PDR
40-8502

SAFETY EVALUATION REPORT

SOURCE MATERIAL LICENSE

WYOMING MINERAL CORPORATION

Docket No. 40-8502

License No. SUA-1341

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1.0 DESCRIPTION OF THE PROPOSED ACTION

1.1 Proposed Action

By letter dated January 28, 1976, the Wyoming Mineral Corporation (WMC) applied for a source material license to receive, possess, use, and transfer source material in the course of performing a commercial-scale in situ uranium solution mining (in situ leaching) operation--500,000 lb/yr U_3O_8--at the Irigaray site in Johnson County, Wyoming. On the basis of evaluations of the application and subsequent related submittals, the proposed action is to grant a license to WMC for the proposed operation.

1.2 Background

In situ leaching of uranium is a process which consists of removing soluble uranium salts, formed by chemical reagent additions to existing groundwater, from a subsurface ore-bearing sandstone aquifer. The chemical reaction(s) reverse(s) the natural process that deposited the uranium in the host sandstone. The resulting uranium-bearing liquor (pregnant lixiviant) is recovered (pumped) from the mineralized (sandstone) zone and directed to a surface processing plant where the contained uranium is extracted from the solution by conventional uranium recovery techniques and ultimately converted to yellowcake (U_3O_8). The uranium-depleted (barren) solution from the recovery operation, after being chemically reconstituted, is recycled to the mineralized zone to leach additional uranium.

After the ore zone is depleted of recoverable uranium, the reagents and other mobilized species remaining in the aquifer are removed to restore the groundwater quality to its premining level.

The Irigaray site is located in northeast Wyoming within the Powder River Basin. The property is in southeast Johnson County, approximately ten miles northeast of Sussex and 43 miles southeast of Buffalo, Wyoming. Access to the property is via gravel roads from the north and south.

WMC's property includes approximately 21,100 acres of leases and claims. The applicant anticipates that solution mining activities will affect about 1,000 acres over the project's life (~20 years). The proposed license, however, will authorize solution mining on a 50-acre area.

Under NRC License No. SUA-1204 issued July 5, 1974, (Docket No. 40-8304) two pilot-scale solution mining tests are in progress on the property. One test area (Section 5) consists of a trailer-mounted uranium recovery plant and three five-spot well patterns occupying a one-acre site. Studies at this site were initiated in November 1975 and were terminated in October 1976 at which time restoration activities were undertaken. The plant flow rate used for the studies at this site was 25 gpm.

A second test site (Section 9) was then developed, and solution mining activities at a flow rate of 25 gpm were initiated in March 1977 ("A" well field) to accumulate additional engineering data. The R&D license was amended in June 1977 to permit the licensee to increase the flow rate capacity to 100 gpm to broaden the engineering and design data base. These tests are still in progress. The licensee anticipates including the "A" well field area in his proposed commercial-scale operation.

Plant equipment to operate at 100 gpm capacity is temporarily housed in the building shell which will contain the 500,000 lb/yr U_3O_8 processing equipment. The commercial-scale operation will operate at a flow rate capacity of 800 gpm. The "A" well field, comprised of ten seven-spot well patterns, is located near the center of the initial proposed production-scale well field unit (about ten acres).

The uranium recovery plant and associated facilities for the commercial-scale operation will occupy a five-acre area; the well field area to be mined during the proposed license period will comprise an area of up to 50 acres.

2.0 REVIEW SCOPE

This safety evaluation included the review, inter alia, of the following WMC submittals:

- Application for a source material license, dated January 28, 1976.
- Environmental Survey in support of an application for a source material license, dated January 28, 1976.
- Correspondence from the applicant, dated May 6 and June 15, 1976, concerning exemptions from the requirements of 10 CFR 40.31(f) and 40.32(e).

- o Amplifications on WMC Environmental Survey, Docket No. 40-8502, dated November 16, 1976.
- o Revised Environmental Report, Irigaray Project, Johnson County, Wyoming, dated July 1977.
- o Clarification and Responses to Staff Questions, dated October 28, 1977.
- o Revised attachments to NRC source material application, Docket No. 40-8502, dated January 9, 1978 and June 21, 1978.

NRC staff also met with the applicant's personnel on February 4, 1977; March 24, 1977; and October 9, 1977 to discuss environmental and health and safety aspects of the proposed program during the review period. The March meeting was held at the NRC offices in Silver Spring, Maryland; the other meetings were held at ORNL in Oak Ridge, Tennessee.

First-hand observations of the activities involved in the solution mining operations were obtained by NRC staff and ORNL personnel assisting NRC in performing the proposal evaluation by visits to the Irigaray project site on November 17, 1976; August 4, 1977; and October 4, 1977.

The R&D studies (pilot-scale operations) were licensed by the NRC on July 5, 1974 (Docket No. 40-8304). Since the start of this operation, two series of inspections to examine the activities conducted under the license as they relate to radiation safety, to compliance with the Commission's rules and regulations, and to the conditions of the license have been performed by personnel of the Office of Inspection and Enforcement. The dates of these inspections were March 23 and 26, 1976, and May 12 and 31, 1977. A review of the inspection findings indicates that only minor administrative deficiencies have occurred during R&D operations. For examples,

- o A quarterly sampling for airborne radioactivity was not conducted during the winter period of Nov. 1975 through March 1976.
- o An area where natural uranium was used or stored in an amount exceeding one hundred times the Part 20, Appendix C quantity was not posted with a sign or signs bearing the radiation caution symbol and the words "Caution (or Danger) Radioactive Material" at the time of the inspection.

- o Each container of natural uranium containing an amount exceeding ten times the Part 20, Appendix C quantity was not labeled with the label bearing the radiation caution symbol the words: "Caution (or Danager) Radioactive Material" and information about the contents at the time of the inspection.

- o Neither the documents required by 10 CFR 19.11(a) nor the notice required by 10 CFR 19(b) were posted at the time of the inspection.

- o Records showing the transferred quantities of licensed source material were not adequately maintained during the period March 20, 1976 to May 6, 1977.

- o Contrary to 10 CFR 20.401(b), which requires that records be maintained in the same units used in Part 20, records of surveys (evaluations) conducted pursuant to 10 CFR 20.201(b) were not always maintained in the necessary units.

These have been corrected in a timely manner. Otherwise, WMC has been in compliance with the NRC's rules and regulations and the conditions of the license.

Personnel from the Wyoming State Department of Environmental Quality, Land Quality Division (DEQ, LQD), have also inspected the site and the activities in progress. Personal communications from their staff (D. Fritz and D. Herlihy) confirmed the NRC inspection findings for the R&D operations.

