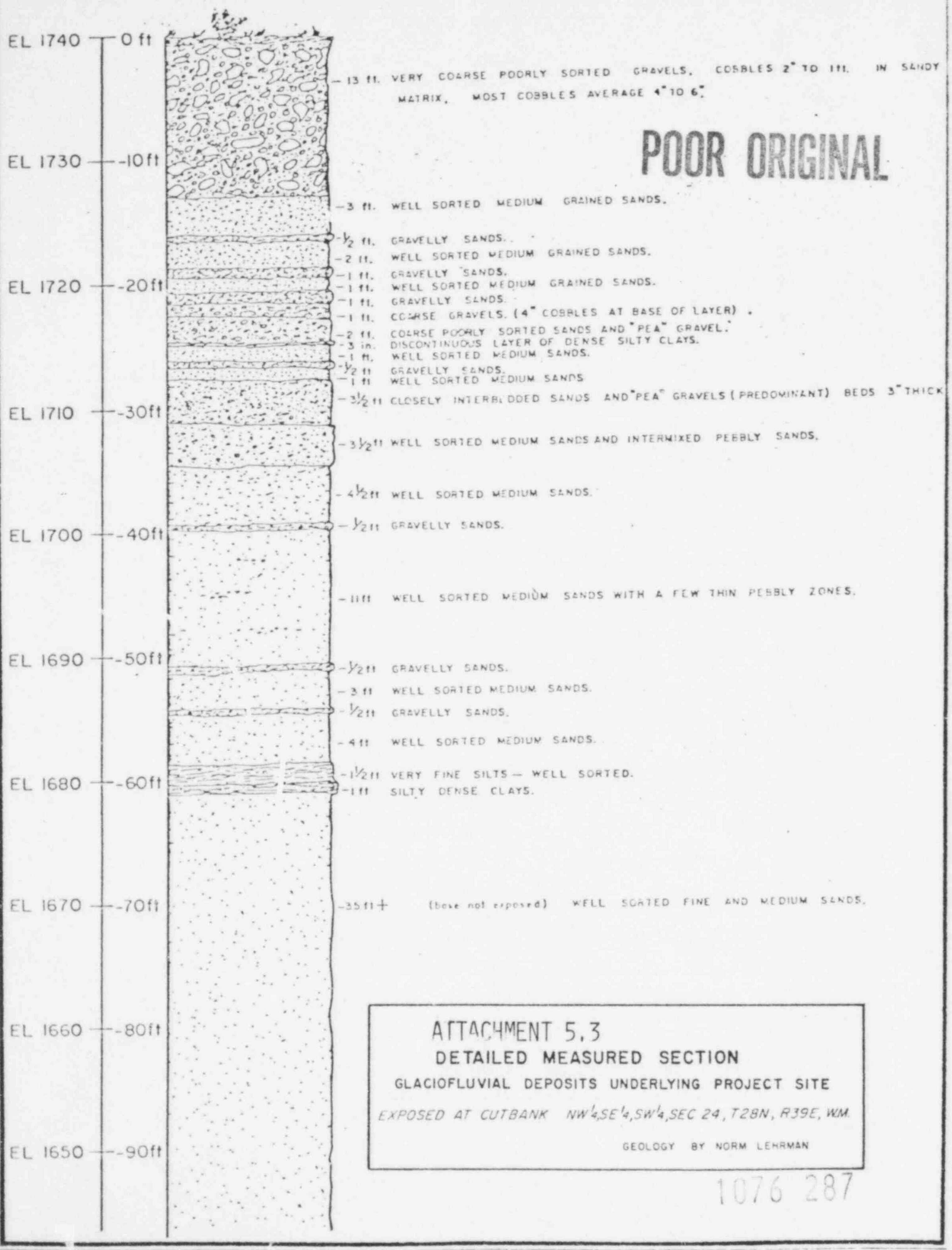


POOR ORIGINAL

ATTACHMENT 5.3

DETAILED MEASURED SECTION

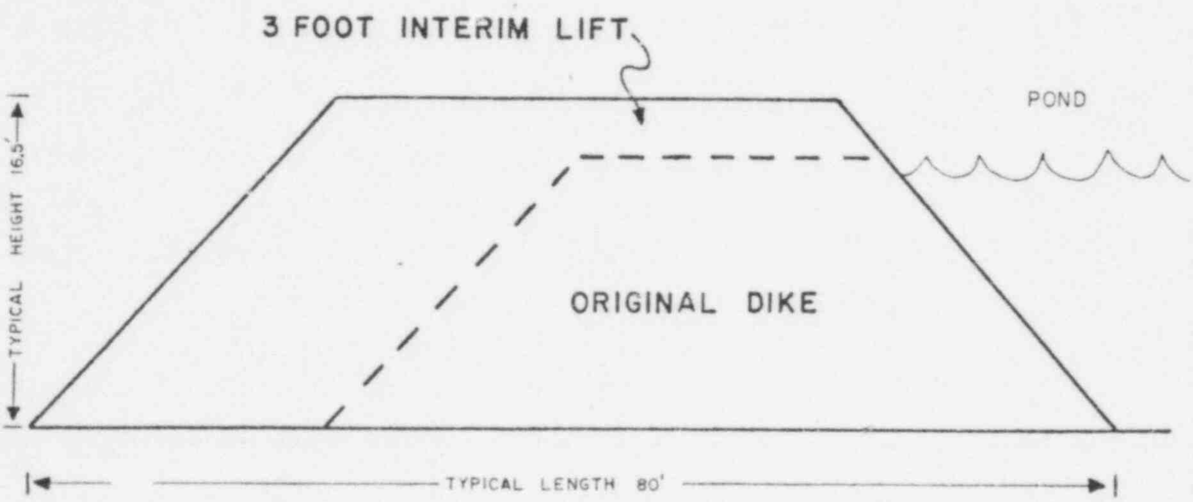
GLACIOFLUVIAL DEPOSITS UNDERLYING PROJECT SITE

EXPOSED AT CUTBANK NW¼, SE¼, SW¼, SEC 24, T28N, R39E, W.M.

