Revisions to

Application for a Source Material License

SHOOTERING CANYON URANIUM PROJECT

GARFIELD COUNTY UTAH

For

Plateau Resources Limited

5.1 Corporate Organization

Figure 5-1 shows the corporate organization of Plateau Resources Limited. The management organization for the construction and operation phases of the Shootering Canyon project are presented in Figures 5-2 and 5-3, respectively.

The Vice President and General Manager of PRL (Figure 5-1) has the responsibility for all production and support operations. He has the full authority to deal with all problems related to the operation of the Shootering Canyon processing facility. He is responsible for assuring the implementation of the quality control and quality assurance programs for the facility. The operational responsibilities and authorities of the Vice President and General Manager in respect to quality assurance, and operations, maintenance, environmental and radiological health, and quality control are delegated to the Program Manager and the Manager of Operations, respectively (Figure 5-1). Also reporting to the Vice President and General Manager is the Chief Geologist, who is responsible for the mineral property exploration and acquisition program.

The Process Manager, Mine Manager, Project Manager, and Personnel Director report directly to the Manager of Operations (Figures 5-1, 5-2, and 5-3). The Project Manager is responsible for the design and construction of all processing facilities. The Process Manager is responsible for the operation of all processing facilities as well as ore purchases. The Program Manager is charged, through the Vice President and General Manager,