3.0 AUTHORIZED ACTIVITIES

The source material license will authorize the possession and use of source material by WMC derived from solution mining the ore zone on a 50-acre area at the Irigaray site to produce up to 500,000 lbs/yr of yellowcake in accordance with the limitations, inter alia, noted in the Summary and Conclusions, item 7, of the Final Environmental Statement related to this operation (Docket No. 40-8502, NUREG-0481).

3.1 Facility Description

The Irigaray property consists of approximately 28 square miles within Townships 45, 46, 47 North, Ranges 77 and 78 West. Historically, the Basin has been a rural, sparsely populated region with a static and, in some cases, declining population. A small number of permanent inhabitants (8-16 persons) are located on a few

scattered ranch headquarters near the WMC solution mining area, i.e., within a five-mile radius of the site.

All operations during the proposed license period will be carried out within approximately 60 acres of the 1,000 acres that could be affected over the life of the project. This lies within the 21,000 acres owned or controlled by WMC through long-term leases. Activities involving radioactive materials will primarily be housed in the uranium recovery plant. Auxiliary buildings and facilities such as offices, shops, and evaporation ponds will be in the immediate area.

3.2 Operations

The WMC uranium solution mining process is illustrated in Figure 1. The recovery process consists of three process circuits:

1. A lixiviant/sorption circuit;
2. An elution/precipitation circuit; and
3. A product drying/packaging unit.

The lixiviant is an ammonium bicarbonate-carbonate solution containing hydrogen peroxide as an added oxidizing agent. In the lixiviant/sorption circuit, solubilized uranium is stripped from the recovered pregnant leach solution using an ion exchange resin unit to effect the process. In this operation, complexed uranium ions are sorbed from the solution by the resin, displacing chloride ions that are sorbed on the resin. The chloride ions thereby enter the barren solution. The uranium depleted solution leaving the ion exchange unit is then refortified with hydrogen peroxide and ammonium bicarbonate and reinjected into the mineralized formation to repeat the leach cycle. Some provision for calcium control is generally incorporated since the recovered lixiviant is generally saturated with respect to calcium carbonate. Such provision may be either upstream or downstream of the ion exchange unit operation used for uranium recovery. Calcium control serves to reduce the potential for calcium carbonate precipitation in the fortified lixiviant. The latter would have a deleterious effect on the solution mining phase of the operation, i.e., plug wells and/or reduce hydraulic conductivity in the ore zone.

The uranium loaded resin is continuously transferred from the sorption circuit to the elution circuit, and a like quantity of eluted resin is transferred in the opposite direction. Thus, the resin transfer system and incorporated wash provisions limit chemical communication between the sorption and elution circuits. In

the elution/precipitation circuit, the sorbed uranium complex is first stripped from the resin with an ammonium chloride eluant. While the solution and resin are in contact, the eluting anion (Cl^-) is sorbed from solution by the resin displacing the previously sorbed uranium complex ion. The elution process serves the dual purpose of stripping uranium from the resin and concentrating it in the eluted solution. The uranium concentration in this eluted solution is about 40 to 60 times greater than that of the pregnant lixiviant from the well field and has an adjusted pH of about 1.5 to 3.0. The adjustment is effected with hydrochloric acid to destroy the residual carbonate species and to retain the uranium in solution.

The eluted solution pH is then readjusted to a range between 5.0 and 8.0 with ammonia to precipitate the uranium present as ammonium diuranate (ADU). The resulting slurry is then separated into a uranium barren liquid fraction and a uranium rich slurry fraction (about 20 percent solids content in a thickener). The barren liquid fraction is reconstituted with ammonium bicarbonate and ammonium chloride, if necessary, to restore the chloride ion strength, and this is recycled through the elution/precipitation circuit.

The ADU slurry is directed to a propane-fired kiln in a separate enclosure, where it is dried and converted to U_3O_8 product (yellowcake). The yellowcake is then packaged in drums. Airborne effluents from the drying and packaging operation are controlled by Venturi scrubbers. Spent scrubber solution is recycled to the elution/precipitation circuit to recover any evolved particulate yellowcake.

Liquid wastes generated in mining and restoration operations will vary in volume and composition. Uranium recovery process liquid wastes and groundwater restoration liquid wastes will be retained in separate, lined solar evaporation pond systems. No liquid effluents will be released from the site.

The applicant estimates that approximately 21 acre-ft of liquid wastes from mining operations will be generated annually. Since the net annual evaporation rate in the region is about four feet per year, solar evaporation ponds covering at least 5.3 acres should accommodate this liquid waste volume.

The volume of liquid waste generated during aquifer restoration activities will depend upon the affected aquifer volume, the characteristics of the host rock, the number of ten-acre production

units undergoing restoration, and the time required to process the volume of liquid. This waste water will also be discharged to lined evaporation ponds and may require additional ponding area.

Solid wastes will be generated from three principal sources in the recovery process: (1) the calcium removal unit, (2) supplemental containment control incorporated in the elution and precipitation circuit of the recovery process, and (3) liquid waste residues from evaporation concentration during solar pond impoundment. Additional wastes will be produced in the future in conjunction with water treatment methods used to effect groundwater quality restoration. These would be generally similar to the solid wastes generated during the uranium recovery process.

Solid wastes from operations, about 500 tons per year, primarily as calcite could be accumulated at the site for a maximum of five years after which time it will be removed and transported to an active uranium mill tailings impoundment for disposal. Other radioactive or toxic wastes accumulated in the evaporation ponds will be removed and also transferred to an active mill tailings impoundment or at the time of site reclamation. All other contaminated solid wastes (e.g., spent resin, filters, hardware) will be disposed of offsite in a licensed burial ground or active tailings pond.

3.3 Potential Radiation Sources Associated with the Process

The solution mining process is chemically selective for uranium. Thus, the majority of gamma-emitting daughter products naturally associated with the product will remain, in situ, within the underground ore body. Less than five percent of the Ra-226 present in the ore would be mobilized. The mobilized fraction of Ra-226 would be coprecipitated with the calcium as calcite solid waste and handled as described above.

The source material will be maintained in an aqueous phase throughout the lixiviant absorption and elution/precipitation operations. Thus, potential internal intake of uranium would be negligible provided good housekeeping practices are maintained.

Under routine operating conditions, two sources of atmospheric radiological effluent are possible:

1. Release of Rn-222 gas from production surge tanks and ponds, and

2. Loss of product (primarily U_3O_8) through the scrubber stack during drying/packaging operations.

These releases, their potential for causing undue exposures and their control are discussed in the subsequent sections of this report.

3.4 Possession Limit

The proposed license will authorize WMC to possess a maximum of 500,000 pounds of uranium equivalent at any one time.