GEOLOGY BY NORM LEHRMAN

1076 287

DAWN MINING COMPANY
FORD, WASHINGTON



1076 288

ATTACHMENT 5.4

TYPICAL CROSS SECTION
PRESENT TAILINGS DAM

Present Tailings Disposal con't.

Process wastes enter the pond near the center of the impoundment area. Classification occurs leaving the sands near the point of entrance with the slime portion spreading out over the rest of the pond. Solution backs up in the lower elevations of the pond. The entire pond area is enclosed with a six-strand barbed wire fence. This fence is posted with no admission and radioactive signs. The gate to the area is kept locked.

Proposed Long-Term Tailings Disposal

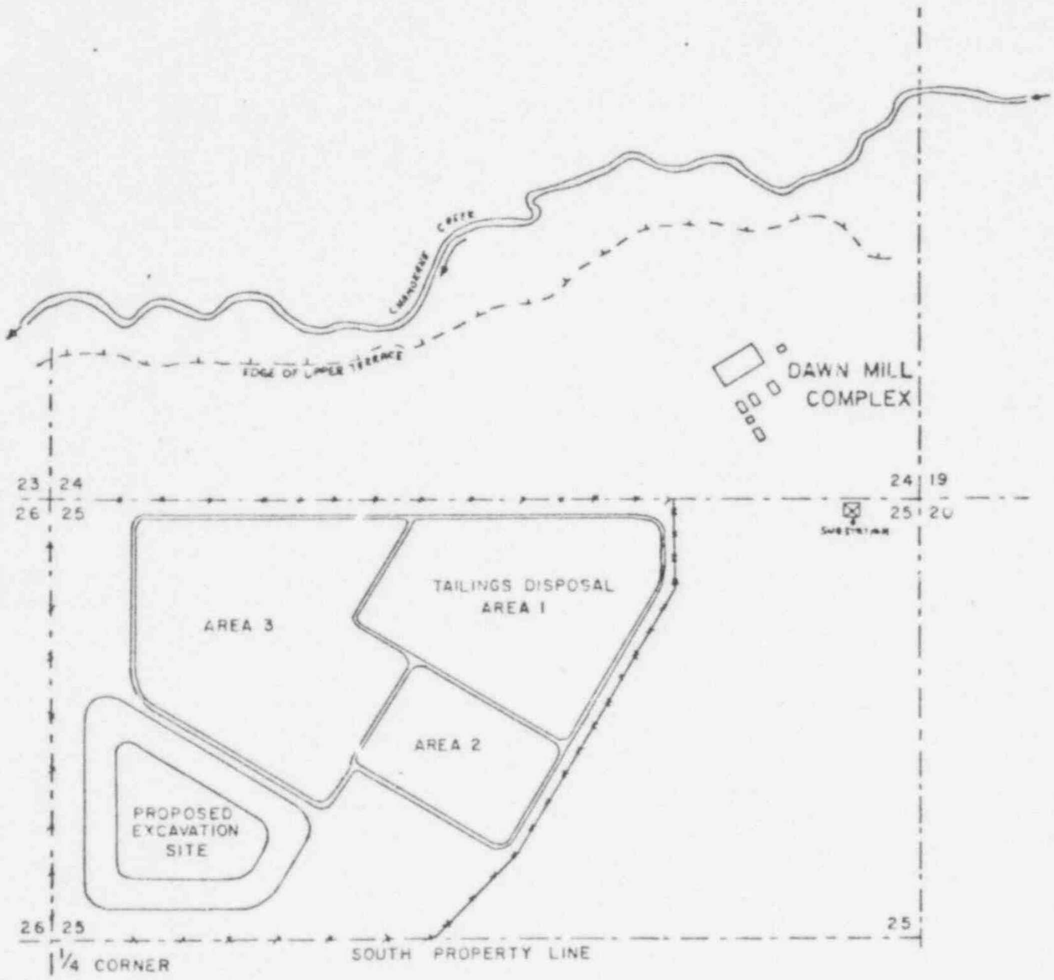
In order to provide an environmentally sound long-term tailings disposal facility, Dawn has evaluated many options available. The following proposal details what Dawn feels is the best choice in light of the new regulations presently under development and economic considerations.

A. Impoundment Structure

A new tailings disposal area will be developed for subgrade disposal of future tailings. A pit will be excavated immediately to the south of the present tailings dams. (Attachment 5.5). The surface area at natural ground level will be 1,224,800 square feet (28.12 acres). The structure would be 65 feet deep, below grade, with inslopes at 1 vertical on 3 horizontal. Some of the excavated materials will be used to construct a 35-foot high dike/stockpile around the new structure, and the remainder will be strategically stockpiled around the periphery of the existing impoundment. The stockpiled material will later be used to cap the entire disposal facility after final termination of milling operations. (Attachment 5.6).