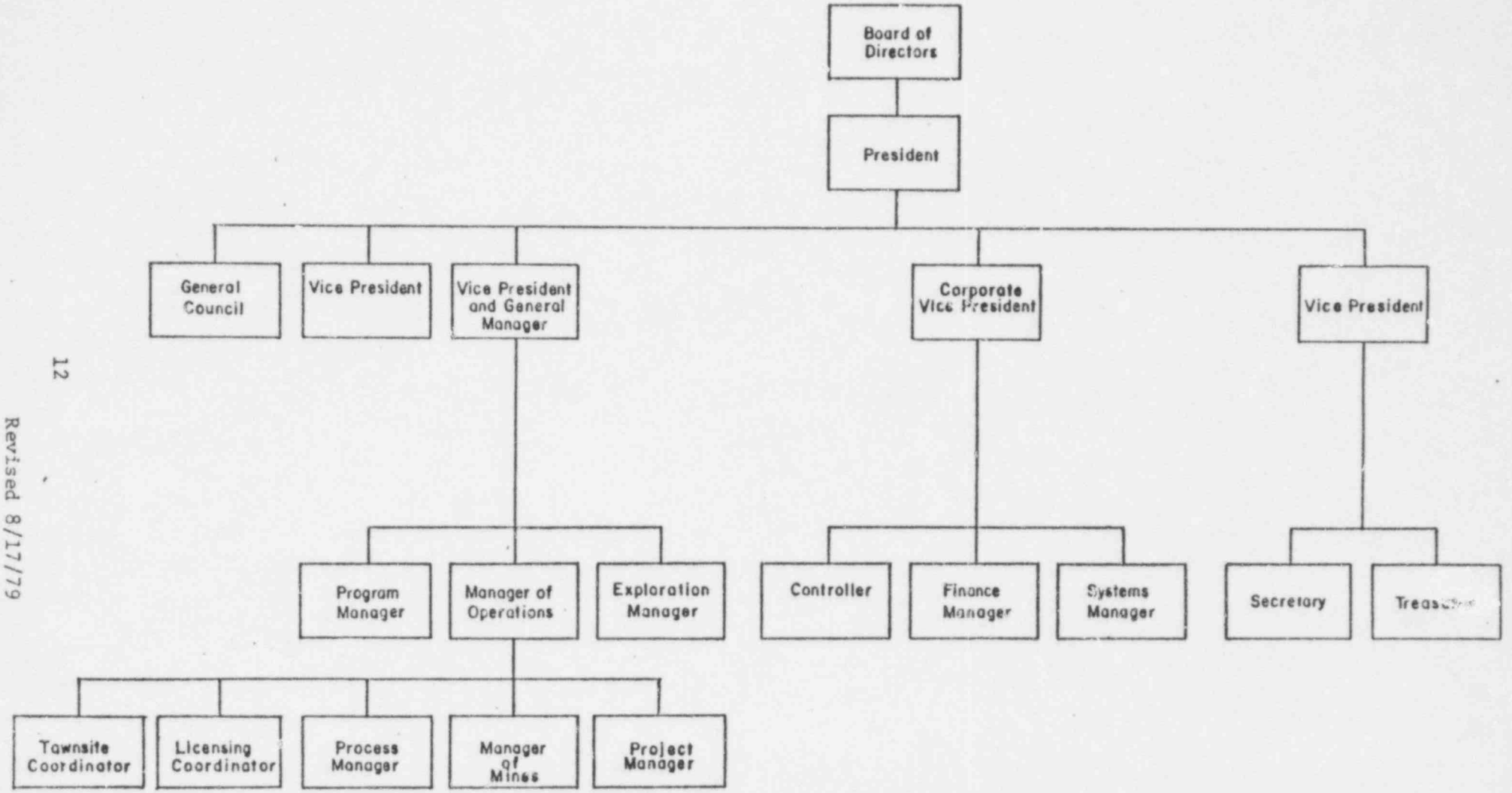

Figure 5-1. CHART OF ORGANIZATION - PLATEAU RESOURCES LIMITED

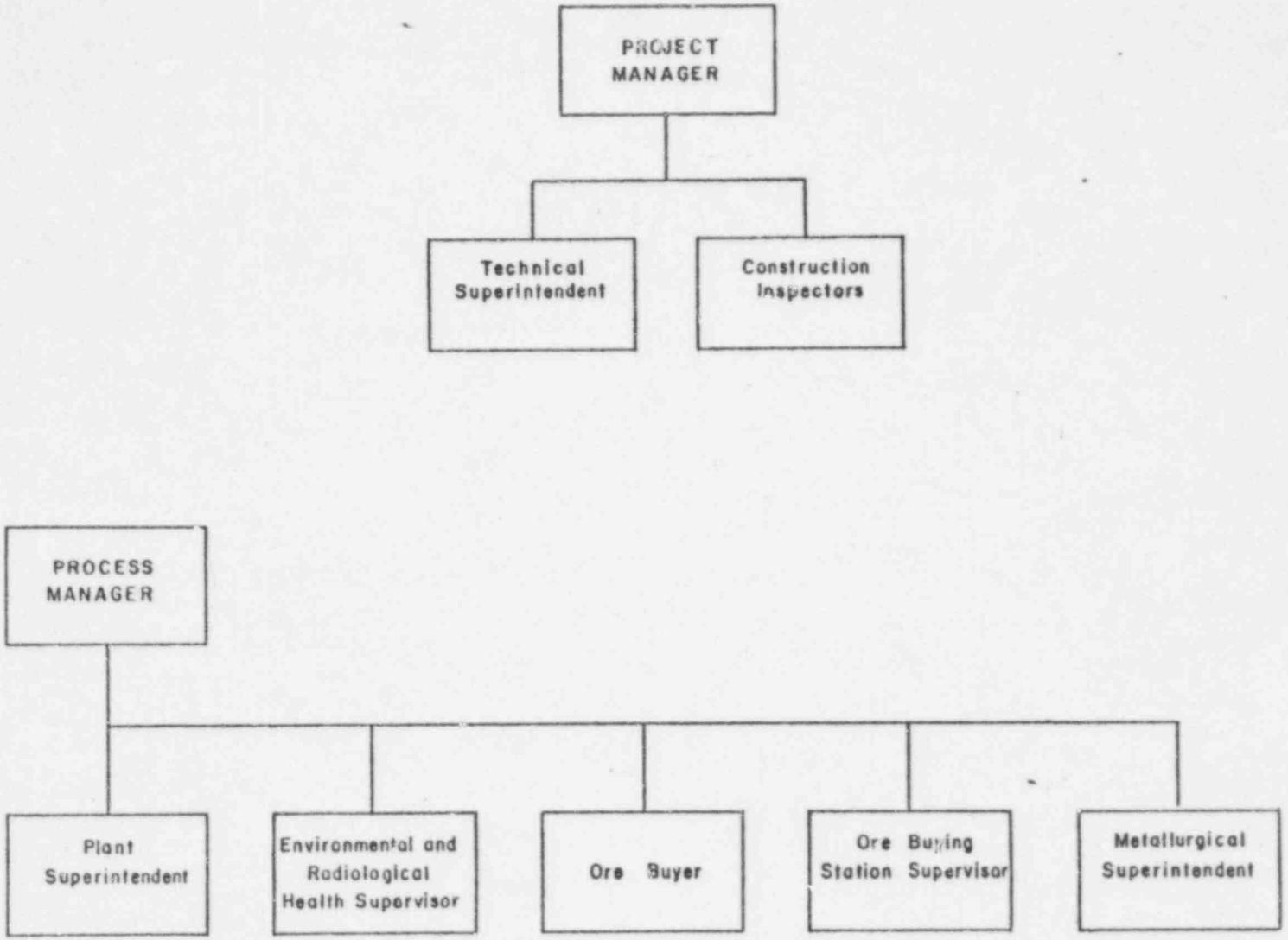

Figure 5-2. CHART OF ORGANIZATION - SHOOTERING CANYON PROCESSING FACILITY, ENGINEERING AND CONSTRUCTION PHASE

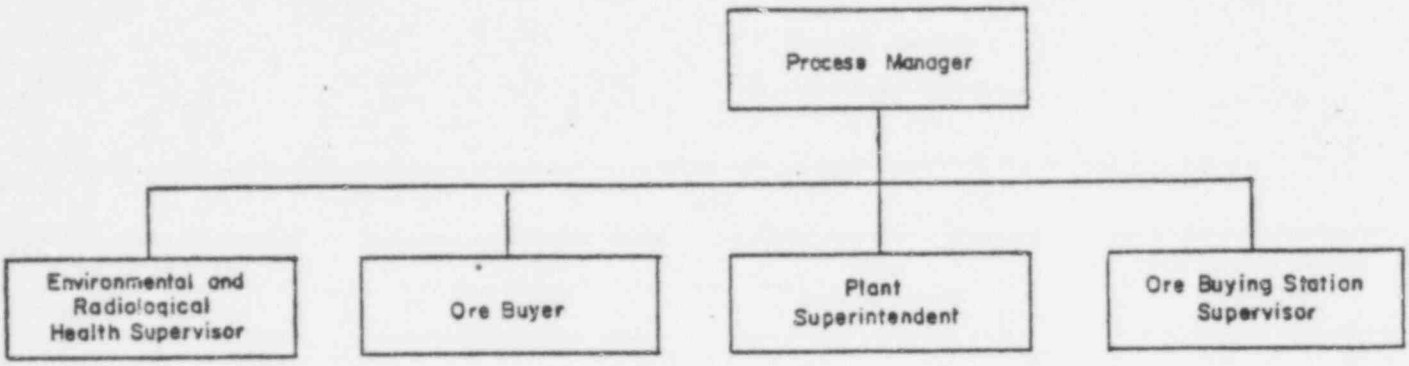

Figure 5-3. CHART OF ORGANIZATION - SHOOTERING CANYON PROCESSING FACILITY, OPERATIONS PHASE

with the responsibility and authority to implement and conduct the quality control program. During the engineering and construction phase of the processing facility, the Project Manager is assisted in performance of these responsibilities by the Technical Superintendent, and the construction inspectors, who all report directly to the Project Manager (Figure 5-2). During the operation of the facility, the Plant Superintendent reports directly to the Process Manager and has the authority to conduct plant operations, maintenance, and the quality control program. The Environmental and Radiological Health Supervisor reports directly to the Process Manager and is responsible for the radiological health and safety program. The Plant Superintendent is responsible for the development, review, implementation, and adherence to operating procedures, environmental and radiation health programs, and routine and non-routine maintenance activities. He has the authority to approve and make changes in these procedures and programs. The Plant Superintendent is assisted by the following members of the staff: the Environmental and Radiological Health Supervisor, the Laboratory Supervisor, and the Technical Superintendent.

The Management control program is described in Section 7.0 of this application. This program contains provisions to ensure that all routine operational activities are conducted in accordance with written procedures that have been reviewed and approved by the environmental and radiological health staff. These operating procedures will be reviewed at intervals not to exceed two years. The program also includes a work order system covering non-routine functions, such as maintenance activities, that are not covered by operating procedures. All work orders are required to be reviewed and approved by the environmental and radiological health staff prior to their implementation.

The management audit and internal inspection program, including types and scopes of reviews, audits, and inspections, and individual responsibilities, is described in Section 7.0 of this application. PRL is committed to maintaining as low as reasonably achievable (ALARA) exposures for personnel and ALARA effluent releases. One of the primary objectives of the plant design (refer to Section 3.0 of the

environmental report) has been to minimize effluent releases. Maintaining ALARA personnel exposures is a function of equipment reliability and performance, personnel training, and job planning. Every attempt will be made to purchase equipment that is reliable and performs to specifications. Personnel training programs will be implemented as described in Section 5.3 of this application. In addition, periodic reviews of operating procedures and routine reviews of work orders by the environmental and radiological health staff will have the specific objective of keeping personnel exposures as low as reasonably achievable. In addition, a Radiation Health Physics Specialist will inspect, review, and approve the project health physics safety programs and records and ALARA philosophy on at least an annual basis.

5.2 Qualification

The Environmental and Radiological Health Supervisor and Radiological Technician are required to have the following qualifications.

A. Environmental and Radiological Health Supervisor
   1. B.S. Degree in the physical sciences, mathematics or engineering from an accredited college or university or a combination of at least four years of relevant experience and education.
   2. Training and/or experience in radiation safety.
   3. Working knowledge of equipment used in radiation and environmental monitoring.
   4. Working knowledge of analytical procedures, both chemical and mathematical.

B. Radiological Technician
   1. High School Diploma - two years of college preferred, with a strong emphasis in math, chemistry, physics.
   2. Training in radiological health.
   3. Knowledge of equipment used in radiation and environmental monitoring.

this form is provided in Appendix B. Employees will be allocated adequate time to examine the documents described above, followed by a question and answer period for further clarification. The initial briefing will include a plant walk-through with particular emphasis on the employee's specific work area.

Exposure Abatement

Exposure abatement is a two-fold problem; i.e., external and internal. Employees will be instructed in proper work scheduling in order to minimize the time spent in any area which poses a significant external radiation dose. Minimizing exposure to significant concentrations of airborne radioactive material will be the most detailed portion of the training program. Employees will be instructed on the modes of entry of radioactive materials into the body; i.e., ingestion, inhalation, absorption through the skin, and absorption directly in the bloodstream.

To limit ingestion, mouth pipetting is prohibited. The consumption of cigarettes and foodstuffs is not allowed in areas where radioactive materials are handled or stored. In addition, a thorough washing is required after handling any radioactive substance.