4.0 FACILITY ORGANIZATION AND ADMINISTRATION

The WMC organizational structure delineating the lines of authority and operating responsibilities for pertinent radiological safety positions are shown in Figure 2.

The manager responsible under the license will be the Irigaray Mine Manager (Plant Manager). The minimum qualifications for the position of Mine Manager are a bachelor's degree in science or engineering, or equivalent work experience, and a minimum of five years of supervisory experience.

The position of Corporate Radiation Protection Officer (RPO) requires a minimum of a master's degree in science or engineering and at least five years of health physics experience. Advanced degree studies may be substituted for some experience.

The position of Site Radiation Protection Officer (RPO) requires a minimum of a bachelor's degree in science or engineering, or at least two years of applied health physics experience.

The position of Site Licensing Engineer requires a bachelor's degree in science or engineering and one to two years of experience.

Foremen or first-level supervisors require a minimum of six months of experience in plant operations. In addition, each foreman will have a minimum of one month of practical experience with the type of equipment used in solution mining. A specific course of training in the theory and operation of the plant equipment may be substituted for the on-the-job training requirement.

4.1 Specific Responsibilities

The Corporate RPO develops and administers efficient and cost-effective radiation protection, nuclear safety, and environmental

control programs to minimize hazards to employees, plant facilities, and the environment. He provides technical guidance and assistance in radiation protection, nuclear safety, and environmental control matters to all locations in the form of formal training programs and consultations for site specific problems. The Corporate RPO also assists in conducting periodic reviews and audits of individual site programs and records to ensure that regulatory requirements are met.

The Irigaray Mine Manager (Plant Manager) supervises operations at the plant site and is responsible for the control of all on-site activities and personnel. Among other responsibilities, he ensures that all state and federal regulations are met including compliance to the terms, conditions, and stipulations of all licenses. He submits required reports to the Denver office for review and regulatory transmittal.

The site RPO monitors plant operations to ensure consistent application of established radiation and environmental procedures, equipment, and controls. He also reviews and evaluates the effectiveness of new plant procedures, equipment, and operations relative to radiation protection and environmental control requirements. Other responsibilities of the plant RPO include maintaining accurate and timely records as required by federal and state regulations, assisting in the preparation of required reports, and assisting in the conduction of routine training programs for the supervisors and employees with regard to the proper application of radiation protection, nuclear safety, and environmental control procedures and equipment.

The Site Licensing Engineer coordinates compliance responsibility for licensing and/or environmental programs with the Plant Manager and other levels of management as required. Among other responsibilities, he also coordinates on-site collection of samples as required by regulations and provides reports as necessary for license compliance.

A Compliance Review Board, whose charter is to conduct internal reviews and audits of the adequacy and the implementation of compliance control systems and the associated records for the WMC facilities subject to regulatory agency or internal control requirements, is also established. The Board members are independent of line management control and are not directly responsible for compliance control systems at the Irigaray site. This adds another insurance level to the maintenance of the safety and compliance requirements for the activities at the site. The Review Board conducts a review

and audit at least annually and documents its findings and recommendations to the General Manager and other relevant management. The Board members will be designated in writing by the Vice-President, Mining.

The staff has determined that the organization and responsibilities of the various levels are satisfactory for the conduction of the solution mining operations in a responsive manner.

5.0 RADIATION SAFETY CONTROLS AND MONITORING

Exposures of personnel to radioactivity in conventional uranium mining operations is partly due to the inherent activity of natural uranium. The major portion of any dosage, however, will result from the activity of daughter products associated with the uranium in the ores. Due to the in situ leaching character of the WMC solution mining process, the bulk of the gamma-emitting daughter products associated with the uranium remain underground within the ore body itself. Radium-226, which is partially mobilized with the complexed uranium, will be coprecipitated with the mobilized calcium and will be the primary gamma source.

In situ solution mining essentially involves the processing of solutions and slurries. The major radiologic effluents anticipated will be radon-222 gas from production surge tanks and evaporation ponds and particulate yellowcake (U_3O_8) which would escape through the scrubber stack during the drying and packaging operations.

5.1 Protective Clothing and Equipment

Operators and maintenance men working in the plant will wear plant coveralls which must be changed to street clothes prior to leaving the plant area. Personnel working in the drying and packaging area will be required to wear SWP-type protective clothing. Survey instruments will be available for employee contamination surveys at the exit side of their change rooms. Provisions for laundering the coveralls will be established. Locker rooms and showers will be provided for all operating personnel.

The applicant has established a training program to assure that operators understand respiratory equipment usage, proper fitting, and maintenance. The program will meet the requirements of paragraph 20.103(e), 10 CFR 20, and assure that usage of respiratory protective equipment will remain as stipulated by Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection."

The staff has determined that the plant requirements for the use of protective clothing and equipment are adequate and comparable to the requirements of uranium milling operations.

5.2 Ventilation and In-Plant Dust Control

The WMC uranium recovery process will essentially be an enclosed, wet process. Uranium-bearing materials will be transferred through the plant in a liquid state or as a slurry thereby eliminating the exposures associated with dry processing operations such as the transporting, storing, and grinding of ore.

The plant will be ventilated by approximately twenty ventilation fans which will exhaust through a stack on the plant roof. The system will be designed to achieve ten air changes per hour within the plant. Additional exhaust systems may be located in the plant where potential sources of radon gas may be released, i.e., the clarifier, recovery surge tanks, and extraction columns.

Drying/packaging operations, when performed, will occur in a separate room of the plant building with its own ventilation system. The drying furnace, drum enclosure, and drum seal will exhaust through a wet scrubber and out a stack on the roof of the recovery plant. The liquid bleed from the scrubber will be returned to the plant circuit (Figure 3). Performance testing of plant exhaust stacks will be pursuant to the regulations of the Department of Environmental Quality, State of Wyoming. The activity content of the scrubber stack emissions will be below the allowable levels specified in 10 CFR Part 20, Appendix B, as applied at the restricted area boundary.

The adequacy of the applicant's dust control system has beer proven by similar operations at mills over the years in their airborne radioactivity monitoring programs.

5.3 Penetrating Radiation (Occupational)

External radiation will be monitored via thermoluminescent dosimeters (TLD's) exchanged and analyzed on a quarterly basis by a qualified service. These dosimeters will be of the personnel and/or area type.

Airborne radioactivity and external contamination will be determined by an ongoing radiological survey program as discussed in a subsequent section. Table 1 indicates the instrumentation that will be available at the site to support this program.