1076 289

ATTACHMENT 5.5

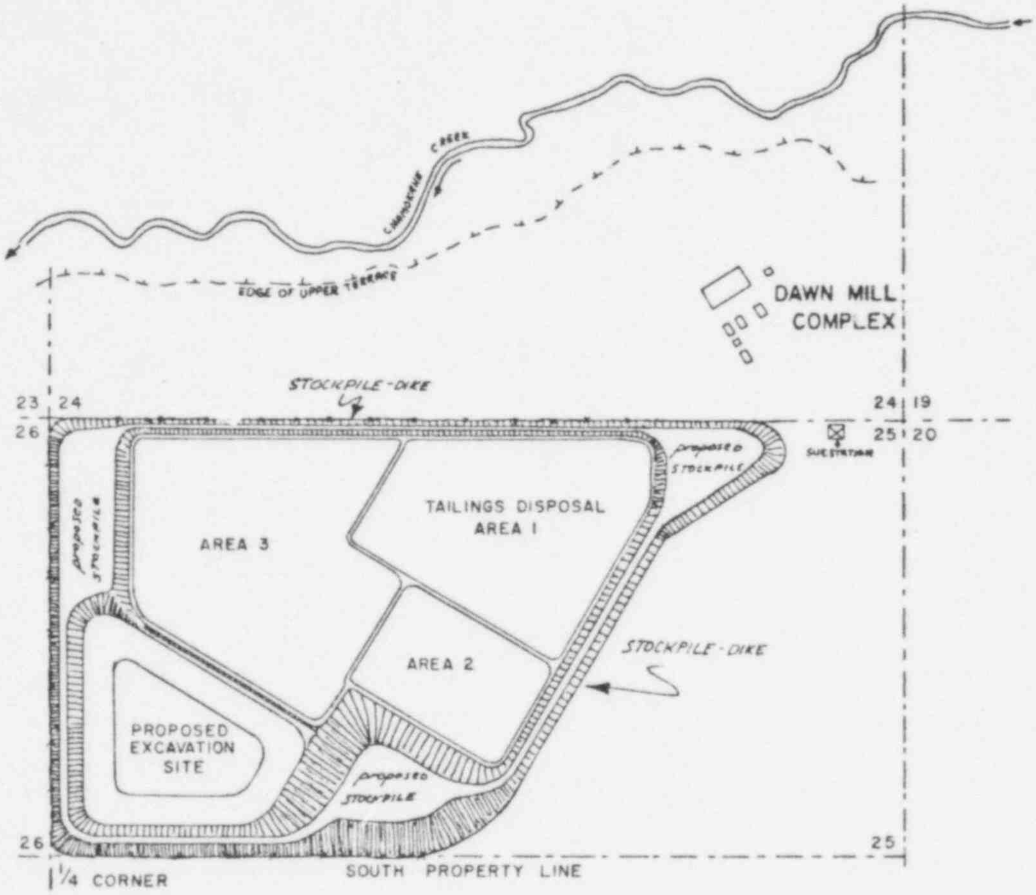


PLAN MAP
DAWN MINING COMPANY
MILL & TAILINGS POND AREA
FORD, WA.

1" = 1200'

1076 290

ATTACHMENT 5.6



PLAN MAP
OF
PROPOSED PERIPHERAL RECLAMATION STOCKPILES
MILL & TAILINGS POND AREA

1" = 1200'

ATTACHMENT NO. 5 CON'T.

A. Impoundment Structure con't.

The total volume available for tailings storage to ground level will be 2.05 million cubic yards, which is adequate for approximately thirteen years of mill production at the present rate of 160,000 tons per year. The five vertical foot lined area above ground level may be used for temporary solution storage during the final stages of pond life.

The excavation will principaly encounter the sands and gravels shown earlier in Attachment 5.2. It is possible that the surface of the deeply weathered basalt may be encountered in the western most part of the pit floor.

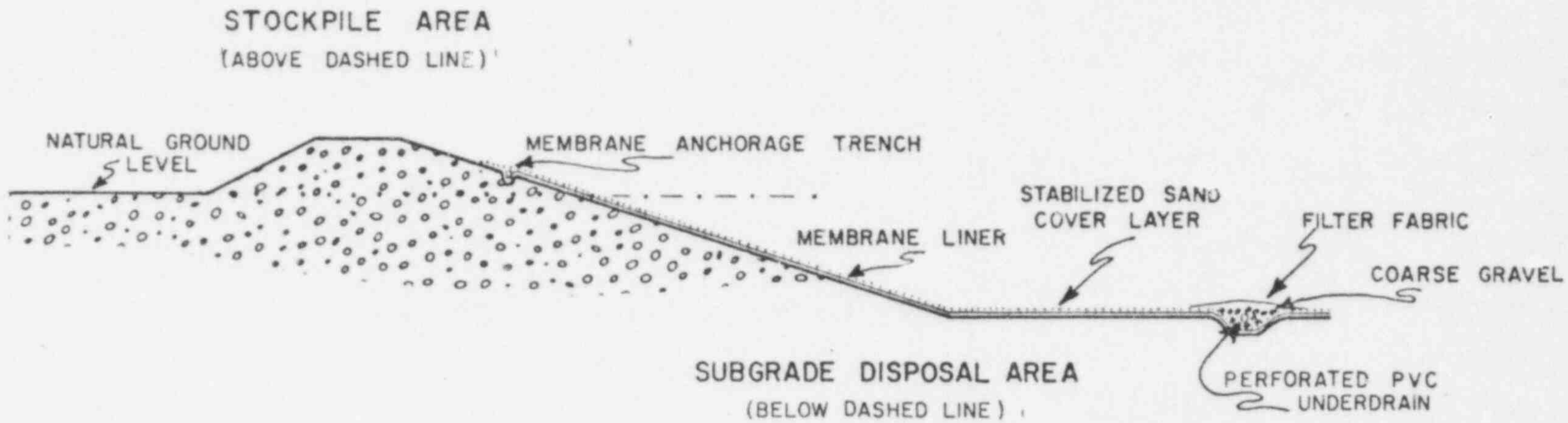
Where the proposed excavation adjoins the existing dike impoundment, a fifty foot wide bench will be preserved at the downstream toe of the dike to assure structural integrity of the dam foundation while pit excavation is underway.

Pit inslopes will be maintained at 3 horizontal on 1 vertical. If sharp or irregular geologic units are encountered by the excavation, they will be blanketed with fine sands to provide a smooth base for liner installation.

Ingress and egress ramps for the excavation work will be located at the northern and eastern extremes of the pit area.

The five foot, membrane liner portion of the above gound dike mentioned previously may be used for solution storage when the pit is nearly full. A typical section of the overall dike/stockpile is shown in Attachment 5.7. Material to be used for dike construction will be taken from the

DIKE/STOCKPILE & SUBGRADE DISPOSAL FACILITY



ENGINEERING SECTION

A. Impoundment Structure Con't.

upper layer of sands and gravels from which all previous dikes have been constructed at Dawn. Maximum rock dimension is less than 4 inches. Each lift during construction will be 12" thick and will be compacted by use of a minimum 25,000 pound vibratory compactor. This will allow compaction levels in excess of Department of Ecology requirements. Moisture content will be maintained so as to insure proper compaction. The original safety berm and dam construction removed most of the topsoil from the area; what remains will be excavated. The foundation material is identical to embankment fill material, eliminating the need for any base preparation other than scoring the surface. The previous dams constructed at the site have shown good bonding between embankment and foundations. The upstream side of the dike will be lined by the same method as the subgrade portion of the tailings impoundment. Residual freeboard will be maintaned greatly in excess of 5 feet. Side slopes on the dike will be 3h:lv upstream and 2h:lv down stream. Top width will be 30 to 35 feet, double the Department of Ecology requirement of 15 feet for this height of dam.

