eberline

February 3, 1978

FI-916084

Mr. Frank Cannaday
Nuclear Dynamics
P. O. Box 20766
Phoenix, Arizona 85036

Dear Frank:

Enclosed is our recommended response to License Application sections 3.1 and 4.1. Upon experience with phase I, safety features will be altered based on the data and information derived. Following this, more specific and detailed procedures can be drafted.

I trust the information is sufficient. Please call upon me for any clarification that may be helpful. We would, of course, be pleased to provide any additional assistance for this project.

Very truly yours,

EBERLINE INSTRUMENT CORPORATION

STANLEY J. WALIGORA, JR.
Technical Director
Nuclear Services Division

SJW/jm

Encls.



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## 3.1 Radiation Monitoring and Safety Program

### 3.1.1 Introduction

The proposed radiation protection program is based upon present knowledge of expected conditions. Experience during Phase I (10 gpm flow) will help define conditions and permit adjustment of the program to provide most complete coverage of potential radiological problems.

Eberline Instrument Corporation personnel will work closely with the applicant in the establishment and evaluation of radiation safety policies. Through experience and evaluation of radiation measurement data, an optimum program will evolve. Through this evolution, Eberline will train personnel to assure program tasks are correctly performed and to assure that management personnel are familiar with the nature of potential radiological hazards. Responsibility for radiological control will ultimately be with the plant manager or superintendant. He, in turn, shall assure that all personnel will be properly trained and familiar with procedures including the radiation monitoring and safety program.

### 3.1.2 Training

Each employee who is to work in the plant will first receive a briefing of approximately one hour. Topics covered during this orientation include:

A. Plant process.

B. Radiation dose limits.

C. Internal deposition of uranium.

D. This procedure.

As a part of this orientation, each employee will receive a copy of these procedures and other information which summarizes the elements of radiation safety and especially contamination control. A form will also be handed out and signed by each employee at the end of the orientation. This will attest to his orientation and basic understanding of the information presented and receipt of this procedure and other handout material.

It is most important that each employee is aware of the individuals who can resolve any questions regarding work with uranium and any questionable practices observed during the work.

3.1.3 Basic Radiation Protection Program

Prevention of the inhalation of radon gas and radon progeny is expected to be the most important radiological protection consideration. Inhalation of airborne uranium or its particulate daughters is an occupational exposure pathway of secondary importance. Finally, some direct radiation exposure to personnel is expected from tanks, filters, and ion exchange columns which will accumulate and concentrate radioactive materials.

Since uranium arrives at the plant in solution, there will be minimum potential for significant airborne concentrations of particulate uranium or daughters. The final product is shipped or handled as a slurry and inhalation of airborne particulate through operations associated with slurry handling or packaging will be minimal.

The only radionuclide expected to be released in significant quantities is radon-222 gas from above the production surge tank and absorption column. Lesser quantities may be released from the production pump located in the process building. If the radon gas is confined in work areas long enough to allow the buildup of radon progeny, the progeny concentration could also present a significant hazard.

The concentration of radon gas in the process building will be controlled by forced ventilation exhaust. The flow will be such that sufficient volume changes will occur to prevent any significant ingrowth of radon progeny. Occupancy times near the process pumps will be minimized since they are a potential source of airborne activity. If possible, airborne concentrations will be kept below the limits for 40 hours/week exposure. In the unlikely event that concentrations exceed the 40-hour MPC, occupancy times in hours/week will be estimated for each person and total exposure will be maintained below 40 MPC-hours/week.

Inhalation of suspended dusts of uranium or other long-lived alpha emitting radionuclides is a possible but not probable hazard. These dusts would originate from spillage of wet ore or yellowcake and become airborne by drying and resuspension. Air particulate sampling for gross alpha activity will be collected one week per quarter near the production pump in the process building.

Direct radiation exposure to personnel from spent resins, from concentrated slurry, and from loaded filters is expected to be a small fraction of the applicable occupational exposure limits; however, a direct radiation (beta-gamma) survey will be performed quarterly to detect any unexpected build-up of direct radiation sources.

Employees who work in the process building will be issued TLD dosimetry badges. The badges will be exchanged and read quarterly to extimate external radiation dose equivalent (skin and whole body) to each person. The exact number of persons to whom badges will be issued is not known but is expected to be less that ten.

Spillage or leakage of wet yellowcake is a potential source of contamination. Consequently, special attention will be given in procedures and training to keep uranium from being transferred to personnel and equipment with subsequent contamination of unrestricted areas.

