Proposed License Condition

11. For use in accordance with statements, representations, and conditions contained in Subsection 3.2, 3.3, 4.1, 4.2 and Section 5 and 7 of the licensee's application dated May 5, 1978, ~~and~~ revisions dated August 17 and September 6, 1979 AND AMENDMENT APPLICATION DATED JUNE 27 , 1980, and in Subsection 2.1, Figure 2.1-3, Subsection 3.2 through 3.5, Figures 3.1-1, 3.2-1, G-12, Table 3.3-1, Subsection 6.2, Tables 6.2-1 and 6.2-2 and Section 7 of the licensee's Environmental Report dated May 1978 with supplements dated August and September 1978 revisions dated August 17 and September 6, 1979. AND JUNE 16, 1980. Whenever the words "will," "would" or "should" are used in the text listed above, it shall denote a requirement.

Explanation

Adds the current amendment application and Environmental Report revision as references.

Denotes deletion: ---------

Denotes additions: CAPITALS

8008060147

Proposed License Condition

12. The maximum throughput shall not exceed ~~1,350~~ 2,740 pounds of barrelled U_3O_8 per day, averaged over a year.

Explanation

Authorizes additional throughput based on increased ore reserves and average ore grade, as well as currently planned mine production and mill capacity: See revised portions of Sections 1, 3, 4, 5, 6, 7, & 9, Environmental Report, dated June 16, 1980 and revisions to Section 5 of Environmental Report Supplement S2.

Denotes deletion: ---------

Revised June 16, 1980

Proposed License Condition

20. . . . .

b. All monitoring and exposure data shall be reviewed monthly to ensure completeness, detection of abnormal conditions and adequacy of follow-up actions as well as to detect trends and/or deviations. A written report to the Process Manager and PERSONNEL DIRECTOR of this review shall be prepared monthly.

c. The ERHS shall review and formally report semiannually to the ~~Manager of Operations~~, the Process Manager, PERSONNEL DIRECTOR, and the Plant Superintendent any upward trends in monitoring or survey data, abnormal emissions, items, of regulatory non-compliance, recommendations for necessary corrective actions and an evaluation of the adequacy of the implementation of license conditions.

d. The ERHS shall submit to the Process Manager and PERSONNEL DIRECTOR annually a formal report of all audits and inspections including conclusions and recommendations regarding the overall radiological health and safety, environmental control and "ALARA" programs. This report will present a review of employee exposures (including bioassay data), effluent release data, and environmental monitoring results as a means of demonstrating (1) if there are any upward trends developing in personnel exposures for identifiable categories of workers, types of operations or effluent releases, (2) if exposures and effluents might be lowered under the ALARA concept, and (3) if the effluent and exposure control equipment is being used, maintained and inspected properly.

Explanation

These reporting channels are consistent with the changed organizational structure. See Section 5 to Amendment Application dated June 16, 1980.

Denotes Deletion: -------------

Denotes additions: CAPITALS

Revised June 16, 1980

Proposed License Condition

21. The ~~Program Manager's office~~ QUALITY ASSURANCE SECTION shall conduct a semiannual audit of operating procedures, exposure records, monthly inspection reports, training programs and reports of safety meetings to evaluate the overall effectiveness of the program. Audit results shall be reported to the Vice President and General Manager, the ~~Manager of Operation~~ PERSONNEL DIRECTOR, and the Process Manager for review and initiation of corrective action on any deficiencies discovered in the course of the audit. In addition, an outside consultant Radiation Health Physics Specialist shall inspect, review and evaluate facility records, the program performance and adhereance to the ALARA philosophy on at least an annual basis and shall submit a report for review and action as above.

Explanation

These reporting channels are consistent with the changed organizational structure. See Section 5 to Amendment Application dated June 16, 1980.

Denotes deletion: -------------

Denotes additions: CAPITALS

Revised June 16, 1980

Proposed License Condition

22. . . . . .

a. Indoctrination training will be continued during the first month of employment after which all new employees will be required to pass a written test, OR IF NECESSARY, THE TEST WILL BE ADMINISTERED IN A MANNER APPROPRIATE TO THE CIRCUMSTANCES OF THE INDIVIDUAL EMPLOYEE INCLUDING, BUT NOT LIMITED TO, READING THE QUESTIONS TO THE EMPLOYEE AND SOLICTING ORAL RESPONSE IF THE EMPLOYEE CANNOT RESPOND IN WRITING, AND EXPLAINED IN A LANGUAGE OTHER THAN ENGLISH IF NECESSARY, demonstrating adequate understanding of radiation safety procedures. The employee's understanding of the plant radiological safety program will be reassessed through annual written tests OR OTHER METHODS DESCRIBED ABOVE. Documentation will be maintained in the training files of all employee's indoctrination and follow-up training and testing.

Explanation

Plateau is subject to federally mandated Affirmative Action and Equal Employment Opportunity programs. The proposed alternative testing method would ascertain retention of radiation safety procedures while not violating the provisions of Affirmative Action or Equal Employment Opportunity programs.

Denotes deletion: ---------------

Denotes additions: CAPITALS

Revised June 16, 1980

Proposed License Condition

25. The licensee shall determine the concentration of radon-222 at all airborne particulate sampling stations at monthly intervals for the first six months of full-scale plant operation. After this, the number of sampling stations may be reduced to the five areas which indicate the highest concentrations during the six month period. Sampling for radon shall be conducted during normal ventilation conditions. These conditions shall be recorded for each sampling period. The modified Kusnetz method OR OTHER METHODS APPROVED BY THE NRC shall be used for sampling and analysis.

Explanation

Would allow Plateau to use the latest acceptable methods without applying for another license amendment.

Denotes additons: CAPITALS

Revised June 16, 1980

Proposed License Conditions

32. The licensee's respiratory protection program shall comply with Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection" and NUREG-0041, "Manual on Respiratory Protection Against Airborne Radioactive Materials." ~~Respiratory-protection-shall-be-required-for-employees-in-plant-areas-where airborne-radiation-levels-are-likely-to-exceed-25-percent-of-MPC.--Respiratory protection-will-be-required-to-be-used-by-all-personnel-working-in-the-yellow-cake-drying-and-packaging-areas.--PRL-will-not-be-permitted-to-take-credit-for the-use-of-respiratory-equipment-in-calculating-employee-exposures-for-routine operating-activities.~~

Explanation

Specifies compliance with Regulatory Guide and NUREG - 0041.

Denotes deletion ----------------

Revised June 16, 1980

Proposed License Condition

40. The licensee shall construct a tailings disposal facility that will meet the safety criteria specified in Regulatory Guide 3.11 and will incorporate the features described in Alternative 1 of Section 10.3.2 in Subsection 3.2.4.7 of NUREG-0583 dated July 1979 WITH THE EXCEPTION OF THOSE PORTIONS DEALING WITH NEUTRALIZATION OF TAILINGS OTHER THAN THAT NECESSARY FOR RECYCLING TAILINGS LIQUIDS THROUGH THE MILL. Subject to revisions based on conclusions of the Final Generic Environmental Impact Statement on Uranium Milling any related rulemaking.

Explanation

Rapid dewatering of tailings in the impoundment area, for recycling of tailings liquids, negates most of the reasons for tailings neutralization. Also, adding relatively large amounts of waste rock to achieve neutralization decreases the useful life of the tailings impoundment area. Accordingly, no additional waste rock (other than that in the cell drainage blanket) will be added to the tailings impoundment area. Recycled liquid tailings would be neutralized only if necessary for use in the mill process. See Tailings Disposal System portions of Section 3.4 of Environmental Report Revised June 16, 1980, and Alternative 1 of Section 10.3.2 and Subsection 3.2.4.7 of Final Environmental Statement NUREG - 0583 dated July 1979.

Denotes additiona: CAPITALS

Revised June 16, 1980

3.0

MILL PROCESS AND EQUIPMENT

3.1 Mill Process

A generalized flow sheet of the plant process is provided in Figure 3.2-1 at the end of Section 3 of the environmental report. Quantitative flow diagrams of the various mill circuits are presented in the following figures from Appendix G of the environmental report:

Figure	Page	Description
G-3	G-3	General Process Grinding and Leaching Flowsheet
G-4	G-4	General Process CCD and Tailings Flowsheet
G-5	G-5	General Process Solvent Extraction Flowsheet
G-6	G-6	General Process Concentrate Product Flowsheet

3.2 Major Equipment

A description of major mill process equipment and operating specifications for this equipment is provided in Section 3.2, pages 3-2 through 3-11, of the environmental report. A description of the general mill layout is provided in Section 3.1, pages 3-1 through 3-2. Figure 3.1-1, shows the general arrangement of process facilities and includes the locations of point sources of mill emissions. The exit flow rate, temperature, and concentration of these emissions are provided in Table 3.3-1. More detailed drawings of the process equipment are provided in Figures G-12 through G-14, Appendix G of the environmental report.

3.3 Instrumentation

The most effective instrumentation currently available will be used to monitor plant operations, plant personnel, and the environment. Automated safety instrumentation will be used in areas of the plant where conditions warrant.

Radiation Safety Instrumentation

Various types of radiation detection instruments will be used in the personnel and restricted area monitoring program. These instruments are described in Section 6.2 of the environmental report.

Industrial Safety Instrumentation

Instrumentation for both safety and control of operations will be installed on nine control panels in the plant. Panels will be arranged with diagrammatic visual displays for the grinding and leaching, thickening, solvent extraction, and precipitation circuits. The parameters monitored will include conductivity, pH, oxidation potential, temperature, density, flow, and tank levels.

Density gauges are likely to employ 200 mCi cesium-137 sources stored in shielded containers equipped with lockable rotary shutters. Specific information on each source will be provided and will be licensed prior to its use. Leak testing of nuclear sources will be in accordance with the license requirements.

Tank levels for the kerosene and fuel oil storage tanks will be

4.1 Gaseous

Sections 3.3 and 3.5 of the environmental report provide a detailed dis ussion of the gaseous emissions from the plant. The locations of exhaust stacks are shown in Figure 3.1-1. A summary of emission control equipment and the efficiency of this equipment, as well as stack height and diameter, and the nature of emissions from each stack is provided in Table 3.3-1. A discussion of emissions and control procedures is provided in the following paragraphs:

Source	Location in Environmental Report
Ore stockpiles	Section 3, pages 3-13 through 3-15
Leaching	Section 3, pages 3-17 through 3-18
Countercurrent decantation thickening	Section 3, pages 3-18 through 3-21
Solvent Extraction	Section 3, pages 3-21 through 3-22
Precipitation	Section 3, pages 3-22 through 3-23
Drying and Packaging	Section 3, pages 3-22 through 3-24
Analytical and metallurgical laboratories	Section 3, pages 3-32 through 3-35
Power	Section 3, pages 3-35 through 3-36

A comparison of expected emissions with current air quality standards is provided in Section 3.3, page 3-24, Section 4.0, page 4-23, and Section 5.0, page 5-20.

The inspection and maintenance of pollution control equipment such as stack scrubbers will follow the manufacturer's recommended procedures.

4.2 Liquids and Solids

A general description of the tailings disposal system is provided in Section 3.3, page 3-24 of the environmental report. A more detailed description of the preliminary design of the system is provided in Preliminary Geotechnical Engineering Report, Shootering Canyon Uranium Project, Garfield County, Utah (Woodward-Clyde Consultants, 1978).

The effects of potential accidental releases of materials from the tailings impoundment are discussed in Section 7.0 of the environmental report.

Financial arrangements to provide for implementation of the reclamation plan are discussed in Section 9.0 of the environmental report. Provisions for acquiring ownership of the tailings impoundment and plans for providing long-term maintenance and control over the tailings are discussed on page 9-10.

4.3 Contaminated Equipment

Contaminated solid wastes, such as filter media, and obsolete or worn-out equipment, will be placed in the tailings impoundment.

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5.1 Corporate Organization

5.1.1 Figure 5-1 shows the corporate organization of Plateau Resources Limited. The Vice President and General Manager of Plateau Resources Limited has responsibility for the processing facility construction and operation. He has full authority to deal with all problems related to operation of the Shootering Canyon processing facility. The Vice President and the General Manager also has responsibility for the overall quality control and assurance programs for the facility. The Corporate Vice President, through the General Services Manager, uses the Quality Assurance Section to perform audits and reviews as part of the Management Control Program.

During the engineering and construction phase of the processing facility, the Project Manager, under direction of the Vice President and General Manager, is responsible for activities associated with the facility, including implementing and conducting the quality control program. During this phase the Project Manager is assisted in meeting these responsibilities by the Technical Superintendent and Construction Inspectors, who report to the Project Manager (See Figure 5-2).

Operational responsibility and authority of the Vice President and General Manager in respect to operations and maintenance are delegated to the Process Manager and in respect to environmental and radiological health are delegated to the Personnel Director (Figure 5-3). The Process Manager reports to the Vice President and General Manager and has authority to conduct plant operations, maintenance, and the quality control program. The Process Manager is also responsible for the development, review, implementation and adherence to operating and maintenance programs, to include approval and change authority for these procedures and programs. The Process Manager is additionally responsible for adherence to environmental and radiation health procedures. The Process Manager is assisted by the Plant Superintendent in meeting these responsibilities.

The Environmental and Radiological Health Supervisor reports to the Personnel Director and has responsibility and authority to develop and implement the environmental and radiological health and safety programs, including preparation and maintenance of written operating procedures for the radiation safety and environmental monitoring and control programs. He supervises all

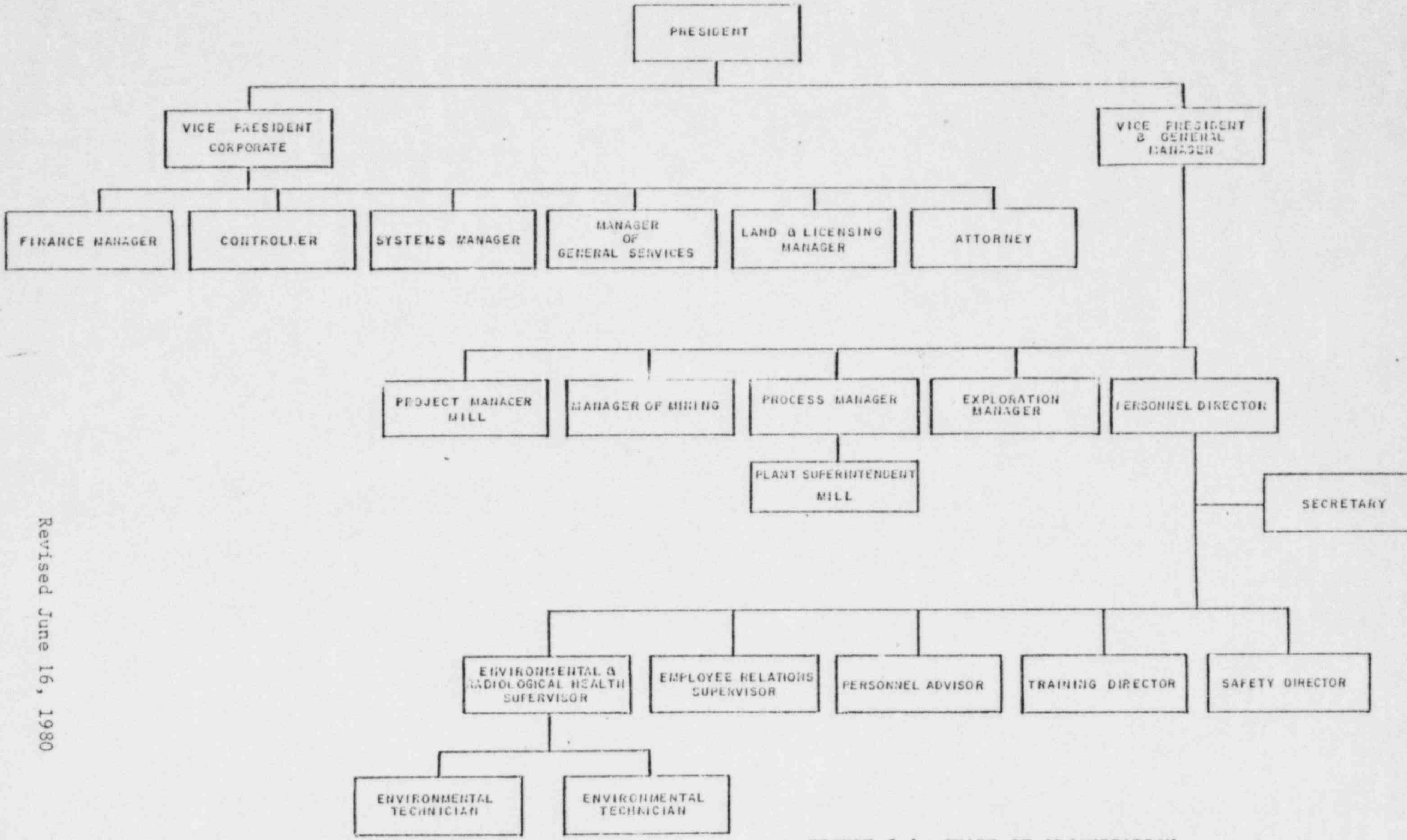

FIGURE 5.1 CHART OF ORGANIZATION

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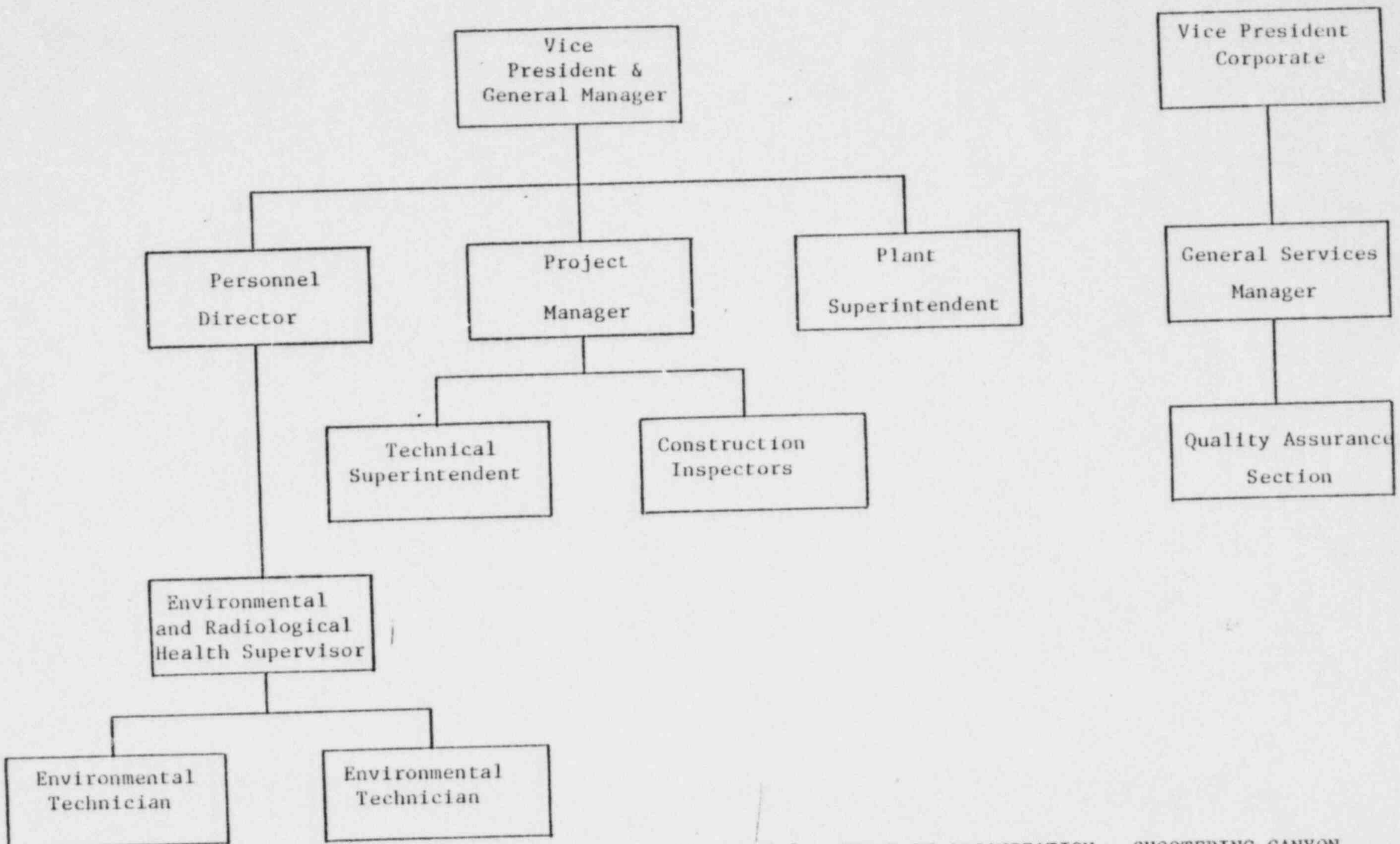

Figure 5-2. CHART OF ORGANIZATION - SHOOTERING CANYON PROCESSING FACILITY, ENGINEERING AND CONSTRUCTION PHASE

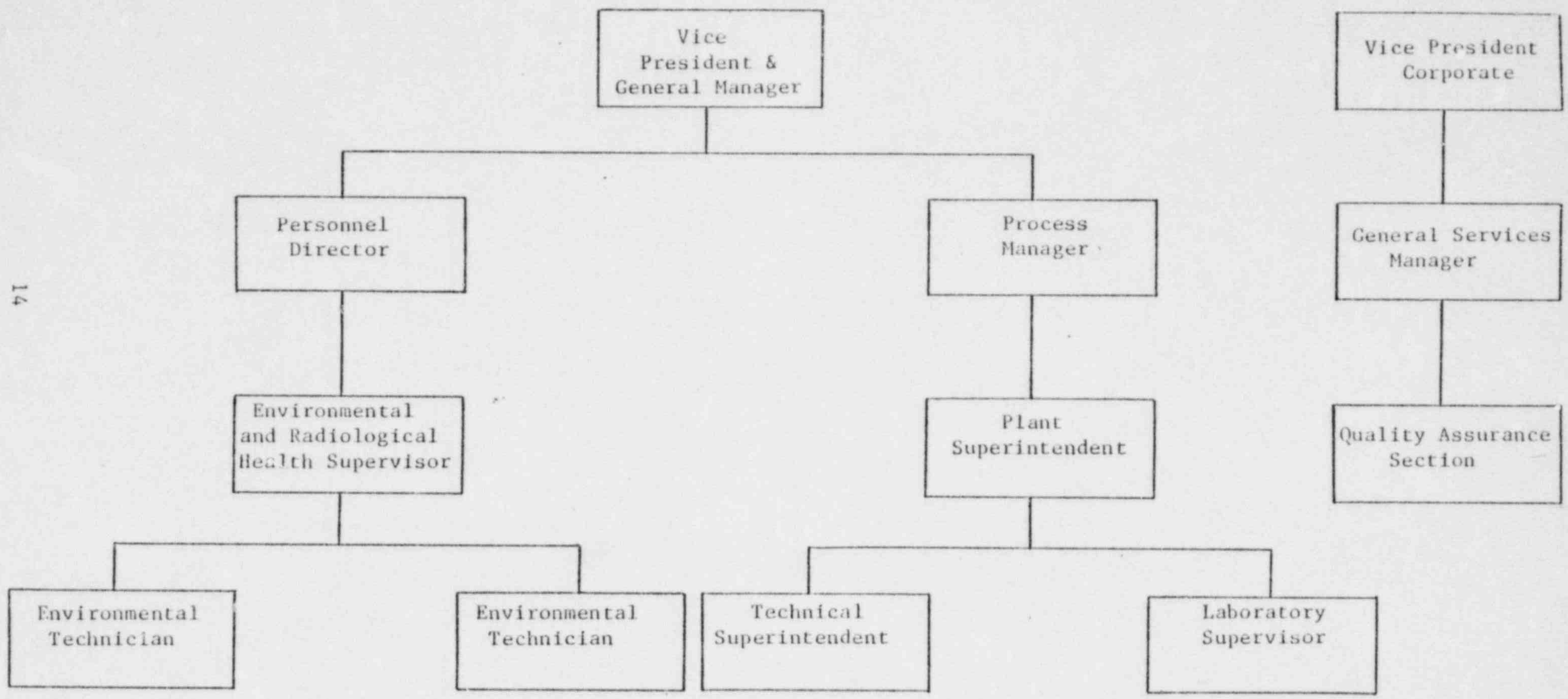

Figure 5-3. CHART OF ORGANIZATION - SHOOTERING CANYON PROCESSING FACILITY, OPERATIONS PHASE

facility radiation, protection and environmental survey, sampling and monitoring programs, and maintenance of radiation exposure and survey records. The Environmental and Radiological Health Supervisor has the authority to cancel, postpone or modify any plant operation or activity upon detection of unusual radiological hazards.

5.1.2 The management control program is described in Section 7.0 of this application. This program contains provisions to en re that all routine operational activities are conducted in accord :e with written procedures that have been reviewed and approved by the environmental and radiological health staff. These operating procedures are to be reviewed at intervals not to exceed one year. The program also includes a work order system covering all routine and non-routine functions. The program also includes a work order system covering all maintenance activities. Non-routine maintenance activities (work order), not covered by normal operating procedure are required to be reviewed and approved by the environmental and radiological health staff prior to their implementation.

5.1.3 The management audit and internal inspection program, including types and scopes or reviews, audits, and inspections, and individual responsibilities, is described in Section 7.0 of this application. Plateau Resources Limited is committed to maintaining as low as reasonable 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 have the specific objectives of keeping personnel exposures as low as reasonably achievable. A Radiation Health Physics Specialist will inspect, review, and approve the project health physics safety programs and records and ALARA philosophy on at lease an annual basis.

5.2 Qualifications

The Environmental and Radiological Health Supervisor and the 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 Technican

1. High School Diploma - two years of college prefered, with a strong emphasis in math, chemistry, physics.

2. Training in radiological health.

3. Knowledge of equipment used in radiation and environmental monitoring.

A resume of the individual who is currently the Radiological Health and Safety Supervisor is provided in Appendix A of this application.

5.3 Training

The enployee radiological protection training program will consist of the following phases:

- Initial briefing on basic radiation safety, NRC regulations and documents, exposure abatement, and basic decontamination.
- Continuing on-the-job training by supervisors and the Radiological Health and Safety Supervisor.
- Monthly safety meetings to keep employees informed on the latest developments in radiological protection practices. These meetings will also allow employees to take an active part in amending and implementing the radiological protection program.