Table 1

Radiation Detection Instruments

Instrument	Radiation Detected	Purpose	Sensitivity/Range (if applicable)
Eberline Instrument Corp. E-120 Survey Meter	Beta, Gamma	General survey	1400 CPM per mR/hr for cobalt-60
Eberline Instrument Corp. PAC-4S Survey Meter (AC-3 Probe)	Alpha	General survey	50-50K CPM, Alpha efficiency = 45% for thorium-230α (1" diameter source, 2π)
Eberline Instrument Corp. RM-14 Radiation Monitor (HP-190 thin window)	Beta, Gamma	General survey	2500 CPM per mR/hr for cesium-137. Beta efficiency: (2π, 1" source) approximately 10% for carbon-14.
Eberline Instrument Corp. RM-19 Radiation Monitor (AC-3-7 Probe)	Alpha	Personnel survey	2×10^7 CPM per $\mu Ci/cm^2$ for ^{239}Pu
Eberline Instrument Corp. Ms-2 Mini Scaler (AC-3 Probe)	Alpha	Air filter particulate analysis	Alpha efficiency = 17% for thorium-230α (1" diameter source, 2π)
Eberline Instrument Corp. SAC-R5 Radon Detection System	Alpha	Radon gas concentration analysis	$< 1 \times 10^{-9}$ $\mu Ci/ml$ radon-222
Eberline Instrument Corp. RD-14 Alpha Detection	Alpha	Sample analysis	75% efficiency of 2π on plateau

All radiation survey instruments will be bench calibrated semi-annually by qualified personnel who have received relevant training by a qualified service. Appropriate calibration standards used for this purpose will be traceable to NBS. Performance checks will be made before each use.

Survey data for a similar WMC operation at Bruni, Texas, indicate that exposure of personnel to external radiation should be minimal. Tables 2 and 3 list the personnel and area monitoring data for the same operation at the Texas site.

Table 2. Personnel Dosimetry Results, Bruni, Texas

Total number of individuals monitored for entire period	22
Total accumulated whole body exposure above background	70 mrem
Average whole body exposure	3.2 mrem/year/man
Total accumulated skin exposure	160 mrem
Average skin exposure	7.2 mrem/year/man
Present occupational (whole body) exposure limit (10 CFR 20.101)	5000 mrem/year/man

The data indicate that the potential for external exposure will be less than one percent of the applicable limits.

Table 3. Area Monitor Data, Bruni, Texas*
Period 10/1/76 through 7/20/77

Badge Number		Exposure Rate
2735-1003	Outer surface of conduit at clarifier feed approximately 4 feet from clarifier junction.	9.18 mrem/wk
2735-1007	On post, approximately 12-14 inches above ground surface, 3-4 feet from clarifier underflow pond	4.63 mrem/wk

*These stations consistently record the highest exposure potential as they are located near the primary exposure source, i.e., calcium removal unit which contains the mobilized radium-226.

The staff concludes that a TLD badge program supported by direct instrument measurements should permit the applicant to conform with the requirements of Sections 20.101 and 20.202 of 10 CFR Part 20.

5.4 Area and Personnel Contamination Control

At uranium recovery facilities, spillage or leakage of process solutions or yellowcake slurry are potential sources of contamination. WMC has provided the employees with detailed information procedures and written instructions to be followed in maintaining basic housekeeping. These are comparable to the standard practices utilized by other uranium mills.

A program of wipe test surveys will be implemented to control surface uranium contamination in the recovery plant. These surveys will be performed at various locations throughout the plant as selected by a certified health physicist. Production areas will be surveyed at least on a quarterly schedule and non-production areas such as the plant change room, first aid room, and offices will be surveyed at least on a monthly schedule. This frequency requirement will follow the contamination survey program practiced by standard uranium mills. Release of materials and equipment from controlled areas for disposal will require prior NRC approval.

Workers in the calcining/packaging area will either shower or monitor themselves at the end of each shift. An alpha survey system will be available at the exit of the change room. Spot surveys will be performed by the site RPO for alpha contamination on workers leaving the plant. Alpha contamination on skin or clothing in excess of 1000 dpm/100 cm^2 shall require decontamination.

5.5 Airborne Radioactivity

Condition No. 24 of the license has been added to require the following air sampling to assess airborne radioactivity concentrations to which employees will be exposed.

1. A representative air sample shall be collected at least weekly at work stations in the calcining/ packaging area to determine airborne uranium concentrations. Additional sampling, including breathing zone sampling, shall be conducted during cleanup and maintenance activities in the calcining/packaging area.

2. Monthly air samples shall be collected at other process and storage locations as appropriate to determine airborne uranium concentrations.

3. Monthly sampling at selected process areas shall be performed to determine radon or radon daughter concentrations. If monthly values should exceed 25 percent of the applicable value in Appendix B of 10 CFR Part 20, the frequency of sampling at these locations shall be increased to weekly.
4. If the air sampling program reveals work locations where concentrations exceed 25 percent of the applicable value in Appendix B, Table 1, Column 1, of 10 CFR Part 20, a program shall be established to determine time-weighted exposures of employees working at these locations and establish such procedures specified by Section 20.103(b)(2) to maintain employee exposures as low as reasonably achievable.

5. Special uranium air sampling, supplementing the routine air sampling program, shall be conducted for anup and maintenance activities as appropriate.

The use of respirators will also be controlled by a respirator protection program as stipulated by Section 20.103 of 10 CFR Part 20 and NRC Regulatory Guide 8.15.

The WMC airborne uranium monitoring program is considered adequate by the staff and is comparable to the programs at other uranium mill facilities.

5.6 Effluent Monitoring

a. Stack Sampling

Condition No. 26 of the license has been added to require the following.

The scrubber circuits for the calcining/ packaging system shall be checked and control readings recorded at least once per shift when the calciner is operating.

Samples representative of a 24-hour release rate shall be collected from the exhaust stack of the calciner scrubber during normal operation of this equipment on a weekly basis and analyzed for uranium.

b. Perimeter Sampling

Condition No. 29 has been added to require the following action.

Twenty-four hour, high-volume air samples shall be taken on a monthly basis at five sampling stations and analyzed for natural uranium, thorium-230, and radium-226. The air sampling shall be correlated with meteorological data to meet the requirements of NRC Regulatory Guide 4.14 on effluent monitoring. This is an acceptable program that is comparable to other uranium mill programs.

The effluent monitoring results are required to be reported on a quarterly basis by Condition No. 28.

c. Other Sampling

The above-noted and additional sampling requirements are listed in Table 4.

Table 4. Operational radiological monitoring program[a]

Environmental element	Sampling location	Sampling frequency	Type of measurement
Air	Yellow cake dryer stack	24-hr sample, weekly	Uranium
Surface water	Surface impoundments[b] and affected drainage	Quarterly, following precipitation events	Uranium, Ra-226, Th-230, Pb-210, suspended solids, sediment
Air	Well field surge tanks	Monthly	Rn-222 or radon daughters
Air	Air quality monitoring sites	24-hr sampling at monthly intervals	Ra-226, Th-230, uranium
Soils, vegetation	At the air quality monitoring sites	Annually	Ra-226, Pb-210

a - The water quality in the ore zone aquifer will be monitored also.

b - Stock watering ponds.