It should be noted that the upper portion of this dike is basically a reclamation material stockpile, under no foreseen circumstances to be used as an empoundment dike beyond a level five feet above ground surface. As described below, this portion will be lined and utilized only for temporary solution storage.

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B. Tailings Pond Liner

The entire pit floor and side slope surface will be lined with a fabric reinforced 30-mil synthetic rubber (Hypalon) liner. The liner membrane will be carried up the dike inslope to a level five vertical feet above the original ground surface elevation in order to permit the lower part of above-grade area to be utilized for solution storage during the final stages of pond life.

A one foot thick cover layer of stabilized sand will be placed over the membrane to prevent aerodynamic wind billowing and to shield the membrane from ultraviolet rays for longer life. Membrane anchorage will be achieved by means of peripheral trench burial in accordance with recommended practice.

C. Underdrain System

Since the proposed facility will be fully lined, normal dewatering by means of seepage into the substrate is precluded. It is therefore necessary to provide a system capable of aiding in the dry-out phase of reclamation and long-term stabilization.

Engineering studies are still in progress to determine the optimum configuration for the drainage duct system. Generally, the system envisioned would include an underdrain grid of French or pipe drains feeding into a combined French/perforated PVC pipe collection sump where solutions can be pumped to the surface for disposal by evaporation. It will likely be necessary to cover the drain system with a polyester filter fabric to prevent clogging of the drainage ducts with tailings fines.

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ATTACHMENT NO. 5 CON'T.

C. Underdrain System Con't.

The potential for inducing liquid migration towards underdrain lines by electrokinetic densification proceedures developed by the Bureau of Mines (Sprute and Kelsh, 1974) is being researched, and may be incorporated into the dewatering plan if feasable.

D. Process Water

Elimination of seepage from the tailings pond area by use of the new lined disposal area will result in a solution disposal problem. If some means of handling the excess solution is not developed, the pond area will fill up to the freeboard limit long before the full life of the pond is reached.

Due to the pressing need to develop a new tailings disposal area, Dawn has concentrated its engineering and design work on the actual pond excavation, etc. As soon as personnel are available, attention will then turn to process water management. It will be three years before the solution build up in the pond will become critical. Present methods being examined for managing the process water problem are:

1. Solution recycle to mill
2. Treating solution for discharge
3. Spray evaporation ponds
4. Dry tailings deposition
5. Other

Final design of the process water management facility will be submitted for approval to the D.S.H.S. on a timely basis.

ATTACHMENT No. 5 CON'T.

Interim Tailings Disposal

Dawn Mining Company has filed for an amendment to the present license to allow a three foot lift of the present tailings disposal dike. Approval of this amendment will allow continued operations while the long term tailings disposal proposal and license renewal application is approved.

It is hoped that this dike lift will not be required at all. If the subgrade tailings disposal proposal is approved on a timely basis, i.e., January 1980, it will not be needed. However, communications with the D.S.H.S. and the N.R.C. have indicated that this may not be possible. Hence, the contingency plan outlined in the application for amendment. Construction of the three foot lift will extend the life of the present pond until July 1981.

Reclamation and Long Term Stabilization

Pursuant to the Washington State "Mill Licensing and Perpetual Care at of 1979" and based on the guidelines presented in NUREG-0511, Draft Generic Environmental Statement, Dawn has developed the following planned program for reclamation and long term stabilization of the tailings pond and mill site. This plan may be modified upon promulgation of final regulations or those in effect at the time of the event.

Tailings Pond

The following steps will be taken to stabilize the present and new tailings disposal areas:

1. The tailings will be allowed to dewater for a period of 1-3 years to allow heavy equipment to work on the tailings surface. Interim dust control measures will be taken to control wind dispersion on tailings

1076 297

ATTACHMENT No. 5 CON'T.

Tailings Pond con't.

2. Tailings surface will be graded to enhance drainage.
3. A layer of clay 2 feet thick will be placed and compacted over the tailings surface.
4. An additional layer of fill 8 feet thick will be placed overlaying the clay.
5. No topsoil will be added to this cover since the area surrounding the project site has a minimal natural "A" horizon soil development.
6. The cover over the tailings will be graded and contoured so as to eliminate the possibility of ponding rainfall over the area. In addition the out-slopes of the pile will be reduced to a slope of 5 horizontal to 1 vertical by the addition of fill material.
7. The entire area will be seeded and fertilized to stabilize the cover. Natural re-forestation will ensue fairly rapidly as evidenced by 20 foot plus trees presently growing on the abandoned tailings berm around areas #1 and 2.
8. The revegetation effort will be monitored for success and remedial measures will be taken to insure coverage of the area.

Mill Site

Decommissioning of the mill site will conform to regulations in effect at the time of closure. Present decommissioning plans which may be modified upon promulgation of final regulations, envision the following steps:

1. Contaminated process vessels will be buried in the tailings pile which will then be reclaimed and stabilized as outlined previously.

1076 298

Mill Site con't.

2. Mill buildings will be dismantled or decontaminated and left in place. Clean up will be thorough enough to permit unrestricted use of the buildings.

3. The site previously used for ore stockpiles will either be covered with 2-3 feet of fill or excavated to remove the contaminated soils. If the latter method is used the material removed will be disposed of at the tailings pile. Again the object will be to permit unrestricted use of the site.

Surety

Dawn Mining Company will post a bond in compliance with Sections 10, 11 and 12 of The Washington State "Mill Licensing and Perpetual Care Act of 1979". The amount of this bond will be $2.5 million. This amount is the current target for Dawn's reclamation fund which is presently being set aside on a monthly basis for future use. The target sum is based on a consultant's study done for Dawn Mining Company in March of 1977. (Attachment 5.9). Studies are in progress to confirm or revise the $2.5 million estimate. The amount of the bond will be revised accordingly.