Initial Briefing

All employees will receive a copy of the radiation safety handbook. Current copies of the following documents will also be available for their examination: 1) 10 CFR Parts 19 and 20; 2) the license, license conditions, or documents incorporated into the license by referenc , and amendments to the license; 3) any notice of violation involving radiological working conditions, proposed imposition of civil penalty, or order issued pursuant to Subpart B of Part 2 of 10 CFR Part 19, and any response from the licensee; and 4) form NRC-3, "Notice to Employees". In addition, new employees will be required to read and sign a form explaining the potential hazards of working in the plant. A copy of

- Develop sampling and surveying procedures for radiation protection and environmental impact considerations.

- Review and approve procurement of radiation protection and environmental monitoring instruments and calibration standards.

- A weekly documented inspection of all work and storage areas with a report to the ERHS of any items of non-compliance affecting radiological safety.

- Perform monthly inspections of work and storage areas and practices with respect to radiation safety and perform monthly reviews of all monitoring and exposure data to ensure completeness, detection of abnormal conditions and adequacy of followup actions as well as to detect trends and/or deviations from the ALAR philosophy. The results of this review will be reported to the Process Manager.

- Quarterly review of the radiation instrument calibration records and procedures.

- Establish and maintain an overcheck program utilizing independent laboratories to verify sample analysis accuracy.

- Quarterly review of the overcheck program records to insure the detection and correction of discrepancies.

- Report semiannually by written report to the Personnel Director, Process Manager, and Plant Superintendent addressing any upward trends in monitoring or survey data, abnormal emissions, items of regulatory non-compliance and recommendations for necessary corrective actions. This report will also include an evaluation of the adequacy of implementation of the license conditions and ALARA philosophy.

The Plant Superintendent will cause the following to be performed:

- A documented visual inspection each shift of the tailings impoundment system.

- A daily documented visual surveillance of all mill areas by an operations foreman to ensure implementation of required radiation safety practices.

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 audits 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

Organizational responsibilities and authorities are described in section 5.1, pages 11-16 of this application.

The General Services Manager will review the quality control program to assure that it complies with the objectives of this plan. Differences of opinion between the General Services Manager and the Process Manager's staff will normally be resolved by the Vice President and General Manager. However, the Corporate Vice President may have such differences of opinion referred to the President of the corporation for resolution at that level. The General Services 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 General Services 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.

Design and Engineering Phase

During design and engineering, the Project Manager will be responsible for assuring that design documents are reviewed for conformance with design criteria. Special attention will be directed to the suitability of design and/or specifications related to the following:

> The proper control of dusting through the use of dust collectors, enclosure of equipment, etc., particularly in operations involving 1) ore handling, grinding, sampling, and storage and 2) ammonium diuranate calcination and yellowcake crushing and packaging.

The proper control of ventilation to minimize release of radon-222 to working areas and to otherwise minimize the dusting of radioactive materials.

The proper design of the tailings impoundment dam, particularly those features impacting on dam height and integrity, and resistence to wave action and erosion.

The proper design and location of sampling wells around the tailings impoundment to permit the detection of leakage of radioactive materials from the impoundment.

The proper design of tailings stabilization when the tailings impoundment is relegated to an inactive status.

The general integrity of facility equipment design involved in the processing or storage of radioactive materials to minimize or prevent leakage of radioactive solids or liquids.

Revised June 16, 1980

Deviations and Corrective Actions

If and whenever the Process Manager receives a communication identifying a problem or prospective problem in the milling facility which might be reasonably expected to create an unacceptable radiological safety condition in the facility or to increase the risk of off-site consequences of the plant's activities, he will immediately initiate an investigation designed to develop a plan for corrective action.

Records and Reports

Records will be maintained to provide documentation of all quality control and quality assurance activities related to the environmental and radiological health program for a minimum of five years. The records will include the results of sampling, analyses, surveys, monitoring, and equipment calibration and training, reports of inspections and audits, subsequent reviews and investigations and corrective actions.

The General Services Manager has the assigned responsibility of developing and maintaining an appropriate system for the collection, verification, filing and retention of all such records.

Training

A training program will be established by the Environmental and Radiological Health Supervisor for all plant personnel which will include:

- principles of radiation safety
- radiological monitoring and analytical procedures
- radiation safety program of plant.

Personnel will be required to complete this training program prior to being assigned to work requiring minimum supervision.

A training program will be established by the General Services Manager for all persons assigned to conduct inspections, audits and surveillance activities which will include:

- objectives of the inspection and radiological monitoring programs

- review of applicable regulations and Plateau Resources Limited license conditions inspection procedures

- 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 General Services 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 health and safety program.

The radiological safety audit will be conducted in two parts. The first part will be conducted semiannually by the General Services Manager's office with internal assistance as required and will include a review of operating procedures, exposure records, monthly inspection reports, training programs and reports of safety meetings. The second part will be conducted annually by an outside consultant Radiation Health Physics Specialist who will inspect, review and evaluate the facility records, the program performance and adherence to the ALARA philosophy. One inspection will be conducted prior to start-up. Other audits will be conducted every six months during the first year of operations and annually thereafter. Quality assurance system audits will provide a biannual evaluation of the effectiveness and adequacy of the quality assurance system.

All audits will be documented and reported to the Vice President and General Manager, the Personnel Director, and the Process Manager for review and initiation of corrective action on any deficiencies discovered during the audit.

Shootering Canyon Uranium Project
Plateau Resources Ltd.

May 16, 1980

PRINCIPLE PARAMETERS FOR RADIOLOGICAL ASSESSMENT

Parameter	Value	
Ore quality, U_3O_8	0.12	%
Ore activity, U-238, U-234, Th-230, Ra-226 and Pb-210	340	pCi/g
Operating days per year (plant factor)	365	days
Ore process rate	3.31×10^5	tonnes/yr
Mill water throughput	3.39×10^5	m^3/yr
Total mine area	N/A	m^2
Active mine area	N/A	m^2
Average mine depth	N/A	m
Annual average morning mixing height	N/A	m
Annual average afternoon mixing height	N/A	m
Ore Handling & Storage		
Estimated capacity of ore per delivery	27	MT
Number of deliveries	33	per day/~~[illegible]~~
Estimated ore dust released in delivery	2.1 at dump hopper ~~[illegible]~~	MT/yr
Average grade of ore and ranges	0.12 (0.04-0.50)	%
Capacity of ore pad: present and final year of operation	average 9100;9100	MT (max. 45,400)
Maximum area of ore pad and height in terms of final year of operation	1×10^4;3.7	m^2, m (maximum)
Approximate amount of ore handled per day i.e., unloaded, loaded, bulldozed, etc. ...	90.7 in ore stockpile; 907 total	MT/day

Operation time of front end loaders, hoppers, feeders and other ore pad equipment	14	hrs/day
Estimated amount of fugitive ore dust emission due to handling of ore <u>on ore pad</u>	1.5	kg/hr
Dust emission control reduction factor by wetting, chemical or other controls	90	%
Ore pad area and height	2×10^3; 3.7	m^2, m (average)
Ore storage time	100	days

Crushers, Grinders, Rod Mills, Fine Ore Blending.

For each piece of potential radioactive emission source equipment please report the following (in terms of final year of operation)

Operation time (hrs/day & days/year)	14;365	
Ore process rate	3.31×10^5	MT/yr
Total ore quantity handled	3.31×10^5	MT/yr
Estimated dust lost to atmosphere	negligible	kg/hr or MT/yr
Efficiency of emission control devices (effective as well as design)	99 (NRC estimate) 99.8 (design)	%
Estimated dust lost to atmosphere through internal ore transportation (e.g., conveyor belts) devices	accounted for under ore delivery	kg/hr, MT/yr
Efficiency of emission controls of internal ore transportation devices (effective & design)	99 (NRC estimate) 99.8 (design)	%
Average daily capacity of temporary bin storage (fine ore bins)	N/A	MT/d
Efficiency of controls for temporary bin storage	N/A	%

Yellowcake drying & packaging (based on last year of operation)

(Please give parameter values for dryer & packaging)

Processing rates	0.122	MT/hr
Operation time (days/yr & hrs/day)	72 hrs/wk, 52wk/year	
Efficiency of control of U_3O_8 dust released to atmosphere (design and effective)	99 (NRC estimate) 99.7 (design)	%
Estimated U_3O_8 dust released to atmosphere	7.7×10^{-3}	kg/hr
Stack height(s)	29.7	m
Recovery rate of U_3O_8 (overall)	94	%
Extraction efficiency	96	%
Yellowcake yield	454	tonnes/yr
Yellowcake quality, U_3O_8	90	%
Yellowcake drying stack effluent, U_3O_8	26.1	kg/yr
Yellowcake drying stack filter efficiency	99 (NRC estimate) 99.7 (design)	%

Heap Leach Piles

Dimensions (height width, length)	N/A	m, m, m
Volume	N/A	m^3
Capacity	N/A	MT
Pile activity for U-238, Th-230, Ra-226, and Pb-210	N/A	pCi/g
Fugitive dust emissions	N/A	kg/hr or MT/yr
Control efficiencies for dusting	N/A	%

Tailings (Please base values on final year of operation)

Area, volume, capacity of sand tailings	N/A[1]	km², m³, MT
Area, volume, capacity of slime tailings	N/A[1]	km², m³, MT
Area, volume, capacity of submerged tailings	(wetted only)	km², m³, MT

If different grades of ore have been used or are going to be used, please indicate for each grade choice

Area, volume, capacity of sand tailings	N/A	km², m³, MT
Area, volume, capacity of slime tailings	N/A	km², m³, MT
Area, volume, capacity of submerged tailings	N/A	km², m³, MT
Operating time for each grade	15	yrs
Activity of U-238, Th-230, Ra-226, Pb-210 to tailings for each particular grade	20;323;339;339	pCi/g
Tailings density	2.0 (saturated)	g/cm³
Drying time prior to reclamation	N/A[2]	yrs
Efficiency of controls for fugitive dusting (wetting, chemical, etc.)	80	%
Tailings activity, U, Ra-226, Th-230, and Pb-210 in slimes	N/A[1]	pCi/g
Tailings activity, U, Ra-226, Th-230, and Pb-210 in sand	N/A[1]	pCi/g
Tailings activity, U, Ra-226, Th-230, and Pb-210 in solution	960;60;4260;320	pCi/l
Total tailings area	2.8×10^5	m²
Tailings pond (solution) area	0 (wetted only)	m²
Tailings impoundment depth (final year)	27 (maximum)	m
Tailings density	2.0 (saturated)	g/cm³

[1] No significant segregation between sands and slimes is expected in the proposed tailings management plan.

[2] Reclamation will be done in increments during plant lifetime, and will be completed one year after plant shutdown.

Seepage rate from tailings impoundment	1*	gpm
Fraction U, Th-230, Ra-226, and Pb-210 to tailings	6;95;99.8;99.8	%

Land Use & Grazing of Cattle

Fraction of year spent grazing locally	N/A	%
Fraction of feed which is pasture graze while grazing	N/A	%
Fraction of stored feed which is grown locally	N/A	%
Acreage required to graze one animal unit (450 kg) for one month (AUM)	N/A	ha

*Assuming tailings drainage system functions as planned

SHOOTERING CANYON PROJECT

/ X RECEP/ EXTRA RECEPTORS

Coordinates[1]

Receptor Identification Name	X (km)	Y (km)	Z (meters)
(1) N.E. Corner of Ticaboo	-0.19 km	- 3.12 km	- 57.93 m
(2) Southern Boundary of Ticaboo (Midpoint)	-1.0 km	- 4.72 km	- 94.51 m
(3) SSW Boundary Ticaboo	-1.78 km	- 1.35 km	- 70.12 m
(4) Bullfrog	-2.78 km	-21.18 km	-240.85 m

[1]Coordinates (X&Y) given in respect to mill site center; latitude 37° 43' 40" and longitude 110° 41' 23". Elevation differentials (Z(m)) given with respect to mill site center elevation; 1387.2 meters.

SHOOTERING CANYON PROJECT

Population Distribution 1977

KILOMETERS*	N 0.0	NNE 22.5	NE 45.0	ENE 67.5	E 90.0	ESE 112.5	SE 135.0	SSE 157.5	S 180.0	SSW 202.5	SW 225.0	WSW 247.5	W 270.0	WNW 292.5	NW 315.0	NNW 337.
0.0 - .1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.1 - .5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
.5 - 1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.0 - 2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.0 - 3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.0 - 4.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.0 - 5.0	0	0	0	0	0	0	0	0	0	[750]**	0	0	0	0	0	0
5.0 - 10.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.0 - 20.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20.0 - 30.0	0	0	0	0	0	0	0	0	41	0	0	0	0	0	0	0
30.0 - 40.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40.0 - 50.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50.0 - 60.0	0	0	0	0	121	0	0	0	0	0	0	0	0	0	0	0
60.0 - 70.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70.0 - 80.0	222	0	0	0	0	0	0	0	0	0	0	0	671	89	29	0

*Distances from center of millsite
**Estimated population of Ticaboo about 1980-present population is zero.

SOURCE: Urban Decisions Inc.

FREQ. Annual Relative Wind Frequency

STABILITY CLASS A

WIND SPEED (KNOTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	21+	TOTAL
N	0.000492	0.000738	0.0	0.0	0.0	0.0	0.001230
NNE	0.000123	0.000123	0.0	0.0	0.0	0.0	0.000246
NE	0.000123	0.0	0.0	0.0	0.0	0.0	0.000123
ENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	0.000492	0.000123	0.0	0.0	0.0	0.0	0.000615
ESE	0.000123	0.000123	0.0	0.0	0.0	0.0	0.000246
SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SSE	0.000738	0.000123	0.0	0.0	0.0	0.0	0.000861
S	0.001353	0.000369	0.0	0.0	0.0	0.0	0.001722
SSW	0.002705	0.001353	0.000492	0.0	0.0	0.0	0.004550
SW	0.001476	0.000984	0.0	0.0	0.0	0.0	0.002459
WSW	0.002091	0.001599	0.0	0.0	0.0	0.0	0.003689
W	0.003812	0.000861	0.0	0.0	0.0	0.0	0.004673
WNW	0.001107	0.000984	0.0	0.0	0.0	0.0	0.002091
NW	0.000615	0.000369	0.0	0.0	0.0	0.0	0.000984
NNW	0.001230	0.000861	0.000123	0.0	0.0	0.0	0.002213
TOTL	0.016478	0.008608	0.000615	0.0	0.0	0.0	0.025701

RELATIVE FREQUENCY OF CALMS 0.0

FREQ. Annual Relative Wind Frequency

STABILITY CLASS B

DIRECTION	WIND SPEED (KNOTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	21+	TOTAL
N	0.001230	0.001230	0.000492	0.0	0.0	0.0	0.002951
NNE	0.000246	0.000615	0.000369	0.0	0.0	0.0	0.001230
NE	0.0	0.000123	0.000123	0.0	0.0	0.0	0.000246
ENE	0.0	0.0	0.000123	0.0	0.0	0.0	0.000123
E	0.0	0.000123	0.0	0.0	0.0	0.0	0.000123
ESE	0.000123	0.000369	0.0	0.0	0.0	0.0	0.000492
SE	0.000123	0.000123	0.0	0.0	0.0	0.0	0.000246
SSE	0.000369	0.000861	0.0	0.0	0.0	0.0	0.001230
S	0.003935	0.005534	0.002951	0.0	0.0	0.0	0.012420
SSW	0.004796	0.009469	0.003689	0.000123	0.0	0.0	0.018077
SW	0.005534	0.002705	0.001722	0.000246	0.0	0.0	0.010207
WSW	0.004550	0.002705	0.001230	0.000123	0.0	0.0	0.008608
W	0.003320	0.001353	0.002091	0.000123	0.0	0.0	0.006886
WNW	0.000984	0.000861	0.000984	0.0	0.0	0.0	0.002828
NW	0.000369	0.0	0.000861	0.0	0.0	0.0	0.001230
NNW	0.001230	0.001476	0.000369	0.0	0.0	0.0	0.003074
TOTL	0.026808	0.027545	0.015002	0.000615	0.0	0.0	0.069970

RELATIVE FREQUENCY OF CALMS 0.0

FREQ Annual Relative Wind Frequency

STABILITY CLASS C

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	21+	TOTAL
			WIND SPEED (Knots)				
N	0.000984	0.000861	0.000369	0.000123	0.000123	0.0	0.002459
NNE	0.000492	0.000615	0.000123	0.000246	0.0	0.0	0.001476
NE	0.0	0.000123	0.000492	0.000369	0.0	0.0	0.000984
ENE	0.000123	0.0	0.000246	0.0	0.0	0.0	0.000369
E	0.000123	0.000123	0.000123	0.000123	0.0	0.0	0.000492
ESE	0.000246	0.000123	0.0	0.0	0.0	0.0	0.000369
SE	0.000123	0.000123	0.000123	0.0	0.0	0.0	0.000369
SSE	0.000984	0.000492	0.000492	0.0	0.0	0.0	0.001968
S	0.005288	0.008116	0.002582	0.000738	0.0	0.0	0.016724
SSW	0.005657	0.008116	0.007624	0.003443	0.0	0.0	0.024840
SW	0.004796	0.004550	0.004304	0.001968	0.0	0.0	0.015617
WSW	0.004304	0.002828	0.001599	0.001107	0.0	0.0	0.009838
W	0.003689	0.000984	0.001722	0.000861	0.0	0.0	0.007255
WNW	0.000738	0.000615	0.001353	0.000492	0.0	0.0	0.003197
NW	0.000738	0.000246	0.001107	0.000492	0.0	0.0	0.002582
NNW	0.001230	0.000738	0.000984	0.000246	0.000123	0.0	0.003320
TOTL	0.029513	0.028652	0.023242	0.010297	0.000246	0.0	0.091859

RELATIVE FREQUENCY OF CALMS 0.0

FREQ. ANNUAL RELATIVE WIND FREQUENCY

STABILITY CLASS D

DIRECTION	WIND SPEED (KNOTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	21+	TOTAL
N	0.018815	0.012297	0.005534	0.002459	0.000615	0.0	0.039720
NNE	0.016478	0.006517	0.003812	0.003320	0.000615	0.000369	0.031112
NE	0.007870	0.001230	0.002828	0.011559	0.005903	0.001845	0.031235
ENE	0.009100	0.000861	0.001107	0.002705	0.000369	0.0	0.014142
E	0.011190	0.001353	0.000492	0.000123	0.0	0.000123	0.013281
ESE	0.005903	0.000738	0.000246	0.0	0.000246	0.0	0.007132
SF	0.004919	0.000984	0.000369	0.000123	0.0	0.0	0.006394
SSE	0.010944	0.006763	0.001722	0.000615	0.0	0.0	0.020044
S	0.019060	0.023856	0.015002	0.004181	0.001230	0.000123	0.063453
SSW	0.012174	0.012297	0.016478	0.015002	0.001599	0.001107	0.058657
SW	0.007747	0.004058	0.007378	0.011559	0.002336	0.000123	0.033202
WSW	0.008608	0.002705	0.003074	0.005534	0.001476	0.000492	0.021889
W	0.014388	0.002828	0.003689	0.003689	0.000123	0.000492	0.025209
WNW	0.004427	0.001845	0.000984	0.000984	0.000492	0.000246	0.008977
NW	0.001968	0.001107	0.000984	0.000861	0.000123	0.000246	0.005288
NNW	0.007501	0.003689	0.002459	0.001968	0.000738	0.000492	0.016847
TOTL	0.161092	0.083128	0.066158	0.064683	0.015863	0.005657	0.396581

RELATIVE FREQUENCY OF CALMS 0.0

FREQ. Annual Relative Wind Frequency

STABILITY CLASS E

DIRECTION	WIND SPEED (KNOTS) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	21+	TOTAL
N	0.017846	0.009838	0.004304	0.000246	0.0	0.0	0.032233
NNE	0.027692	0.005534	0.005042	0.000738	0.0	0.0	0.039005
NF	0.011446	0.001599	0.007993	0.003074	0.0	0.0	0.024112
ENE	0.009846	0.000615	0.001353	0.001107	0.0	0.0	0.012920
E	0.010708	0.000492	0.000984	0.000246	0.0	0.0	0.012429
ESE	0.008000	0.000738	0.000123	0.0	0.0	0.0	0.008861
SE	0.005538	0.003689	0.001599	0.000246	0.0	0.0	0.011072
SSE	0.007015	0.009715	0.005534	0.000123	0.0	0.0	0.022387
S	0.013415	0.012297	0.015986	0.002951	0.0	0.0	0.044650
SSW	0.008246	0.005165	0.007501	0.002336	0.0	0.0	0.023248
SW	0.002708	0.002213	0.005288	0.001353	0.0	0.0	0.011562
WSW	0.005169	0.002705	0.005534	0.001599	0.0	0.0	0.015007
W	0.008246	0.003566	0.005657	0.000615	0.0	0.0	0.018084
WNW	0.003815	0.000369	0.001230	0.0	0.0	0.0	0.005414
NW	0.000369	0.000246	0.000246	0.0	0.0	0.0	0.000861
NNW	0.005415	0.002091	0.003320	0.000492	0.0	0.0	0.011318
TOTL	0.145475	0.060871	0.071692	0.015125	0.0	0.0	0.293163

RELATIVE FREQUENCY OF CALMS 0.000123

FR 1. ANNUAL RELATIVE WIND FREQUENCY

STABILITY CLASS F + G (COMBINED)

WIND DIRECTION	WINDSPEED (KNOTS) 0-3	4-6	7-10	11-16	17-21	21+	TOTAL
N	0.014703	0.007378	0.000615	0.0	0.0	0.0	0.022696
NNE	0.015301	0.007132	0.000861	0.0	0.0	0.0	0.023294
NE	0.003979	0.002583	0.000738	0.0	0.0	0.0	0.007299
ENE	0.004487	0.000492	0.000246	0.0	0.0	0.0	0.005225
E	0.005113	0.000492	0.000123	0.0	0.0	0.0	0.005727
ESE	0.001618	0.000984	0.0	0.0	0.0	0.0	0.002602
SE	0.003104	0.002214	0.000246	0.0	0.0	0.0	0.00[illegible]563
SSE	0.003831	0.00455	0.000615	0.0	0.0	0.0	0.008996
S	0.005833	0.004304	0.001599	0.0	0.0	0.0	0.011736
SSW	0.004718	0.001599	0.000492	0.0	0.0	0.0	0.006809
SW	0.001377	0.000615	0.000369	0.0	0.0	0.0	0.002361
WSW	0.004369	0.000492	0.000369	0.0	0.0	0.0	0.00523
W	0.004987	0.000861	0.000123	0.0	0.0	0.0	0.00597
WNW	0.002882	0.000615	0.0	0.0	0.0	0.0	0.003497
NW	0.000746	0.000123	0.0	0.0	0.0	0.0	0.000869
NNW	0.003992	0.000738	0.000123	0.0	0.0	0.0	0.004853
TOTAL	0.081038	0.035169	0.006518	0.0	0.0	0.0	0.122725

SUPPLEMENT S2

ENVIRONMENTAL REPORT

SHOOTERING CANYON URANIUM PROJECT
GARFIELD COUNTY, UTAH
DOCKET NO. 40-8698

Section 2.7 METEOROLOGY AND AIR QUALITY
Results of the One-Year Site Monitoring Program

Section 5.0 ENVIRONMENTAL EFFECTS OF PLANT AND MINE OPERATIONS
(Sections 5.1, 5.2 and 5.3)
Reassessment of Impacts from Airborne Emissions

Section 6.0 EFFLUENT AND ENVIRONMENTAL MEASUREMENTS AND MONITORING
PROGRAMS (6.1, 6.2 and 6.3)
Description of Preoperational and Operational Air Quality and Meteorology Monitoring Programs, and Descriptions of Atmospheric Dispersion Models Used

Prepared For
PLATEAU RESOURCES LIMITED

By

WOODWARD-CLYDE CONSULTANTS

September 1978

Revised June 16, 1980

5.2 RADIOLOGICAL IMPACT ON MAN

AIRBORNE EFFLUENTS

For purposes of calculating diffusion and dispersion of uranium-bearing dust and radon-222, the NRC XOQDOQ and EPA Valley Models were applied, utilizing one year of meteorological data from the site. A ground-level release was assumed for the ore pile, tailings, and mines. The ore receiving and conveying system, bucking room, and yellowcake drying and packaging system are all vented through stacks equipped with wet dust collectors. The tailings impoundment was treated as a point source. No decay of radon-222 was assumed in the dispersion process; however, complete secular equilibrium of the radon daughters was assumed. The net effect of these assumptions is to add a degree of conservatism to the calculations. Modeling is described further in Appendices S2-F and S2-H.

The mines are expected to produce ore at about the same rate at which the plant will process ore. Both mining and processing will result in the release of radon in the air exhausted from the ventilation systems. In addition, small amounts of ore dust will be released and dispersed from loading operations at the mine, as described in Section 5.3.

Two reference points were used in the dispersion calculations; one for the plant (shown in Figure S2-5.2-1) and the other for the mines. The plant reference point corresponds approximately to stack S-3 shown in ER Figure 3.1-1. The mine reference point was located along the property boundary just east of the midpoint of the boundary between Sections 8 and 9 in T35S, R11E.

SUMMARY OF ANNUAL RADIATION DOSES

The only pathways that appear capable of imparting any significant exposure to man are inhalation of airborne effluents, immersion in airborne effluents, and deposition of radioactive dust on the ground or vegetation. Particulate deposition gives rise to irradiation of man by ground shine and by the consumption of wildlife or livestock that have inhabited the area. The pathway through wild animals is relatively insignificant because of their small populations in the area and the small fractions of those animals consumed by man.

Total-body and specific organ doses resulting from immersion in and inhalation of airborne radionuclides, as well as from ingestion of meat and vegetables raised in the vicinity of the plant, were calculated for a 50-mile radius using the models and methods described in Appendix F of the ER. The most significant exposures to man due to particulates from the plant and mines at locations of interest are given in Table S2-5.2-1 for all pathways. Doses due to radon releases are given in Table S2-5.2-2. Residents of the planned town of Ticaboo are assumed to be exposed by ingestion. Exposure of the other nearby receptors would occur via the immersion, inhalation, and ground shine pathways only.

The doses shown in Tables S2-5.2-1 and S2-5.2-2 are for individuals spending all their time at the existing community of Bullfrog Basin Marina and the proposed Ticaboo community, and for individuals spending 5 percent of their time at the site boundaries as shown in Figure S2-5.2-1. The occupancy factor for the site boundary is equivalent to an individual spending approximately 4 hours a day, 2 days a week, 52 weeks a year at the site boundary.

Food crops grown in the project vicinity, on which airborne radioactive material could be deposited, are expected to be confined to small areas of

5.3 EFFECTS OF CHEMICAL DISCHARGES

AIRBORNE EMISSIONS

Section 5.3 of the ER qualitatively discusses the results of preliminary impact analyses of operational emissions. These analyses were based on six months of site data. Impacts have been reassessed after collection of one year of site meteorological and air quality data and the results are presented in this supplement. Because mining and ore processing activities will be separated by more than 4.5 miles of complex terrain, air pollutant emissions from each have been found not to interact significantly.[a] Thus, their air quality impacts are discussed separately in the following sections.