To limit exposure by inhalation, all employees will be supplied with an approved respirator as required. Those individuals assigned to areas requiring the use of a respirator must be deemed physically able to perform the work and use the respiratory protective equipment. A physician is to make this determination prior to assignment of the worker and is to review the medical status of each respirator user at least annually.

Respirator protection will be required for employees if airborne levels are likely to exceed 25 percent of MPC. PRL's respiratory protection program is based on Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection" and NUREG-0041, "Manual on Respiratory Protection Against Airborne Radioactive Materials." This program will be directed by the RSO.

Standard procedures will be developed for respirator use. These procedures will include all information and guidance necessary for their proper selection, use, and care. Random inspections will be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

Each respirator wearer will receive fitting instructions including demonstrations in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators will not be worn when conditions prevent a good face seal. Such conditions may include growth of a beard, sideburns, a skull cap that projects under the face piece, or temple pieces on glasses. To assure proper protection, the respirator fit will be checked by the wearer each time it is worn. This may be done by following the manufacturer's instructions.

Routinely used respirators will be collected, inspected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided for the wearer. Each worker will be briefed on the cleaning procedure and be assured that he will always receive a clean and disinfected respirator.

After inspection, cleaning, and necessary repair, respirators will be stored to protect them from dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Routinely used respirators will not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons.

Work areas requiring the use of respirators will be minimized through the proper operation of pollution control equipment and ventilation systems. All employees responsible for the operation of this equipment, and employees assigned to areas where this equipment is utilized, will be instructed in efficient operation of pollution control and ventilation equipment. Baghouse filtration systems will not discharge filtered solids into the atmosphere. In addition, any baghouse developing

On-The-Job Training

The continuing on-the-job training will be carried out informally, primarily by the workers' immediate supervisor, but supported by the Radiological Health Supervisor. This training will be very specific for the job the particular worker has been assigned. It will generally cover the same training as the initial briefing, but will also include emergency procedures.

Safety Meetings

Monthly radiological safety meetings lasting at least 30 minutes will be attended by all workers and supervisors. These meetings will generally consist of a film or other educational aid followed by open discussion. The use of films and other aids will facilitate the training of all employees in recent advancements in radiological health protection. The open discussion will allow employees to voice ideas, questions, and grievances concerning radiological health protection; thereby involving all levels of the company in maintaining a viable and safe radiological safety program.

5.4 Security

The boundary limits of the processing facility will be posted and enclosed by a fence restricting the area to people and large animals, such as cattle. The process plant, run-of-mine ore lay-down patio, ancilliary facilities (such as laboratory, office building, warehouse and maintenance facilities, electrical power distribution, reagent storage, and water wells), and the entire tailings disposal area will be located within the boundary limits of the facility. Gates will control the designated points of access to the facility. Posted signs strategically located, will state "keep Out - Restricted Area," for such areas as the tailirgs impoundment. Similar warning or information signs will be posted in pertinent locations.

An essential feature of any program is periodic evaluation of the adequacy of the program and of its implementation at the processing facility. The program provides for periodic audits of the operation of the quality control program and for audits and/or evaluations of the effectiveness of the program itself. These audit functions may be carried out by members of the staff of Plateau or by outside personnel, or by a combination of these. Where outside personnel are used in any phase of this audit and evaluation, the same criteria for performance of the quality related functions will be applied as required by the Plateau Program. The portion of the program described in this paragraph is hereinafter referred to as quality assurance.

Organization and Responsibilities

The table of organization of Plateau Resources Limited is set forth in Figures 5-1, 5-2, and 5-3. The Vice President and General Manager has the responsibility for all production and support operations. He has the full authority to deal with all problems related to the operation of the processing facility, including the quality control and quality assurance programs associated therewith. He is responsible for assuring the implementation of the quality control and quality assurance programs outlined herein. The operational responsibilities and authorities of the Vice President and General Manager, in respect to quality assurance and quality control set forth herein, are delegated to the Program Manager and the Manager of Operations, respectively. Also reporting to the Vice President and General Manager is the Chief Geologist, who is responsible for the mineral property exploration and acquisition program.

The Process Manager, Mine Manager, and Personnel Director report directly to the Manager of Operations. The Project Manager is responsible for the design and construction of all processing facilities. The Process Manager is responsible for the operation of all processing facilities as well as ore purchases. The Process Manager is also charged,

through the Manager of Operations and Vice President and General Manager, with the responsibility and authority to implement and conduct the quality control program. During the engineering and construction phase of the processing facility, the Project Manager will be assisted in performance of these responsibilities by the Technical Superintendent and the Plant Superintendent, who report directly to the Project Manager. During the operations phase, the Plant Superintendent reports directly to the Process Manager and has the authority to conduct the quality control program. The Plant Superintendent will be assisted by the following members of the staff. the Environmental and Radiological Health Supervisor, the Laboratory Supervisor, and the Technical Superintendent, in the conduct of the quality control program during the operations phase.

The Program Manager will review the quality control program to assure that it complies with the objectives of this plan. Differences of opinion between the Program Manager and the Manager of Operations' staff will be resolved by the Vice President and General Manager. The Program Manager may receive assistance from members of the operations organization in the discharge of his responsibilities in the quality assurance program related to health and safety activities. In the event the Program Manager obtains such assistance in connection with audit, inspection and evaluation activities, in no case shall any operations employee participate in an inspection, audit or evaluation of activities which are directly under his supervision or which he performed.

Quality Control Responsibilities

Responsibilities relating to the Quality Control Program are assigned as follows.

Construction Control

Inspection of Construction. During construction of the processing facility, the Project Manager or his delegate will be responsible for the following:

- Reviewing and approving procedures and material specifications.
- Implementing controls to prevent inadvertent issue and use of unapproved design documents.
- Reviewing, approving, and documenting design changes.
- Implementing a receiving inspection system to assure that materials and components are inspected for conformance to specifications and that nonconforming items are identified and controlled to prevent inadvertent use.
- Implementing a program of independent or vendor-certified testing of materials and components to verify conformance with specifications.
- Performing and documenting overchecks to verify that final installations meet required standards.
- Inspection of construction of the tailings dam, lining of the pond, and other pond related construction activities for concurrence with the plans and specifications.

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Start-Up. Prior to facility operations, the Plant Superintendent will verify or cause to have verified:

- Proper operation of level indicators.
- Leak-tightness of process piping system.
- Separation of sanitary and process water system.
- Proper routing of drains.
- Operability of remote actuation valves.
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- Operability of remote actuation valves.
- Proper function of the ventilation systems and air cleaning equipment.

Prior to facility operation, the environmental and Radiological Health Supervisor will verify:

- Operability of air monitors.
- Readiness of emergency equipment.

Operational Control

The Environmental and Radiological Health Supervisor will be responsible for radiation protection and environmental monitoring. He will:

- Develop and implement a radiation protection orientation and training program for all employees.

- Establish a program for training the radiation protection specialist(s).

- Perform annual reviews of training documentation to verify the adequacy of course content and training records.

- audit principles, as they are applicable to the responsibilities of the particular individuals involved.

Personnel will be required to complete the training programs prior to initiating any inspection, audit, or surveillance activity.

Audits

A system of planned and documented audits is intended to assure continuing compliance with the quality assurance program described herein for controlling the quality of work related to radiological safety in the facility. The responsibility for conducting, reporting and following up on these audits is assigned to the Program Manager and his staff. The audits will be conducted in accordance with a predetermined schedule using a check list covering the elements of the system which are to be audited.