5.7 Bioassay

The applicant is required to develop a bioassay program taking into consideration the elements identified in the proposed Regulatory Guide 8.22, Bioassay at Uranium Mills. This would include quarterly urinalysis and annual in-vivo lung counting for uranium shall be performed for employees assigned to the calcining/packaging operations. The routine uranium urinalysis program shall be supplemented by additional samples collected from employees when exposure to airborne uranium exceeds 40 MPC hours in any seven consecutive days. If any urinalysis exceeds 30 micrograms of uranium per liter, an additional sample shall be collected from the employee. A confirming sample result shall initiate an investigation to determine the cause of the exposure. A justification would be provided for any deviations from the proposed guide. The planned bioassay program will be submitted along with the start-up notification of the calcining/packaging unit operation.

6.0 ENVIRONMENTAL IMPACT

The evaluation of the environmental impact of the proposed licensing action is contained in a prepared Environmental Statement (NUREG-0481). An ongoing environmental monitoring program is required by the staff as discussed in the FES and included in the License as Condition Nos. to conform with the program described in the Environmental Statement. Condition Numbers 29 and following are consequences of the environmental evaluation.

7.0 CONCLUSION

The staff has concluded that issuance of a license to Wyoming Mineral Corporation to authorize receipt, possession, use, and transfer of source material in the course of in situ uranium solution mining at the Irigaray site in Johnson County, Wyoming, will not constitute an undue risk to the health and safety of the public and has determined that the application and supplements fulfill the requirements of Sections 43, 44, and 45 of 10 CFR Part 40.

The conclusion is based upon the assessment of the applicant's submittals and includes the additional conditions developed by the staff. The staff has further concluded that conformance by the WMC to their proposed conditions for administering procedures, organization, technical qualifications, and radiation safety, in addition to the staff's conditions, should ensure a safe operation.

The staff, therefore, recommends that a license be granted to Wyoming Mineral Corporation subject to the following:

1. Authorized use: For uranium recovery from a maximum of 20 ha (50 acres) of well field by in situ solution mining of uranium ore bodies in accordance with statements, representations, and conditions contained in the applicant's revised application dated January 9, 1978, and supplement of June 21, 1978. Notwithstanding the latter, the following conditions which modify and add to commitments in the documents identified above, shall override any conflicting statements contained in the application and supplement.

2. The plant throughput shall not exceed 500,000 pounds of U_3O_8 or equivalent on an annual basis and the maximum recovery plant flow rate shall be 800 gpm.

3. Modifications to the basic process presented in Figure 1 of the applicant's revised application dated January 9, 1978, shall require NRC approval through amendment of this license prior to use of the modified system.

4. The licensee is excepted from the requirements of Section 20.203(e)(2) of 10 CFR Part 20 for areas within the plant provided all entrances to the plant are conspicuously posted in accordance with Section 20.203(e)(2) and with the words, "Any area within this plant may contain radioactive material."

5. Written operating procedures shall be maintained for all process operations and shall incorporate operating instructions and appropriate safety precautions for the work. The employee training program shall include detailed review of the operating procedures applicable to the employee's assignments. The requirement for written operating procedures shall include establishment of procedures for the conduct of the radiation safety and environmental monitoring programs, including analytical procedures and instrument calibration requirements. Written procedures and subsequent changes to the procedures shall be reviewed and approved by the plant radiation protection officer (RPO) and the plant manager. At least annually, all procedures shall be reviewed to assure continued applicability.

6. Unless the operation or maintenance work is covered by an effective operating procedure, a Radiation Work Permit (RWP) shall be prepared for all work involving entry into a system containing radioactive material or where a potential for release of contamination exists such that the airborne radioactivity concentration to which employees are exposed from the proposed operation or work is likely to exceed the concentration in Appendix B, Table 1, of 10 CFR 20.

7. The following inspections and audits shall be performed by the licensee:

   (a) Weekly inspections by the plant RPO of process and storage areas and a report to the plant manager on any items of noncompliance with operating procedures, license requirements, or safety practices, including housekeeping practices, affecting radiological safety.

   (b) Quarterly plant inspection by the Corporate RPO and audit of the weekly inspection reports of (a) above and audit of all monitoring data, both in-plant and environmental, resulting in an evaluation of the data and a written report to the Corporate Licensing Manager. The report shall recommend any necessary corrective actions and include an evaluation of the adequacy of the implementation of license requirements.

   (c) Annual audit of the plant operations by the Corporate Compliance Review Board in accordance with the Charter of the Board as described in the licensee's application dated January 9, 1978 as amended by the supplement of June 21, 1978.

8. A semiannual report shall be prepared by the Corporate RPO for the plant manager and Corporate Licensing Manager evaluating employee exposures, effluent releases and environmental data to determine (1) if there are any upward trends developing in personnel exposures for identifiable categories of workers, of types of operations or in effluent releases, (2) if exposures and effluents might be lowered under the concept of maintaining exposures and effluents as low as reasonably achievable, and (3) if equipment for exposure and effluent control is being properly used and maintained.

9. The results of sampling, analyses, surveys, and instrument calibrations, reports on inspections and audits, employee training records as well as any related reviews, investigations, and corrective actions shall be documented. Unless otherwise specified in NRC regulations, all such documentation shall be maintained for a period of at least three years.

10. The licensee shall maintain a fire protection system as described on Page 6, Attachment 5, of the supplement dated Janaury 9, 1978. The licensee's training program for employees, including annual refresher training, shall include instructions on the fire protection system and actions required of employees in event of fire.

11. The scrubber circuit(s) for the calciner/packaging system, when in operation, shall be checked and control readings recorded at least once per shift to document that the scrubber systems are functioning properly.

12. The licensee shall comply with the following regarding surface radioactive contamination:

    (a) Release of equipment and materials from the controlled areas shall be in accordance with the attached Annex A dated November, 1976.

    (b) Workers in the calciner/packaging area shall shower and/or monitor themselves at the end of each shift. An alpha radiation survey meter shall be available at the exit of the change room for monitoring. In addition, the licensee shall perform spot surveys for alpha contamination, at least quarterly, on workers leaving the plant. Alpha contamination on skin or clothes exceeding 1000 dpm/100 cm^2 shall require decontamination and an investigation by the plant RPO as to the cause.

    (c) The licensee shall conduct alpha contamination surveys of the lunch rooms, change rooms, and offices at least weekly. If the surveys reveal contamination levels that exceed the appropriate values in the attached Annex A, the area shall be decontaminated immediately and an investigation made by the plant RPO to determine the cause and corrective measures required to prevent recurrence.