Mining Operations

Together the Tony M and Frank M mines (shown in ER Figure 3.6-1) will produce about 365,000 tons of ore annually during the 15-year lifetime of the project. Waste rock quantity is expected to average about 365,000 tons annually for the first 5 years of project operation, and 120,000 to 180,000 tons per year thereafter. These two mines are expected to produce at approximately equal rates and will produce approximately equal amounts of air pollutants.

Air pollutants emitted by underground mining activities will include small amounts of equipment engine exhaust and some dust from within the mines, both of which will be emitted through a total of about 24 vents (12 at each mine) as mining areas are developed. In addition, some ore dust will be released from ore storage bins outside

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[a] As discussed below, mining activities are predicted to increase offsite annual average particulate concentrations by less than 1 μ/m^3 and will not significantly influence offsite concentrations resulting from mill operations.

each mine entrance, and fugitive dust will be emitted from mine waste dump areas. An emission factor of 0.02 lb/ton is available for dust emissions from dumping coarse mine material (PEDCo, 1976). Doubling this factor to account for dumping into and out of ore storage bins, it is estimated that about 0.04 pounds of ore dust will be emitted from the ore storage bins per ton of ore produced. Ore buggies from the mines will dump into the bins and the ore will subsequently be dumped into haul trucks destined for the mill. At the mine, about 7.3 tons of fugitive ore dust will be emitted annually from ore handling. Dumping of mine waste rock will produce another 3.7 tons per year for the first 5 years of project operation, and 1 to 2 tons annually thereafter.

Based on atmospheric dispersion modeling, combined emissions from the ore bins and waste dumping are predicted to increase annual average suspended particulate concentrations by about 1 $\mu g/m^3$ or less at locations beyond property boundaries (shown in ER Figure 3.6-1). Likewise, these sources are predicted not to affect offsite short-term concentrations substantially. Annual average dispersion coefficients (X/Q) were calculated for the ore bins represented as two point sources, one at the southeast end of the Tony M orebody and the other at the midpoint of the southeastern edge of the Northeast orebody (as shown in ER Figure 3.6-1). A version of the EPA Valley Model (EPA, 1976) was used to calculate coefficients at set distances in each wind direction sector from a reference point located along the property boundary just east of the midpoint of the boundary between Sections 8 and 9 in T35S, R11E. These dispersion coefficients (X/Q) are provided in Appendix S2-F).

Haul Road Travel

Travel of ore trucks (30-ton capacity) along the haul road between the mines and mill will generate fugitive dust. Haul trucks will make a total of about 33 trips per day, and will operate 14 hours per day, 7 days per week. About one-half of the trips will be along a gravel road up Shootering Canyon for 4-1/2 miles to the Tony M mine. The other one-half will travel approximately 1.2 miles along the gravel mill access road to State Highway 276 (paved), north along the state highway about 4 miles, and along another 2-mile gravel access road to the Frank M mine. Total daily round trip travel will therefore average about 149 miles along Shootering Canyon to the Tony M mine, and about 106 miles along gravel roads to the Frank M mine. The gravel roads will be watered frequently to reduce fugitive dust emissions.

The following fugitive dust emission factor was calculated for the haul road according to EPA (1975):

$$E = 0.81 \times (12\%\ \text{Silt}^{a}) \times \frac{20\ \text{mph}}{30\ \text{mph}}\ ^{2^{b}}\ \frac{365-60^{c}}{365} = 3.6\ \text{lb/mile}\ \text{(uncontrolled)}$$

EPA (1975) indicates that about 40 percent of these emissions settle rapidly and that 50 percent reduction in emissions can be attained through implementation of the above control measure. Thus, the corrected emission factor is 1.08 lb/mile, and average emissions during each 14-hour shift will be about 6.7 lb/hr (0.85 gm/sec) for the Tony M mine and about 4.8 lb/hr (0.60 gm/sec) for the Frank M mine.

Calculations based on Sutton's equation (Turner, 1970) for line sources, modified to correct for gound level turbulence (EPA, 1976), indicate that fugitive dust from the haul roads will cause 24-hour average particulate concentrations to increase by less than one microgram per cubic meter (above background) beyond 1 kilometer from the road. These calculations were performed for the following worst-case meteorological

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[a] The road surface is assumed to have a 12 percent silt content (EPA, 1975).

[b] Average truck speed is assumed to be 20 mph. Cowherd (1974) indicates that emissions are a function of the square of the vehicle speed below 30 mph.

[c] Figure 11.2-1 of EPA (1975) indicates that there are an average of 60 days per year with at least 0.01 inches of rain at the project site.

conditions: 10 hours* of continuous wind direction, F stability class, and 2 m/sec wind speed. Furthermore, the dispersion calculations did not allow for settling of fugitive dust particles that will reduce downwind concentrations.

Mill Operations

Sources of air pollutants at the facility site are described in Section 3.3 of the ER. In addition to information provided in ER Table 3.3-1. The two diesel generators are predicted to exhaust 6926 cfm of gases at about 300° F. each. The boiler and boiler stack have been eliminated from the project design. Table S2-5.3-1 presents maximum ground-level concentrations that are expected to occur outside of property boundaries. Distances in the table are relative to a reference point that was used for modeling that corresponds approximately to stack S-3 in ER Figure 3.1-1. Annual average concentrations were calculated using the EPA Valley Model (EPA, 1976) and annual wind-stability data for the site (Valley Model output is provided in Appendix S2-H). Twenty-four-hour average concentrations were also calculated by the Valley Model for the following worst-case meteorological conditions: persistent wind direction, 2 m/sec wind speed, and F stability for 6 hours. The same meteorological conditions were assumed for averaging periods less than 24 hours and the Pasquill-Gifford equation (Turner, 1970) was used to calculate concentrations at the closest point where plume impaction will occur (where ground level is within 10 meters of the plume centerline elevation). The Briggs plume rise equation was used, and wind meander factors were calculated according to the method of Gifford (1975) for the latter calculations.

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* A longer period of persistent wind direction was chosen for the haul road than for mill emissions (6 hours) since much of the road will pass through a relatively narrow canyon (about 1/4 miles wide).

Table S2-5.3-1. MAXIMUM OFFSITE POLLUTANT CONCENTRATIONS (ABOVE BACKGROUND) FROM MILL FACILITY OPERATIONS

Pollutant	Averaging Time	Direction	Distance (m)	Concen-tration (μg/m³)	Federal Standard (μg/m³)	PSD* Increment (μg/m³)
Suspended Particulates	Annual	NNE	1075	5	60 (secondary)	19
	24-hour	E	650	76	150 (secondary)	37
Sulfur Dioxide	Annual	NNE	1075	2	80 (primary)	20
	24-hour	E	1000	15	365 (primary)	91
	3-hour	SE	910	140	1,300 (secondary)	512
Nitrogen Dioxide	Annual	NNE	1075	30	100 (primary)	--
Carbon Monoxide	8-hour	SE	910	380	10,000 (primary)	--
	1-hour	SE	910	93	8,000 (primary)	--
Hydrocarbons	3-hour	SE	910	100	160 (primary)	--

* PSD increments are not expected to apply to the facility, but are provided in this table for reference.

Sources of particulate matter that were considered in the dispersion calculations included ore dust from the stockpile area and from the ore receiving and handling stack, and particulates from the generator stacks. Relative to these sources, particulate emissions from the calciner and packaging room stacks will be insignificant. The calculations described above indicate that maximum offsite annual concentration increases will be well below the PSD increment, but the 24-hour increment may be exceeded occasionally near the site boundary (Table S2-5.3-1).[b] However, the 37 $\mu g/m^3$ increment is predicted not to be exceeded beyond one-half mile (800 meters) from the mill. The 24-hour secondary standard is known to be exceeded in the region due to natural fugitive dust (ER Section 2.7) and emissions from facility activities may influence the exceedance of this standard at locations near the property boundaries, but this influence is not expected to extend to significant distances. Conditions at Ticaboo should not be affected measurably. Modeling indicates that annual secondary standard will not be exceeded outside property boundaries.

Sources of sulfur dioxide, carbon monoxide, nitrogen dioxide, and hydrocarbons will include the generator stacks. As shown in Table S2-5.3-1, neither ambient air quality standards nor PSD increments for these pollutants will be exceeded outside property boundaries. Baseline concentrations of each are well below the standards in this region (ER Section 2.7).

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[a] Ore dust emissions from the stockpile area are discussed in the answer to NRC question number 27 submitted on August 29, 1978.

[b] PSD increments are not expected to apply to the facility, but are discussed in this supplement for comparison purposes.

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1.0 PROPOSED ACTIVITIES

Plateau Resources Limited (PRL) is mining and proposes to process uranium ore in the vicinity of Shootering Canyon,* Garfield County, in southeastern Utah. The facilities will be located approximately 14 miles north of Bullfrog Basin Marina, on the shores of Lake Powell. Also, PRL is purchasing uranium ore from other mines in the region and proposes to process those ores at the Shootering Canyon facility. The purpose of this document is to identify and describe the potential environmental effects of the mines and the ore processing facility.

Plateau Resources Limited is a wholly owned subsidiary of Consumers Power Company, Jackson, Michigan. The proposed facility will produce uranium concentrate (yellowcake), which PRL plans to ship to a uranium hexafluoride conversion plant as the next step in the process of manufacturing fuel for Consumers Power Company's nuclear power plants.

The primary source of ore for the project will be PRL mines in Shootering Canyon. PRL has acquired several mines and mining claims and leases in the area and initially is reactivating one of the mines (the Tony M). Mines were originally opened in the Canyon in the 1940s. The mines extract ore from the Salt Wash sandstone member of the Morrison Formation. Access to these underground mines is from horizontal adits

*Also known as Shitamaring Canyon and Shootaring Canyon located in the Canyon wall, well above the Canyon floor. As of April 23, 1980, ore containing approximately 9.0 million pounds of U_3O_8 had been identified (indicated and inferred); in addition, an estimated 5,900,000 pounds of potential and speculative potential reserves had been identified. Average grade of this ore is estimated to be approximately 0.12 percent U_3O_8. The principal uranium ores are of carnotite-type secondary uranium minerals in conjunction with high-valent vanadium, uraninite and coffinite minerals in conjunction with low-valent vanadium. The $V_2O_5:U_3O_8$ ratio is approximately 1.8:1. The ore bodies are randomly distributed within the Salt Wash sandstone as "roll" type deposits.

Secondary sources of ore for the project will be purchases from other mines in the region and discoveries from PRL's active exploration and acquisition program in the vicinity of Shootering Canyon. Regional ores will be of two types - the Morrison Formation uranium, which is similar to the Shootering Canyon ore described above, and low-vanadium ores mined principally from the basal unit of the Chinle Formation (Shinarump, Moss Back, Monitor Butte, etc., members).

An ore processing facility was located near the mines acquired by PRL for this project. PRL acquired that facility and is in the process of decommissioning it. The plant was designed to extract uranium from the heaped ore utilizing a sodium carbonate leach solution. The overall uranium recovery process did not yield satisfactory recovery rates and the facility was taken out of service. Plateau Resources Limited has undertaken an extensive testing program on the ore, using consultants, and has determined that conventional semi-autogenous grinding, acid leaching, tailings separation by a countcurrent decantation, solvent extraction process will give acceptable uranium recovery results. Flooding potential at the existing facility, on the floor of Shootering Canyon near the existing mines, precludes the prudent investment of capital at this location to modify the existing facility to an acid leach process. Therefore, PRL has selected an alternative site nearby where adequate space is available for the plant, and for the disposal of tailings from the plant and those residues present at the existing facility.

Uranium ore will be selectively mined and transported to the ore processing facility by truck. Truck-hauled ore may be either deposited in a stockpile or dumped and fed directly to the plant's grinding system. Provision is included for stockpiling as much as 100,000 tons of ore.

The operating plan is based on an average ore processing rate of 1000 tons per day of dry ore. It is assumed that the plant will operate 365 days per year. The facility was designed to achieve an overall uranium recovery efficiency of 90 percent with a grade of 0.07 percent U_3O_8; at the indicated grade of 0.12 percent, recovery efficiency is espected to be about 94 percent. Based on presently identified ore sources, the plant is expected to have an operating life of 15 years. Product output is expected to be

$$\frac{1000 \text{ tons ore}}{1 \text{ day}} \times \frac{2000 \text{ lb.}}{1 \text{ ton}} \times \frac{0.0012 \text{ lb. } U_3O_8}{1.0000 \text{ lb. ore}}$$

$$\times \frac{365 \text{ days}}{1 \text{ year}} \times 0.94 \text{ recovery} = 823{,}440 \text{ lb. } U_3O_8/\text{year.}$$

or approximately 410 tons per year, with a ceiling of 500 tons. Daily output is expected to be approximately 2260 pounds U_3O_8.

Plant operations are expected to begin in the second quarter of 1981. The process circuit involves grinding the sandstone ore into a sandlike material, then dissolving the uranium from the grain surfaces using a sulfuric acid solution. The acid solution containing the uranium will be separated from the solids in a six-stage, countercurrent decantation (CCD) process. The leached solids will be contained in a tailings impoundment. The uranium will be transferred from the aqueous acid phase to an organic phase by means of a solvent extraction process. The uranium will be removed from the organic phase by ammonium sulfate solution and will then be precipitated by the injection of ammonia gas. The final precipitate, commonly called "yellowcake" $(NH_4)_2U_2O_7$, will be washed, filtered, dried, and packed into 55-gallon steel drums.

The plant facilities will consist of several large buildings, several small buildings, an ore storage patio, and an array of tanks of various sizes. Facilities have been designed and arranged for economical construction and efficient operation and to present a well-integrated, compact appearance. The major plant components are:

ore receiving, weighing, and storage yard
grinding and leaching equipment
clarification and filtering equipment
countercurrent decantation
solvent extraction (liquid-Liquid ion exchange)
product washing, filtering, drying, and packaging equipment
offices
warehouse and maintenance shop
laboratory

The clarifier and filter system and the six thickener tanks used to separate the leached solids from the acid-uranium solution will be located outdoors. Other major plant components will be housed or covered. A slurry pipeline will transport tailings from the plant to the tailings impoundment, about 500 feet to the southwest, for disposal. This impoundment will be stripped of topsoil, and lined with clay before use to limit seepage. A dam will be constructed to contain the tailings. The slurry pipeline will discharge to the impoundment through movable distributor pipes located around its perimeter. The coarser materials will settle near the discharge points at the perimeter of the impoundment, and the finer materials will settle progressively farther from the discharge points. The tailings impoundment has been sized to allow for 15 years of plant operations at the plant design rate of 1000 tons per day of ore. By the time mine and plant operations are completed (15 years), tailings depth in the deepest part of the impoundment will be about 100 feet, and the tailings will cover approximately 70 acres. The total volume of tailings will be about 2600 acre-feet. At the termination of plant operations, the impoundment area will be reclaimed by covering with fill. This will prevent the tailings and other waste materials from endangering livestock and wildlife, and from contaminating the surrounding area.

At the peak of the construction phase, the proposed Shootering Canyon project is expected to provide employment for about 225 to 250 persons. The total operating work force at the ore processing facility is expected to reach approximately 75 by 1981 and remain at that size when the project is onstream. Mining activities will provide employment for 100 to 125 persons throughout the project operations. Plateau Resources Limited is working closely with local and state government agencies and planners to ensure that these employees integrate smoothly and rapidly into the area. A new town of Ticaboo near the project site is being constructed by an independent developer to accommodate

Bullfrog Basin Marina staff and the project workers and their families. The project will make an economic contribution to the surrounding area, particularly to Garfield County, the town of Hanksville, and to the Bullfrog Basin Marina complex.

The annual project payroll will be more than $2 million. In addition, direct (corporate) and indirect (salaries, sales, gasoline, etc.) taxes are expected to exceed $4 million annually.

Plateau Resources Limited has retained Woodward-Clyde Consultants to conduct studies on the potential effects of the project on local communities and the environment.

Page, Arizona, near the southwestern end of Lake Powell and near the Glen Canyon Dam, is about 70 air miles from the project site. The nearest shoreline of Lake Powell is about 9 miles from the site, and the Glen Canyon National Recreation Area extends to within about 4 miles of the project area.

Plateau Resources Limited intends to construct the plant facilities on mill site claims. (PRL is taking steps to acquire title to the land. See Section 9.7.) The placer claims, lode claims, and mill site claims near the proposed facilities are shown in Figure 2.1-2, and the general layout of the plant site is shown in Figure 2.1-3. The plant facilities will occupy approximately 100 acres.

A private developer is constructing a new town, Ticaboo, approximately 3.5 miles south of the plant site. Operating staff for the proposed project, including miners, are establishing residence in the new town as space becomes available.

The general region of the proposed facility is used primarily for recreation, livestock grazing, wildlife habitat, and mineral exploration.

Vegetation in the area is exclusively native, uncultivated, and generally sparse. The topography in the project vicinity is characterized by mesas intersected by deeply incised drainage channels.

2.2 REGIONAL DEMOGRAPHY AND LAND USES

The uranium processing facility proposed by Plateau Resources Limited is expected to have some impacts on the socioeconomic characteristics and land use patterns in the project region. The impacts will be a function of the project's geographic location, available transportation systems, project-induced population fluctuations, residential distribution patterns of in-migrant population, and absorption capacity of the regional infrastructure. These impacts are generally expected to be localized because of the extremely low population density in the affected region. Pertinent baseline information is provided mainly for Garfield and Wayne counties.

DEMOGRAPHIC CHARACTERISITICS

The people who live in the immediate project area are located at the Ticaboo townsite, about 3.5 miles south of the proposed ore processing facility, and at Bullfrog Basin Marina (Figure 2.2-1). Some of the residents reside at Ticaboo during the work week and return to permanent residences, mainly in Green River and Moab, Utah, on weekends, awaiting further establishment of Ticaboo.

Bullfrog Basin Marina, is 14 miles south of the facility, at Lake Powell. This recreational community, part of the Glen Canyon National Recreation Area, consists of approximately 100 employees (and their families) of the federal park system and related support and concession facilities. Transient residence at Bullfrog Basin Marina is limited by park regulations to two months at a time. Peak use of the Marina may approach 20,000 persons on 3-day summer holiday weekends.

The remainder of the land in Garfield County is owned by the state, by county and local governments, and by private individuals. The State of Utah has jurisdiction over 7 percent of the land in Garfield County. These holdings consist of park and recreation lands and school sections. The county and local governments own only about 0.01 percent of the land. Private ownership, primarily in agricultural land, accounts for about 4 percent of the land in the county. These private holdings are generally concentrated in the vicinity of Loa, Bicknell, and Torrey, although some ranches and farms are scattered across the county. The 1976 assessed valuation of taxable land holdings in Garfield County was $13,716,000 (Utah Foundation, 1977).

Construction is underway to develop the townsite of Ticaboo on state land in Section 16, T36S, R11E, approximately 3.5 miles south of the facility site. This development is well into planning and development stages, and has received the encouragement of the Utah Land Management Board in the light of comprehensive planning done in Garfield County and in the Four Corners area. This development is discussed further in Chapter 4 of this report, and in an Environmental Impact Report on the Ticaboo Subdivision prepared by the Utah State University Foundation (1977).

ECONOMIC BASE

The proposed mine and ore processing facility is anticipated to have favorable effects on the economies of Garfield and Wayne counties. Employment, mineral production, trade, service industries, agriculture, and personal income are the major economic activities and factors that will be affected.

Employment

Garfield County had an average labor force of nearly 1600 persons in 1975 (Table 2.2-5). The county's average unemployment rate of almost 15 percent is the second highest for all counties in Utah and is about double the state unemployment average of 7.2 percent. Employment in the county decreased somewhat in the 1960's as a result of termination of some mining activities. The largest single employment sector is government (Tables 2.2-5 and 2.2-6). Other significant employment sectors include services (primarily tourist-oriented), agriculture, and manufacturing.

Wayne County had an average labor force of 870 persons in 1975 (Table 2.2-5). The unemployment rate of 7.9 percent in this county was slightly higher than the state average. Agriculture, which employs 32 percent of the total work force, is the principal employment sector in the county (Tables 2.2-5 and 2.2-6). Government is the next largest sector, employing 22 percent of the work force.

At present (May 1980) 126 persons are working at the Plateau Resources Limited mine in Shootering Canyon. Employment at the proposed ore processing facility is expected to increase to a peak of approximately 225 during plant construction. Approximately 75 persons will be employed during operation of the proposed plant and 100 to 125 persons will be employed at the mines.

Mineral Production

Although the exact number is unknown, an estimated 100 to 150 uranium mines (active and inactive) are present in the four-county area

Wayne County. The two counties ranked 19 (Garfield) and 24 (Wayne) among the 29 counties of Utah in per capita income.

The percentage of people on public welfare was lower in Garfield (4.3 percent) and Wayne (2.8 percent) counties than the average for Utah (4.7 percent) (Utah Foundation, 1977). However, the number of families with an income below the national low-income average of $3388 was slightly higher in these two counties (12 and 10 percent, respectively) than the average for Utah (9 percent) (Table 2.2-10). Both the median family income and the average monthly wage are significantly lower in Garfield and Wayne counties than the average for Utah.

HOUSING AND SOCIAL SERVICES

Housing

Housing for facility related personnel is now becoming available at Ticaboo. Currently, 50 private mobile homes are in place at Ticaboo including five Recreational vehicles which represent mine employees.

Development of the Ticaboo Subdivision is crucial to meeting housing demands generated by employees of the mining and processing operations. When Ticaboo is established, employees will have the option of purchasing or leasing land and/or housing within the town boundaries. The new town will provide housing and services for approximately 600 residents. Bullfrog Basin Marina is not expected to absorb any facility employees, since permanent residence is limited to park

Table 2.2-10. FAMILY AND INDIVIDUAL INCOME, 1970 CENSUS

	Garfield County	Wayne County
Total Number of Families	823	419
Income		
Less than $3000	11.1%	16.7%
$3000 - $4999	19.5%	21.7%
$5000 - $6999	20.3%	23.6%
$7000 - $9999	23.8%	21.7%
$10,000 - $14,999	20.3%	12.2%
$15,000 - $24,999	3.8%	2.4%
$25,000 or more	3.2%	1.7%
Per Capita Money Income	$2388	$1757
Median Family Income	$71[illegible]	$5828
Families Below Low Income Level*	12.3%	10.5%
Families Below 125% of Low Income Level	21.7%	24.6%
Individuals Below Low Income Level	485	276
Persons 65 and Older Below Low Income Level	14.6%	16.3%

Source: U.S. Bureau of the Census, 1972b.

*National average low income level for families: $3388.

personnel, and park regulations limit transient residence to two months.

Educational Facilities

School facilities are available at Ticaboc for Kindergarten through 12th grade. There are currently 35 students with a staff of 5 teachers. The school falls under the jurisdiction of the Garfield County school district.

Health Services

Three emergency medical technicians, facilities for first-aid treatment, and two ambulances are present at the mine camp. A family nurse practitioner is on-site full-time at Ticaboo and works out of a mobil Meditest unit. A medical doctor is at this unit two days a month. Another nurse practitioner is available in Green River. The closest medical doctors and hospitals are in Monticello and Moab, approximately 120 and 160 miles from the site, respectively (Figure 2.2-1). San Juan County Hospital, in Monticello, has a 36-bed capacity, with an average occupancy of 40 percent, and four physicians.* Allen Memorial Hospital in Moab has a 38-bed capacity, with an average occupancy of 30 percent, and three general practitioners. The hospital is hoping to attract additional physicians to provide more comprehensive coverage.**

*Dr. Freestone, San Juan County Hospital; Monticello, Utah; personal communication, 1977.

**Ms. Kay Hawkins, Allen Memorial Hospital; Moab, Utah; personal communication, 1977.

Law Enforcement

The BLM lands in the vicinity of the facility are under the jurisdiction of the Garfield County Sheriff's Department. A deputy Sheriff is located at Ticaboo. Glen Canyon National Recreation Area and Bullfrog Basin Marina are within the jurisdiction of the National Park Service.

Fire Protection

Fire protection at the existing mines is provided by Plateau Resources Limited. Seven fire hydrants located on the site are connected to a 15,000 gallon water storage facility. Well water can also be provided if necessary to increase this capacity. Some limited support could also be available from Bullfrog Basin Marina, which has one fire truck.

Water Supply

Water for use at the mines and mining camp is pumped from wells located on the site. Water supplies for the new town is also being pumped from wells.

Waste Treatment

Sewage disposal at the mine site is by septic systems, and solid wastes are buried nearby in a canyon at an approved landfill.

Utilities

Electricity for the mines is provided by two 500-kilowatt generators. An additional 500-kilowatt generator on standby service is available.

Recreation

Lake Powell and the Glen Canyon National Recreation Area (within 14 miles of the facility site) and numerous state and national parks (within a 2- to 3-hour drive) (Figure 2.2-1) provide ample opportunities for a variety of recreational experiences.

Transportation

The main transportation route in the vicinity of the proposed facility is State Highway 276, which provides access to Bullfrog Basin Marina from the north and the east (Figure 2.2-1). East-west travel in eastern Garfield County is restricted because of the absence of paved highways. An unimproved road connects Escalante with State Highway 276, but this road is recommended only for 4-wheel-drive vehicles. Traffic along State Highway 276, a two-lane paved road passing 1.2 miles east of the facility site, consists almost exclusively of tourist and service traffic to Bullfrog Basin Marina (where the highway terminates) and traffic to the existing mine in Shootering Canyon. A gravel road connects the proposed facility with State Highway 276.

The closest scheduled air service to the project site is at Cedar City (about 35 miles southwest of Panguitch) and at Moab (Figure 2.2-1). The closest municipal airports are at Blanding in San Juan County and at Loa in Wayne County. There is a landing strip at Bullfrog Basin Marina. No railroad facilities serve the area.

2.3 REGIONAL HISTORIC, SCENIC, CULTURAL, AND NATURAL LANDMARKS

HISTORY AND ARCHAEOLOGY

In 1977, Plateau Resources Limited contracted Archeological-Environmental Research Corporation of Salt Lake City, Utah, to conduct a surface historical and archaeological reconnaissance of the facility site and vicinity. The reconnaissance covered 270 acres and included both the facility site and the proposed access roads (Figure 2.3-1).

The area was surveyed by a two-man team on September 7 through 9, 1977. No prehistoric or historic sites were discovered at the facility site during the survey. However, one archaeological site, a lithic scatter, was identified in the vicinity of the proposed access road. The right-of-way for this road has been routed to avoid all of the lithic scatter.