Two categories of audits will be conducted: audits of the operations of the quality control plan and quality assurance system audits. The objective of the audits for the quality control plan is to evaluate the extent of compliance of the operating organization to the requirements of the plan. The audits will involve a review of the following:

- adherence to established procedures
- measurement quality control program
- inspection activities
- sample evaluation program
  measurement results
- nature of identified deficiencies and corrective actions
- taken in connectection with these deficiencies
- adequacy of documentation
- training programs
- radiological safety program

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plateau resources LIMITED

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April 6, 1979

Mr. Ron Daniels
State of Utah
Division of Oil, Gas & Mining
1588 West North Temple
Salt Lake City, Utah 84116

Dear Ron:

A mine and mill reclamation plan was submitted to your office on January 25, 1979 for approval.

Attachment number 4 to the reclamation plan was taken from text which was later revised and submitted to the Nuclear Regulatory Commission. Accordingly, I have revised attachment number 4 and marked the changes for your convenience.

Also, it was felt by our processing personnel that you might have an interest in the tailings underdrainage system. I have enclosed a copy of a letter dated December 5, 1978 from Woodward-Clyde Consultants to the NRC explaining this system in detail as a response to some of their questions during the preparation of our Draft Environmental Statement.

Should you have any questions about this system, please do not hesitate to contact me.

Sincerely,

Pam Newman

Pam Newman
Administrative Assistant

PN
enclosures
cc: Mr. R. B. Sewell

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PLATEAU RESOURCES LIMITED
SHOOTERING CANYON PROCESSING FACILITY

RECLAMATION AND RESTORATION

The purpose of a reclamation program is to restore lands disturbed by project activities to a productive condition consistent with past and present uses of the area. This generally consists of restoring landscape contours to slopes similar to predisturbance conditions and replacing a sufficient thickness of topsoil to enable native vegetation to become reestablished whenever possible. Reclamation of the tailings impoundment will include measures to reduce the emanation of radon to a level about twice that which naturally emanates from soils in the vicinity.

Several characteristics of the project area, and southeastern Utah in general, are considered nonconducive to the rapid reestablishment of native plant species on disturbed areas. The most significant factors are the arid climate and the poorly developed soil. The low average annual precipitation; frequent droughts; extreme temperatures; high wind erosion; and a loose, undifferentiated soil profile with poor moisture-holding capacity and little organic content contribute to inherent reclamation problems in the area.

Based on the types of disturbances anticipated, the environmental characteristics of the area, the present and proposed land uses, and the state-of-the-art knowledge on reclamation in arid environments, reclamation of areas disturbed by the project will consist of the following procedures:

- -Cover and stabilize the tailings impoundment
- -Remove structures and regrade or reshape disturbed areas to blend with surroundings
- -Replace topsoil material in areas amenable to plant growth
- -Revegetate disturbed areas using native species

PRESENT AND PROPOSED USE OF THE LAND

Historically, the project area has been used for seasonal grazing of livestock and as wildlife habitat. Human use of the project area for activities such as camping, hiking, sightseeing, and hunting has been minimal to date, although other areas in southeastern Utah are important for one or more of these activities.

Livestock grazing and wildlife habitat will probably continue to be the principal uses of the affected area after termination and closure of the proposed project. Agricultural use of the area, for either crop or hay production, is not anticipated due to the poor soil structure and scarcity of water. There are presently no urban or industrial developments in the project area; and other than the facilities related to the proposed project, none are planned for the future.

The purpose of the reclamation program is to restore those lands disturbed by project activities to an acceptable condition for livestock grazing and wildlife habitat. Since the existing vegetation is generally sparse, and is dominated by widely spaced shrubs and by relatively few grasses that produce useful amounts of forage, successful reclamation in the project area will result in the establishment of sparse vegetation with generally low forage production.

LANDS DISTURBED FOR ORE PROCESSING PLANT

Approximately 18 acres will be graded before construction of the ore processing facility. For approximately 90 percent of that area, grading will involve excavation to develop smooth, nearly level surfaces. Filling will be required over the balance of the graded area. Typically, cuts will range from zero to about 15 feet in depth, except in localized areas (such as the ore crushing structure and connecting conveyor tunnel) where excavation will be as deep as 45 feet. Maximum fill depth will be approximately 40 feet at a corner of the ore storage patio. Unsupported cuts and fills will be sloped at two horizontal to one vertical (2:1).

At project termination all plant structures and facilities will be dismantled and removed from the plant area. Structural foundations, tank containment dikes, and other elements extending above the general grade of the plant site will be leveled, and probably will be used to fill

de pressions within the plant area, such as the excavation for the ore crushing structure. All depressions within the plant site will be filled and the general surface gradient of the graded area will be maintained so that all runoff from the area will continue to flow to the tailings impoundment area. After this general leveling is completed, the entire plant area will be covered to a depth of about 1 foot with previously stockpiled topsoil, fertilized and seeded to promote the establishment of native vegetation. Plant species to be seeded include: sage (Artemisia spp.), Indian ricegrass (Oryzopsis hymenoides), and Mormon tea (Ephedra), if available. A plant population density commensurate with that of the surrounding undisturbed area may be achieved in this way.

An area adjacent to the plant site will be cleared and graded for use as a construction equipment and materials storage yard. Additional contiguous land may be graded and cleared for temporary housing purposes if the Ticaboo Subdivision is not completed in time to be used by plant construction workers. When plant construction is completed, the construction yard and housing area will be closed, all structures and equipment will be removed, the area will be regarded to conform with the general topography of its surroundings, and disturbed areas will be fertilized and seeded with native plant species as indicated above for the plant site.

CLOSURE OF TAILINGS IMPOUNDMENT

Reclamation and restoration of the impoundment area will progress throughout the operating life of the ore processing facility, and will be concluded promptly after the termination of the processing operations. The tailings management plan for the project is designed to take advantage of the tendency of the sand and slimes fractions in the tailings to segregate during placement. Tailings will be delivered by pipeline to the impoundment area, and will be discharged through carefully placed and operated distributor pipes. The discharge pipes probably will be placed

at the elevation of the full impoundment and frequently repositioned so that they will remain at the perimeter of the impoundment as it fills. Discharged tailings will flow down the slopes of the impoundment basin; the sand fraction will be deposited near the discharge points, while the slimes will flow toward the lowest part of the basin. As filling progresses, the pipes will be repositioned to continuously extend the tailings sand beach at the level of the full impoundment and the resulting new sand beaches will be reclaimed by constructing the required cap.

It is expected that enough water may be withdrawn from the slimes by evaporation to stabilize them to the extent that they will not be displaced from the bottom of the impoundment basin by the subsequent placement of additional tailings. An important variable in the tailings placement operation is the location of the spigot discharge. By varying the distance between the point of discharge and the low part of the basin, the exposure of the flowing slimes to the atmosphere can be varied. Properly controlled discharge positions should result in well-dewatered slimes collecting in the low part of the tailings basin. Thus, at the end of the project life, a large mass of liquid slimes will not be concentrated in the central portion of the impoundment area, and there should be no difficulty in completing the cap to be placed over the entire impoundment area. By continuously stabilizing the tailings slimes as they are discharged into the impoundment, it will be possible to provide the maximum feasible burial of that portion of the tailings containing the preponderant part of the radionuclides. Also, this disposal technique should result in a well-consolidated, dense mass of low porosity, which will be effective in limiting the emanation of radon gas from the tailings.