13. As an alternative to the licensee's commitment that external exposure of personnel will be monitored by TLD dosimeters, area TLD dosimeters, located at appropriate locations in the processing and storage areas may be used to determine the need for personnel monitoring equipment specified by Section 20.202, 10 CFR Part 20. Dosimeters shall be evaluated quarterly.

14. The use of respirators shall be controlled by a respiratory protection program as stipulated by Section 20.103 of 10 CFR Part 20 and Regulatory Guide 8.15.

15. The licensee shall conduct an air sampling program to assess airborne radioactivity concentrations to which employees may be exposed as follows:

    (a) A representative air sample shall be collected at least weekly at work stations in the calcining/ packaging area to determine airborne uranium concentrations. The weekly samples shall be

supplemented by worker breathing zone sampling at least monthly to determine the representativeness of the station air samples.

(b) Monthly air samples, representative of potential employee exposure, shall be collected at other process and storage locations, as appropriate, to determine airborne uranium concentrations.

(c) Monthly sampling at selected process areas including well field buildings shall be performed to determine radon or radon daughter concentrations. If monthly values should exceed 25 percent of the applicable value in Appendix B of 10 CFR Part 20, the frequency of sampling at these locations shall be increased to weekly.

(d) If the air sampling program reveals work locations where concentrations exceed 25 percent of the applicable value in Appendix B, Table I, Column 1, of 10 CFR Part 20, the licensee shall establish a program to determine timeweighted exposures of employees working at these locations and establish such procedures specified by Section 20.103(b)(2) to maintain employee exposures as low as reasonably achievable.

(e) Special uranium particulate air sampling, supplementing the routine air sampling program, shall be conducted for cleanup and maintenance activities in the calcining/ packaging area, when performed, and other process areas as appropriate.

16. The licensee shall institute a monitoring measurement procedure to develop a radon source term (curies per year) for the overall project operation.

17. The licensee shall collect and analyze a representative 24 hour sample from the exhaust stack for the calcining/packaging equipment weekly during normal operation. This sample shall be analyzed to determine the uranium particulate releases.

18. The flow rate of the process stack identified in Condition No. 26 above shall be measured annually and whenever any process equipment changes are made that might significantly alter the flow rate.

19. The licensee shall submit a report to the NRC Region IV Office (address given in Appendix D of 10 CFR Part 20) with copies to the Director of Inspection and Enforcement, U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, within 60 days after January 1 and July 1 of each year which shall contain the following information:

(a) Average and maximum weekly uranium concentrations (uCi/cc) measured at the exhaust stack identified in Condition No. 25 above, for the six-month period ending January 1 and July 1 of each year.

(b) Average uranium release rate (uCi/sec) and total quantity of uranium released (uCi), identifying the flow rate used for the stack to calculate the releases.

(c) Average concentrations and release rates through the stack for radium-226 and thorium-230, which may be based upon representative analyses of the yellowcake product.

(d) Such other information that may be appropriate to enable the NRC to estimate the maximum potential radiation doses to the public resulting from effluent releases.

(e) The estimated radon overall release for the project as determined in Condition 25.

20. The licensee shall, as a minimum, conduct the following environmental monitoring program:

Environmental Element	Sampling Location	Sampling Frequency	Type of Measurement
Surface Water	Surface impoundments and affected drainage	Quarterly	Uranium, Ra-226, Th-230, Pb-210
Air	Air quality monitoring sites	24 hr sampling at monthly intervals	Particulates, Ra-226, Th-230, uranium
Soils, vegetation	At the air quality monitoring sites	Annually	Uranium, Ra-226, Th-230, Pb-210

21. Analyses of degraded resin generated in the mining and recovery operations shall be performed to determine uranium, radium-226, and thorium-230 contents.

If the analyses show concentrations exceeding 0.05 percent uranium, 3×10^{-8} uCi/gram of radium-226, or 2×10^{-6} uCi/gram of thorium-230, the solid wastes shall be shipped to a licensed commercial disposal site.

22. The licensee shall submit a written report to the NRC within 30 days after a leachant excursion has been detected and verified. The report shall describe the corrective action(s) taken and an evaluation of the results achieved. If corrective action is continuing at the time of the report, a supplemental report shall be filed which describes and evaluates the final results.

23. The licensee shall inform the NRC of any proposed revisions in the Wyoming State Mine Permit.

24. The use of an ammonium - bearing lixiviant shall be limited to a maximum well field area of 20 ha (50 acres) and shall include the existing well field for the 100-gpm pilot-scale test.

25. A well field unit undergoing restoration shall be isolated from other operating well field units within the 20 ha (50 acres) by a minimum of two production cell unit widths to avoid compromising the restoration by continuing mining activities.

26. Groundwater quality restoration of at least the first entire production well field unit shall be completed prior to mining any area beyond the maximum 20 ha (50 acres). A report describing the intended restoration plan shall be provided to the NRC for review and approval. It shall also describe the sequential groundwater quality restoration activities to be effected for the remaining well field units in the 50 acre area.

27. Following restoration of the initial well field (Condition 35), the licensee shall implement a post-restoration monitoring program as described in Section 8.2.3.7 of NUREG-0481.

28. The licensee shall perform postmining monitoring subsequent to mining and restoration of production well field units as stated and recommended in Section 8.2.3.8 of NUREG-0481.

29. The licensee shall submit a plan for determining ammonia transport and conversion on the original section of the 5I7 test site before March 15, 1979.

30. The licensee shall dispose of process radioactive wastes by transporting them to an active tailings pond. A maximum accumulation of five years of calcite waste shall be permitted prior to its removal from the site. Other radioactive bearing wastes from uranium recovery and/or restoration activites shall be removed from the site to a licensed tailings pond or to a licensed burial site during sequential restoration/reclamation operations as needed.

31. The licensee shall maintain a liquid seal on waste storage ponds except when removing their solids content for disposal. Release of process liquid wastes to surface waters shall be prohibited.

32. The licensee shall implement the environmental monitoring programs specified in Sections 8.1.5.1, 8.1.5.3 and 8.2.1 of the Final Environmental Statement (NUREG-0481).

33. The licensee shall provide plans for minimizing environmental impact on riparian habitats or streambeds (i.e. Willow Creek) to the NRC at least 180 days prior to conducting activites in such areas.

34. Before engaging in any activity not evaluated by the NRC, the licensee shall prepare and record an environmental evaluation of such activity. If such activity may result in a significant adverse environmental impact that was not evaluated or that is significantly greater than that evaluated in NUREG-0481, the licensee shall provide a written evaluation of such activity and obtain prior approval for its inception from the NRC.