An effort will be made to limit significant uranium contamination to areas where uranium is handled. Provision will be made for washing down any spills to a sump. The material in the sump will either be recovered or disposed as low level radioactive waste. Persons who work in the yellowcake handling area will wear coveralls and rubber gloves. Rubber boots will be required when necessary for contamination control. Clothing lockers, a shower, and wash basin will be located in the process building. Contamination surveys of exiting yellowcake handling areas personnel will be performed.

Written instructions will be provided to each employee who is required to work in the process building. The following represents general instructions that will be given in written form:

> Prior to working in the process building, you must receive a briefing on use of anti-contamination clothing and other equipment for personal protection in this area. Every effort shall be made to keep from spreading any material that may be spilled. Eating or smoking in the process building is prohibited. Uranium slurry spills shall be cleaned up promptly. When you leave the area the special clothing shall be removed and left in the area provided for this purpose. Prior to eating, smoking or going home, you shall wash your hands. In some cases, showers also will be required prior to going home. As an additional procedure to verify adequate control, you shall be asked to submit periodic urine samples to detect any uranium uptake through inhalation or ingestion. By following these written

and other verbal instructions, persons working with uranium can do so safely. If you have any questions about the radiological safety program or any potential hazard to yourself or others who work with uranium ore, ask your supervisor.

3.1.4 Gamma Radiation Surveys and Dosimetry

A survey of the restricted area will be made quarterly to determine gamma radiation exposure rates (in mR/hr) at representative locations. Measurement will be made with an Eberline Model E-140 beta-gamma survey meter equipped with an HP-270 probe, or equal equipment. Exact survey locations will be established after the initial survey has been completed.

Direct radiation exposure to personnel from spent resins, from tanks of uranium, from loaded filters, and from other areas of the plant are expected to be less than one-fourth of the applicable occupational exposure limits. Radiation Areas, as defined in the U. S. NRC Standards for Protection Against Radiation, are expected to exist; but no High Radiation Areas. Employees who work in the process building will be issued TLD badges. The badges will be exchanged and read quarterly to estimate external radiation dose equivalent to each person. The exact number of persons to whom badges will be issued has not been established but is expected to be less than ten. Results will be recorded in total dose equivalent (mrem) to the skin (penetrating plus non-penetrating) and dose equivalent of penetrating radiation to the total body.

3.1.5 Internal Deposition and Bioassay

Employees who work routinely in the process building will submit urine samples (single voiding) bi-weekly. Maintenance personnel who work occasionally in the process building will submit urine samples whenever air sampler results indicate exposure above 40 MPC-hours/week or for any employee when potential uptake has occurred through a spill or some other untoward incident. Each sample will be analyzed fluorometrically for uranium. At least during Phase I, no use of respiratory protective equipment is anticipated. Should air sample results show any consistent elevation above 25% of the permissible or derived air concentrations (DAC), a program will be implemented . This same procedure

will be followed if airborne concentrations, scaled up to higher production rates will exceed 25% of the DAC.

3.1.6 Contamination Surveys

Contamination surveys will be performed at each personnel access to yellowcake areas and in adjacent areas, especially any areas approved for eating, drinking or smoking. The frequency of these area contamination surveys will depend on results obtained but will not be less than monthly, even when good radiological control has been demonstrated. All personnel will be surveyed prior to their exit from suspect areas.

A record of contamination surveys will be maintained in terms of dpm/100 $cm^2$ total and removable alpha activity. Total alpha activity will be monitored using an alpha survey meter, Eberline AC-3/PAC-4S or equivalent. Removable alpha activity will be monitored by dry swipes counted in an Eberline SAC-4 or equivalent.

Equipment used inside the process building will not be released for unrestricted use unless contamination levels are below limits (5000 dpm/100 $cm^2$ total and 1000 dpm/100 $cm^2$ removable) specified in the proposed Standard, ANSI N328-197 "Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to be Released for Uncontrolled Use". Contamination outside the process building will be kept as low as reasonably achievable below these limits. Any detectable contamination of personnel will be removed by washing prior to their exit from potentially contaminated areas.

3.1.7 Air Sampling

Radon Gas:

Significant quantities of radon gas may be released from above the production surge tank and the absorption column. Lesser quantities may be released from the production pump.

Due to the design of the process building exhaust system the maximum concentration of radon is expected to be at its point of release, above the production surge tank and absorption column. Employee occupancy time in this area is not expected to be more than a few hours per week. However, radon is a heavy gas which if not purged will drain to lower occupied areas of the

process building.

Radon concentrations may also be elevated near the production pump. Occupancy near this pump will be limited and posted if the concentrations detected warrent such action. Radon gas air samples will be collected routinely above the production surge tank and absorption column and at several locations in the process building. Sampling frequency will be determined on radon concentrations measured during the first few months of operations but is presently estimated to be monthly.