Present plans are to construct the cap over the tailings using -3- materials. The cap will be a minimum of 9 feet thick. A 6-foot-thick layer of clayey material will be placed immediately over the tailings. This material will be compacted to at least 95 percent of Standard Proctor Density. A 2-foot-thick layer of locally available sandy soil material is to be placed on top of the clay, and it too will be well compacted. To provide the necessary surface stability against wind

erosion, special care will be exercised to obtain a concentration of gravel and small rocks in the upper additional 1 foot of the cap.

It is noted that optimization in the design and construction of caps for uranium mill tailings is an evolving technology. Therefore, the plan for capping tailings from the Shootering project presented here is tentative. When the time comes to construct the cap, the best technology then available for the purpose will be employed. Since the cap construction will continue throughout most of the project operating life, this project will provide excellent opportunities for contributions to the evolution of the technology.

At this time it is not certain that net benefits may be realized by establishing vegetation over closed tailings impoundments in semiarid regions, such as the Shootering project area. With a well-established vegetative cover, water losses from the cap due to evapo-transpiration will be greater than evaporation losses from a similar cap without vegetation. It seems quite certain that maintaining as much water as possible in both the cap and the underlying tailings is beneficial in controlling radon emissions from the tailings. The surface layer of gravel and rock required on the cap to prevent wind erosion is not conducive to plant growth. It is expected that there will be continuous accretion to the tailings cap at Shootering due to retention of sediments carried onto the cap by runoff from the small tributary watershed of the basin (approximately 220 acres above the impoundment dam). The tailings cap and impoundment dam will be protected from runoff-caused erosion by a spillway to be excavated in the sandstone abutment of the dam. This spillway will have an overflow crest about 3 feet higher than the level of the completed tailings cap. Until sediments have accumulated on the cap to the level of the spillway crest, it is expected that spillway discharge will be a rare event. As sediments accrue on the cap, seeds of plants native to the area will also find their way onto the cap and natural processes will then establish a vegetative cover typical of the area on the cap. Experimental seeding of those portions of the cap constructed during the early part of project operations should

indicate whether a complete vegetative cover on the cap should be encouraged immediately after the cap is placed or if natural processes are preferable for this aspect of the project restoration program.

COSTS FOR PROJECT CLOSURE

After termination of uranium mine and processing facility operations, the surface structures and foundations will be removed from the site so the area can be reclaimed. Trash and nonsalvageable materials will be buried. Disturbed areas that will be reclaimed will be graded and topsoil will be replaced to promote revegetation. Sale of some of the equipment and materials will aid in recovery of a portion of the decommissioning cost; however, the cost of decommissioning the uranium mine and the processing facility in Shootering Canyon is estimated to be on the order of $250,000 for each element for a total estimated cost of $500,000.

A general plan for decommissioning of the processing facilities and ancillary structures will be submitted to NRC toward the end of project operations.

LONG-TERM SURVEILLANCE, MAINTENANCE, AND CONTROL OF TAILINGS DISPOSAL AREA

The design, construction, operation, and closure of the Shootering Canyon tailings disposal system have been planned with the objective of creating a facility that, after closure, will endure for many years without requiring either monitoring or maintenance while continuing to provide an environmentally safe and satisfactory service. However, the operation of the disposal system will be observed for five years after closure to ensure that the system is performing as intended. Accordingly, a proposed monitoring program is described in the following paragraphs. It is planned that monitoring will continue for five years after the tailings impoundment is closed. If there are any deficiencies in the system performance, they are expected to become apparent during the monitoring period and to be corrected before the monitoring program is terminated.

Factors of long-term concern with respect to uranium tailings may be summarized as follows:

-Tailings dispersal by erosion
-Contamination of groundwater
-Radon release to the atmosphere

TAILINGS DISPERSAL BY EROSION

Erosion by Water - The Shootering Canyon uranium project tailings impoundment dam will be designed and constructed with a crest extending above the maximum water level that would be reached in the impoundment area under the conditions of the maximum probable precipitation likely to occur at the site. A spillway around the left (east) abutment of the dam will divert runoff exceeding the retention capacity of the impoundment. The spillway crest will be about 3 feet higher in elevation than the top of the cap to be placed over the tailings, and the dead storage volume provided over the cap and below the spillway crest must be filled before any runoff is passed downstream from the dam. This storage is provided to maximize the capture of available moisture and thereby keep the tailings perpetually moist or wet for purposes or reducing radon emissions without reducing the safety of the structure. Overtopping of the dam crest, with consequent possible erosion, will be prevented by the spillway. The toe of the dam will be protected from erosion during periods of spillway discharge. The downstream face of the dam will not be eroded by incident rainfall.

Surveillance required to establish that the dam will continue to perform as designed (no overtopping) will include visually checking the spillway channel to see that it is unobstructed. Wind-deposited sand into the channel, rock falls or slides from the walls of the channel, and heavy vegetative incursions into the channel are conceivable types of obstructions. Channel maintenance would involve removal of such obstructions.

The dam will be constructed on a sandstone foundation. The techniques to be employed in construction of the dam will yeild a stable and

dense structure. Some deflection in both the vertical and downstream directions must be expected, however, when the dam is subjected to the intended loads. Although not expected to be significant, normal settlement under and within the dam will cause the crest of the dam to deflect with respect to the level of the spillway crest. If any settlement is noted by periodic inspections, it may be necessary to make instrument measurements to determine the amount of settlement and the consequent risk of dam overtopping. Settlement on the order of a foot or more would require a geotechnical investigation to determine the causes of the settlement. Nominal settlement due merely to internal consolidation of the dam after project closure could be remedied by adding a small amount of material to the crest, to prevent possible overtopping during heavy precipitation. Major settlement due to any cause would probably require an engineered remedy after the causes of the settlement were established. To prevent dispersal of project tailings by water erosion, it is necessary that the dam not be subjected to substantial and prolonged overtopping.

Erosion by Wind - The rock and gravel zones on the downstream slope and crest of the dam, and the rock and gravel layer to be placed at the top at the tailings cap, will prevent wind erosion of those exposed surfaces. It is expected that the thickness of the tailings cap will increase over time due to deposition of sediments transported onto the cap by runoff from the catchment area. Also, because the tailings disposal basin is effectively surrounded by natural cliffs and hills, it is expected that there will be net deposition of windborne soils over the impoundment area, rather than loss of covering over the tailings due to wind erosion. Accordingly, natural deposition will be exploited to enhance the security of the projected tailings impoundment.

Surveillance or monitoring required to determine the effects of wind on the tailings impoundment will be by visual inspection of the dam and the tailings disposal area. If there are any signs of local erosion, rather than deposition, locally available igneous rocks may be placed in the eroding areas to improve the erosion resistance of the

surface.

GROUNDWATER CONTAMINATION

The tailings management plan for the Shootering Canyon uranium plant has been developed to prevent contamination of groundwater underlying the tailings disposal area. Before tailings are placed in the basin, a clay blanket will be placed over the natural sandstone of the impoundment area to limit the rate of seepage from the tailings into the foundation rock. To reduce the amount of tailings liquids available for seepage from the impoundment, tailings will be distributed around the basin, in such a manner as to continuously provide a large wetted area exposed for evaporation. Also, if excess tailings liquids collect in the impoundment, they may be recycled to the process circuit or recirculated within the basin to increase evaporation. By keeping the tailings wet during and after placement, wind erosion and dispersion of the tailings can be minimized.