Perpetual Care and Maintenance

Dawn Mining Company will comply with the provisions of the Washington State "Mill Licensing and Perpetual Care Act of 1979" Sections 3.1 (b), 2(b), 6, 7 and 8, or the current laws in effect at the time of the event.

1076 299

Other Wastes

Pieces of equipment and large process vessels removed from the mill that are contaminated have been stored above ground in a fenced and posted area. If the proposed subgrade disposal method is approved for tailings disposal, Dawn proposes that these comtaminated items be buried at the bottom of the new tailings facility.

ATTACHMENT 5.9

POOR ORIGINAL

STABILIZATION OF TAILINGS AND DECONTAMINATION OF MILL SITE - DAWN MINING COMPANY MILL NEAR FORD, WASHINGTON

MARCH - 1977

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ATTACHMENT 5.9

POOR ORIGINAL

I. THE PROBLEM

The Dawn Mining Company jointly owned by Newmont Mining Corporation and Midnite Mines, Inc., operates a uranium mine/mill complex in Stevens County, Washington. The mill, having a rated capacity of 440 tons ore per day, is situated near Ford, Washington. (Ore is derived from an open pit operation some 20 miles away.) This complex is currently estimated to have four or five more years of life.

Dawn Mining Company is planning ahead to the point in time when operation ceases. A specialized area of attention and need for advance planning, in connection with cessation, is the stabilization of the mill tailings and mill site so as to protect the environment and health and safety of the public.

Specifically Dawn Mining Company has asked for an estimate of what it might cost to perform such stabilization as well as provide for future maintenance and surveillance of the site. This is with the view of immediately beginning to set aside funds on a regular basis so as to have them available at the time of cessation.

1076 302

ATTACHMENT 5.9

POOR ORIGINAL

II. BACKGROUND

This section is intended to acquaint the reader with the general matter of contamination of the environment from milling wastes and relate the Ford mill situation to it.

Nearly 300,000 tons of U_3O_8 have been produced in U. S. to date, generating something on the order of 150 million tons of tailings. Hence, on an historical basis, about 500 tons of tailings are created for each ton of U_3O_8. When one considers that requirements between now and the end of the decade are estimated to be over 1 million tons U_3O_8, possibly from lower grade ores, one begins to visualize the magnitude of the tailings problem.

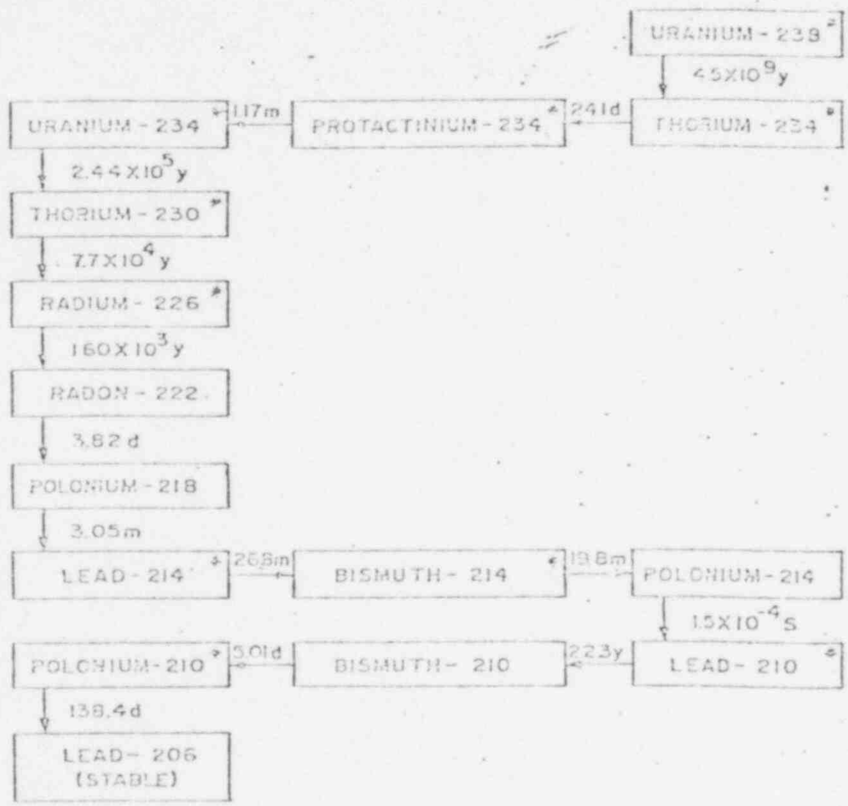
The tailings, as of now, occupy approximately 3000 acres at 42 sites. Sixty-five percent of the acreage and tonnage are at 15 sites connected with currently conducted milling operation; 5% of the area and tonnage are at the sites of 3 mills considered to be on standby; and the remainder (30% of the acres and 20% of the tons) are at 24 locations where mills have been decommissioned or removed.

Although the tailings contain only around five percent of the uranium which was initially in the ore, they contain nearly all the radioactive daughter products. The principal environment and health implications appear to be related to the uranium-238 decay chain (See Figure II-1) primarily thorium-230, radium-226, radon-222, and the progeny from radon-222. Exposure pathways to the general population are:

1026 303

POOR ORIGINAL

ATTACHMENT 5.9



NOTE:
VERTICAL DIRECTION REPRESENTS ALPHA DECAY, HORIZONTAL DIRECTION INDICATES BETA DECAY. TIMES SHOWN ARE HALF LIVES. ONLY THE DOMINANT DECAY MODE IS SHOWN.
* ALSO GAMMA EMITTERS

FIGURE 11-1
RADIOACTIVE DECAY CHAIN OF URANIUM-238

1076 304

POOR ORIGINAL

ATTACHMENT 5.9

1. Radon-222, a gas, escaping to the surface between the grain particles of the tailings material and carried by the wind into habitable structures. Some of the daughter products of radon-222 are retained in the lungs increasing the risk of cancer there.
2. Windblown particulate material lifted from the surface of the tailings, carried down wind, and inhaled, thus exposing the lungs to radiation.
3. Gamma rays from the tailings pile itself which may penetrate the air so as to expose persons on or near the tailings piles.
4. Radioactive and toxic materials from the tailings piles leached into the ground water.
5. Tailings material used in the construction of habitable structures.
6. The mill and ore stockpile sites which always show elevated gamma exposure levels because of contamination by ore as well as processing solids and solutions.
7. Exposure from the milling equipment (or parts of the mill building itself) after dismantling and introduction into the used equipment or scrap market.
8. Contamination of food through uptake and concentration of radioactive elements by plants and animals.