The archaeological site is approximately 400 meters by 50 to 100 meters in size and appears to have been a campsite and chipping area for chert quarried at another location. Using the U.S. Bureau of Land Management Cultural Resource Evaluation System, Archeological-Environmental Reasearch Corporation assigned the site an S2 rating (Appendix A). Artifacts found at the site consisted of blanks, preforms, a hammerstone, a projectile point, and knives. While the cultural origin and approximate age of this site could not be determined, it is likely that it was used for a relatively long period of time.

To prevent potential vandalism, the location of the archaeological site and the archaeologist's report have been excluded from this document.

increments for suspended particulate matter and sulfur dioxide. Class II* increments presented in Table 2.7-8 apply to most areas in the vicinity of the facility site, except for Capitol Reef National Park, about 15 miles west of the site, where more stringent Class I increments apply.** Since an air quality permit was issued by the Utah State Bureau of Air Quality before March 1, 1978, a PSD review and permit will not be required by the EPA since initial construction began prior to December 1978.

Suspended Particulate Matter

The Utah Bureau of Air Quality has monitored suspended particulate matter at Bullfrog Basin Marina (Figures 2.7-1 and 2.7-2) since 1971 using the high-volume method. Data from this monitoring program (summarized in Table 2.7-9) indicate that particulate concentrations are generally low but occasionally increase to relatively high levels. Observed high concentrations are probably related to events such as dust storms. The reported annual geometric mean is well below the federal secondary standard, 60 micrograms per cubic meter ($\mu g/m^3$). The 24-hour federal secondary standard (150 $\mu g/m^3$) is exceeded generally once or twice a year, probably due to natural fugitive dust, but the federal primary standard (260 $\mu g/m^3$) is rarely exceeded.

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* All areas of the United States have initially been designated as Class II, except for specific scenic and culturally important areas that have been designated Class I to further protect pristine air quality conditions.

**In this area of Utah, Canyon Lands National Park, about 40 miles northeast of the facility site, has also been designated Class I.

Table 2.7-8. ALLOWABLE DETERIORATION INCREMENTS ($\mu g/m^3$) FOR PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY

	Area Classification	
	Class I	Class II
Suspended Particulate Matter		
Annual geometric mean	5	19
24-hour maximum	10	37
Sulfur Dioxide		
Annual arithmetic mean	2	20
24-hour maximum	5	91
3-hour maximum	25	512

Sources: Clean Air Act amendments of 1977. Public Law 95-95, August 7, 1977. Also 40CFR52.

This section presents a description of the proposed Shootering Canyon uranium project, and details of how operation of the facility will interact with the environment.

3.1 EXTERNAL APPEARANCE OF THE PLANT

The general arrangement of the ore processing facilities is shown in Figure 3.1-1. An architect's perspective view of the plant is shown in Figure 3.1-2. Process flow diagrams, plot plans, and sectional elevations of the various plant components are shown in Appendix G.

Arrangement of the various ore handling and processing systems was based on economy in construction and efficiency in operation. To achieve these goals, compact arrangement of the plant components was required. All process units except the countercurrent decantation tanks and the clarifier are housed or covered. The plant support buildings and facilities, such as office, warehouse/maintenance, laboratory, power house, and storage tanks are located around the perimeter of the process units in a manner to yield a compact, well-integrated complex. Architectural treatment of the individual buildings, and of the complex as a whole, was an important consideration in the design. The building exteriors will be colored in earth-tone shades to blend with the surroundings of the plant as seen from State Highway 276. A short stretch of highway, about 2 miles Northeast of the site, provides the only convenient public view of the plant (except from the air). From the highway the only signs of activity at the plant will be vehicular movement.

There will be no plumes of smoke or dust marking the plant location. There are several stacks varying in height from 37 feet to 97.5 feet above plant grade, but they will not appear in silhouette from the highway. The largest building in the complex will be about 140 feet by 180 feet in plan dimensions, and less than 60 feet high.

3.2 PLANT CIRCUIT

SUMMARY

It is anticipated that the facility will process an equivalent of 1000 tons of ore per day, 365 days per year. The amount of ore processed per day may be varied to allow for planned and unscheduled shutdowns.

Original exploration of the ore bodies indicated an average ore grade of 0.10 percent uranium oxide (U_3O_8). More recent exploration and development activities indicate an average ore grade of 0.12% U_3O_8. Based on these more extensive investigations, estimates of total indicated and inferred reserves have been increased to 4500 tons of

U_3O_8; potential and speculative potential reserves amount to an additional 2950 tons of U_3O_8.

It is expected that the plant will have an overall uranium recovery rate of 94.0 percent from 0.12 percent ore. Based on this anticipated recovery, on the average processing rate of 1000 t/d of ore, and on an average ore grade of 0.12 percent, the plant will produce about 2256 pounds per day (lb/d) of U_3O_8 on the average, or approximately 823,440 pounds per year (lb/yr). Maximum production of U_3O_8 will be approximately 1,000,000 lb/yr, as a result of probable variations in ore grade and ore through put rate.

A series of operations will be required to extract uranium from the ore. The ore to be processed is of a sandstone type. The uranium compounds are present in the ore as a coating on the sand grains and as a filler in the intergranular spaces. The uranium compounds are soluble in strong sulfuric acid solutions and will be leached from the ore by a conventional acid leach process. Figure 3.2-1 presents a simplified process diagram for the plant.

First it will be necessary to grind the ore, (Appendix G, Figure G-12) to reduce it to sand-sized particles, in order that the acid may come in intimate contact with the grain surfaces. After grinding, the ore will be introduced into a two-stage, multiple-tank system used for the leaching process (Figures G-3, G-12).

After leaching and removal of some clarified pregnant liquid (see below), the slurry will be pumped to countercurrent decantation tanks (CCD) (Figures G-4, G-13A, G-13B) where most of the remaining dissolved uranium will be recovered with the decanted liquid. The six decantation tanks will be operated in series, with the solids passed through them in one direction and the acid wash solution in the opposite direction.

From the decanting system the solids in the form of a slurry will be discharged as waste material for impoundment in a natural basin which will be lined with clay and closed by a dam. The decanted, acidic liquid will be returned to the first-stage leaching tanks.

A primary thickener located between the first-stage and second-stage leaching tanks (Figure G-3) will separate most of the uranium-bearing solution from the solids. This overflow liquid from the thickener will be passed through a clarifier and sand filters to remove suspended solids. The separated solids from these two processes will be returned to the second-stage leaching tanks. The filtered liquid will be transferred to a solvent extraction (liquid ion exchange) system.

In the solvent extraction system (Figure G-5), the uranium-bearing liquor passes through a series of stages in which the uranium is transferred from the aqueous phase to an organic phase and is then stripped from the organic solvent by aqueous ammonium sulfate solution. Ammonia will be added to the strip solution to precipitate the uranium as yellow cake (Figure G-6). Finally, precipitated yellow cake will be dried, packaged, and shipped to another plant for the next phase of the fuel manufacturing process.

ORE STOCKPILE

Ore from the mines will be hauled by trucks to the plant, a distance of approximately 4 1/2 miles from the "Tony M" Mine and 7 1/2 miles from the "Frank M" Mine. The arriving ore can be fed directly to the grinding system or stockpiled on the ore storage patio northeast of the dump pocket. Patio storage capacity is approximately 100,000 tons.

During operations, the stockpile will be available on the patio as backup plant feed in case the mine does not deliver ore to the plant at the desired plant feed rate. Ore deposited on the patio will be picked up by a front-end loader and fed to the ore grinding system as required.

ORE GRINDING

Typically, uranium compounds in the project area are deposited as thin coatings and pore fillings between grains of sandstone. To efficiently remove the uranium compounds from the sand grains, mined ore must first be reduced in size to fine particles by grinding so that a large surface area is exposed to the acid leach solution. The grinding process begins with loading of the ore through a stationary grizzly with 14 inch openings and into a receiving hopper; occasional oversize pieces will be broken in place. The hopper will discharge the ore through an apron feeder and onto a second stationary grizzly with 3 inch openings. Material passing through the grizzly will discharge directly onto a 42-inch conveyor belt; the grizzly will have a steeply-sloping surface, and oversize material will roll down the slope and discharge onto the bedding surface formed by the undersize material which passed directly onto the conveyor belt. The conveyor will be equipped with a magnetic metal detector to aid in the removal of tramp iron that might cause damage to equipment downstream of the conveyor.

From the conveyor the ore will be fed directly into a Semi Autogenous Grinding (S.A.G.) mill. The flow rate through the S.A.G. mill and the number of hours per day of S.A.G. mill operation will be regulated to provide a plant feed rate of approximately 1000 tons of ore per day. The mill will rotate slowly and water will be added to produce a slurry containing approximately 70 percent solids. As the mill rotates, the impact of steel balls and larger ore pieces on the smaller ones will reduce the ore to sand-sized particles. The slurry discharged from the S.A.G. mill will be screened to remove oversize particles. The material passing the screen will fall by gravity to a sump and be pumped to a sampler and agitated holding tanks. The oversized particles from the screen will be returned to the S.A.G. mill by gravity flow.

LEACHING

The leaching circuit (Figure G-12) will dissolve the uranium compounds from the surface of the sandstone grains. Leaching will be done with a solution of sulfuric acid and controlled amounts of sodium chlorate as an oxidant. The process will take place in wood-stave tanks. A two-stage leaching circuit, with a primary decant thickener between the leaching stages, will be used. The ore slurry from the holding tanks following the S.A.G. mill will be pumped to the first-stage leach (three tanks in series) where it will be mixed and agitated with acid leach solution (overflow from CCD thickener #1). Sulfuric acid and sodium chlorate will be added as required to maintain required pH and emf. Following the first-stage leach, the slurry will be transferred to the primary decant thickener. From the thickener, the decanted liquid containing dissolved uranium will pass through a clarifier and advance to the solvent extraction unit, as discussed below, while the thickened solids will advance to the second-stage leaching circuit (four tanks in series). Further leaching is accomplished at this stage by the addition of more sulfuric acid and sodium chlorate. The average consumption of sulfuric acid and sodium chlorate is estimated to be 203 lbs/ton of ore and

1.07 lbs/ton of ore, respectively in the entire leach circuit. All leach tanks will have agitators to keep the sand particles in suspension.

Discharge from the second-stage leach circuit will be a slurry consisting of the solids and a sulfuric acid solution with dissolved uranium. This slurry will be pumped to the countercurrent decantation system.

COUNTERCURRENT DECANTATION THICKENING

The leached slurry will be transferred to the first of a series of six countercurrent decantation tanks (known as "thickeners") (Figures G-4, G-13A, G-13B). The solids will settle to the bottom of the first thickener, and will then be transferred to the second thickener, and so on until they are discharged from the sixth thickener to the tailings impoundment. Acidic wash water will be added to the sixth thickener. The liquid that overflows the sixth thickener will advance to the fifth thickener and so on to the first thickener. This countercurrent flow of liquid and solids will wash the residual dissolved uranium compounds from the solids. The liquid that overflows the first thickener will be pumped either to the surge tanks ahead of the first-stage leach, or directly to the first-stage leach tanks (Figure G-3 and G-4). A long-chain polymer compound will be added to each thickener feed to increase the settling rate of the solids.

SOLVENT EXTRACTION FEED

The acidic uranium-bearing (pregnant) solution decanted from the primary thickener following the first-stage leach will be transferred to a clarifier. It is estimated that this liquid will contain approximately 200 ppm solids. The clarified liquor, containing about 50 ppm solids, will be pumped through sand filters to a storage tank which feeds the solvent extraction circuit. The filtered liquid is expected to contain less than 10 ppm solids. Settled solids from the clarifier and solids backwashed from the sand filters will be discharged to the second-stage leach tanks.

SOLVENT EXTRACTION

The primary purpose of the solvent extraction circuit is to concentrate and upgrade the uranium bearing pregnant solution. This circuit consists of two unit operations (Figures G-5, G-12). In the first operation, the uranium is transferred from the aqueous leach solution to an immiscible organic liquid by ion exchange. In the second operation a reverse ion exchange process then strips the uranium from the organic solvent using aqueous ammonium sulfate.

To accomplish the first operation, the clarified and filtered pregnant leach solution will be mixed with an organic solvent in an extraction mixer tank, and the two solutions will then be allowed to separate in a settling tank. After going through a series of four mixing and settling tanks, almost all of the uranium will have been transferred from the leach solution to the organic solvent. The uranium-rich organic solvent will then be advanced to the stripping operation. Most of the barren acid leach solution (raffinate) will be returned for use as wash water in the countercurrent decantation tanks; a portion may be bled from the circuit and discharged with the process tailings, as required for quality control.

In the stripping process, the loaded organic solvent will be mixed with an aqueous ammonium sulfate solution; ammonia will be added to the solution to control the pH. The ammonium sulfate solution will strip the uranium from the organic solvent. After processing through four mixing and settling tanks, the barren organic solvent will be recycled to the beginning of the solvent extraction operation, and the uranium-rich ammonium sulfate solution will advance to the precipitation circuit.

PRECIPITATION

The pregnant ammonium sulfate solution will be pumped through a heat exchanger to control its temperature, and from there into reaction tanks (Figure G-6, G-12). The reaction tanks will also be temperature controlled. Ammonia will be injected into the reaction tanks to neutralize the solution and effect the precipitation of uranium (yellow cake). The barren ammonium sulfate solution will be filtered and recycled to the stripping stage of the solvent extraction circuit, and the precipitated yellow cake will be transferred to a thickener, where it will be held until an amount sufficient for further processing has accumulated.

DRYING AND PACKAGING

Precipitated yellow cake will be washed to remove soluble impurities, dewatered, and dried in a multiple-hearth furnace (Figures G-6, G-12). The dried product will then be passed through a crusher for reduction to minus 1/8 inch, and discharged to steel drums at a design rate of approximately 270 pounds per hour. Drying and packaging operations will be performed for about 72 hours per week. Product output from the plant will be approximately 20 to 30 barrels of yellow cake per week, each barrel holding approximately 800 lbs of product. Filled drums will be stored until a sufficient number have been assembled for shipment.

3.3 SOURCES OF PLANT WASTES AND EFFLUENTS

Processed ore, or tailings, will be the major waste generated by the Shootering Canyon uranium ore processing facility. Disposal of the tailings will be by permanent storage in an impoundment that utilizes a natural depression, or basin, located adjacent to the proposed plant site. The plant and its support facilities will also produce lesser quantities of other liquid and solid wastes and effluents which, for the most part, will be either recycled in the various process operations or discharged to the tailings impoundment or to a sanitary waste leach field.

Gaseous emissions and dust released by the plant will be discharged from eight stacks. Locations of the stacks are shown in the plant plan (Figure 3.1-1). Estimated emissions from the various stacks are listed in Table 3.3-1. This table also includes data on emission control equipment to be furnished with each stack and performance data for that equipment.

The following discussion provides a more detailed description of significant releases of wastes and effluents from the plant, and describes plans for controlling and limiting the release of effluents. Design changes replacing the crushers and rod mill with a S.A.G. mill have eliminated several dust emission sources, and will result in a decrease in the expected total dust emissions.

ORE STOC ILES AND DUMP HOPPER

Solid Effluents

Stockpiled ore on the storage patio will be exposed to the atmosphere and normally will be dry. When dictated by wind conditions or when the stockpile is being worked, either to add or remove ore, the active area of the stockpile will be sprayed with water as needed to control dust.

During a given day, as much as 1,000 tons of ore might be transferred on the ore patio, resulting in 800 lb of dust daily or a 24-hour average emission rate of 33 lb/hr (4.2 gm/sec). On a yearly average basis, however, it is estimated that only 10 percent of the ore processed by the mill will be handled on the ore patio; the remaining 90 percent will be dumped directly into the ore dump pocket by the trucks transporting the ore from the mine to the mill. Thus, annual average emissions are estimated to be 3.3 lb/hr (0.42 gm/sec).

EPA (1975) states that about 40 percent of stockpiling emissions result from vehicular traffic. As a conservative estimate, it is assumed that at least half of this traffic dust, or 20 percent, will be from local soils. Consequently, 80 percent of the stockpiling dust emissions, or 2.7 lb/hr (0.34 gm/sec), will be ore dust.

Taking the average ore grade as 0.12 perecent uranium oxide, U-238 emissions are:

$$2.7 \text{ lb/hr} \times 454 \text{ g/lb} \times 8760 \text{ hr/yr} \times 0.0012\text{g } U_3O_8/g_{ore}$$

$$\times\ 0.85\ g_{U\text{-}238}/gU_3O_8 \times 3.3 \times 10^{-7}\ Ci/g_{U\text{-}238}$$

$$= 3.6 \times 10^{-3} \text{ Ci of U-238/yr.}$$

The daughter isotopes are assumed to be in secular equilibrium with the U-238. U-235 is assumed to be present in natural quantities.

As ore is deposited at the dump hopper, water sprays at the hopper will reduce fugitive dust emissions. Ore will be discharged from the dump hopper through an apron feeder and stationary grizzly onto a hooded conveyor belt which will carry the ore directly to the S.A.G. mill. Dust will be collected at the apron feeder and discharged to a wet process dust collector. Scrubbed exhaust from the dust collector will be released through a stack having a release height of approximately 100 feet. The slurry from the dust collector will be pumped into the process circuit ahead of the grinding mill. This system of conveyance will control fugitive dust. Because they are enclosed, the apron feeder, stationary grizzly, and belt conveyor are not expected to release significant quantities of dust to the environment. Effluent air from the wet dust collector is expected to contain 0.03 to 0.05 g/m^3 of ore dust. Assuming an average ore grade of 0.12 percent uranium oxide, this ore dust will contain about 15.4 pCi/g of uranium-235, and 340 pCi/g of uranium-238. Release rates for daughter products of uranium are assumed to be the same as those for uranium.

Liquid Effluents

The only liquid effluents released from the ore receiving area will result from precipitation in excess of absorption capability of the ore on the storage patio. All drainage from the ore patio will be collected in the plant drainage system, which will discharge into the tailings impoundment.

Gaseous Effluent

Radium-226 contained in the uranium ore will continously decay to radon-222, a radioactive gas. The half-life of radon-222 is 3.8 days; therfore, over 99 percent of the escaping gas would decay within four weeks to solid radionuclides. If ore piles were left undisturbed, a negligible amount of the radon gas generated within the piles would diffuse out of the bulk ore before decaying to a solid radionuclide. However, disturbance of the ore by transporting it from the stockpiles to the dump hopper will release a portion of the entrapped radon gas to the atmosphere; radon gas emissions are discussed more fully in the next section.

ORE GRINDING

Solid Effluent

Ore will be fed into the S.A.G. mill from the dump hopper via a hooded conveyor. The ore will be wetted as it is discharged from the conveyor and will form a slurry in the mill. As a result, grinding of the ore will not release significant amounts of dust.

Liquid Effluent

The S.A.G. mill slurry will contain about 70 percent solids. Any spillage from the mill, or from the slurry pumps and piping system, will be collected in a floor sump. The floor will be sloped to drain to the sump and to facilitate washdown. From the sump the spilled materials will be pumped back into the process.

Gaseous Effluent

The primary pollutant released into the environment from the S.A.G. mill and associated equipment will be radon-222 gas. To minimize the impact of this gaseous release, all pump boxes, the mill discharge trommel, and the screens will be enclosed and vented through a demister system for the grinding and leaching circuits.

The stack gas radon concentration shown in Table 3.3-1 is an upper limit which assumes that all the radon gas generated during ore residence in the plant escapes to the atmosphere, through stack S-5. The total radon-222 emissions have been estimated for an ore throughput of 1000 t/d with an assumed grade of 0.12 percent uranium oxide. On this basis, the activity of uranium-238 entering the plant each day is 3.1 x 10^5 uCi/d:

$$\frac{1000 \text{ t ore}}{\text{day}} \times \frac{0.12 \text{ t } U_3O_8}{100 \text{ t ore}} \times \frac{9.07 \times 10^5 \text{ g}}{\text{t}} \times \frac{714 \text{ g U}}{842 \text{ g } U_3O_8}$$

$$\times \frac{0.993 \text{ g. } U\text{-}^{238}}{\text{g. U}} \times \frac{0.334 \text{ uCi } U\text{-}^{238}}{\text{g. } U\text{-}^{238}}$$

$$= 3.06 \times 10^5 \frac{\text{uCI}}{\text{day}} U\text{-}^{238} \left(=3.54 \frac{\text{uCi}}{\text{sec}}\right)$$

Ore samples show radium-226 activities about 60 percent those of uranium 238, giving a daily radium generation of 1.8×10^5 uCi/d. The average ore residence time is about 3 days in the plant and 10 days* on the ore pad, or about 13 days, during which time the daily throughput of radium results in the creation of about 1.7×10^5 uCi/d of radon gas, or approximately 1.9 uCi/sec.

LEACHING

Solid Effluent

No solid effluents will be released from the leaching circuit.

Liquid Effluent

The leaching tanks will contain a slurry of about 30 to 50 percent solids (Figure G-12). These tanks will be placed on a sloping floor which drains to a floor sump. Any spillage from the tanks will drain, or be washed, into the sump and will be pumped back into the process circuit. The recessed impoundment area of the floor will be large enough to contain the entire volume of a single leach tank.

Gaseous Effluent

The leach tanks, the primary thickener, and all associated pump boxes and head tanks will be covered, and the covers will be vented

*This is weighted value for all the ore coming into the plant, and is based on an average residence time of 100 days for stored ore and an estimate that 10 percent of all incoming ore will pass through the stockpile.

through a demister system. Gaseous effluents in the building are therefore expected to be minimal. Escaping gaseous effluent will contain small amounts of radon-222 and sulfuric acid mist. The building is vented through roof ventilators at the rate of two (2) air changes per hour.

The ore grinding and leaching systems are grouped in the same part of the process building. The same roof ventilators therefore serve both systems. A single central demister system vents both the leach tanks and the equipment in the grinding circuit. Exhaust air from this demister will be released to the atmosphere, and demister discharge liquid will be pumped back into the process circuit.

COUNTERCURRENT DECANTATION THICKENING AND TAILINGS IMPOUNDMENT AREA

Solid and Liquid Effluent

Acid wash solution will be separated from the ore slurry in the countercurrent decantation tanks. The barren tailings will be discharged to an impoundment as slurry consisting of about 49 percent solids by weight. The rate of discharge will be approximately 1000 tons of tailings and 248,000 gallons of water per day. The water in the slurry will contain the following estimated concentrations of cations, anions, and compounds at a pH of 1.5:

	mg/l
U_3O_8	.40
Fe (total)	1730
Al^{+++}	320
Ca^{++}	26
Mg^{++}	3500
SiO	520
So_4^{--}	26,500
Cl	160
V_2O_5	530

At an average ore grade of 0.12 percent and a uranium recovery rate of 94.0 percent, the tailings will consist of fine sand containing 0.144 pound of uranium oxide per ton of dry tailings.

Exposed tailings surfaces in the impoundment area will be kept moist until they are capped as part of the reclamation process. Consequently, dust emissions from the tailings are not expected to be significant. At the conclusion of ore processing operations, the entire area of the tailings impoundment will be covered with an earth cap.

The countercurrent decant thickeners will be located outdoors (Figure G-13A, G-13-B), and on a concrete slab which will be curbed and sloped to one end. A catch basin and pumps will be located at the lower end of the slab. The curbed slab and sump will have sufficient capacity to hold the contents of a single thickener tank. An 8 foot long by 6 inch deep overflow weir will be provided at the sump, should a spill occur that cannot be contained on the slab. Such a spill would discharge to the tailings impoundment area by gravity. A short length of concrete trough from the sump will discharge into an eighteen inch diameter polyethylene half-pipe which will serve as a conduit to the tailings impoundment, to prevent contamination of the surrounding area by a spill. The tailings line also will be supported on this half-pipe. For normal leaks and spills, or tank rupture, the spilled material will be returned to the decant thickeners for reprocessing.

Gaseous Effluent

Some water vapor, acid mist, and minor amounts of radon-222 will escape into the atmosphere from the open thickeners. Natural air currents will provide sufficient dispersion and dilution to prevent any hazardous concentrations of these materials in the area, including at the surface of the tanks.

Radon gas emissions from the tailings disposal area have been conservatively estimated for conditions as they will exist near the termination of the ore processing operations. At that time the tailings impoundment area is expected to cover a gross area of about 68.3 acres. However, it is estimated that approximately twenty percent (20%) of the impoundment area will contain exposed tailings at any time during the operating life of the facility. The maximum exposed area, 13.7 acres, will emit about 600 Ci/year of radon. At the conclusion of the ore processing operations, the tailings impoundment area will be covered with several feet of selected earth materials to prevent the dispersion of tailings containing radionuclides by wind and water, and to absorb gamma radiation emitted from the tailings. This earth cover will also serve to control the emission of radon gas from the tailings to a level which will comply with NRC staff position for interim land clean-up criteria for decommissioning uranium mill site or with applicable standards at the time.

SOLVENT EXTRACTION

Solid Effluent

No solid effluents will be released from the solvent extraction circuit.

Liquid Effluent

The solvent extraction and stripping tanks and their associated mixers, pumps, piping, tanks, and other appurtenances will be located in an enclosed building (Figure G-12). The concrete floor of this building will be curbed and the volume enclosed below the top of the curb will be large enough to accommodate the entire volume of any one of the tanks.

It is estimated that about 26 gallons of kerosene will be lost each day from the solvent extraction circuit. Based on the experience of presently operating plants, it is estimated that about 90 percent of such kerosene losses result from adsorption onto suspended particulates in the barren acid solution (raffinate) that is returned to the leaching circuit. Eventually the kerosene will be discharged from the plant in the tailings, and it will remain adsorbed on tailings particles.

Gaseous Effluent

Approximately ten percent (10%) of the kerosene losses from the solvent extraction circuit will result from evaporation. Assuming a specific gravity of 0.82 (Chemical Rubber Company, 1970), roughly 8.3 kg/d, or 0.10 g/sec, will evaporate from the settling tanks. Air in the solvent extraction building will be released into the atmosphere through three roof ventilators at the rate of six (6) air changes per hour. These ventilators are located about 45 feet (14 meters) above ground level, and each will have a forced draft of about 12,000 cubic feet per minute (cfm).

PRECIPITATION

Solid Effluent

No solid effluents will be released from the precipitation circuit.

Liquid Effluent

The precipitation and yellow cake thickener tanks, as well as all associated piping and appurtenances, will be contained in the product building (Figure G-12). Any spillage from these facilities would be collected and returned to the process circuit.

Gaseous Effluent

The precipitation tanks and yellow cake thickener will be covered and ventilated through the demister system that serves the ore grinding and leaching area. Based upon similar operations elsewhere, it is estimated that the air vented from the yellow cake units will contain about 100 ppm ammonia and traces of radon-222. The ammonia introduced into this demister will be essentially consumed in the process of partially neutralizing, and thereby reducing the amount of, sulfuric acid mist emitted to the atmosphere through the stack. Essentially no ammonia will be emitted to the atmosphere through this stack.