At the project site net evaporation from exposed water surfaces will average approximately 40 inches per year, which is equivalent to about 2.06 gallons per minute per acre of exposes surface. At an ore processing rate of 750 tons per day, and assuming a tailings slurry containing 45 percent solids by weight, approximately 153 gallons per minute of tailings liquids will be delivered to the impoundment. Saturated, dense, settled tailings would be expected to have a moisture content of not less than 35 percent. Based on this assumption, approximately 67 gallons per minute of the tailings liquids will be retained in the settled tailings, leaving approximately 86 gallons per minute of liquid available for evaporation and seepage from the pond. Keeping about 42 acres of the impoundment area continuously wetted should make it possible to dispose of practically all surplus tailings liquid by evaporation, leaving little available for seepage toward the ground water surface, which is at least 90 feet below the lowest point of the tailings impoundment basin. It should be noted that about 68 acres will be exposed in the impoundment area at the full basin contour level.

Since the tailings management plan provides a means for disposing of all excess tailings liquids during the project operation, no significant amount of free tailings liquid will remain in the impoundment at project termination to seep into the groundwater. Also, after the project is terminated, normal evaporation from the tailings cap will dispose of much of the incident precipitation, including runoff from the basin watershed, on the impoundment basin. Little potential will therefore exist for groundwater contamination from this project, and the requirements for surveillance of the groundwaters of the area will be minimal.

The monitoring positions (which will be located near the impoundment perimeter) for monitoring seepage from the basin during project operation will be maintained for at least five years after project termination, and observation will be maintained for at least five years after project termination, and observation will be made to see if any water has collected at those locations in the postoperational period. If water is collecting in any observation well or wells, it will be sampled and analyzed to determine its source and properties. Test results indicating a significant potential for groundwater contamination will be cause for instituting a field investigation and analysis to determine the scope of the potential problem and to develop appropriate remedies. Conceivable remedies could include installation of collector wells to intercept the contaminated flows, and transfer of the collected liquid to a safe evaporative disposal system. The possibility of groundwater contamination from the Shootering project is considered remote, and opportunities for observing and remedying any potential contamination before it becomes significant to the environment are substantial.

SUMMARY

The proposed postclosure monitoring program for the tailings disposal system is summarized as follows. All observations and measurements are to be made at 3-month intervals over a 5-year period following completion of the project closure procedures.

-Dam: visual inspection for settlement of crest and erosion downstream slope
-Spillway: visual inspection for obstructions in channel
-Groundwater: visual check for water in observation wells and seepage at toe or downstream from dam
-Tailings Cap: visual inspection for signs of wind erosion
-Radiation: change radon cups and TLDs at five monitoring stations and analyze results

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Pam-File NRC

December 5, 1978
60255A

Mr. J. Rothfleisch
Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Shootering Canyon Project - Docket 40-8698

Dear Mr. Rothfleisch:

This is to supplement our responses of December 4, 1978 to the issues raised in your telephone conversation with Mr. Sewell of Plateau Resources Limited. In particular, additional information is provided concerning estimates of seepage from the project tailings impoundment, and water balances for the impoundment under various assumptions. The letter of Mr. W. P. Staub, November 9, 1978, of the Oak Ridge National Laboratory, and addressed to you, is referenced. With respect to our letter of December 4, we note that we deferred submitting responses to your questions concerning our initial responses to your earlier letters of July 6, 1978, questions 4 and 28; and August 25, 1978, question 4. Those 3 questions and Mr. Staub's comments are the subject of this letter.

NRC Letter of July 6, 1978, Question 4 and 28, and August 29, 1978
Question 4 - Seepage from tailings impoundment and water balance

Response - In accordance with the suggestions of Mr. Staub, we have made additional estimates of seepage rates from the tailings impoundment assuming non-saturated foundation conditions rather than the saturated conditions as used in our preliminary estimates.

For our preliminary estimates we assumed that a readily available local clay-like material would be used for the impoundment liner, and that the liner thickness would be 10 percent of the worst case hydraulic head on the liner. Limited laboratory testing of this material indicated that it should be relatively easy to compact it in the field so as to obtain a permeability coefficient of about 5×10^{-7} centimeters per second. Also tests using a simulated tailings liquid indicated there would be slight reaction with the liner material, and that the reaction probably would reduce the permeability of the clay-like material.

During the course of the project field investigations it was noted that substantial quantities of bentonitic clays were located about 10 miles north of the plant site. Clay from this source may be substituted for, or blended with, the locally available clay as required to reduce the liner permeability for the control of seepage. It is intended to

evaluate this alternative on a more detailed basis in the project final design phase.

Estimates of seepage that will occur under operating conditions must be recognized as somewhat hypothetical. Plateau Resources Limited intends to conduct their tailings disposal operations so as to control the quality and the quantity of seepage from the tailings impoundment. For this purpose they have adopted a tailings management plan which provides a great deal of flexibility in their operations. A primary aspect of their plan includes neutralization of the tailings liquid within the impoundment, utilizing mine waste rock containing an appreciable amount of carbonate to react with the acid content of the liquid. The primary purpose of this procedure is to cause precipitation of numerous radioactive, toxic and heavy metal ions from the liquid within the tailings mass contained in the impoundment. Precipitation will limit the potentials for those ions to escape the impoundment with recirculated or seepage water. PRL plans to monitor the pH of the liquid in the impoundment and modify their operations as required to obtain the desired pH. It is expected that neutralization within the impoundment will reduce the acidity of the tailings liquid from an initial pH of about 1.5 to a pH in the range 5.0 to 6.5.

Another important aspect of the PRL tailings management plan is to try to drain surplus liquid from the tailings within the impoundment utilizing a tailings underdrainage system. For this purpose a network of perforated collector pipes will be installed on top of the impoundment clay liner. The network will include a primary drain in approximately the center of the impoundment area and extending the full length of the impoundment. Present plans are to install transverse collector drain pipes across the impoundment area at approximately 500 feet centers.

Continous vertical sand drains, or blankets, will be constructed over the pipe drains. The first parts of the sand drain system will be constructed of imported sand, but after the project is in operation tailings sand will be used for the vertical drains. The tailings sand will be obtained by hydraulic separation of the tailings as they are placed in the impoundment. If during initial project operations it is determined that a greater or lesser separation of the transverse drains might improve the drainage performance the spacing will be changed accordingly.

The network of drain pipes and continuous vertical sand drains will divide the impoundment area into compartments, or cells. Tailings placement will be sequentially rotated among cells, and discharge to any cell will be sequentially rotated among the corners thereof. It is expected that after project routines are established, tailings placement will continue for about one week at a corner of one cell and then the discharge will be shifted to another cell. Also it is expected that 4 cells will be required in the placement rotation at any time although more or fewer

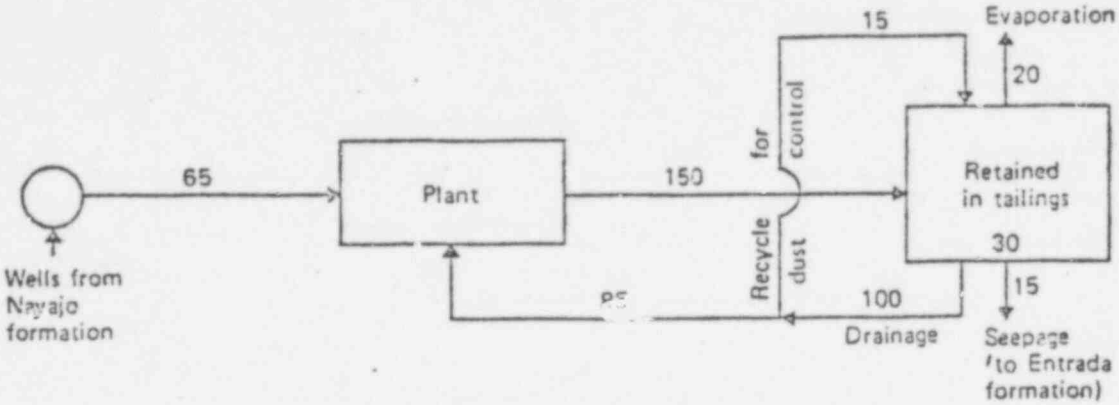
cells may be required in order to achieve stabilization of the slimes fraction of the tailings between tailings placement cycles. The objective will be to dessicate and drain the surface layer of slimes covering the lowest part of each cell sufficiently between placement cycles to where they are not displaced by the subsequent placement operations. By rotating the tailings discharge to the corners of the cells beach areas of coarse tailings will be maintained against the vertical sand drains. Material from the beaches will be used to raise the drains separating the cells. The placement procedure will create a layered sand-slimes mass in the central part of each cell and a continuous (horizontal and vertical) sand mass in contact with the vertical sand drains.