The radon sample consists of filtered air drawn into an Eberline SC-6 scintillation cell, or equivalent. The scintillation cell is a 1.4 liter flow-through chamber with an inside coating of zinc sulfide. The zinc sulfide emits a light scintillation when struck by an alpha particle. The scintillation is detected by an Eberline SAC-R5 Radon Gas Detector and registered by an Eberline MS-2 scaler, or equivalent. The sensitivity for the above described system is about 0.2 pCi/liter of radon.

Radon Progeny:

If the radon gas released into the process building is not purged, than the subsequent buildup of radon progeny could present a significant inhalation hazard. When confined, radon progeny can reach 95% of equilibrium within 2 hours after release of the precursor, assuming no removal mechanisms such as rainout or plateout occur.

Monitoring for radon progeny will be performed as described in ANSI Standard N7.1a-1969. One collects a 5 minute filter sample at a minimum flow of 2 LPM. The filter is counted for gross alpha activity approximately 40 minutes after sampling. The results are expressed in units of "working Levels".

Sampling location and frequency for radon progeny will be similar to those for radon gas. Again, the frequency will be determined on the concentrations measured during the first months of operations but, it is estimated to be monthly.

Airborne Dust:

The only known source of radioactive airborne dust other than radon progeny is from the resuspension of dried yellowcake which had spilled from process equipment. This source term will be kept small by the maintenance and housekeeping procedures of the facility. All spills will be expediantly cleaned to contamination levels consistent with ambient background levels throughout the plant.

To verify that long-lived alpha airborne activity is negligable, air filter samples will be collected and counted for gross alpha activity. If gross alpha activity indicates air concentrations exceed $1 \times 10^{-12}$ uCi/ml, isotopic analysis for total uranium, Radium-226, Thorium-230 and Lead-210 will be performed.

3.1.8 Effluent Measurement

Liquid Effluent:

Process control and the nature of the initial experiments will require sampling and analysis of liquid effluent to the two solar evaporation ponds. The concentrations and quantities will be recorded. Because of the construction of these two small ponds, liquid is not actually released to the environment. This data will assist in providing a source term and therefore the degree of control required to prevent any significant dose path to biota or man.

Airborne Effluent:

In addition to the air samples taken for occupational safety, periodic air samples will be taken from plant exhaust including radon-222 samples and air particulate samples. The air particulate samples will be analyzed for long-lived alpha activity (after several days decay). If gross alpha concentrations exceed $1 \times 10^{-12}$ uCi/ml, then filters will be analyzed for uranium, Radium-226, Thorium-230, and Lead-210. These concentrations and the total exhaust flow will be recorded to identify this source term and to permit scaling up to higher production rates.

3.1.9 Waste Disposal and Decontamination

Some low level wastes will be generated during this experiment. They will be properly packaged and disposed of either in an existing mill tailings pond or through shipment to a commercially operated waste burial site.

Normal decontamination of personnel, tools and equipment will be through use of soap and water. These very low concentrations will be directed to either of the two sumps within the plant for subsequent recovery or to one of the two solar evaporation ponds.

4.1 Equipment and Facilities for Protection From and Monitoring of Radioactivity

4.1.1 Radiation Detection Instruments

| Manufacturer and Model (or equivalent) | Radiation Detected | Use |
|---|---|---|
| Eberline Model E-140 (1 ea.) (Geiger Counter) | Gamma | Survey tanks, filters, and other areas of concentrated activity to estimate personnel exposure |
| Eberline Ratemeter w/AC-3 Probe (2 ea.) (Alpha scintillation survey meter) | Alpha | Contamination surveys of personnel, equipment, and plant areas |
| Eberline SAC-4 (1 ea.) (Alpha scaler) | Alpha | Count air filters and swipes |

4.1.2 Calibration

A Thorium-230 electrolplated calibration standard, traceable to the U. S. National Bureau of Standards, will be procured and used to check calibration of the alpha detection instruments during each use (daily if used daily). Every quarter (3 months) the standard will be used with either potentiometers adjusted to read the correct count rate or counting efficiency redetermined for the SAC-4. Records of calibration will be maintained.

4.1.3 Facilities

The primary control associated with plant design will be adequate exhaust ventilation above the ion exchange columns and the production surge tank to remove Radon-222 gas escaping from the recovery well solution as it enters the plant. This reduces lung dose due to inhalation of the radon and radon progeny.

Showers will be provided for both chemical safety and for personnel decontamination in the event of some unforeseen spill of activity or spread of contamination to personnel.