DRYING AND PACKAGING

Solid Effluent

After the precipitated yellow cake has been washed and dewatered, it will be dried in a multiple-hearth furnace, passed through a crusher, and loaded directly into steel drums in an enclosed room (Figure G-12).

Air from the furnace, yellow cake crusher, packaging system, and drums will pass through a common wet dust collector before being vented through a stack to the atmosphere (Table 3.3-1). Yellow cake dust (about 90 percent U_3O_8) will be emitted from this stack at a rate of about 0.017 lb/hr (7.7 gm/hr) during operation. These units will operate for about 72 hours per week; thus the annual average yellow cake emission rate will be approximately 0.0073 lb/hr (3.3 gm/hr). The yellow cake will contain approximately 0.25 uCi/g of uranium-238 and 0.012 uCI/g of uranium-235; release rates for daughter products of uranium are assumed identical to those of uranium.

Liquid Effluent

No liquid effluent will be released from the drying and packaging circuits.

Gaseous Effluent

The exhaust gas from the drying furnace is estimated to contain about 5 ppm ammonia.

COMPARISON WITH STANDARDS

Assuming an average daily plant throughput of 1000 tons of dry ore, particulate emissions will be less than the maximum emission rates allowed by applicable air quality standards. Estimates of ambient air quality impacts of facility construction and operation are discussed in Sections 4.0 and 5.0.

3.4 CONTROLS OF PLANT WASTES AND EFFLUENTS

Except for tailings disposal, the control systems used to minimize emissions from the plant are discussed in Section 3.3. Many of these systems have been incorporated into the design of the plant processes and equipment. Volatile fuels and reagents will be stored in closed tanks to minimize the escape of vapors to the atmosphere. Many unit operations will be performed within buildings or closed vessels.

The gases from vessels will be passed through wet dust collectors or demisters to remove dust, mists, and gaseous pollutants. The efficiencies of these controls are listed in Table 3.3-1. Gaseous effluents and dust will be discharged from stacks to promote atmospheric dilution and dispersion.

Buildings housing various plant operations will have concrete floors. These floors will be sloped to sumps to collect any spillage. Spilled materials will be pumped back into the appropriate plant circuit. The floors of the buildings will be curbed or recessed so that they can contain the volume of any single process tank in the event of a tank rupture. Fuel oil, kerosene, and acid storage tanks will be located in open areas, and will be surrounded by impoundments capable of holding the volume of the enclosed tanks (Figure G-14).

TAILINGS DISPOSAL SYSTEM

Tailings from the ore processing operation will be discharged to a dammed impoundment located about 2,000 feet (Figure 2.1-3). The impoundment has been designed with a net capacity of about 2600 acre-feet, sufficient to contain the total expected project tailings generated during an operating life of 15 years, based on a plant throughput of 1,000 tons of dry ore per day, 365 days per year operation. At the end of 15 years the tailings in the impoundment will cover an area of approximately 70 acres. The impoundment will be fenced to exclude livestock.

The tailings management system for the Shootering Canyon project has been designed to incorporate best available technology, with tailings to be stabilized within a few days to a few weeks of their placement in the impoundment. This stabilization will be accomplished by draining the tailings as they are placed in the impoundment. For this purpose, a drainage system will be installed in the bottom of the impoundment and a prescribed tailings placement procedure will be followed to facilitate the drainage. As a result of this procedure, no deep concentrations of tailings slimes are expected to form within the impoundment; it will therefore be possible to reclaim the tailings disposal area shortly after it is filled to its ultimate level.

A site selection survey (Woodward-Clyde Consultants, June, 1977) has been completed to identify locations near the Shootering Canyon uranium mines best suited for the safe and efficient disposal of tailings and convenient to areas suitable for an ore processing facility. A preliminary design and construction specification (Woodward-Clyde Consultants, May, 1978) has been completed for a dam and tailings impoundment facility at a candidate site identified in the earlier study. A third study (Woodward-Clyde Consultants, January, 1978) reviewed alternative tailings disposal systems considered for the project. A supporting document, presenting the results of an assessment of the performance of the tailings disposal system included with the proposed ore processing facility, was submitted to the NRC in June, 1978. That report included comparative data on costs and performance for the alternative methods of tailings disposal considered for the project. Construction plans and specifications for the tailings disposal dam and impoundment area clay liner, and a final design report, were submitted to the NRC in May, 1979.

Prior to construction of the tailings impoundment, such topsoil as exists within the impoundment area will be removed and stockpiled for use in future reclamation activities. After the topsoil has been removed, the floor of the impoundment will be shaped to remove surface irregularities, unsuitable materials will be removed, and the surface will be compacted; care will be taken to ensure that the natural southwesterly slope of the area is maintained. Following the foundation dressing and compaction, select clay will be spread evenly over the impoundment area and compacted to 95 percent Standard Proctor Density with a sheepsfoot compactor. Water will be used to wet the clay during this operation to facilitate proper compaction. Total depth of the compacted clay liner will be at least 2 feet in all areas. A layer of sandy material will be spread over the clay liner promptly after it is placed, to preserve its integrity.

A dam key trench, about 40 feet wide and extending up the abutments above the level of the top of the dam, will be excavated across the natural drainage outlet from the impoundment basin. Initially, a dam about 260 feet wide at the base and 60 feet high will be constructed. Exterior slopes of the dam will not be steeper than two horizontal to one vertical (2:1). The initial structure is expected to serve without raising for the first 6 to 10 years of operations, depending on the performance of the tailings drainage and stabilization system. Materials for constructing the dam will be selected from the vicinity. Adequate quantities of all materials required for the dam and the impoundment area clay liner have been identified in the locality.

Tailings will be transported, in the form of a slurry of about 45-50 percent solids, to the impoundment through a 4-inch diameter high-density polyethylene pipe. The 4-inch pipe will be supported within an 18-inch half-round polyethylene pipe, which will contain any potential leakage from the 4-inch pipe and will conduct the leaked material to the impoundment by gravity flow.

The tailings impoundment area will be divided into disposal cells, with the cell dividers constructed mainly of tailings sand (initially, before tailings sand is available, the cell dividers will be started using locally available sandy material). The first cells to be used will be at the upstream end of the impoundment area; a cross-valley berm located about 2000 feet upstream from the dam will mark the downstream limit of these initial cells.

Perforated drain pipes will be installed under the cell dividers, on top of the impoundment's clay liner. These drains will connect to a main drain to be installed essentially along the course of the natural drainage channel traversing the length of the impoundment area. This main drain will in turn discharge to a collection sump located initially at the downstream toe of the cross valley berm. Liquid drained from the tailings will be returned to the plant process circuit by pumping; some liquid may be used for wetting the exposed tailings surfaces to control wind dispersion of the tailings.

Tailings discharge to the cells will be progressively rotated to all the corners of each cell, and to the various cells in the placement cycle. It is expected that all the five cells would be used in a rotational cycle at any time, with the actual number dependent upon the performance of the tailings drainage system, and the time required to achieve the desired degree of tailings stabilization between placement cycles. Present expectations are that it will be feasible to discharge the entire flow of tailings slurry from a single spigot at one corner of a cell, and that this flow may be continued for a period chosen to provide efficient cell operation, before the discharge is shifted to the lowest corner of the cell that is next in the rotational cycle.

The sand and slime fractions of the tailings will segregate as they are discharged to the cells, with the sand depositing nearer the point of discharge and the slimes flowing to the lowest area within the cell (which will continuously be shifting in location because of the shifting discharge points). The sands, being concentrated near the points of discharge, will be readily accessible for use in progressively raising the tops of the cell dividers. These cell dividers, because they will consist of relatively clean tailings sand, will serve as continuous vertical sand drains discharging into the underlying perforated drain pipes.

At the end of each tailings placement cycle, a relatively large area within the central portion of each cell is expected to be covered with a shallow layer of slimes. These slimes will remain undisturbed until the next placement cycle, and during the intervening period they are expected to stabilize by evaporation and drainage, to the extent that they will not be significantly displaced by the next tailings discharge to the cell. Since each layer of slimes will collect and stabilize in the lowest part of the cell and since the next tailings discharge will be from the lowest corner of that cell, it is expected that each layer of slimes will be largely covered by sand. Ultimately, the central part of each cell will be filled with alternating layers of sand and slimes lying in a helical configuration; at the cell perimeter there will be only tailings sand. This configuration will facilitate drainage and consolidation of the slimes, and will lead to continuous burial of that part of the tailings containing most of the residual radioactivity in the processed ore.

The tailings management plan permits the wide variation in tailings placement procedures needed for developing a method best serving the objectives of the plan. For example, the number of cells in the rotational cycle may be increased or decreased; the duration of tailings placement in a cell may be varied; and the number of simultaneous points of discharge may be adjusted. It seems likely that these procedures will require seasonal adjustments due to the large local seasonal variations in evaporation rates. A major advantage of the system, if it performs as expected, will be that most of the tailings liquid will be reclaimed for reuse in the process circuit, significantly affecting the amount of fresh water to be consumed by the plant. Since the tailings liquid will be acidic, its recovery will have an important effect on the total acid requirements of the plant.

As previously noted, tailings placement will start at the upstream end of the impoundment basin. The available tailings disposal volume upstream from the initial cross valley berm is sufficient to store the tailings from the first two to three years of plant operation. Since the tailings are expected to be stabilized essentially as they are placed (no significant flow potential) it will be feasible to fill the initial cells to their ultimate capacity before a second cross valley berm and new cells are put in operation further down the impoundment basin. Similarly, the second set of cells may be filled to their ultimate level before use of the third (and final) set of cells is started. Accordingly, the tailings dam will not require raising until tailings placement is underway in the cells abutting the dam.

Since the tailings are expected to stabilize essentially as they are placed, and since the initial cells will be filled to their ultimate capacity before the tailings placement operation is shifted to the next set of cells, it should be feasible to cap the tailings in the initial cells within three to four years of the onset of plant operations. As soon as the tailings are capped the risks of tailings dispersion by wind is effectively eliminated. Therefore, progressive reclamation of the impoundment area throughout the operating life of the plant is planned.

At project termination the tailings dam will be approximately 120 feet high, and will have a maxiumum base width of about 500 feet. The crest of the dam will extend about 13 feet above the level of the tailings against the dam face. Reclamation of the tailings impoundment area will be accomplished with a tailings cap including about six feet of compacted clay, which will limit, to near background levels, radon emanation from the tailings to the atmosphere.

To protect the clay cap from cracking due to desiccation, it will be covered with about 2 feet of sandy material; to protect the sandy cover layer from wind erosion, it will in turn be covered with a layer of sand gravel and cobbles about one foot thick.

Runnoff from the roughly 150 acres of drainage area above the tailings impoundment will carry eroded material onto the tailings cap;

deposition of this material will result in a net addition to the thickness of the cap. Water flowing onto the cap will seep down through its upper layers onto the clay layer; this will tend to maintain the clay's moisture content at near saturation, in turn enhancing the cap's effectiveness as a barrier to the movement of radon emanating from the tailings.

The setting of the tailings impoundment is sheltered by a massaive bluff on the west. It is expected that this bluff will cause a net deposition of wind borne soil onto the tailings cap, adding to its thickness.

Soil added to the cap by deposition from wind and water will contain seeds of native plant species. Some seeds will germinate and ultimately a vegetative cover will be established on the tailings cap. It is not expected that the plant roots will penetrate the clay layer of the cap; thus the integrity of the containment will not be degraded as a result of the vegetative cover. It is not considered desirable to deliberately promote a vegetative cover on the cap, because it seems preferable to minimize the use of the area after abandonment, and vegetation would probably attract animals to the area.

To provide for the long-term stability of the tailings containment system, water flowing across the face of the dam should be minimized. For this purpose a spillway will be provided through the sandstone of the left abutment of the dam, with a crest about 3 feet lower than the crest of the dam, and one foot higher than the top of the constructed tailings cap. This design will allow retention of water on the cap to maintain a relatively high moisture content in the cap's clay layer, while providing reliable runoff protection for the dam. It is expected that the tailings cap will ultimately build up to the spillway crest level due to deposition of wind and water borne soils. No accumulation above this level will occur because runoff waters will maintain the cap at the spillway crest level by erosion.

3.5 SANITARY AND OTHER PLANT WASTE SYSTEMS

SEWAGE TREATMENT

Sewage disposal will be in conformance with the requirements of the Water Quality Division of the Utah State Division of Health (Permit approved 1979). All toilets and shower rooms in the complex will be connected to a central precast concrete septic tank and a buried leach field. The leach field will consist of perforated pipes set in gravel packed trenches.

ANALYTICAL AND METALLURGICAL LABORATORY

The plant will have an analytical and metallurgical laboratory which will routinely analyze and test the ore and process streams to provide a basis for optimizing processing in response to ore properties. The laboratory will routinely analyze the various process reagents and the finished product as quality control measures. The fume hoods of the laboratory will collect air and an undefined mixture of chemical fumes and mists and discharge them through a scrubber and stack to the atmosphere. The effluent will not contain sufficient quantities of potential contaminants (radioactive or nonradioactive) to constitute a significant impact. In addition to the analytical and metallurgical laboratory, a separate building has also been provided to house an environmental laboratory.

POWER

Electrical power requirements for the Shootering Canyon ore processing facility will be supplied by diesel generating units located in the Utility Building. To ensure that the plant receives continuous power, three (3) units will be installed. Only two (2) units will normally be required to supply the requirements of the plant. The generators will be powered by V 12 diesel engines each capable of producing approximately 850 kW. Diesel fuel No. 2 will be used in the engines.

Waste heat recovery units and heat exchangers remove heat from the exhaust and cooling jacket of the engines. This heat will be used in the process and also for building heat. Small oil fired unit heaters are provided in the warehouse and maintenance building and [illegible] the pump house to provide supplemental heat during periods of e[illegible]d.

Emissions from the diesel engines will be vented to the atmosphere through stacks (one for each engine). The estimated total emissions from the two operating engines is listed in Table 3.5-1.

3.5-1 ESTIMATED POLLUTANT EMISSIONS FROM DIESEL ELECTRIC GENERATING UNITS

Pollutant	Emission Rates[a] lb/hr	gm/sec
Carbon monoxide	15.2	1.9
Hydrocarbons	5.6	0.7
Nitrogen dioxide	70.4	8.8
Sulfur dioxide	4.7	0.59
Particulates	5.0	0.63

a. Based on EPA (1975) emission factors continuous operation of two 850-kW units is assumed; the third unit is assumed to be idle on stand-by.

DUST CONTROL EQUIPMENT

Dust control equipment contemplated for use in the plant is as follows:

<u>West Dust Collectors</u>. Swenco, or equivalent. These units operate on high-energy Venturi principles. Dust and fume removal is 99+ percent efficient in the sub-micron range. An externally adjustable orifice permits maximum collection efficiency at varying gas flow.

Mist Vapor and Fume Collector. Koch mist vapor and fume collector or equivalent. This is a wet collector system that used a polypropylene mesh pad to provide large areas of flooded contact surfaces and efficient scrubbing of exhaust air or gas.

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3.6 MINING ACTIVITIES

GENERAL

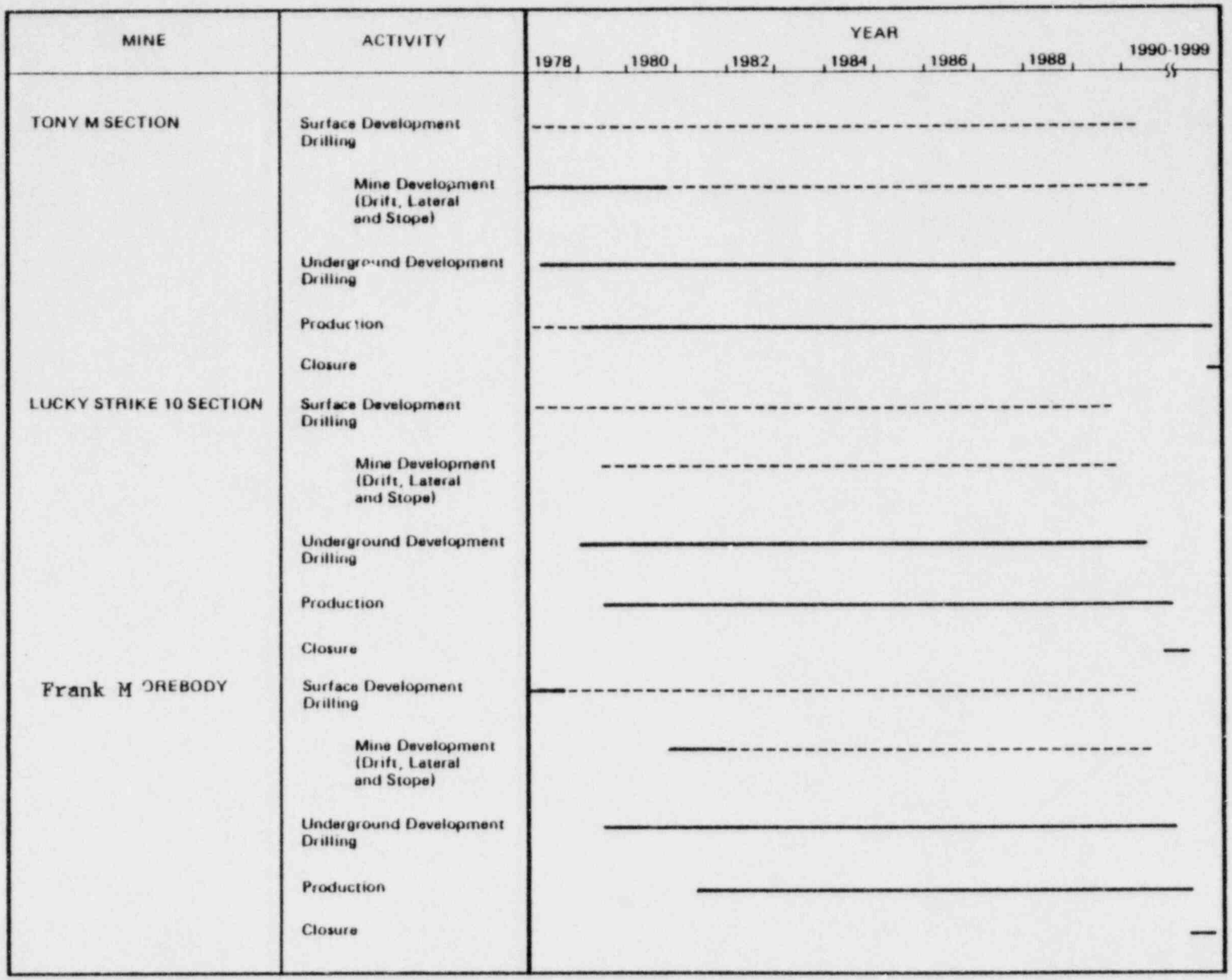
Ore for the proposed Shootering Canyon uranium ore processsing facility will be supplied primarily from an existing mine and new underground mines in and near Shootering Canyon. The existing mine and the current development activities for new mines are located in the following townships (all referred to the Salt Lake baseline and meridian, and indicated in Figure 3.6-1):

T33S	R12E
T33S	R11E
T33S	R10E
T34S	R12E
T34S	R11E
T34S	R10E
T35S	R11E
T35S	R10E
T36S	R11E
T36S	R10E

Plateau Resources Limited has conducted an extensive ore development program in the Shootering Canyon area, including the existing Lucky Strike 10 and Tony M sections and the Frank M ore body discovered to the northeast of the Tony M section. Indicated and inferred ore reserves, based on drilling results to April 23, 1980, in the Tony M and Frank M ore bodies, amounted to an estimated 9,000,000 pounds of U_3O_8, sufficient to sustain production for over ten years. An estimated 5,900,000 pounds of potential and speculative potential reserves are expected to extend the lives of these mines. The average ore grade is estimated at about 0.12 percent U_3O_8. Ore grade will vary from 0.04 percent to approximately 0.5 percent. Present plans will permit the inclusion of ore with a minimum grade of 0.04 percent uranium oxide in the process operations.

Development work is in progress in the area of the Frank M ore body. It is anticipated that detailed mine planning for this mine will commence in late summer or early fall of 1980; drift or decline development will begin about January 1981. Production is scheduled for early 1981. Production from this mine will supplement the production from the existing mine sections. The planned schedule for project mine development, production, and closure is indicated in Figure 3.6-2. It is expected that surface drilling, which is in progress or planned for the various mining claims delineated in Figure 3.6-1, will alter and/or better define the existing indicated and inferred ore reserves.

In the Shootering Canyon vicinity uranium ore is found in the Salt Wash Member of the Morrison Formation. Typically, the Salt Wash sandstone in the area is overlain by from 100 to 800 feet of non-ore-bearing sandstones. The type and amount of this overburden precludes economic extraction of the uranium ore except by underground mining techniques. At many locations in the project vicinity, the Salt Wash sandstone is exposed on the walls of the deep canyons dissecting the surface of the region. Over the past 30 years at many exposed locations, horizontal drifts, or adits, have been driven directly into the ore bodies from the canyon walls. This procedure will be continued for this project. Borings to locate ore concentrations are drilled vertically from the surface through the overburden and ore horizon. The deep canyons in the area provide drainage to adjacent higher strata, and mines throughout much of the Salt Wash Member will encounter little or no groundwater.



LEGEND

— Denotes continuous, intense effort

--- Denotes intermittent or less intense contin··us effort

Figure 3.6-2. MINE DEVELOPME·:T SCHEDULE

MINING METHODS

Uranium ore mining for the Shootering Canyon project will be by conventional underground mining techniques (face drilling and blasting, loading and haulage). Development work has identified the locations of ore grade minerals in the Salt Wash sandstone. Further development is in progress. Existing or new adits from the canyon walls will be used for access to the ore bodies. Drifts will be extended in the directions of the known ore bodies. Scanning of the rock at the face of the drifts will indicate when ore grade rock is encountered. Drift advancement will follow a regular sequence of drilling, blasting, and mucking. Drifts will be about 11 feet wide and 9 feet high. Tunnel structural stability in the drifts will be maintained by strategic placement of rock bolts, steel sets, and wood supports, as required.

Waste rock will be segregated from ore grade rock at the mine exit. Mining machines will load, haul, and dump fractured rock from the advancing drifts. These machines will deliver the rock to nearby loading stations, where it will be transferred to a belt conveyor which will transport the rock to the surface. Ore grade rock will be delivered directly to ore storage bins located near the mine entrances. Waste rock will be delivered to established disposal areas near the mine entrances.

Mining will be performed on a schedule of two 10-hour shifts per day, four days per week. Ore production is expected to average about 437.5 tons per shift in each mine, or about 365,000 tons per year.

Transport of ore from the mines to the processing plant will be done by trucks. The transport system will be planned to operate for 14 hours per day, 7 days per week.

WASTE DISPOSAL

Waste rock from the mines will be added to the existing talus slopes and waste rock now piled against the bottom of the Canyon walls. The belt conveyor system hauling waste rock from the mines will dump the rock at the mine waste area.

The waste rock will assume its natural angle of respose as it is dumped. Appearance of the waste rock piles will be similar to the appearance of the numerous natural talus slopes now bordering the floor of Shootering and other canyons in the vicinity. The quantity of waste rock expected from the operations at the Tony M and Frank M ore bodies will be in the ratio of 1:1, waste rock to economically recoverable ore, during the first 5 years of operation, and in the ratio of 1:2 or 3, waste to ore, thereafter. On an annual basis, waste rock quantity will average about 365,000 tons for the first 5 years, and 120,000 to 180,000 tons thereafter. The area adjacent to the Tony M mine entry has an estimated capacity of approximately 2,500,000 to 3,000,000 tons of waste rock over the life of the project. Waste rock dumps will be located so as to minimize their apparent size and their environmental and visual impacts. Dumping is controlled to prevent obstruction to roads and drainage channels on the floor of the canyons.

4.0

ENVIRONMENTAL EFFECTS OF SITE PREPARATION, PLANT CONSTRUCTION, AND MINE DEVELOPMENT

Potential impacts attributable either to site preparation, plant construction, and mine development or to mine and plant operation cannot be readily separated for some of the environmental parameters discussed in this report. The impacts on socioeconomic conditions, biological communities, and hydrological and water quality conditions are often similar for both construction and operation of the mines and plant. For these reasons, all potential biological, hydrological, water quality, and socioeconomic impacts of both construction and operation of the project will be discussed in this section.

4.1 SOCIOECONOMIC ENVIRONMENT

Construction of the ore processing facility began in September 1979, extending over an 18 month period. Mining operations have been underway for many years, and processing operations are expected to begin in the second quarter of 1981. Full operations of the mining and processing facility is also expected in 1981.

The facility will represent an investment of about $38,000.000 in materials and labor for construction. When in full operation, the facility will process an average of 1000 tons of ore per day, with the capability of producing up to 1,000,000 lbs. of yellowcake per year. Plateau Resources Limited estimates that this product will have an annual value ranging between $49,000,000 and $144,000,000, depending on the then prevailing market price. Given known ore availability at the project site, the estimated project life is a minimum of 15 years.

DEMOGRAPHIC IMPACTS

Construction and operation of the proposed project will introduce a significant new population to an otherwise sparsely populated area. There is a settlement 14 miles south of the project site, at Bullfrog Basin Marina, which is comprised of National Park Service personnel and their families. The closest town is Hanksville, about 60 miles north; however, its population is only 181 persons (1970 census). Both construction and operation labor will be recruited from such areas as Green River, Salt Lake City, Grand Junction, Phoenix, and Albuquerque.

Population related to construction activities will fluctuate according to labor requirements. The construction work force will average 245 persons (Table 4.1-1). Because construction work will be relatively short term, it is unlikely the work force will generate any significant secondary employment or population locally. Since no permanent housing is expected to be available during the construction period, most workers will reside in temporary construction-force housing during the work period and commute to permanent residences elsewhere on days off. Given the limited living accommodations, it is not expected that many workers will be accompanied by their families or will establish permanent residences.