A drainage blanket will be placed at the bottom of the cells above the clay liner. This blanket will be about 3 feet thick and it will consist of waste rock from the mines and coarse sand that may be locally available. It is expected that this blanket will have an average coefficient of permeability of about 5×10^{-2} cm/sec. The natural slope of the impoundment area is not less than 5 percent in any location. At that slope and permeability water will drain through the blanket under a cell to the collector pipes at approximately the rate that excess liquid will be added to a cell during the placement part of a cycle. Excess liquid is considered to be all the liquid that can be removed from the tailings by gravity drainage. Accordingly it is concluded that with the tailings drainage system in operation the maximum hydraulic head on the liner will be about 3 feet. Further, since the drainage system is designed to remove surplus liquid from a cell at the rate which it is added to the cell with the tailings the drainage rate will soon decrease to nearly zero at the conclusion of a placement cycle in the cell. The head on the liner available to cause seepage from the cell will simultaneously decrease to essentially zero. Therefore, if the drainage system performs as designed only one cell at a time will be contributing towards seepage from the impoundment, and no cell will subject the liner to more than 3 feet of head throughout the project operations. Vertical stand pipes will be installed in the first few cells to be put into service for purposes of monitoring the liquid level in the cells during both the placement and stabilization phases of the tailings disposal cycle.

Drainage from the tailings will be collected in a sump to be installed at the lowest point within the impoundment. A pump will be installed at the sump and the collected liquid will be pumped either to the plant for re-use in the process circuit or to a distribution system which will be utilized for wetting exposed tailings surfaces to control dusting.

A schematic diagram indicating the estimated water balance for the project tailings system follows. This diagram represents the performance expected of the system under average conditions for the bulk of the project operating life. There will of course be seasonal variations in evaporation, but changes in the amount of water returned to the process

circuit will compensate for those variations. The indicated flows are expressed in gallons per minute and are based on 750 tons per day of dry ore being processed, tailings discharged from the plant containing 45 percent solids by weight, and settled tailings having a moisture content of about 26 percent (weight of water/weight of dry solids).



As noted previously there are several uncertainties concerning the performance of the tailings impoundment, and therefore flexibility in the operations is a major aspect of the tailings management plan. For example, the effectiveness of the tailings drainage system is not known. We know of no comparable system that has been installed and the performance documented. It seems clear that even if the drains do not work as well as expected, in terms of quantity of water removed from the impoundment, there will still be substantial benefits from its operation. The most likely cause of poor performance of the drainage system would be that the tailings liquid could not flow fast enough into the drainage blanket and the vertical sand drains. But if the pump is operated to empty the collector pipes then the possible head on the liner will be simultaneously reduced and seepage from the impoundment will be controlled. Accordingly it is planned to operate the drainage system and pump even if only small amounts of water can be drained from the tailings. Drainage in the range of 1 to 120 gallons per minute will be accommodated by the system.

It may be that a higher water content in the tailings discharged from the plant will yield better segregation of the coarse and fine fractions in the impoundment and this would in turn yield better performance of the drainage system. With recycling of the surplus tailings liquid to the process circuit excess liquid that could be removed by drainage would not be a problem. PRL plans to adjust the water content of their tailings discharge to obtain the best practical performance of the system as a whole.

With the tailings liquid neutralized to a pH of not less than about 5.0 PRL believes that it will be acceptable to recycle up to about 100 gpm of tailings water to the process circuit. The continuous monitoring re-

quired to optimize the process performance will permit ready identification of any effects the recycled water may have on the process. If it is determined that the process circuit cannot accommodate all the water that can be drained from the tailings then PRL will install an evaporation pond to dispose of the surplus.

Following is a summary of the estimated water balance for the tailings impoundment and the range of quantities assumed for design in each component to allow for variations in performance.

Item	Quantities, gallons per minute	
	Expected	Range for design
wells to plant	65	50 - 150
plant to tailings	150	130 - 200
retained in tailings	30	28 - 40
seepage from impoundment	15	0 - 30
evaporation from impoundment	20	10 - 50
drainage from impoundment	100	0 - 120
recycle to plant	85	0 - 100
recycle to control dusting	15	0 - 50

Impoundment seepage rates were estimated utilizing the computational model proposed by David B. McWhorter and John D. Nelson, Colorado State University, (1978) for seepage through an unsaturated foundation. It was assumed that 4 cells would be used in the rotational cycle, that the drainage system would limit head on the cell in service to 3 feet maximum and the average head on the 4 cells in the cycle would be 1.5 feet, that the clay liner varied from 2 feet to 10 feet thick, that the average cell size was 250,000 square feet (about 500 feet on each side) and the clay liner would have a constant coefficient of permeability of 5×10^{-7} cm/sec. On that basis the totel seepage fromm the impoundment at any time would average about 15 gallons per minute. Based on a porosity of about 25 percent for the foundation rock it would take at least 10 years to saturate the rock immediately under the impoundment. Considering that there probably are relatively imperious strata in the foundation rock which would cause some lateral flow, and that the mound of saturation also would spread laterally over time, it seems likely that the saturation mound would not contact the bottom of the impoundment during the project operating life. Seepage flows therefore should be based on unsaturated conditions as used in the calculaiton.

It is noted that seepage from the impoundment will enter the Entrada sandstone formation. The water table in the Entrada formation is located about 100 feet below the lowest point in the tailings impoundment. Yields from the Entrada aquifer are relatively small, compared to yields from the Navajo formation. Borings and well tests indicate that there is no hydraulic connection between the Entrada and Navajo aquifers in the project vicinity. It seems doubtful that the Entrada aquifer ever will be developed

in the project vicinity as a significant source of water because the Navajo aquifer is available and is so much superior as a producer. It is concluded that potential seepage of tailings liquid to the Entrada aquifer would not be of serious consequences.

Mr. Staub has suggested that a cost analysis should be performed for using a synthetic membrane as an alternative to a clay liner for the tailings impoundment. We have the following comments.

In our experience with synthetic liners for water storage reservoirs we have found that it was not possible to achieve zero leakage. Imperfections in the manufactured membrane, punctures during transport, installation and blanketing, and faulty seams were the most common causes of leakage. We would expect similar difficulties using membranes in tailings impoundments. To account for leakage an effective permeability coefficient for a membrane liner would probably be in the range of 10^{-8} to 10^{-9} cm/sec. This may be compared with clays in the Shootering vicinity having coefficients in the range of 10^{-7} to 10^{-8} cm/sec. A synthetic membrane 0.01 foot thick would have about the same resistance to seepage as 1.00 foot of clay.