With the probable exception of item (5) attention will probably need to be directed to all the pathways listed above at the time the Ford mill is decommissioned and dismantled. It has one element of uniqueness in that the mill building is entirely of wooden construction.

II-2

1976 305

ATTACHMENT 5.9

POOR ORIGINAL

As the orebody reaches exhaustion towards the end of 1982, the Ford mill will have accumulated nearly 3,000,000 tons of tailings occupying 105 acres. Possibly another 15 acres of ground will have been contaminated at the mill and ore stockpile sites. Unrestrained tailings are thought to have environmental and health implications for distances of around one-half mile, the exact nature of the pattern being a function of the prevailing winds, concentration of radioactive materials in the pile, impediments to air flow, etc. A fish hatchery, a highway, and a number of dwellings are within one-half mile of the tailings. (See accompanying aerial photos.)

The most difficult pathway to restrain is that which results from radon emanation and the one which has received the least attention, from a tailings stabilization standpoint, to date. Two feet of packed earth which has been seeded to support vegetation will essentially shield the gamma radiation and cure the windblown particulate problem. (See Figure II-2.) However, it does little to impede emanation of radon. Some researchers claim that it would take 10 to 20 feet of dry soil to reduce radon significantly; whereas, only a few feet are needed if a high moisture content in the cover material is maintained. Six feet of packed dry cover will eliminate about 95%. If combined with an underlying clay layer, further attenuation could be accomplished. It is our feeling that during the next few years, techniques to control radon without excessive cover will be developed.

When one considers the 1620 year half-life of radium-226, it can be recognized that current stabilization techniques are only an interim control, which will require frequent inspection

1076 306

ATTACHMENT 5.9

POOR ORIGINAL

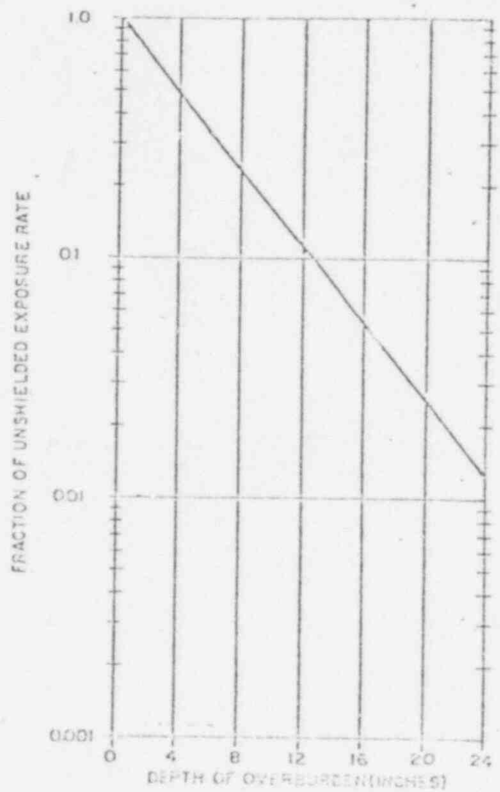


FIGURE 11-2
REDUCTION OF GAMMA EXPOSURE RATE RESULTING FROM PACKED EARTH SHIELDING

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POOR ORIGINAL

ATTACHMENT 5.9

and routine surveillance. Since the time factors involved are possibly greater than the life of a corporate interest, or probably the corporation itself, some arrangement for financing long term surveillance must be considered. On the premise that such surveillance relates to health problems, the states seem to be preparing themselves to take on this role, and they are expecting financing to come from industry, probably in the form of endowment funds.

1076 308

II-4

POOR ORIGINAL

ATTACHMENT 5.9

III. APPROACH TO PROBLEM

In attempting to make a judgment of costs which might attend the stabilization and decontamination aspects of shutdown, it was decided not to pursue it from physical chemistry or biological viewpoints largely because of the apparent low level of general understanding in such areas coupled with the lack of expertise by the authors in these specific disciplines. An estimate based on a detailed engineering design seemed beyond the scope of the assignment and further might not relate to the situation at the time of shutdown.

After considerable research and to more nearly approach what is, at this point, a changing picture of confusing, often broadly expressed, issuances by various federal and state agencies, it was decided to make estimates in more general cost categories based on what is considered to be the current "state of the art" and what it might be five years hence, with emphasis on steps directed toward reducing radon emanation. To implement this approach, information was drawn from the following sources:

1. Discussions with members of Union Carbide's staff who have much experience in stabilizing and preventing pollution from tailings piles.
2. Discussion with the ERDA personnel responsible for stabilizing tailings, ore stockpile sites, and mill sites at Monticello, Utah and decontaminating the various ore purchase depots (and stockpile sites) which AEC controlled.