35. If unexpected harmful effects or evidence of irreversible damage not otherwise identified in NUREG-0481 dated September, 1978, are detected during construction or operations, the licensee shall provide the NRC with an acceptable analysis of the problem and a plan of action to eliminate or significantly reduce the possible harmful effects or damage.

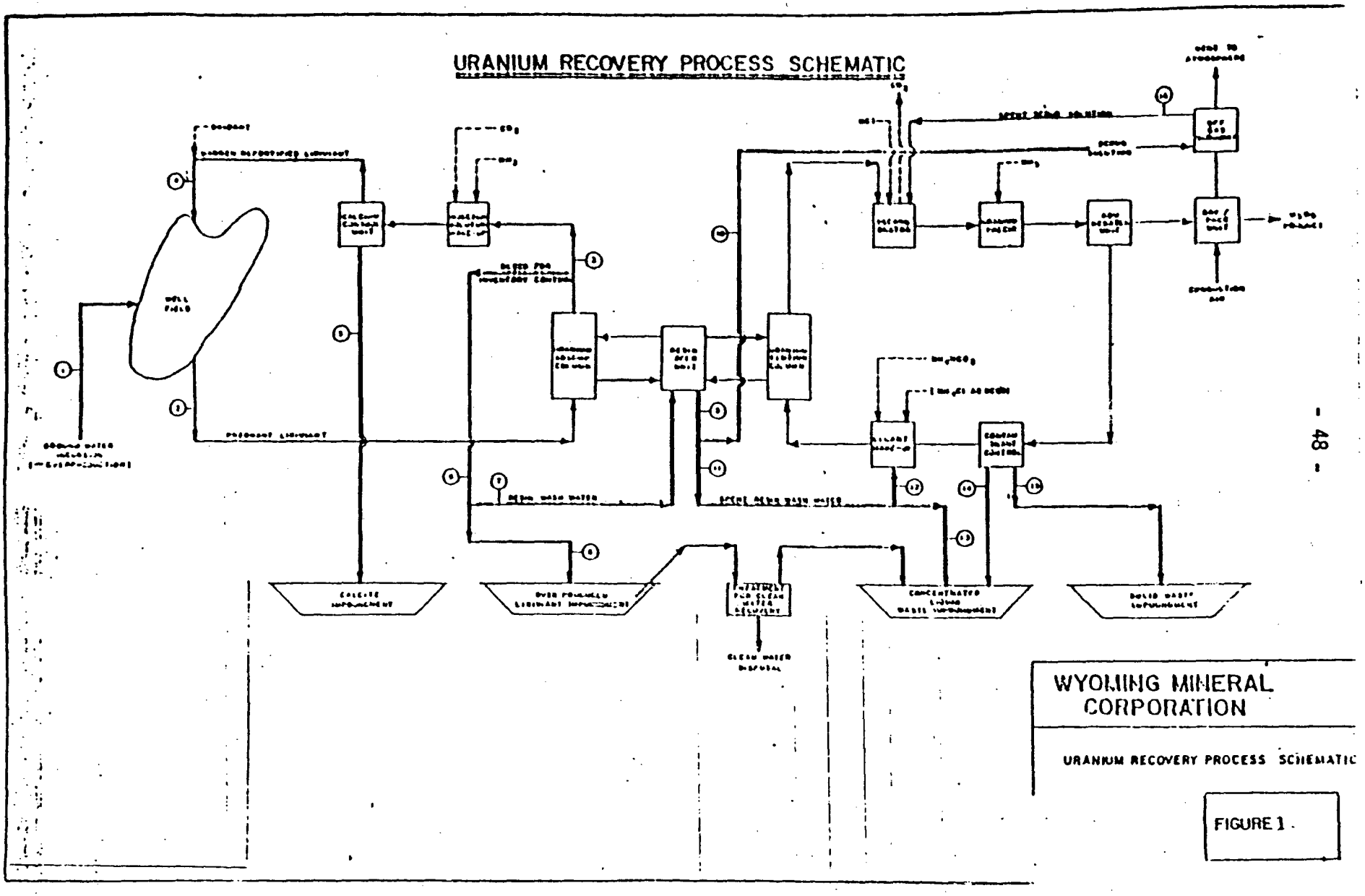
36. Prior to disturbing any land, including topsoil removal, outside the area surveyed for any solution mining related activities, including site decommissioning, the licensee shall have an archeological survey of the area performed and shall submit the results to the NRC for review. The licensee shall not proceed with any land disturbance until the NRC has evaluated the report and given the applicant approval to proceed.

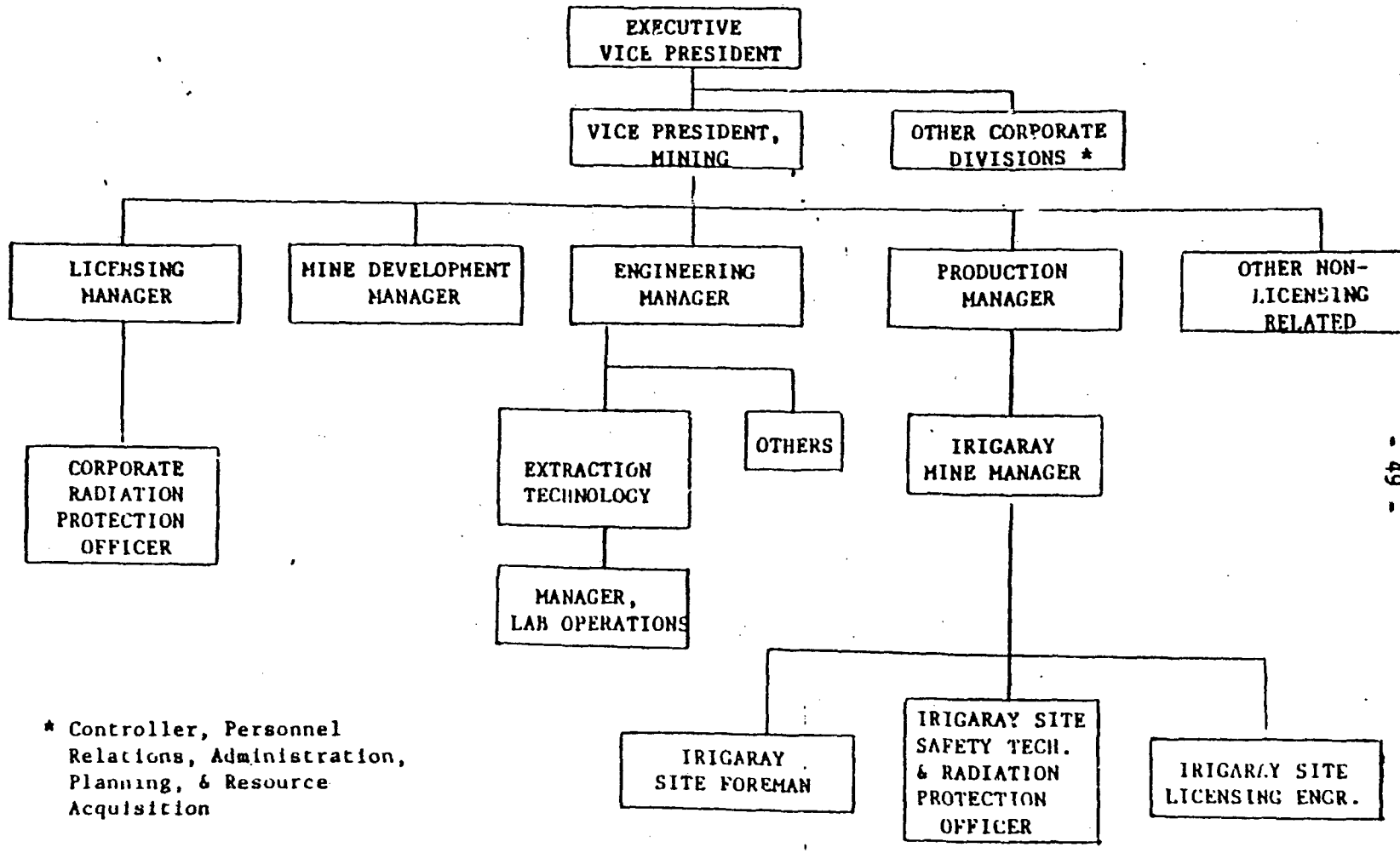
37. The licensee shall notify the NRC and the Wyoming State Archeologist when any artifacts of earlier culture are encountered during site preparations or operations. Further activity in the immediate area shall be deferred until a determination of their significance by the NRC is completed. Mitigating measures, if needed, to preserve them shall be proposed by the licensee.