We estimate that at the Shootering site the minimum installed cost for a membrane liner would be about $0.50 per square foot or about $20,000 per acre. Clay liner at this location probably can be installed for $3 to $4 per cubic yard or $4000 to $6000 per acre per foot of thickness. On that basis cost comparison indicates that 3 to 5 feet of clay can be installed for the same cost as a synthetic membrane. In our opinion installation of a variable thickness clay liner as presently proposed is technically preferable and more cost effective than use of a synthetic membrane liner. A clay liner, properly designed and installed, will satisfactorily limit seepage from the Shootering tailings impoundment.

We hope the above has satisfactorily answered your questions. Please call if you need additional information.

Sincerely,

M B Bennedsen

M. B. Bennedsen
Senior Project Engineeer

cc: Mr. Sewell PRL
Mr. Rockstool PRL

bcc MSG

BEFORE THE BOARD OF OIL, GAS, AND MINING
DEPARTMENT OF NATURAL RESOURCES
in and for the STATE OF UTAH

IN THE MATTER OF THE APPROVAL OF THE NOTICE OF INTENT AND RECLAMATION PLAN SUBMITTED BY PLATEAU RESOURCES LTD., SHOOTERING CANYON PROCESSING FACILITY, GARFIELD COUNTY, UTAH.	)))))	ORDER TO SHOW CAUSE NO. ACT/017/016

THE STATE OF UTAH TO ALL OPERATORS, TAKERS OF PRODUCTION, MINERAL AND ROYALTY OWNERS, AND PARTICULARLY ALL PERSONS INTERESTED IN TOWNSHIP 35 and 36 SOUTH, RANGE 11 EAST, SLBM, GARFIELD COUNTY, UTAH.

Notice is hereby given that tentative approval was given to Plateau Resources Ltd. by the Utah Division of Oil, Gas, and Mining to commence primary uranium processing on Sections 33 and 34, Township 35 South, Range 11 East, and Sections 3 and 4, Township 36 South, Range 11 East, Garfield County, Utah. The name of the facility is the Shootering Canyon Processing Facility and the person representing the company in this matter is Mr. R.B. Sewell, Manager of Operations, Plateau Resources Ltd., 772 Horizon Drive, Grand Junction, Colorado 81501.

Plateau Resources has fulfilled obligations under the Mined Land Reclamation Act of 1975 (Section 40-8, U.C.A., 1953 as amended) and will employ the following reclamation techniques on 350 acres which will comprise the land affected. Legal access to the land affected is by mill site claims, lode claims and placer claims.

DURING OPERATIONS:

1. This facility will process 750 tons of uranium ore into U_3O_8 (yellowcake) per day and will operate seven days a week. The facility is expected to be in operation for 20 years.
2. A two-lane, all weather road, approximately two (2) miles in length will connect the plant site with State Highway 276. The road will be gravel surface and maintenance will be occasional grading and spraying for dust control.
3. A small amount of desert shrubbery present on the site will be removed and buried in an area to be designated within the limits of Plateau Resources Limited property lines.
4. The topsoil will be removed and stockpiled for future use. The stockpile will be vegetated to reduce wind erosion.
5. Plant species for revegetation will be determined from test plot data.

6. A tailings disposal facility will be constructed and will incorporate features that will meet the safety criteria specified by the NRC.

7. The release of airborne particulates from tailings will be controlled by the use of a water sprinkler system, chemical stabilization, covering with soil, or other equivalent means until reclamation of the tailings is completed.

8. An environmental monitoring program will be implemented as described in the plan.

9. The Office of the State Archaeologist will be notified if artifacts are discovered during construction of the mill or tailings disposal areas.

10. If unexpected harmful effects or evidence of irreversible damage not otherwise identified in the Environmental Statement are detected during construction and operation, Plateau Resources Ltd. will provide to the NRC and the Division of Oil, Gas, and Mining an acceptable analysis of the problem and a plan of action to eliminate or reduce the harmful effects or damage.

AFTER OPERATIONS:

1. All plant structures and facilities will be dismantled and removed from the plant site. Depressions will be filled in and runoff from this area will continue to flow towards the tailings area.

2. The entire plant site will be covered to a depth of approximately 1 foot with the previously stockpiled topsoil, fertilized and planted with native vegetation.

3. Reclamation and restoration of the tailings impoundment area will progress throughout the operating life of the ore processing facility, and will be concluded promptly after the termination of the processing operations. Observations and measurements to be made at 3-month intervals over a 5-year period following completion of the project closure procedures will be as follows:

   A. Dam - visual inspection for settlement of crest and erosion downstream slope,
   B. Spillway - visual inspection for obstructions in channel,
   C. Groundwater - visual check for water in observation wells and seepage at toe or downstream from dam,
   D. Tailings Cap - visual inspection for signs of wind erosion,
   E. Radiation - change radon cups and TLDs at five monitoring stations and analyze results.

Reclamation performance surety will be posted prior to final approval of the reclamation plan.

ORDER TO SHOW CAUSE
ACT/017/016

Any person or agency aggrieved by this tentative decision is hereby requested to submit written protest within 30 days from August 7, 1979, to the Division of Oil, Gas, and Mining, 1588 West North Temple, Salt Lake City, Utah 84116, setting forth factual reasons for his or her complaint, and thereafter, at a time and place heretobe established, appear before the Board of Oil, Gas, and Mining, to show cause, if any there be, why this plan should not be approved.

DATED this 31st day of July, 1979.

STATE OF UTAH
BOARD OF OIL, GAS, AND MINING

Thalia R. Busby

THALIA R. BUSBY
Secretary of the Board

SCOTT M. MATHESON
Governor

GORDON E. HARMSTON
Executive Director,
NATURAL RESOURCES

CLEON B. FEIGHT
Director

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS, AND MINING
1588 West North Temple
Salt Lake City, Utah 84116
(801) 533-5771

July 30, 1979

Let it be known, that on July 27, 1979, the Board of Oil, Gas and Mining, by general consent of its members and so stated by John L. Bell, Acting Chairman, did in fact give concurrence to Tentative Approval for Plateau Resources Ltd., Uranium Processing Facility (ACT/017/016).

The amount and form of surety for this facility was also approved by the Board.

The form of surety, as a contract was approved with the following conditions: 1. that the operator will not sell, lease, transfer or otherwise dispose of it's assets without the consent of the Board, 2., that the surety contract will be reviewed and renewed every five (5) years and 3., that a letter of credit for Plateau Resources, drawn up by a lending agency, be submitted to the Division to demonstrate sufficient solvency.

Thalia R. Busby

THALIA R. BUSBY
Secretary to the Board

SUMMARY OF ESTIMATED RECLAMATION COST AFTER FINAL CLOSURE OF THE PROCESSING FACILITY

	Facility	Area To Be Reclaimed (Acres)	Unit Cost Per Acre	Total Estimated Cost
1.	Process Plant Decommissioning	(See Attached)		$245,000
2.	a. Process Plant Land	14	$ 2,830	$ 39,620
	b. Maintenance And Equipment Storage Yard	2	$ 2,860	$ 5,720
	c. Solid Waste Disposal Site	5	$ 2,890	$ 14,450
	d. Topsoil Stockpile Area	7	$ 1,625	$ 11,375
3.	Process Plant Access Roads	6	$ 3,400	$ 20,400
4.	Tailings Impoundment Area After Final Closure	12	$38,000	$456,000
				$792,000

Revised 7/12/79