When the plant is in full operation, an estimated total of between 206 and 231 workers will be employed by the combined mining and ore processing operation. The Utah State University Foundation (1977) has estimated that 85 percent of the workers will be married and have families and that 15 percent will be single individuals. For those with families, a population multiplier of 3.7 results in a population estimate of 562 to

Table 4.1-1. PROJECTED CONSTRUCTION CRAFT MANPOWER

	Months																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	m/m*
Asbestos Workers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	7	7	7	7	29
Boilermakers and Sheet Metal Workers	-	-	-	-	-	-	-	3	6	6	6	6	6	6	6	6	6	3	3	-	63
Cement Masons and Bricklayers	-	-	-	-	2	2	2	2	3	3	3	2	2	-	-	-	-	-	-	-	2
Carpenters	-	-	-	-	8	12	16	18	18	18	18	12	12	12	12	10	4	-	-	-	170
Electricians	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron Workers, Rebar	-	-	-	-	8	8	8	12	12	12	10	8	7	-	-	-	-	-	-	-	85
Iron Workers, Other	-	-	2	2	24	30	30	30	30	30	30	30	30	30	15	10	10	10	5	-	348
Laborers	-	-	1	4	10	17	32	32	32	32	32	32	32	18	10	10	10	5	5	5	319
Millwrights	-	-	-	-	-	-	2	2	4	4	6	6	6	6	6	6	6	6	4	-	6
Operators and Teamsters	-	-	2	4	4	7	20	20	20	20	20	20	20	20	20	20	15	15	15	14	276
Pipe Fitters	-	-	-	-	6	24	24	24	24	30	30	30	30	30	30	30	30	30	30	10	412
Pain ers	-	-	-	-	-	-	-	-	4	4	4	5	[illegible]	6	6	6	6	6	6	6	6
Total Nonsupervisory MSE Manpower	-	-	5	10	62	100	134	143	153	159	159	151	15[illegible]	128	105	99	94	88	75	42	1861
Electrical and Inst. Subcontracting - All Crafts	-	-	-	-	-	10	15	5	-	-	12	20	20	20	20	20	20	20	20	15	217
Site Preparation and Road Subcontracting - All Crafts	-	-	16	45	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106
Dam and Pond Subcontracting - All Crafts	-	-	-	-	-	-	-	-	-	-	-	-	-	15	40	50	60	60	40	-	265
Total Subcontracts	-	-	16	45	45	10	15	5	-	-	12	20	20	35	60	70	80	80	60	15	588
Total Nonsupervisory Manpower	-	-	21	55	107	110	149	148	153	159	171	171	170	163	165	169	174	162	135	57	2489
Total Indirect Manpower	-	-	-	6	9	12	18	22	27	30	30	33	33	33	33	33	22	13	12	6	372
Total Manpower	-	-	21	61	116	122	167	170	180	189	201	204	203	196	198	202	196	175	147	63	2861

Source: Mountain States Engineers (MSE), 1978.

*m/m = man-months

659 workers plus dependents directly associated with the project (Utah State University Foundation, 1977). In addition, the Foundation used a multiplier of 0.15 to project the indirect employment to be generated by the new facility-related population. Several points argue in favor of such a low multiplier. Only a limited amount of local commercial development is expected, since the total estimated population is relatively low. It is expected that most individuals will leave the area, particularly on weekends, for recreation and entertainment. By applying the multiplier to the above project-induced population, and by making similar assumptions about family composition, the total estimated local secondary population is expected to range between 80 and 100 persons.

The total local population increase to be generated by this project is expected to range between 600 and 800 individuals, most of whom will leave the area at project termination.

LAND USE IMPACTS

The construction of the proposed mine and ore processing facility will affect approximately 350 acres in the immediate project area. The major impact will be the conversion of low-density grazing and open-space areas to industrial use. Primary impacts associated with the project will be a result of construction activities revolving around the creation of mine openings, spoil piles, and the tailings impoundment; the presence of the plant complex and accompanying facilities; and the construction of offsite facility access roadway(s). Secondary land use impacts associated with the project are occurring with the development of the Ticaboo Subdivision, a residential area being constructed by a private developer, located approximately 3.5 miles south of the project site.

Mine

There are presently two underground mine sections in Shootering Canyon; these will produce much of the ore processed at the facility. Because of the depth of the ore and the difficulty of removing overburden, it is anticipated that all mining activities will be conducted underground. At present the Lucky Strike 10 Section and the Frank M Mine are on standby status; the Tony M section is being developed for extraction. These mines are expected to be productive for about 15 years.

The total land requirement for construction and operation of additional mines is not presently known, but will depend on the size and scope of the operation. All lands developed for mining will be restored in accordance with federal and state requirements at termination of extraction activities.

Ore Processing Facility

Construction and operation of the ore processing complex (e.g., ore storage, conveying facilities, grinding and leaching equipment, solvent extraction equipment, countercurrent decantation tanks) and accompanying facilities (office, warehouse and maintenance shop, laboratory, and tailings impoundment) will remove 280 acres from their current grazing and open-space use for the project life (presently anticipated to be 15 years) and will convert the acreage to industrial use. Approximately 20 additional acres may be required southeast of the facility during construction activities; however, no long-term impact is expected.

The above-ground structures will appear as features of the landscape for the operational life of the project. With the possible exception of the tailings basin (approximately 70 acres), the land committed to industrial use will be permitted to return to its original state upon termination and abandonment of the project.

Access Road

A two-lane, all-weather access road, approximately 2 miles in length, will be required to connect the facility site with State Highway 276, the only road leading into and out of the Shootering Canyon area. All construction equipment, materials, and supplies must be trucked into the area, creating a nominal increase in traffic on State Highway 276. Commuter traffic will be minimized since the construciton work force will be housed near the job site. Individuals will work one shift per day, requiring two trips per day, five days per week.

HOUSING AND SOCIAL INFRASTRUCTURE IMPACTS

Housing

The Ticaboo Development Corporation has prepared plans for and is developing a subdivision about 3.5 miles south fo the facility site. It will provide a mix of permanent structures and mobile unit lots in a school section (Section 16, T36S, R11E). As noted previously, the closest settlement, Hanksville, is about 60 miles from the plant site; since this is beyond a comfortable commuting range, most of the operations work force is expected to desire local housing. Based upon the population and employment estimates, the total number of housing units needed will range between 195 and 230 units (Utah State University Foundation, 1977).

In addition to housing, provisions are being made for commercial space and for schools and public services. The costs of all initial development will be borne by the Ticaboo Development Corporation, as is the usual practice in such subdivision construction.

Several factors point to the necessity for the construction of this subdivision.

The new subdivision affords the opportunity for planned development in an area suitable for safe construction. In addition, although some workers can and will provide their own housing in the form of mobile homes, the greater number will need to purchase or lease accommodations.

Education

School facilities, include semipermanent classrooms and busing services, and is a part of the Ticaboo Subdivision development. Increased industrial development in the area may eventually create the need for expanded vocational training in the region, a need which can be addressed by the county and the affected industry.

Medical Services

A mobil Meditest facility is located in the town of Ticaboo with one full-time family practioner nurse and accommodates one medical doctor two days per month. The nearest hospitals are at Moab and Monticello. Air and ground ambulance service is available, and emergency medical technicians are on the staff of Plateau Resources Limited to treat industry-related injuries.

Law Enforcement

The mine and ore processing facility and the Ticaboo Subdivision fall under the jurisdiction of the Garfield County Sherriff's Department. A Deputy Sheriff is located at Ticaboo.

Fire Protection

A ' project vehicles carry fire extinguishers (2-1/2 to 10-pound). Also, fire extinguishers will be placed at regular intervals in all project buildings. The office, shop, and plant buildings will be equipped with overhead sprinkler systems. Around the plant area, fire hydrants will be placed at 250-foot intervals with 250 feet of fire hose provided adjacent to each fire hydrant. These will be capable of releasing 2125 gpm for at least two hours.

Water Supply

The water supply for the mine site presently comes from two wells, one in the Entrada geologic formation and one in the Navajo geologic formation.

The Entrada well pumps approximately 4 hours per day at a rate of 60 gallons per minute. The water is used to fill water trucks which support the surface drilling operation and road maintenance program.

The Navajo well pumps approximately 9 hours per day at a rate of 30 gallons per minute. This system provides water for the mine and associated facilities. It is estimated that the mine and associated facilities will use up to 90 gallons per minute at full production.

A well field capable of supplying 500 gpm on an intermittent basis and 400 gpm on a continuous basis has been completed east of the proposed tailings impoundment area. The water from this source is stored in two tanks of 100,000 and 250,000 gallons and is used for domestic consumption, plant operation, and fire protection. It is estimated that an average of about 15 gpm of potable water and 200 gpm of industrial water will be used in daily project activities.

Waste Disposal

Nonradioactive solid wastes from the plant operation will be disposed of in a sanitary landfill. Treatment of industrial wastes from mining and ore processing activities is discussed in Section 3.4. Radioactive solid wastes will be disposed of in the tailings impoundment.

For sewage treatment, a system of precast concrete septic tanks will be installed in the general area of toilets and shower rooms. The effluent from these tanks will flow by gravity in pipelines to nearby leach fields.

Energy

Electric power to the mine and associated facilities is presently supplied by three 550 kVA diesel generators. Total estimated kVA needs for future production are 1800 to 2200 kVA.

To ensure that the processing facility receives continuous power, there will be a power house building containing three diesel generators capable of producing 800 kVA each. Two of the units will operate continuously, with one unit maintained as standby.

Transportation

Prior to development of the Shootering Canyon facility, State Highway 276 served primarily as an access highway to the Lake Powell Recreation Area - specifically, the settlement at Bullfrog Basin Marina. Project development will create some increase in traffic on the road but should not interfere with traffic flow, since the proximity of workers' residences will minimize commuter traffic.

Recreation

The project site is immediately adjacent to the Lake Powell Recreation Area, which offers such activities as boating and swimming. The State of Utah offers many state and national parks within easy driving distance of the site. For more urban activities, individuals will have to drive somewhat farther, to Green River, Moab, or Grand Junction and Salt Lake City.

Construction of the mine and plant facility will offer access to areas not previously utilized for recreation. New access roads could draw hikers and off-road vehicles to areas not previously accessible.

ECONOMIC EFFECTS

The payroll for the required work force over a 14-month construction period is estimated at $10,575,000. Subtracting state and federal income taxes, the disposable income will be about $7,000,000. With the

4.3 AESTHETICS

Two vent stacks rising between 90 and 100 feet above plant grade level and one stack 80 feet high will be the tallest elements of the ore processing facility. Other than the stacks, the tallest structure at the facility, the grinding and leaching building, will rise no more than 60 feet above grade. No elements of the ore processing facility will appear in silhouette against the skyline as the plant is viewed from State Highway 276, the only publicly traveled road which provides a view of the plant. Persons near the tops of Mt. Pennell and Mt. Hillers may see the plant from distances up to about 20 miles; otherwise, the plant will be hidden from view in most directions by nearby hills and cliffs. When the proposed facilities can be seen, the lines and forms they create will tend to contrast with the natural lines and forms of the landscape. This contrast will be accentuated by the differences in color and reflectivity between the plant structures and the surrounding landscape.

4.4 HYDROLOGY

Before discussing hydrologic impacts, it is appropriate to summarize briefly the major hydrologic characteristics in the vicinity of the plant site. The surface hydrology is controlled by narrow, steep, rocky washes, which are tributary to broader washes that have been cut below the surrounding mesas. The principal hydrologic events are flash floods created by cloudbursts in late summer and early fall. Such floods are characterized by steep, short-duration hydrographs, and the flood waters carry a high sediment and debris load, making the fluid much denser than clear water. Groundwater is the principal exploitable water resource in the project vicinity.

GROUNDWATER

The subsurface hydrology is dominated by the existence and movement of groundwater in the Entrada and Navajo formations. Seeps and springs in the vicinity usually reflect surface exposure of the water table in the Entrada Sandstone. The Navajo Sandstone, located below the Entrada, is confined by the intervening Carmel Formation. The Navajo Sandstone is exposed south of the facility site in the area of Lake Powell. Recharge areas for both the Entrada and Navajo formations are along the southern flanks of the Henry Mountains, which lie north and east of the plant site. The general groundwater movement is southerly, with a south-southwesterly component near the facility site. Project-related activities will draw upon the groundwater resources of the area as estimated in Table 4.4-1.

Wells drawing primarily from the Navajo Sandstone will supply the project water requirements. These wells are or will be located near the mines, at the plant site, and at the Ticaboo townsite. The area and

Table 4.4-1. ESTIMATED PROJECT WATER REQUIREMENTS

	Acre-Feet
Construction Period (14 to 16 months)	
Potable uses	50
Tailings pond dam and liner	20
Dust control	30
Subtotal	100
Project Operations (annual)	
Potable uses	100
Process water discharged with tailings	270
Dust control	40
Subtotal	410
Project Closure (1 year)	
Potable uses	10
Capping of tailings	20
Dust control	20
Subtotal	50
Total: 100 + 15(410) + 50 = 6300 acre-feet	

Source: Woodward-Clyde Consultants' estimates rate of aquifer recharge is not well defined; but without allowing for recharge, it is estimated that a pumping rate for the project-related water requirements of 260 gpm for 17 years will cause a drawdown of about 13 feet at the facility site area. This estimate is based on the assumption that the well field southeast of the facility site will supply most of the water used, and that the effects of pumping the Ticaboo and mine wells will be negligible.

The potable and industrial water supply for the ore processing facility consists of a well field developed to extract up to 400 gallons per minute (gpm) continuously from the Navajo Formation. The estimated average demand on this system will be about 200 gpm. This well field is located about 1000 to 2000 feet southeast of the plant site. A pump test in April 1978 on the first well completed values of transmissivity (T) ranged form 16,000 gpd/ft to 22,500 gpd/ft, with the coefficients of storage (S) ranging from 5.0×10^{-4} to 4.2×10^{-3}. A detailed description of the pump test and an analysis of the test results is presented in Appendix C2.

Water supply for the mines is from two wells near the existing mine. One of these wells taps the Entrada Sandstone and supplies nonpotable water, which is used for drilling, dust control, and other industrial uses. The other well draws from the Navajo Sandstone and supplies the potable water requirements of the mine camp and the mine. As new mines are opened, additional wells may be developed nearby to eliminate the need to transport water to supply the new mines. It is planned that all new wells for supplying the project mines will be developed to draw water only from the Navajo Formation.

The Ticaboo Subdivision will be supplied with water form one or more wells to be developed in the vicinity of the planned development. These will exploit groundwater from the Navajo Sandstone aquifer.

SURFACE WATER

Project-related impacts on regional surface waters will result from road crossings of drainage courses, possible increased runoff from the area of the ore processing facility and the Ticaboo townsite, and retention of all runoff from the drainage basin above the tailings impoundment dam. Drainage channels may be temporarily blocked by the road crossings during periods of flash floods, or the roads may be locally flooded or washed away by such floods, but the floods will not persist for more than a few hours at any occurrence, and any interruption of communication may be quickly restored after passage of the floods. Since flood flows normally are saturated with sediments, the construction of roads across the drainage channels will have no net impact on the quantity of sediments transported by any flood.

The entire area of the ore processing facility will be graded and shaped to drain to the tailings impoundment. Radionuclides may be transported with runoff from stockpiled ore at the plant site, or from process leaks or spills within the plant area. All runoff from the plant area will be contained within the tailings impoundment by maintaining the crest of the tailings dam at a height above the tailings level sufficient to contain the entire volume of runoff resulting from the maximum probable precipitation likely to occur in the area. No surface runoff from the plant site and tailings impoundment area will be discharged downstream from the tailings dam.

Site preparation included stockpiling surface soils from the tailings pond and the plant site areas. Surface runoff from the stockpiles may cause erosion of these materials, depending on the soil characteristics, the slopes of the stockpiles, and vegetative cover. The soils and sandstone of the area lack cementation after being disturbed, and in this semiarid area the development of vegetative cover is a gradual process. It can be expected, therefore, that during high kinetic energy rainfall events, such as cloudbursts, soil erosion will be directly related to stockpiling practices. To minimize erosion, stockpiles will be finished with nearly level surfaces, and low dikes will be constructed around the stockpile perimeters to cause ponding and containment on the stockpiles of rainfall in excess of the soil holding capacity.

4.5 WATER QUALITY

Vegetation removal and stockpiling of surface soils and mine waste rock during construction and operation of the proposed project will increase the possibility of erosion and could result in an increase in the level of suspended solids during periods of runoff. The mine waste rock is neither alkali- nor acid-production; and due to limited precipitation in the area, leaching by rainwater is not anticipated to be a problem. As noted in Section 2.6, however, significant runoff in the project area causes "mudflows," which are characterized by a thixotropic mass of water, soil and debris, with a density as much as 1.5 times the density of water.

Plateau Resources Limited will institute a variety of mitigating measures to minimize the potential for erosion due to project activities. At the plant site these measures will include diversion of surface water runoff, seeding of disturbed areas, and grading to control runoff velocities.

Control of process tailings will be effected to reduce the potential for adverse impacts on water quality within the project area. The surface of the tailings disposal area will be sealed with compacted clay to limit seepage from the impoundment. Monitor wells have been installed to detect seepage on the downstream side of the tailings dam. In addition, these interceptor (monitoring) wells have been drilled around the impoundment as a precautionary measure to detect radial seepage that could potentially cause groundwater contamination. The tailings disposal system will be engineered to maintain its integrity even in the event of the maximum probable precipitation or earthquake likely to occur at the site.

Sanitary waste at the mine and associated facilities area is routed to septic tanks, each with an independent leach field. The mine is presently serviced by one 1500-gallon tank and facilities associated with the mine are presently serviced by three 2500-gallon tanks. Similarly, a system using septic tanks will be installed to service the ore processing facility. Effluent from those tanks will flow by gravity to buried leach fields consisting of perforated pipes set in gravel-packed trenches, and located as indicated in Figure 3.1-1. Such treatment will be in conformance with the requirements of the Water Quality Division of the Utah State Division of Health. No significant environmental impacts are expected to result from the discharge of sanitary wastes through these systems.

Potable and industrial water for the project will be obtained from wells. As described in Section 2.6, the mine camp currently withdraws water from two wells - one in the Entrada geologic formation and the other in the Navajo geologic formation. The Entrada will pumps approximately 4 hours per day at a rate of 60 gpm. This water is used for dust control and other industrial purposes. The Navajo will pumps approximately 9 hours per day at a rate of 30 gpm. It supplies potable and industrial water for the mine and associated facilities. It is estimated that 90 gpm of potable water will be used at production. Untreated, the water from the Navajo formation meets recommended drinking water criteria. Water supplies for the plant are obtained from a well field capable of supplying 500 gpm intermittently and 400 gpm on a continuous basis. Water from this well field is pumped first into a 100,000 gallon tank and then into a 250,000 gallon tank and will be used for domestic consumption and process makeup, as required. The water will be treated prior to use if it does not meet applicable standards.

4.6 AIR QUALITY

Particulate matter and gaseous pollutants will be released into the atmosphere during site preparation and facility construction. Emissions presently also result from mine development activities. The most significant emissions are and will be fugitive dust from roads and working areas.

Particulate measurements at the mine camp (discussed in Section 2.7) indicate that present mine development and related activities have resulted in a slight increase in annual mean suspended particulate concentrations, but well within applicable state and federal standards. The 24-hour average secondary standard is exceeded occasionally in the region due to natural fugitive dust, and it is not apparent that exceedances are significantly more frequent at the mine camp. Ambient air quality outside Plateau Resources Limited's property is not expected to be affected significantly by mine preoperational development activities.

Similarly, fugitive dust will be the major air pollutant emitted during plant construction. Minor amounts of other pollutants will also be emitted in vehicle and equipment engine exhaust. Effects of construction-related emissions will be temporary. Preliminary analyses of potential air quality impacts of facility construction indicate that ambient air quality standards will not be exceeded outside property boundaries. Haul roads and active working surfaces will be watered or treated with stabilizing agents to control fugitive dust generation as required. A more detailed quantitative analysis will be performed after completion in July 1978 of the one-year meteorological monitoring program at the site. The analysis results were reported in an addendum to this report entitled Supplement S2 dated September 1978.

4.7 NOISE

Offsite noise levels resulting from onsite activities associated with operation of the PRL uranium project will be a function of distance between source and receptor. The following mining and processing activities are expected to be the most significant sources of noise:

- ore removal from the underground mines
- ore transportation
- ore processing at the plant facility

Near the mine mouths, equipment might be expected to produce intermittent noise levels as high as 80 to 90 dB(A) at 50 feet. This noise will of course vary with operational activities and schedules. Much of the mine noise will be absorbed and reflected by canyon walls in the vicinity. Noise near haul roads will be intermittent, with a maximum of about 80 to 90 dB(A) at 50 feet during passage of a haul truck. Ore trucks are planned to be in operation seven days per week and 14 hours per day.

Noise from project operations should have a minimal impact on inhabitants at the proposed community of Ticaboo, which will be established about 3.5 miles south of the plant facility. Noise levels in this proposed community should be comparable to noise levels in other small towns or quiet suburbs. Noise levels from haul trucks at the plant facility are expected to be generally insignificant [less than 50 dB(A)] or inaudible at Ticaboo. Noise from operation of the PRL uranium project should have no impact on residents at Bullfrog Basin Marina, 14 miles to the south, or at Hanksville, about 60 miles to the north of the project.

5.0

ENVIRONMENTAL EFFECTS OF PLANT AND MINE OPERATIONS

5.1 RADIOLOGICAL IMPACTS ON BIOTA OTHER THAN MAN

EXPOSURE PATHWAYS

The tailings impoundment, ore piles, and the processing plant are expected to be the principal sources from which nonhuman biota can be exposed to radionuclides. The significant means of exposure include particulate emissions (i.e., dust) from the ore piles and from plant operations, plus radon gas escaping from the tailings area, the plant, and the mines.

The tailings impoundment will contain thorium-230, radium-226, and lead-210. Small amounts of these radionuclides could enter natural food chains if they were distributed as windblown dust into the surrounding area and assimilated by plants or ingested by animals. However, such dispersal will be held to insignificant levels by keeping the tailings wet or moist. A security fence will be built around the tailings impoundment area to prevent large animals from entering the zone where significant external whole-body gamma exposure and ingestion of radioactive materials would be possible. However, arthropods, reptiles, and small mammals will be able to gain access to the impoundment through and under the fence. It will also be possible for birds, including migratory waterfowl, to land within the tailings impoundment fence, including on and adjacent to the impoundment. In addition, raptors may seek prey around the impoundment.

Since the tailings water will be acidic (pH about 1.5 to 2.0), it will be distinctly unpalatable and will discourage the approach of small animals and waterfowl. It is therefore unlikely that appreciable quantities of radionuclides will enter the food chain through ingestion of tailings water by small mammals and waterfowl.

Because of their smaller size, the ore storage piles have a lower potential for exposing the area's biota to radiation than the tailings impoundment. The ore piles will contain about 0.12 percent uranium oxide and approximately equilibrium amounts of lead-210, radium-226, and thorium-230. Some potential exists for radionuclides to enter the food chain from windblown dust originating from the ore piles. However, dust from the ore piles will be held to insignificant levels by keeping the piles wet, or by treating them with a surface stabilizing agent.

Radon-222 will emanate from the tailings impoundment, the mine areas, the ore piles, and the processing plant. The radon and daughters will, in large part, be dispersed in the atmosphere. The air dispersion and inhalation pathways will contribute only small doses to biota.

The possible paths of radionuclides through the various trophic levels are illustrated in Figure 5.1-1. Plant and animal species in the area have been analyzed for present levels of radionuclides (Table 2.9-3). Any significant increases can be noted by reanalysis of these species. The reanalyses can provide an indication of incipient contamination of the surrounding areas.

RADIOACTIVITY IN THE ENVIRONMENT

The plant will generate some effluents that could distribute modest amounts of natural radioactivity (uranium and daughters) to the project

AIRBORNE EFFLUENTS

The primary source of airborne radioactivity from the project will be uranium-bearing dust (i.e., dust from ore, product, and tailings) and radon-222 emitted from the plant, tailings, and mines. Small amounts of radionuclides, such as thorium-230 and radium-226, will be released in the dusts. The possible dose from such releases is small and will be controlled by such measures as keeping ore piles and haul roads wetted and by the use of pollution control equipment. It is estimated that less than 10 percent of the maximum permissible concentration of these radionuclides will be released to the unrestricted area on an annual average (10 CFR 20).

For purposes of calculating diffusion and dispersion of uranium-bearing dust and radon-222, the models given in NRC Regulatory Guide 1.111 were applied, utilizing six months of meteorological data from the site, as discussed in Section 5.3. A ground-level release was assumed for the ore pile. The ore conveying and transfer system and yellowcake drying and packaging system are all vented through stacks equipped with wet dust collectors. The tailings impoundment was conservatively treated as a point source. No decay of radon-222 was assumed in the dispersion process; however, complete secular equilibrium of the radon daughters was also assumed. The net effect of these assumptions is to add a degree of conservatism to the calculations.

The mines are expected to produce ore at about the same rate at which the plant will process ore. Both mining and processing will result in the release of radon in the air exhausted from the ventilation systems. Since the plans for mine production and ventilation have not been completed, it is not possible at this time to make firm estimates of the radiation doses due to mining. However, since no significant radioactive particulate emissions are expected from the mines the only pathway of concern from this source is the lung dose due to radon-222. In that pathway the residents of the proposed community of Ticaboo would be the nearest receptors (approximately 7 miles south of the mines). Natural dispersion and diffusion will reduce the radon-222 concentrations significantly over that distance. The concentration of radon from the mines and resultant lung dose at Ticaboo is expected to be less than 30 millirem (mrem) per year.

Total-body and specific organ doses resulting from immersion in and inhalation of airborne radionuclides, as well as from ingestion of meat and vegetables raised in the vicinity of the plant, were calculated for a 50-mile radius using the models and methods described in Appendix F. The most significant exposures to man due to particulates from the plant at locations of interest are given in Table 5.2-1 for all pathways. Doses due to radon releases are given in Table 5.2-2. Residents of the planned town of Ticaboo will be the nearest receptors and are assumed to be exposed by ingestion. Exposure of the other nearby receptors would occur via the immersion, inhalation, and ground shine pathways only.

Food crops grown in the project vicinity, on which airborne radioactive material could be deposited, are expected to be confined to small areas of production. Forage may collect low levels of uranium-bearing dust (see Section 5.1), but no large doses are expected through that pathway.

SUMMARY OF ANNUAL RADIATION DOSES

The only pathways that appear capable of imparting any significant exposure to man are inhalation of airborne effluents, immersion in airborne effluents, and deposition of radioactive dust on the ground or vegetation. Particulate deposition gives rise to irradiation of man by ground shine and by the consumption of wildlife or livestock that have inhabited the

5.3 EFFECTS OF CHEMICAL DISCHARGES

LIQUID EFFLUENTS

The only significant liquid effluent from the ore processing operations will be contained in the tailings slurry discharged to the tailings impoundment. An assay on a simulated tailings liquid is reported below.*

"Mountain States Engineers was requested to furnish Woodward-Clyde with a chemical assay of a simulated tailings liquor that will be sent to the tailings pond. The chemical assay of the simulated liquor shipped on February 6, 1978, is as follows:

Sulfate	26,500 mg/l
Magnesium	3,500 mg/l
Calcium	26 mg/l
Chloride	160 mg/l
Iron	1,730 mg/l
Silica	520 mg/l
Aluminum	320 mg/l
V_2O_5	530 mg/l
U_3O_8	906 mg/l

The solution is an acid leach liquor that has not been run through solvent extraction. The actual plant liquor will have an uranium content of about 0.4 ppm. This solution has a pH of 1.5."