III-1

1070 309

ATTACHMENT 5.9

3. Review of EPA 520/1/76/001, a report issued in January 1976 by EPA dealing with radiological impact to individuals living near inactive uranium mill tailings piles.
4. Review of a report prepared by Ford, Bacon and Davis pertaining to costs necessary to decontaminate and prevent pollution from the old Vitro uranium mill site at Salt Lake City. Ford, Bacon, and Davis have a contract with ERDA to study the matter of stabilization of the 24 inactive mill sites mentioned earlier in this text.
5. Review of an environmental impact statement prepared by the Bureau of Indian Affairs dealing with the proposed mine/mill complex to be constructed by Western Nuclear Corporation near Welpinit, Washington. This complex is referred to as the Sherwood Project.
6. Review of an environmental impact statement prepared by Rocky Mountain Energy in concection with their new operation in Powder River Basin in Wyoming, such operation being referred to as the Bear Creek Project.
7. Review of an environmental statement issued January 1977 by the U.S. Nuclear Regulatory Commission and related to the Bear Creek Project. This statement is a good indication of what the future "state of the art" might look like, or at least cost.
8. Review of a preliminary draft copy (January 1977) of "Policy Recommendations Related to Financing of Stabilization and Perpetual Surveillance and Maintenance of

POOR ORIGINAL

ATTACHMENT 5.9

Uranium Mill Tailings" by the Committee on Mining and Milling of Nuclear Fuels of the Western Interstate Nuclear Board.

9. Conversations with people from Washington State Department of Social and Health Services Division.
10. Conversations with people from Solution Engineering, Inc. who have considerable experience in monitoring for the contamination of subsurface waters.
11. Conversation with an individual with wide experience in decontamination of hardware and equipment sold or scrapped from ERDA's operations at Rocky Flats.
12. A brief review of existing regulations and nomenclature mainly for the purpose of grasping material presented in the foregoing documents and discussions.

Such data sources became the input for making broad judgments about costs, reaching conclusions, and presenting recommendations.

Those portions of the reports and studies listed above which are pertinent to the problem accompany this report as a separate appendix. The appendix will be useful if the reader wishes to probe more deeply into the rationale developed by the authors. It would also be helpful for whatever additional in-house study and engineering may be directed toward the problem. All the documents from which excerpts have been taken are available in their entirety through normal public channels.

1076 311

ATTACHMENT 5.9

POOR ORIGINAL

IV. COST ESTIMATION

Cost estimates have been made so as to relate to broad elements falling into three categories as follows:

1. Those not directly related to tailings stabilization. These are costs which will not be significantly influenced by changes in the "state of the art" of stabilizing tailings.
2. Tailings Stabilization. Current "state of the art" is assumed to be reflected by the environmental statement which the Bureau of Indian Affairs prepared for Western Nuclear's project near Welpinit. The Nuclear Regulatory Commission's statement on Rocky Mountain Energy's Bear Creek Project is assumed to presage future "state of the art".
3. Other Possible Costs. These are costs which may or may not occur, could be offset by salvage, or otherwise be incremental.

Under the foregoing general guidelines, costs were estimated in accordance with the following outline and rationale:

A. OTHER THAN TAILINGS STABILIZATION $350,000

1. Cleanup and Decontamination of Mill Site, Including Stockpile Area - $120,000

This cost item pertains to the situation after mill shutdown when it becomes necessary to eliminate, or acceptably reduce, the radiation which derives from surface contamination and leaching from the stockpiled ore, spills

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of milling solution and solids and other dispersion of radioactive material. AEC accomplished their cleanup by blading down the surface and filling with new soil. Generally a foot or two was adequate. On the average their costs were about $4000/acre foot. We have estimated that 15 acres bladed down and refilled to an average depth of 2 feet might be necessary here. Hence 15 x 2 x 4000 = $120,000. The Rocky Mountain Energy reclamation program included $170,000 for a similar activity and Ford, Bacon, and Davis included $125,000 for the Vitro situation.

2. Fences, Signs, Ditches, Gates, Other Isolation Features - $105,000

Access to the area, and most particularly the tailings, will have to be restricted. In addition to the fencing and security now applied to keep the general public away, the tailings pile will probably need to be surrounded by a fence designed to keep stray livestock and deer from grazing on the tailings pile. Rodent proofing is another desirable objective if it can be accomplished. Ford, Bacon, and Davis estimated that this general category would cost $105,000 for the 107 acre tract at Vitro. Since the tailings area in this case is 105 acres, we are utilizing their estimate.

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3. Ground Water Monitoring - $25,000

Monitoring of ground waters to detect introduction of radioactive and toxic materials, is done by placing wells around the tailings area and sampling the water at regular intervals. The authors have not investigated the hydrology of the area, but for the purpose of this estimate are assuming a ring of 25 wells around the tailings area at $1000 apiece. The ultimate distribution of such wells depends on the direction of the ground water gradient.

4. Long Term Surveillance - $100,000

The long lived radionuclides in uranium tailings require maintenance and surveillance to go on indefinitely. A financing system now being widely discussed is the use of an endowment fund the interest from which would provide the necessary funds. Review of the previously mentioned environmental statements showed annual cost estimates in the range of $3,000 to $5,000 per year to be funded by endowments ranging from $50,000 to $70,000. It is our judgment that a fund of $100,000 accruing interest at 8½% is minimal to provide the necessary funds and stay ahead of inflation.

B. TAILINGS STABILIZATION

1. Present "State of the Art"

a. Using Western Nuclear's Cost - $315,000

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The environmental statement estimated $295,000 to bury 100 acres with 2 feet of material plus 6" of top soil, contour it, and seed it. This derives from using 65¢ per cubic yard for burial and contouring plus $300 per acre for seeding, etc. Applying these constants to 105 acres yields $310,000 (rounded).

b. Adjusting Western Nuclear's Costs - $666,500

The burial cost of 65¢ per cubic yard seems low when one considers that the material must be spread and compacted and the hole from which it came reclaimed. It is not unreasonable to think that the costs could be on the order of $1.50 per cubic yard. On that basis the burial cost would be $635,000 plus $31,500 for fertilizing, seeding, etc. (105 acres @ $300/acre).

2. Possible Future "State of the Art"

a. Using NRC's Recommended Approach for Rocky Mountain Energy - $840,000

This system would cover the tailings with 1 foot of clay overlain by 6 feet of soil which would be contoured and seeded. Applied to 100 acres of tailings it would cost nearly $800,000. Proportioning it to 105 acres yields $840,000. The basic unit costs are 65¢ per cubic yard for burial and

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$649 per acre for soil preparation and seeding.

b. Adjusting (2a) to $1.50 Per Cubic Yard - $1,848,000

The cost per yard adjustment is made for the same reasons expressed in (1b) above. On such basis the burial would cost $1,780,000 (rounded) and allowing $68,000 ($649 per acre) for soil preparation and seeding makes a total of $1,848,000.