R. Cooperstein, Ph.D.
Fuel Processing & Fabrication Branch
Division of Fuel Cycle and
Material Safety

Approved:

W. T. Crow, Section Leader
Uranium Fuel Fabrication Section
Fuel Processing and Fabrication Branch
Division of Fuel Cycle and
Material Safety


URANIUM RECOVERY PROCESS SCHEMATIC
WYOMING MINERAL CORPORATION
URANIUM RECOVERY PROCESS SCHEMATIC
FIGURE 1



* Controller, Personnel Relations, Administration, Planning, & Resource Acquisition

FIGURE 2 WYOMING MINERAL CORPORATION ORGANIZATIONAL STRUCTURE

OPERATIONAL FLOW DIAGRAM

DRYER FACILITY AND ANCILLARY EQUIPMENT

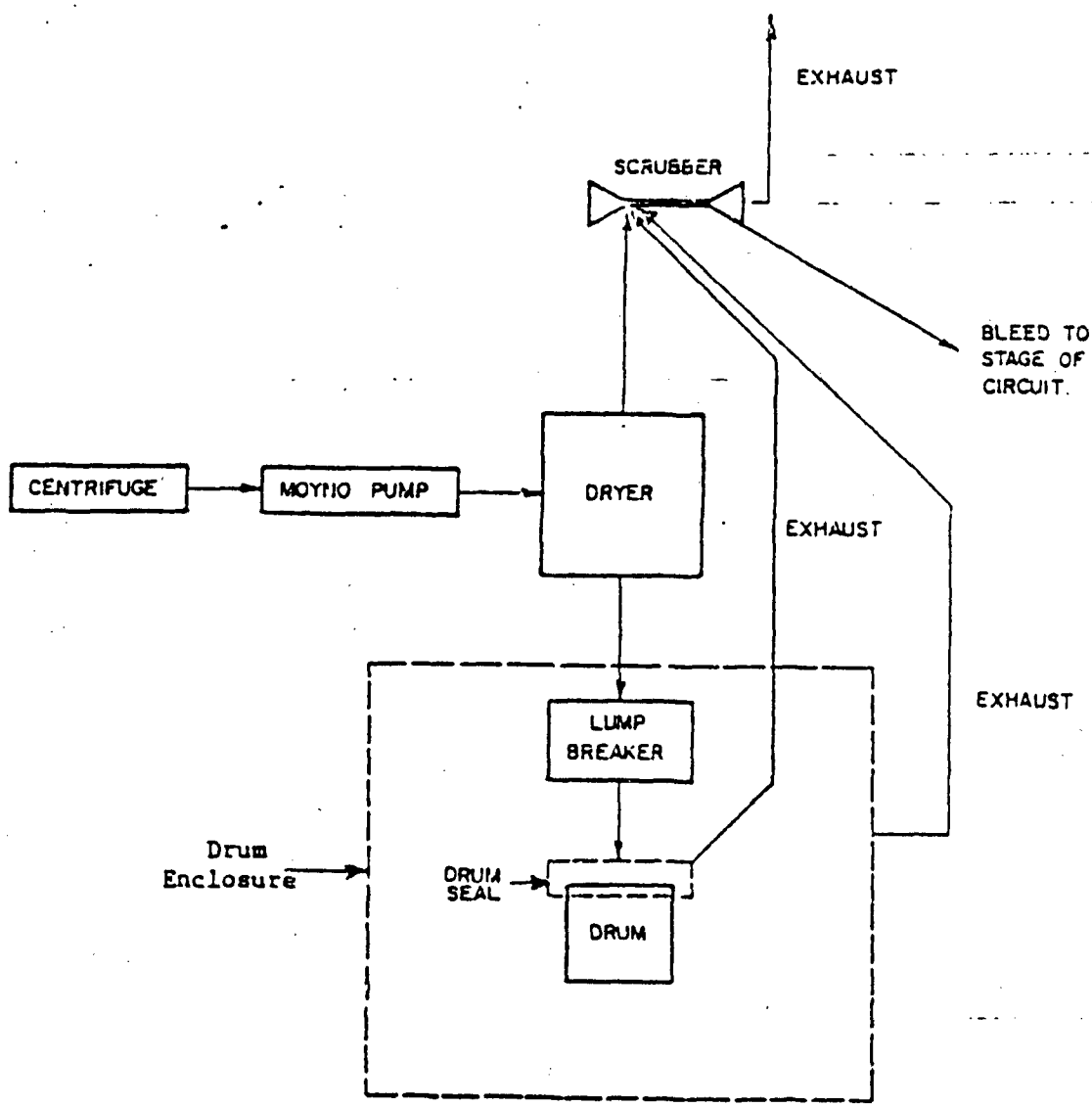


FIGURE 3