*Private communication, Mountain States Engineers to Woodward-Clyde Consultants, February 22, 1978.

The tailings slurry is expected to contain 49 percent solids by weight. At an ore processing rate of 1000 tons per day, approximately 1040 tons per day of tailings liquid will be discharged to the tailings impoundment. Tailings liquid will be collected through a network of drains within the impoundment area; see Section 3.4. Some of this liquid will be used to keep the surfaces of the impoundment liner and the tailings moist, and most of it will be recycled to the plant process.

The bottom of the tailings pond will be lined with compacted clay. The bottom of the tailings pond will be about 200 feet above the level of the natural groundwater table in the area. Because of the different permeabilities of the intervening strata between the pond bottom and the natural groundwater table, it is not possible to portray accurately the movement of seepage water from the pond toward the groundwater.

Initially, a wetting front will advance downward through the sandstone. The moisture content of the sandstone will be significantly increased behind the wetting front, but saturation will not be achieved during this phase.

If, however, the wetting front encounters a stratum of significantly lower permeability than the pond liner, that stratum will serve as a barrier to flow and the wetting front will then start advancing horizontally in the more permeable overlying strata. At this stage nearly complete saturation of the sandstone may occur behind the wetting front. Ultimately, the wetting front will penetrate all the strata and reach the groundwater table, but by that time the wetting front may also have traveled a great distance horizontally in one or more of the upper strata, and it may in fact have appeared at the ground surface downstream from the tailings dam.

INCREASED HUMAN ACTIVITIES

The operation of the uranium facility will increase the amount of human activity in the project vicinity. This increased activity may affect some wildlife species (such as certain species of raptors) that seem to be particularly sensitive to the presence of humans. A relatively small number of wildlife may also be lost as a result of road kills and sport shootings. The importance of these impacts is considered to be relatively minor due to the small number of wildlife (including important game species) that would be affected.

EFFECTS OF TAILINGS WATER

Tailings liquid will be drained from the impoundment through a network of perforated pipes to be installed within the impoundment area; consequently no large areas of open tailings liquid are expected to form at any time. For further details of the tailings management plan, see Section 3.4.

5.6 RESOURCES COMMITTED

A variety of energy supplies and raw materials will be required to operate the PRL mines and plant facility (Table 5.6-1). Diesel fuel will be used in ore trucks, mining equipment, and diesel generators. Mechanical process equipment will be electrically driven. Process steam will be provided by heat recovered from electric generators. Fuel oil will be used for firing the yellowcake dryer. Concentrating the uranium from the ore into yellowcake will consume several chemical products, including sulfuric acid, sodium chlorate, ammonia, sodium carbonate, and others (Table 5.6-1). Water will be supplied from wells in the vicinity.

The total energy requirements during the 15-year operation of the mines and plant facility are estimated at about 25,000,000 gallons of oil and gas products, and 287,000,000 kilowatt-hours of electricity. The total water consumption during the 15-year operation is estimated at about 1800 acre feet for process water and 1500 acre-feet for potable and other uses. The total amount of uranium that will be recovered during the 15-year operation is 5570 tons.

Operation of the PRL mines and plant facility will preclude other land uses on an estimated 200 acres of land in the project vicinity. All of the disturbed lands will be reclaimed and, with the exception of the tailings impoundment area, allowed to revegetate. The 70-acre tailngs impoundment may be excluded from its present type of uses for an indefinite period while post operational monitoring establishes the success of the closure procedures. It is expected that wildlife populations similar to those present in adjacent undisturbed areas will become reestablished in all of the reclaimed areas.

TABLE 5.6-1 ESTIMATES OF RESOURCES COMMITTED DURING OPERATION OF THE SHOOTERING CANYON ORE PROCESSING FACILITY

Resource	Per Year	Total for 15-year Operation
Electricity (kWh)	10,792,320	161,884,800
Plant Facility		
Water (total) (acre-feet)	220	3,300
Process (acre-feet)	120	1,800
Potable and other (acre-feet)	100	1,500
Petroleum Products		
Diesel Fuel (gallons)	839,353	12,590,295
Gasoline (gallons)	206,350	3,095,250
Process Chemicals		
Sulfuric Acid (tons)	33,333	500,000
Sodium Chlorate (pounds)	614,400	9,216,000
Ammonia (pounds)	196,800	2,952,000
Sodium Carbonate (pounds)	72,000	1,080,000
Dow MG 200 (pounds)	52,200	783,000
Tertiary Amine (ex. Alamine 304)	5,353	80,300
Tridecanol (pounds)	10,707	160,600
Kerosene (gallons)	48,480	727,200
Charcoal (pounds)	56,667	850,000
Coarse Ore (tons)	365,000	5,475,000
Uranium (tons)	371.42	5,571.4
Manpower		
Plant Facility	75 man-years	1125 man-years

Source: Mountain States Engineers

Table 6.2-2. AIRBORNE RADIATION SAMPLE LOCATIONS

Ore feed hopper
Ore conveyor gallery
Ore sampling preparation area
Semi-Autogenous mill feed area
Semi-Autogenous mill discharge area
Leach tank area
Contercurrent Decant thickener area
Solvent extraction extraction section area
Solvent extraction stripping section area
Yellowcake precipitation tank area
Yellowcake thickener area
Yellowcake drum filter area
Yellowcake drier area
Yellowcake packaging area
Yellowcake storage area
Laboratory area
Environmental Laboratory
Lunch area
Change room
Maintenance shop area
Shift foreman office
General office area

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above the surface at locations where the geologic and topographic conditions are essentially constant for a distance of 100 yards. Soil samples from the surface and from depths of 1 foot and 3 feet will be collected from the nine sites when the first TLDs are installed. These samples will be analyzed for total uranium, thorium, radium, and potassium. The TLDs will be replaced on a quarterly basis. The overall radiation levels will be determined after the TLD readings have been corrected for altitude and influences of local soil and subsoil components. Any incremental increases that can be attributed to plant operation or tailings accumulation will be noted and related to production rate.

Airborne Particulates. Airborne particulates will be collected on a continuous basis at four locations in the vicinity of the proposed plant (Figure 2.7-2). The chosen locations represent the principal directions (north, east, and south) dust is likely to travel from the plant site and tailings impoundment. The face of the butte adjacent to the tailings impoundment essentially prevents dust blowing in a westerly direction.

Filters on the samplers will be changed on a weekly basis (unless dust loading necessitates a more frequent schedule) to provide a total of 208 airborne particulate samples per year. At the time of collection, the elapsed time, collection data, differential filter weight, and total volume of air sampled will be recorded for each location. The filters will then be enclosed in individual plastic envelopes and stored. Once each three months, portions of each filter from a given location will be composited and sent to a certified laboratory for analysis of total uranium, thorium-230, radium-226, and lead-210. The rest of the filter will be retained for future reference or for specific analyses should the quarterly analyses indicate any abnormalities that may require correlation with observed meteorological conditions.

A graphic record of the quarterly composite results will be kept on an annual basis for each sampling location. These records will enable an analysis ofthe relationship of air particulates to seasonal meteorological fluctuations and plant production.

Radon. Radon levels will be determined from air samples taken on a continuous basis for at least one week per month at each of the airborne particulate sample sites (Figure 6.2-1). The sampling period will correspond to the air particulate sampling period. Samples will be collected by means of an incremental air pump and a tedlar bag, unt . more suitable techniques are developed. Sampling with the tedlar bags will take place for 48 hours or less, and several sequential sampling periods will provide the one-week samples. Samples will be sent to an analytical laboratory as soon as practical after collection to minimize decay losses. A graphic record of the week-long monthly samples will be kept on an annual basis for each sampling location to allow an evaluation of radon concentrations relative to plant production and observed meteorological conditions.

Radionuclides in Liquid Effluents. No liquid effluents will be discharged to any unrestricted area. Septic effluents will be discharged to leach fields located on land for which rights have been acquired and ownership is being sought. Sewage from the facility should not contain any significant radionuclides above background levels.

All process liquid effluents will be discharged to the tailings impoundment. Most of this liquid will be drained and recycled, both to maintain tailings moisture and to extend process water usage. The nearest exposed waterbody is Lake Powell, approximately 15 miles (drainage course) from the site. Therefore, only groundwater and surface seepage that develops between the tailings area and the unrestricted zone will be monitored.

passed through wet dust collectors in the ore receiving and handling area and at the yellowcake drier. In addition to radiological analyses described earlier in this section, these samples will be analyzed for total particulate weight.

METEOROLOGICAL MONITORING

Wind speed and wind direction will be recorded continuously during the life of the project, except for normal equipment downtime for servicing and calibration, using instrumentation similar to that used for preoperational monitoring.

AIR QUALITY MONITORING

Concentrations of suspended particulate matter will be monitored periodically at stations located around the perimeter of the property and claim area boundaries (as indicated in Figure 6.2-1) and at other important receptor locations. This monitoring will be performed in conjunction with the radiological monitoring program. Spot checks of other pollutants will also be performed as required. The exact number and location of monitoring stations will be reviewed and updated after analysis of one year of meteorological data; station number and location will also be based on a detailed air quality impact model to be prepared after completion of the one-year preoperational monitoring program in July 1978. Details of the operational monitoring program were documented in an addendum to this report.

ECOLOGICAL MONITORING

Ecological monitoring during the operational phase of the proposed facility will be at a level of intensity consistent with the level of possible impacts. Radiological hazards, primarily from radon and its daughters, are potentially the most significant cause of any impacts on the vegetation and wildlife in the project area. Monitoring of radiological levels in major species of plants and animals collected in the vicinity will be done on an annual basis. Details of this monitoring program are presented under "Environmental Radiological Monitoring."

Nonradiological operational impacts on the vegetation and wildlife in the vicinity are considered to be minimal (see Section 5.5) and will therefore require a less intensive monitoring effort. Vegetation and wildlife in the vicinity will be qualitatively assessed when samples of vegetation and wildlife are collected in the project area for the radiological monitoring. These assessments will consist of a general survey of the area to note any unusual or unexplained changes in any of the plants or animals. Such changes could include any unusual discoloration or dieback of parts or entire plants or any unusual changes in the health or behavior of animals in the vicinity. If such changes are observed and cannot be explained by normal processes and if there is some possibility that such changes could be caused by operation of the uranium facility, additional investigations will be conducted to confirm the presence and determine the probable cause of suspected changes to any plants or animals. The methods used would be comparable to preoperational methods when appropriate (for example, to determine changes in species composition, distribution, or abundance). When appropriate, other methods would be used to document changes in the vegetation and wildlife that were not assessed during the preoperational studies.

be activated in case of a fire. Thirty-pound portable foam fire extinquishers would also be placed at 50-foot intervals around the building; thus a fire in one of the process tanks could be contained before additional process tanks were involved. The smoke generated in the b ilding would be released to the atmosphere through ceiling vents and would cause some short-term impacts on the local air quality. It is possible that some uranium could be dispersed with the heavy smoke if a major fire occurred at a location containing uranium in the organic phase. Battelle Northwest Laboratories (1973) estimates that as much as 1 percent of the uranium contained in the organic phase could be dispersed under these circumstances. As a worst-case condition, a rupture and fire at the organic surge tank when full could result in the release of as much as 720 grams (1.6 pound) of U_3O_8 to the environment. In a documented case of a fire in a uranium solvent extraction circuit, no detectable uranium was found in surface soil samples taken at distances of 100 feet and 1/4 mile from the burned building.*

Failure of the Air Cleaning System in the Yellowcake Drying Room

No changes are expected in U_3O_8 emissions due to a yellowcake drying area air cleaner failure. Variations in product output are accomplished by variations in duty times rather than in volume; consequently, total yellowcake in process at any given time would be approximately as originally designed.

*Mill Superintendent, Petrotomics, personal communication to Humble Oil and Refining Co., 1971.

Other Accidents at the Plant Site

Other plant site accidents can be postulated, but such accidents would in general not involve the release of uranium to the environment. The postulated accidents would be similar to accidents, such as leaks in tanks or piping and reagent spills, that occasionally occur in other industrial chemical process operations. The consequences of such accidents will be minimized by utilizing standard design techniques, such as dikes or concrete curbs around reagent storage tanks and work areas. Safety regulations - such as no smoking in posted areas, proper handling of toxic chemicals, and regular equipment maintenance - will be enforced to minimize the possibility of such accidents. The environmental effects of accidents of these types will be confined to the plant site. The probability of any significant impacts on the offsite environment is negligible.

7.2 FAILURE OF THE TAILINGS DISPOSAL SYSTEM

Tailings from the ore processing operation will be transported from the plant to the tailings impoundment in a pipeline. The tailings impoundment site, the tailings dam design, and the tailings management plan were selected and developed to minimize the possibility of tailings release from the impoundment. Uncontrolled tailings releases have occurred at other uranium facilities. Of twelve documented cases of accidental tailings releases between 1959 and 1971 (USAEC, April 1974), seven releases occurred as a result of dam failure or dam overtopping due to flooding, and five were the result of pipeline failure.

Pipeline Failure

The tailings pipeline will be supported on an 18" diameter polyethylene half pipe. In the event of a rupture of the tailings pipeline, the tailings slurry will be contained within this half-pipe, and will flow by gravity to the tailings impoundment. The plant freshwater system will be utilized to flush any residual tailings in the trough into the tailings impoundment after the pipeline has been restored to service.

Flooding

During plant operations, the crest of the tailings impoundment dam will be maintained sufficiently higher in elevation than the level of the tailings within the impoundment so that adequate storage capacity will always be available within the impoundment to contain the full volume of runoff resulting from the maximum probable precipitation at the site. No flood flows will be passed through or over the tailings dam throughout the project operating life.

Upon conclusion of ore processing activities at the Shootering Canyon plant, the entire area of the tailings impoundment will be covered (capped) with a layer of earth materials. Drainage from the watershed above the impoundment will flow onto the cap, where it will be contained until it attains a depth of approximately 3 feet; at that time, flow will be initiated in the impoundment spillway. A spillway channel will be excavated around the left end of the impoundment dam, in the natural sandstone of the abutment. An unregulated overflow crest will be provided on the spillway. Capacity of the spillway will be adequate to pass the project maximum probable flood, and no part of the dam crest will be overtopped by the maximum probable flood. The spillway discharge will not contact nor affect the tailings impoundment dam. The cap placed over the tailings will separate the tailings from any waters draining across the impoundment area, and the drainage waters will be unaffected by the tailings. No project tailings will be released or disbursed due to flooding of the tailings impoundment area. The major effect of natural storm runoff on the tailings will be to increase the thickness of the cap over the tailings due to sediment deposition from drainage waters retained on the cap. Retained waters normally will be lost by evaporation within a few days or weeks after a storm.

Tailings Dam Failure

Failure of the tailings dam during project operations could release tailings liquids and slimes from the impoundment into the natural drainage channel downstream from the tailings dam. Released materials could flow down that channel to Shootering Canyon, from the Canyon into Hansen Creek, and finally into Lake Powell. The quantities and properties of liquids and slimes contained in the impoundment at any time during the project operations will be such that, if released into a dry channel, they would not flow freely down the approximately 1-mile-long drainage course to the intersection with Shootering Canyon. However, concurrent or subsequent natural flows in that channel could carry materials released from the tailings impoundment dam will be designed and constructed to resist all probable forces and events appropriate to the site. The crest of the dam will be maintained at a height above the level of the tailings in the impoundment sufficient to provide adequate flood storage capacity within the impoundment to contain the full volume of runoff from the maximum probable precipitation extimated to occur at the site. Also, the operating plan for the impoundment includes continuous removal of tailings liquids from the impoundment.

Because the slimes will be continuously dewatered as they are placed, they will tend to consolidate and stabilize. As they stabilize, they will become capable of supporting subsequent layers of tailings. Tailings will be distributed within the impoundment area in such a way as to promote alternate layering of slimes and sand. The result will be continuous stabilization of the slimes throughout the operating period. At the completion of operations, there will be no free liquid within the tailings impoundment, and the contained tailings will have suffcient strength so that they would not flow if the dam were removed. The dam will continue to be needed to prevent tailings dispersal by erosion, but it will not be needed for structural purposes.

In the event of a failure of the underground drainage system, tailings liquid would collect in the lowest part of the impoundment. A pump would then be installed on a floating platform to collect the liquid and either return it to the process circuit of the plant or the liquid would be recirculated within the basin to increase the moistened area and evaporation rate.

Seismic Damage to Tailings Dam

The probability that an earthquake-induced ground motion would result in tailings dam failure is extremely low due to the following factors:

- The probable maximum intensity of an earthquake felt at the project site is calculated to be III to IV MM (see Section 2.5).
- The probability is 0.10 or less that an earthquake would cause a horizontal acceleration exceeding 0.04g at the site during the next 50 years (see Section 2.5).
- The dam has been designed with a 2:1 slope. The properties of the materials to be used in the dam are such that the slopes will be stable throughout any earthquake likely to occur at the site.

If a dam failure were to occur in spite of these site characteristics and design features, the impacts would probably be less extensive than those resulting from a flood-induced failure of the dam, as there would be no water to transport the tailings. The extent of tailings to the general public as a resul of an ammonia shipment to the PRL facility is estimated to be less than 5.0×10^{-3} per year.

Shipment of Yellowcake

Any accident occurring during the shipment of yellowcake from the PRL facility is considered significant because of the volume of concentrated radioactive materials involved. Based on published accident statistics (USAEC, 1972; BNWL, 1975) the probability of a truck accident is about 1.6 to 2.6×10^{-6} per mile. Based on an annual U_3O_8 yield of 410 tons and an estimated yellowcake purity of 90% U_3O_8, approximately 25 trips will be required annually; each trip is about 1300 miles. Therefore, the liklihood of a truck accident involving a yellowcake shipment from the PRL facility is approximately 0.07 during any one-year period.

In the event of an accident, some of the steel drums in which the yellowcake will be transported could rupture and release yellowcake to the environment. Most of the yellowcake would be deposited on the ground in the immediate vicinity of the accident. A fraction of the spilled yellowcake would also be dispersed to the atmosphere. Battelle has developed expressions for the dispersal of similar material to the environment based on actual laboratory and field measurements over several years (BNWL, 1975). Using several assumptions (wind speed of 10 miles per hour, 24-hour release time, population density of 160 people per square mile), the consequences of a truck accident involving a shipment of yellowcake from the plant facility would be a 50-year dose commitment* to the general population of approximately 13 man-rem to the lungs for a 16,000-pound release and 0.9 man-rem to the lungs for a 1100-pound release of yellowcake.

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*Doses integrated over a 50-year period following exposure.

In September 1977, a truck overturned and released an estimated 15,000 pounds of uranium concentrate on the ground and truck trailer. The consequence of this accident was calculated to be a 50-year dose commitment of 11 man-rem to the general public for a population density of 160 persons per square mile. The consequence would be much less in the area of the proposed plant facility (a 50-year dose commitment of only 0.04 man-rem), since the average population density of Garfield County is only 0.6 person per square mile.

If yellowcake is spilled on land, it can be detected with sensing equipment and picked up and reclaimed. Some small amounts of topsoil and vegetation may also need to be removed to ensure that radiation levels are comparable with background radiation levels.

The truck accident in September 1977 revealed that better contingency planning could have resulted in a quicker cleanup of the released uranium concentrate and probably could have reduced the amount of exposure to the general public. PRL is currently developing an emergency action plan to reduce potential environmental impacts from an accidental release of yellowcake. This plan will include the following elements:

- the emergency response team's organization, job descriptions, and responsibilities
- the response instructions for accidents occurring during production and/or transportation of uranium concentrate
- the manpower and equipment resources for PRL and resources available from other sources

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATION

8.1 BENEFITS

The Plateau Resources Limited mine and ore processing facility will provide industrial development representing an investment of approximately $38,000,000. The product will be fuel for electric power production, contributing between $49,000,000 and $144,000,000 annually to the regional product.

A direct consequence of the project will be the creation of about 190 construction jobs and 170 to 200 permanent jobs for the area. This is requiring development of new housing, services, and commercial facilities and may attract related service industries and development to the area.

The Ticaboo Subdivision will generate revenues primarily to Garfield County. The largest proportion will be property taxes on residences; motor vehicles will represent the next most significant tax generator. Table 8.1-1 gives the estimated projection of county revenues prepared by the Utah State University Foundation. The Foundation's figure for property tax on the mine and plant may be conservative; Plateau Resources Limited expects property taxes to be about $600,000 per year on the total facility during operation.

Tables 8.1-2 and 8.1-3 give a more detailed breakdown of real property values and assessed valuation for the Ticaboo Subdivision and

Table 8.1-1. PROJECTIONS OF ANNUAL GARFIELD COUNTY REVENUES FROM TICABOO SUBDIVISION

	Low Projection	High Projection
Real Property Tax:		
Residential	$ 29,200	$ 34,900
Commercial	2,000	2,300
Sales Tax[a]	6,800	8,050
Federal Revenue Sharing[b]	6,300	7,400
Motor Vehicles and Miscellaneous Property	8,500	10,050
Property Tax - Shootering Canyon Uranium Mine and Plant[c]	175,000	175,000
TOTAL Annual Revenue	$227,800	$237,800

Source: Utah State University Foundation, 1975.

[a]Based on 30 percent of local income being spent locally on taxable goods and services.

[b]Based on statewide average of $9.72 per capita to county governments for the 1975-1976 fiscal year.

[c]Minimum estimate.

Table 8.1-2. REAL PROPERTY CHARACTERISTICS AND PROJECTED TAX REVENUES, TICABOO SUBDIVISION

	Average Unit Size (sq ft)	Market Value per sq ft	Market Value per unit	No. of Units	Gross Market Value	Assessed Value	Annual Property Tax[a]
High Projection							
Residential							
Single family	1,200	$25	$30,000	86	$2,580,000	$387,000	$19,900
Multifamily	850	20	17,000	43	731,000	109,650	5,650
Mobile homes	910	15	14,000	86	1,204,000	180,600	9,300
Commercial	(12,000)[b]	25	--	--	300,000	45,000	2,300
Low Projection							
Residential							
Single family	1,200	$25	$30,000	72	$2,160,000	$324,000	$16,690
Multifamily	850	20	17,000	36	612,000	91,800	4,730
Mobile homes	910	15	14,000	72	1,008,000	151,200	7,800
Commercial	(10,300)[b]	25	--	--	257,500	38,550	2,000

Source: Utah State University Foundation, 1977.

[a]Based on current property tax levy of 51.50 mills per $100 assessed valuation.

[b]Total commercial space.

Table 8.1-3. TAXABLE VALUE OF SHOOTERING CANYON FACILITY, 1978-1979

	1978	1979
Assessed Valuation		
Cost of Plant	0	32,114,000
Mine	0	3,586,000
	0	35,700,000
Assessment rate	-	30%
Assessed value	0	10,710,000

Source: Plateau Resources Limited budget, 1978-1979 for the mine and plant facility. The industrial project will generate taxes in the area for a minimum of 15 years, the present lower estimate of project life. The subdivision will likely generate revenue for a longer time period but at a reduced rate after termination of the uranium project.

8.2 COSTS

The primary costs to the community from facility development will be for the provision of municipal and social services to the facility and to employees and their families. The initial costs of construction of the proposed town of Ticaboo are being borne by the developer. These costs may include school buildings and local administrative buildings. Access roads to the project site are being built as part of the overall construction process. However, maintenance of these facilities may eventually fall to the county. Since the subdivision may be an unincorporated settlement, municipal service responsibility may also fall to the county.

The Utah Department of Natural Resources has proposed the creation of a special service district, involving cooperative effort of Kane, Garfield, and Wayne counties, to provide necessary services, particularly for fire and police protection and for transportation. This will reduce the burden on Garfield County, and ensure that the county's ability to provide necessary public services is not unduly taxed.

A large proportion of the costs for providing categorical social services will be borne by the federal government under Title XX of the Social Security Act. With the exception of family planning, for which it will provide 90 percent funding, the federal government will provide 75 percent of funding for all federal programs. Twenty-five percent of the funding for most programs is provided by the state, with partial funding coming from local government. The program will be administered by the Utah Department of Social Services.

Table 8.2-1 and the accompanying explanation, prepared by the Utah State University Foundation, gives a breakdown of categorical services and their estimated costs to various levels of government. For purposes of estimating these costs, it was assumed that the cost for providing most services would approximate the state average. These categorical social services may be important to the community, given the history of social problems associated with rapid community development resulting from energy resource development in previously undeveloped areas.

The initial costs of the ore processing facility construction to Plateau Resources Limited will be about $38,000,000 including materials and labor. Plateau Resources Limited estimates that annual operating labor costs will be $3,200,000. Direct and indirect operating costs, including taxes and materials, are expected to exceed $4 million annually. The estimated cost of decommissioning the facility at project termination is $792,000.

The estimates in Table 8.2-1 are based upon the services required for a total population in the Ticaboo Subdivision of between 600 and 800 persons. The project work force of 170 to 200 will generate a direct project-related population totaling 562 to 659 individuals. The secondary employment is estimated to be 25 to 30; total secondary population is estimated at 80 to 100 individuals. (See Section 4.0 for demographic projections.)

Table 8.2-1. PROJECTED YEARLY COSTS OF CATEGORICAL SOCIAL SERVICES TO BE PROVIDED TO TICABOO RESIDENTS, BY GOVERNMENT LEVEL* (rounded to nearest dollar)

	Federal	State	Local	Total
Adoptive Services	$ 11	$ 4	$ 0	$ 15
Counseling Services	1,187	185	210	1,582
Day Care Services	1,675	533	25	2,233
Developmentally Disabled Services	823	165	110	1,098
Education & Training Services	91	18	12	121
Employment Service & Training	131	42	1	174
Family Planning Service	170	16	3	189
Health Services: Guidance & Mediation	233	76	1	310
Home Management Services	590	193	4	787
Housing Services & Landlord/Tenant Mediation	11	4	0	15
Information, Referral, & Follow-Up Services	614	164	40	818
Legal Services	79	11	16	106
Protective Services	1,045	330	18	1,393
Socialization & Reassurance Services	363	56	65	484
Substitute Care	1,527	489	20	2,036
Transportation	119	36	4	159
TOTAL	$8,669	$2,322	$529	$11,520

Source: Utah State University Foundation, 1977.

*An explanation of the social service categories and calculation of costs is given on the following pages.

foundations will be leveled and the area will be regraded as required to restore the surface to a condition generally similar to the surrounding undisturbed area.

9.3 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 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 depressions within the plant area. 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 regraded 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.