C. OTHER POSSIBLE COSTS

1. Decontamination of Mill Equipment - $150,000

If any of the mill equipment is to be introduced into the used equipment market, for other than uranium milling, or sold as scrap, it must be decontaminated. Wooden tanks, pumps, and piping would probably not be decontaminated but instead be buried in the tailings pile. Crushing and grinding equipment, steel tanks, and columns probably would be. Assuming no salvage value or use of the equipment in another uranium circuit, the cost is estimated to be on the order of $150,000. This composite figure was arrived at by discussing the flow sheet with an individual with considerable background in decontaminating equipment although not necessarily from milling operations. Some parts of the structure itself can become contaminated and the

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cisions made in those areas. Several things have come to the authors attention (and there are no doubt more) during the composition of this report which could have a bearing on the "state of the art" at shutdown.

The Nuclear Regulatory Commission is currently preparing a generic environmental statement pertaining to uranium milling. Such statement has a target date for mid-1978. In this regard, the January 1977 statement dealing with the Bear Creek project and referring specifically to the stabilization practice we have used in B,2 (possible future "State of the Art") states, "Although it is the NRC's position that the tailings impoundment method (discussed) represents the most environmentally sound and reasonable alternative now available, any NRC licensing action will be subject to express conditions that approved waste generating processes and mill tailings management practices may be subject to revision in accordance with conclusions of the final generic envi[illegible]onmental impact statement and any related rule making."

The policy study by the Western Interstate Nuclear Board (See item 8 under "III - THE APPROACH") contains a section (7.3) dealing with long term costs. They estimate that the maintenance, surveillance, and monitoring of a tailings pile containing 12 million tons would cost $55,000 per year requiring a million dollar endowment fund at 5½% interest. This is greater than estimates by others by about a factor of 10.

The New Mexico legislature passed a bill in March 1977 (SB447) which empowers the New Mexico Environmental Improvement Agency to require a bond from each mill operator sufficient

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same rules would apply. The Ford mill is unique in that it is entirely of wooden construction which, if contaminated, would be more difficult to decontaminate.

2. Engineering and/or Environmental Statement - $100,000

It is likely that an environmental statement will be required which would entail all the engineering and specialized data normally included. Even without the necessity of submitting such a statement, a certain amount of engineering and pre-planning must take place before final commitment to a plan.

The following table summarizes the material present in the foregoing outline:

		Add C.1	Add C.2
A plus B, 1, a.	$ 660,000	$ 810,000	$ 910,000
A plus B, 1, b.	$1,016,500	$1,166,500	$1,266,500
A plus B, 2, a.	$1,190,000	$1,340,000	$1,440,000
A plus B, 2, b.	$2,198,000	$2,348,000	$2,448,000

As has been previously indicated in the text, the matter of stabilization and surveillance of tailings is in an early stage of development with much effort being directed toward the physical chemistry, biology, engineering, legal, and financial aspects of it. Where costs finally land within the spectrum shown above will be a function of findings and de-

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to cover the cost of tailings stabilization. The size of the bond would vary with the situation. In addition, a fee of 10¢ is to be assessed for each pound of U_3O_8 produced so as to develop a fund for long term maintenance and surveillance. Up to one million dollars may be collected from each mill operator via the 10¢ fee. The point here is, Washington, like New Mexico, is an agreement state and it could take a cue from New Mexico and pass some similar type legislation between now and shutdown at Ford.

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V. EVALUATION AND CONCLUSIONS

Examination of the cost summary presented in the preceding section will reveal a range of possible costs spreading from $660,000 to $2,448,000. To some degree this reflects the fluid nature of the situation and the uncertainties which confront one in making an evaluation of this sort. However, even assuming that the present "state of the art" were to prevail, to expect to accomplish it at the low end of the range defies all reasonable chance. Possibly it could be done for one million dollars.

With the mounting pressure directed toward reduction of exposure from radon and its progeny one should count on the present practice being unacceptable in the future. Costs will no doubt move upward. However, it is felt that operators confronted with the high unit cost (dollars/acre) reflected at the upper end of our range will seek less expensive ways of accomplishing the same purpose, possibly through combining burial with plastic sealants, patented drilling muds, creation of buffer zones, or other schemes not yet apparent. To set aside funds aimed at the upper end of the range might also be unreasonable.

It is our judgment that a program should be commenced to accrue 1.5 million dollars between now and shutdown. This is probably ample from the standpoint of the present "state of the art" and is within the estimated range ($1,190,000 to $2,448,000) of what it might cost to satisfy future requirements. The adequacy of the amount should be reviewed as new guidelines and regulations appear. Of particular interest should be NRC's generic environmental statement to be issued next year.

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VI. RECOMMENDATIONS

It is recommended that:

1. A fund accrual be commenced which will accumulate $1,500,000, in terms of 1976 dollars, by the time of shutdown of the Ford mill, such fund to be utilized in connection with stabilizing tailings, decontaminating the mill and stockpile site (and possibly certain equipment), and providing for adequate security and long term maintenance.
2. The fund be reviewed from time to time to insure its adequacy, especially next year following NRC's generic environmental statement.

At the risk of going outside the scope of our assignment we would like to make the following suggestions:

1. That engineering and environmental study be initiated so as to develop a detailed plan well ahead of shutdown. Included in this would be exploration of various alternatives, study of the sub-surface water system, collection of meteorological data, sampling of the wood in the mill building to determine its state of contamination, sampling to determine surface and sub-surface contamination, air sampling for radon dissemination, and other elements leading up to a comprehensive plan. Such data would also be useful if an environmental impact statement were needed.
2. The identification of someone in-house to become as expert as possible in the physical chemistry and

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health aspects of the problem and to stay abreast of the host of regulations which apply to it.

3. That conversations be started as early as practical with those officials of the State of Washington charged with enforcement and promulgation of regulations pertaining to your problem. This would minimize any last minute or after-the-fact misunderstandings and the chances of being forced to make costly modifications after the completion of the project.