9.4 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 impoundment area will be divided into compartments, or cells, and the tailings will be drained through a network of perforated polyethylene drainage pipes. Tailings will be piped to the impoundment and deposited in a systematic fashion in a number of cells; the drainage system will permit continuous dewatering of the tailings. See Section 3.4 for further details of this operations. The deposition pattern and the dewatering are expected to result in fairly rapid stabilization of the tailings slimes, and the system of cells will permit progressive capping of the impoundment as the various cells are filled.

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 three types of material. The cap will be about 8 feet thick. A 6-foot-thick layer of compacted clay material will be placed immediately over the tailings. A 2-foot-thick layer of locally available sandy material is to be placed on top of the clay. To provide the necessary surface stability against wind erosion, special care will be exercised to obtain a concentration of sand, gravel, and cobble in the upper 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 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 natural deposition will be exploited to enhance the security of the project 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 70 inches per year, which is equivalent to about 3.6 gallons per minute per acre of exposed surface. At an ore processing rate of 1000 tons per day, and assuming a tailings slurry containing 49 percent solids by weight, approximately 175 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 51 gallons per minute of the tailings liquids will be retained in the settled tailings, leaving approximately 124 gallons per minute of liquid available for evaporation and seepage from the pond. Keeping about 61 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 groundwater surface, which is approximately 200 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 (as described in Section 6.2) will be maintained for at least five years after project termination, and observations 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 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.

RADIATION EMISSIONS

The cap to be placed over the tailings impoundment area will be designed and constructed with the goal of limiting radon gas and gamma radiation emissions from the tailings. After the cap is constructed, a monitoring program will be implemented to determine the actual level of emissions through the tailings cap and the background emissions from nonimpoundment areas.

Three monitoring stations are proposed on the tailings cap. One station would be located near the upstream toe of the dam, where the total depth of tailings will be greatest. Another station would be located near the central portion of the impoundment, where tailings slimes are expected to be most concentrated. The third monitoring station would be positioned at the upper part of the impoundment area, where, due to the segregation techniques to be employed in placing tailings in the impoundment, relatively clean tailings sand would be concentrated.

One thermoluminescent dosimeter (TLD) and two radon cups would be installed at each monitoring station. The TLD would be mounted 3 feet (or 1 meter) above the tailings surface. One radon cup would be placed approximately 4 feet beneath the surface; the other, at a depth of about 1 foot. Radon measurements from the two depths at each station would provide data from which a concentration gradient (C_n) could be established; this would indicate the effectiveness of the tailings cap in controlling radon emissions from the impoundment.

Background radon and radiation emissions would be measured at two stations, both located in surface soils near the top of the Entrada Sandstone, similar to the natural surface at the tailings impoundment. One background measuring station would be located approximately one-half mile downstream, or south-southwest, (and upwind) from the tailings impoundment dam; the other station would be located to the northeast (downwind), about one-half mile from the impoundment area. Two radon cups and one TLD would be installed at each background monitoring station. The TLDs would be mounted 3 feet above the ground and the radon cups would be placed below the ground surface at 1 and 4 feet, as above.

Radon cups and TLDs at the five proposed monitoring stations would be collected, and new ones installed, at 3-month intervals. Data collected for preparing the radiological baseline section of this report (Section 2.9) indicated marked differences in radon emissions between dry and wet seasons. The differences in emissions were attributed to differences in soil moisture content during the two sampling periods. Since there are pronounced seasonal variations in normal precipitation for the project area, it is suggested that the radon monitoring program should be operated with due regard for seasonal influences. It is proposed that radon cups, and also the TLDs, be installed and collected in conformance with the change of seasons.

After collection, TLDs and radon cups are to be delivered to a laboratory for processing and analysis. The analysis will establish if radon and gamma radiation emissions from the tailings are below the prescribed limitations. If radon measurements at any time exceed the limits, it may be necessary to take remedial action. Such action could include increasing the thickness of the cap, either locally or of uranium ore in Shootering Canyon is not excluded by this option. If mining is to be continued, however, the ore would have to be transported to a distant processing facility, assuming processing services were available. Only very small quantities of the highest available grade of ore have in the past been economically recoverable under this condition, and it is expected that this situation will continue indefinitely if the proposed plant is not constructed. Accordingly, the no-action alternative could result in the lower grade uranium ores in the project area remaining unmined, or if mined, not segregated from the mining waste rock.

Uranium concentrate to be produced by the proposed plant will be fabricated into fuel for use in two existing and two new generating units currently being installed by Consumers Power Company (CPC) at Midland, Michigan, and scheduled for commercial operation in 1984 and 1985 respectively. Consumers Power Company has formed Plateau Resources Limited, as a wholly owned subsidiary, for the purpose of producing uranium concentrate. This action was taken because CPC had concluded that the U.S. uranium mining and ore processing industry was not expanding rapidly enough to ensure that an adequate supply of uranium concentrates would be available in the early 1980s and beyond to satisfy the requirements of the domestic nuclear power industry. Data published by the Energy Research and Development Administration (ERDA, January 1977) support this conclusion, as shown in Table 10-1.

According to the same source, in recent years imports of uranium concentrates have been exceeding exports by as many as 2300 tons per year. A comparable imbalance is projected for the next few years, but by the late 1980s the imbalance is expected to decrease to a few hundred tons per year. From this it is concluded that net imports of uranium concentrates are not expected to supply a significant part of the total United States demand during the operating life of the proposed Shootering Canyon ore processing facility, and that domestic supplies must be developed to reliably satisfy the national demands for nuclear energy.

Table 10-1. FORECAST OF U.S. URANIUM CONCENTRATE REQUIREMENTS AND COMMITMENTS (1977-1990)

Year	Forecast of Domestic U_3O_8 Requirements (tons)	U.S. Commercial U_3O_8 Delivery Commitments* (tons)
1977	12,300	15,900
1978	19,800	17,900
1979	24,400	18,400
1980	28,600	20,400
1981	32,300	19,000
1982	36,100	19,200
1983	35,500	15,000
1984	41,300	13,000
1985	39,900	11,500
1986	41,200	8,400
1987	44,500	7,200
1988	43,400	6,400
1989	44,200	6,400
1990	45,100	5,200

Source: ERDA, January 1977.

*Commitments as of January 1, 1977

12.0

ENVIRONMENTAL APPROVALS AND CONSULTATION

The federal agencies with jurisdiction over uranium facilities in Utah are the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA). Since Utah is a nonagreement state, the NRC, rather than the state, is responsible for licensing of the processing facility. At the state and local levels, numerous governmental agencies have a role in the regulation of uranium facilities. The various licenses, permits, and approvals (and their status) related to environmental protection are as follows:

1. Right-of-way Approval from BLM for Access Road: Permit issued 11/2/79; Amendment Request submitted 1/29/80.

2. Recordation of Mining Claims: continuing requirement fulfilled on a claim-by-claim basis.

3. Quantity Grant Selection Application Approval from BLM: applied for by Utah State Land Board in April 1978.

4. Source Materials License from NRC: License SVA1371 issued 9/21/79 SVA1371 Amendment #1 issued 9/28/79.

5. Notice of Commencement of Construction to the Rocky Mountain District of the Mine Safety and Health Administration, U.S. Department of Labor: PRL will file at appropriate time if required.

6. Deleted

7. Radio Transmitter License from the Federal Communications Commission: transferred to PRL in 1977.

8. Approval from the Utah State Land Board of proposal to purchase quantity grant property from University of Utah: approved March 1978.

9. Approval from the University of Utah, Institutional Council, for the proposal to purchase quantity grant selection: approved March 1978.

10. Construction Approval from the Utah State Division of Health, Air Conservation Committee: approved February 1978.

11. Solid Waste Disposal Permit from the Utah Board of Health: Approval issued 5/24/79.

12. Deleted

13. Filing of Mine Reclamation Plan with the Utah Department of Natural Resources, Division of Oil, Gas, and Mining: Final approval issued 10/29/79.

14. Deleted

15. Appropriation of Water Certificate from the Utah State Enginerr: appropriation approved for change of diversion location approved 10/2/78.

It is not anticipated that a Water Quality Certification under Section 401 of the Federal Water Pollution Control Act or a National Pollutant Discharge Elimination System (NPDES) permit from the EPA will be required since the proposed project will not involve any dredging or filling of or discharge into "navigable waters." The NPDES requirement will be reviewed by EPA from a New Source Environmental Questionnaire (NS/EQ) to be submitted by Plateau Resources Limited.

PLANNING AUTHORITIES CONTACTED OR CONSULTED

In view of the anticipated effects of the construction and operation of the proposed facility on the economic development of southeastern Utah, Plateau Resources Limited has contacted or consulted the following federal, state, local, or regional planning authorities:

Federal Agencies

- Bureau of Land Management: existing leaching facility, process facility, quantity grant, site selection, existing/new license requirements, socioeconomic data

- Nuclear Regulatory Commission: process facility, existing leaching facility, site selection, existing/new license requirements

- Environmental Protection Agency: water discharge permit requirements

- Mine Safety and Health Administration: mine safety requirements

- National Park Service, Glen Canyon National Recreation Area: process facility, existing leaching facility

State of Utah

- Division of State Lands: process facility, existing leaching facility, mine camp, quantity grant

- State Land Board: processing facility, existing leaching facility, mine camp, quantity grant

- State Department of Planning: socioeconomic information

- University of Utah: quantity grant

- University of Utah Institution Council: quantity grant

- Air Conservation Committee, State Health Department: process facility, existing leaching facility

- Division of Water Rights: well drilling permits, water appropriation

- Division of Oil, Gas, and Mining: existing leaching facility, process facility, reclamation plans, bonding

- Attorney General: processing facility, need for telephone service

- Public Service Commission: processing facility, need for telephone service

ACTIVITY RELEASES

The radiological releases from the proposed Shootering Canyon project are estimated to be as given in Table F-1. The estimates are based on an average of 0.12 percent U_3O_8 content in the ore. The estimates for releases from the tailings are based on the methods outlined in the Bear Creek Project Draft Environmental Statement (USNRC, 1977), adjusted for ore grade and impoundment area. Estimates of plant releases are based on information provided by the architect-engineer for this project.

Table F-1. ACTIVITY RELEASES

	Releases (Ci/yr)				
Isotope	Ore Pile	Ore Receiving & Handling	S.A.G. Mill	Yellowcake Operations	Tailings
Lead-210	4.07E-5	2.61E-2	----	1.43E-5	9.02E-3
Radon-222	2.70E+1	-----	5.60E+1	-----	2.97E+3
Radium-226	4.07E-5	2.61E-2	----	1.43E-5	9.02E-3
Thorium-230	4.07E-5	2.61E-2	----	3.57E-5	8.59E-3
Uranium-238	4.07E-5	2.61E-2	----	7.13E-3	5.42E-4

Revised June 16, 1980

DOSE MODELS FOR AIRBORNE EFFLUENTS

Individual and population doses are calculated at various locations around the site as a function of pathway and organ (including the whole body). Individual doses are summed over all pathways at a given location so that the maximum individual dose can be determined. Population doses are summed over all pathways to obtain the total population dose at a given location. Population doses are then summed over all locations to obtain the total population dose for each organ.

Inhalation and ingestion dose conversion factors are based on NRC Regulatory Guide 1.109.

The dose model for exposure from contaminated ground is based on the assumption that the receptor is 1 meter above a uniformly contaminated plane that extends in all directions. Dose conversion factors used in the analyses are discussed by Soldat (1971) and others.

The external exposure dose model assumes that the contaminated medium is large compared with the range of emitted radiation. Under this assumption, the energy absorbed is equal to the energy emitted.

The following calculational models based on NRC Regulatory Guide 1.109, Rev. 0, were used to evaluate the individual and population exposures resulting from releases of airborne radioactive material. The pathways by which an individual may be significantly exposed are immersion, ground shine, inhalation, and ingestion.

IMMERSION DOSES

The model for gamma whole-body dose is based on the assumption that the contaminated medium is an "infinite volume." An "infinite volume"

11.0

BENEFIT-COST ANALYSIS

The purpose of this section is to analyze project-related benefits and costs from the viewpoints of:

- internal and external costs and benefits
- quantitative and qualitative costs and benefits, and
- cost-benefit relationships.

The emphasis is on the more important of these effects and on the aggregation of potential project effects.

The following discussion of costs and benefits will be based largely on key information regarding the construction and operation of the proposed mine and plant. Much of this information is shown in tabular form at the end of the discussion. It is important that the following points be noted:

- Internal project and external government costs and revenues are not additive -- that is, costs and benefits for Plateau Resources Limited and for affected governmental jurisdictions represent different viewpoints and both costs and benefits will be different for each.

- The benefit and cost aggregations represent the best data available but can only be preliminary at this time.

- The responsibilities for some costs are not firmly determined at this time.

11.1 INTERNAL COSTS AND REVENUES

COSTS

Plateau Resources Limited has estimated its costs for acquiring mining claims in the Shootering Canyon area and the costs for mine exploration and development, as well as capital costs for production equipment to operate the mines. In addition, PRL has estimated its total capital costs for constructing the proposed ore processing facility. Those costs are summarized in tabular form in Table 11.2-1. Total estimated capital costs to be incurred by PRL, to the time of initial plant operation, are $89.4 million. The present worth of those costs (1980), based on a 12-percent discount rate, is $91.5 million.

Also, PRL has estimated the annual costs to operate and maintain the project over the planned 15-year operating life. PRL expects O & M costs to total $396.2 million over the 15-year project life. The present worth of those costs is $128.2 million, again referred to a 1980 base and applying a uniform discount rate of 12 percent. It should be noted that in estimating annual O & M costs escalation was included in the calculations.

BENEFITS

Project economic benefits result from the sale of product. PRL has analyzed the world market for uranium and estimated the world price for uranium for each year of the planned project life. Based on those prices, PRL expects annual revenues from the sale of project uranium to range from $11 million in 1980 to $144 million in 1995. The total project revenues are estimated at $1,161.9 million and the present worth of the total revenues stream for the project over 15 years is $395.0 million, again referred to a 1980 base year and utilizing a 12-percent discount factor. A summary of the benefits estimate appears at the conclusion of Section 11.2.

11.2 EXTERNAL COSTS AND BENEFITS

The table accompanying this section shows some of the more important external costs related to the overall project. These external effects are discussed below according to costs and benefits likely to accrue to:

- Individuals associated with the project, and
- county, state, and federal governments.

Benefits to direct and secondary employees will probably include the following:

- Construction: 245 jobs for 17 months for many different crafts, generating a total of about $11.4 million in wages.

- Operations: 206 to 231 jobs for at least 15-year period, generating a total of about $3,750,000 per year in wages over that period (present worth of $48,000,000, assuming a 12-percent discount factor, a 10-percent escalation factor, and a 15-year production period).

Cost to this work force (for food, clothing, medical care, schooling, etc.) will probably be comparable to costs in an urbanized area. However, the quality of education and medical services may be considered lower than in an urbanized area and the spectrum of affordable recreation and social choices will be more limited.

COUNTY GOVERNMENTS

The cost-benefit summary shows $540,000 in potential property taxes accruing to Garfield County each year over a 15-year period.

Cost responsibilities that would be borne by the county are primarily for social services but also include possible road maintenance costs. The larger costs will probably be those for education, police, etc., as mentioned earlier in Section 8.0. Anticipating costs of about $500 per capita for 600 to 800 persons, these costs could total between $300,000 and $400,000 per year.

STATE GOVERNMENT

About $6,000 per year in payroll taxes will accrue to Colorado over the 17-year construction and operation period. These taxes result from PRL management and administrative staff assigned to the project but working and living in Grand Junction, Colorado, and making occasional to frequent visits to the project site. It is difficult to identify significant project-related costs for which Colorado would be responsible.

Taxes likely to be collected by the State of Utah could include sales and use taxes of about $702,000 per year during the 15-year operating period. In addition, Utah would probably collect payroll taxes of about $179,000 per year over the operations period. Corporate income taxes are estimated because of the difficulty of making such projections.

Project-related cost responsibilities likely to be borne by the State of Utah are also discussed in Section 8.2.

THE FEDERAL GOVERNMENT

Federal payroll taxes may run about $1,091,000 per year over the life of the project. It was not possible to estimate federal corporate income taxes. Social cost responsibilities for project-related personnel likely to be borne by the federal government were detailed in Section 8.2.

Table 11.2-1 summarizes both costs and benefits of the proposed project.

TABLE 11.2-1. COSTS AND BENEFITS SUMMARY

Internal Costs and Revenues

A. Capital Costs (millions)

Acquisition	$ 8.9
Exploration	4.9
Mine Development	22.2
Mine Equipment	11.2
Ore Processing Plant	42.2
Total	$89.4
Present Worth (1980, 12%)	$91.5

Construction work force: 245 average for 17 months
418 maximum or peak

B. Operating and Maintenance Costs

Total, mining and processing, 15 years	$396.2 million
Present Worth (1980, 12%)	$128.2 million

Operating labor force, mines and plant: 206 to 231 persons for 15 years

C. Revenues

1981: $11 million to 1984: $ 31 million
1985: $49 million to 1995: $144 million

Total revenue, 15 years	$1,161.9 million
Present worth (1980, 12%)	$ 395.0 million

D. Comparison ($ millions)

	Total	PW (1980)
Costs		
Capital	$ 89.4	$ 91.5
O & M	396.2	128.2
Total	$485.6	$219.7
Benefits (Revenues)	$1,161.9	$395.0
B/C ratio	2.39	1.80

(Continued)

External Benefits (Annual)

	1980 to 1995
Utah State royalties	$ 150,000
County property taxes	$ 540,000
Utah use taxes	$ 400,000
Other taxes	$ 302,000
Utah payroll taxes	$ 179,000
Colorado payroll taxes	$ 6,000
Federal payroll taxes	$1,091,000
State and Federal income taxes	$5,056,000

Source: Plateau Resources Limited communication of June, 1980

Revised June 16, 1980

APPENDIX G

URANIUM ORE PROCESSING FACILITY

SHOOTERING CANYON, GARFIELD COUNTY, UTAH

PLATEAU RESOURCES LIMITED

Drawings prepared by Mountain States Engineers, project architect and engineer, showing the proposed process flow diagrams, and plot plans and sectional elevations for the process units of the plant, make up this appendix and are listed below. The layout of the plant and tailings impoundment on the site was presented in Figure 2.1-3; Figure 3.1-1 illustrated the general arrangement of the plant as a whole; a perspective view of the plant was shown in Figure 3.1-2.

Figure	Title
G-3	Process: Grinding and Leaching Flowsheet
G-4	Process: Countercurrent Decantation and Tailings Flowsheet
G-5	Process: Solvent Extraction Flowsheet
G-6	Process: Concentrate Product Flowsheet

10787

Revised June 16, 1980

G-12	General Arrangement: Grinding, Leaching, Solvent Extraction, and Concentrate Product, Plan
G-13-A G-13-B	General Arrangement: Countercurrent Decantation Thickeners, Plan and Section
G-14	Process: Utilities and Reagents, Flowsheet

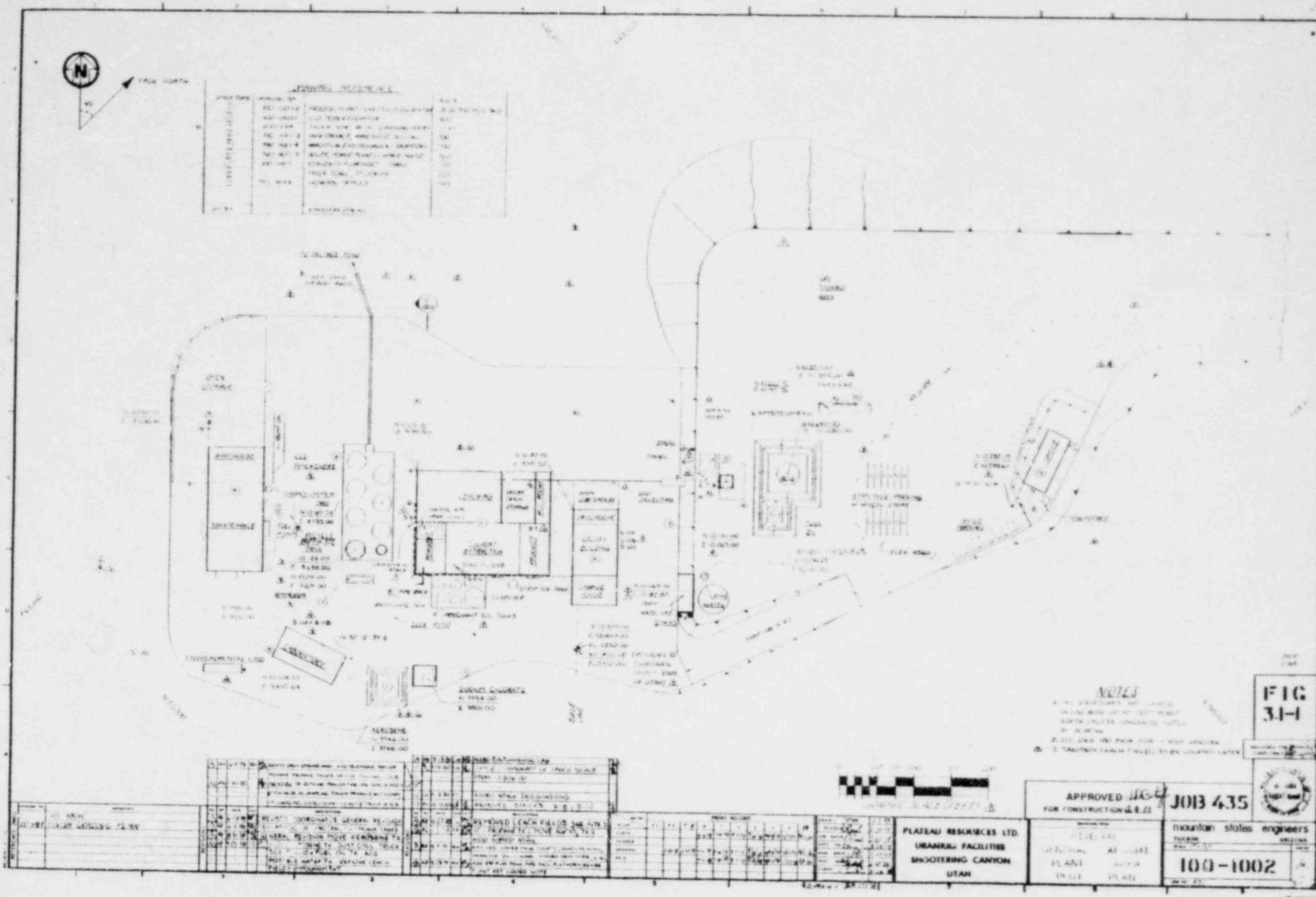
FIG
3.1-1
NOTES
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URANIUM FACILITIES
SHOOTERING CANYON
UTAH
mountain states engineers
100-1002

16787

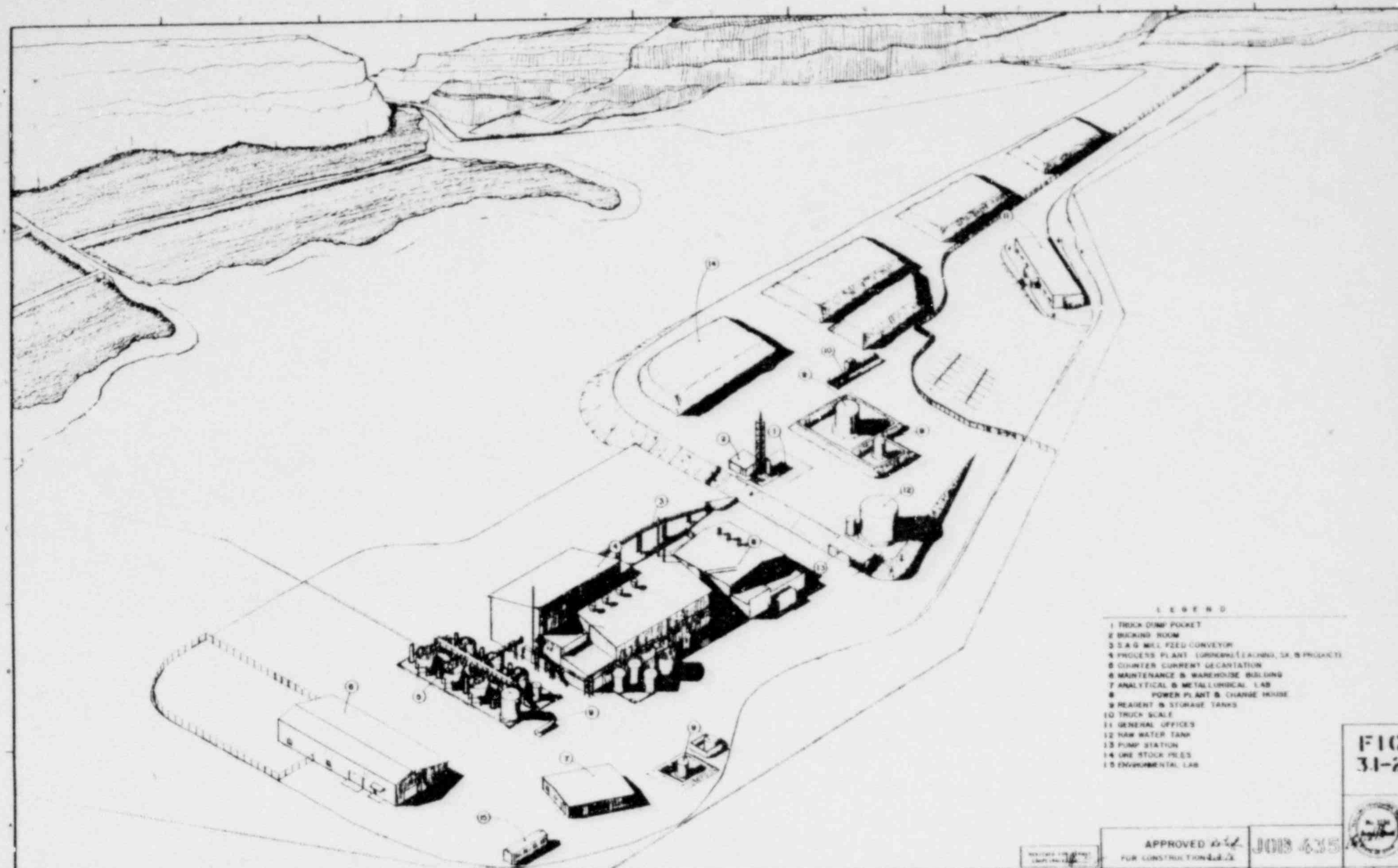

FIG 31-2

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URANIUM FACILITIES
SHOOTERING CANYON
UTAH

GENERAL
GENERAL ARRANGEMENT
PLANT AREA
ISOMETRIC

mountain states engineers

100-1010

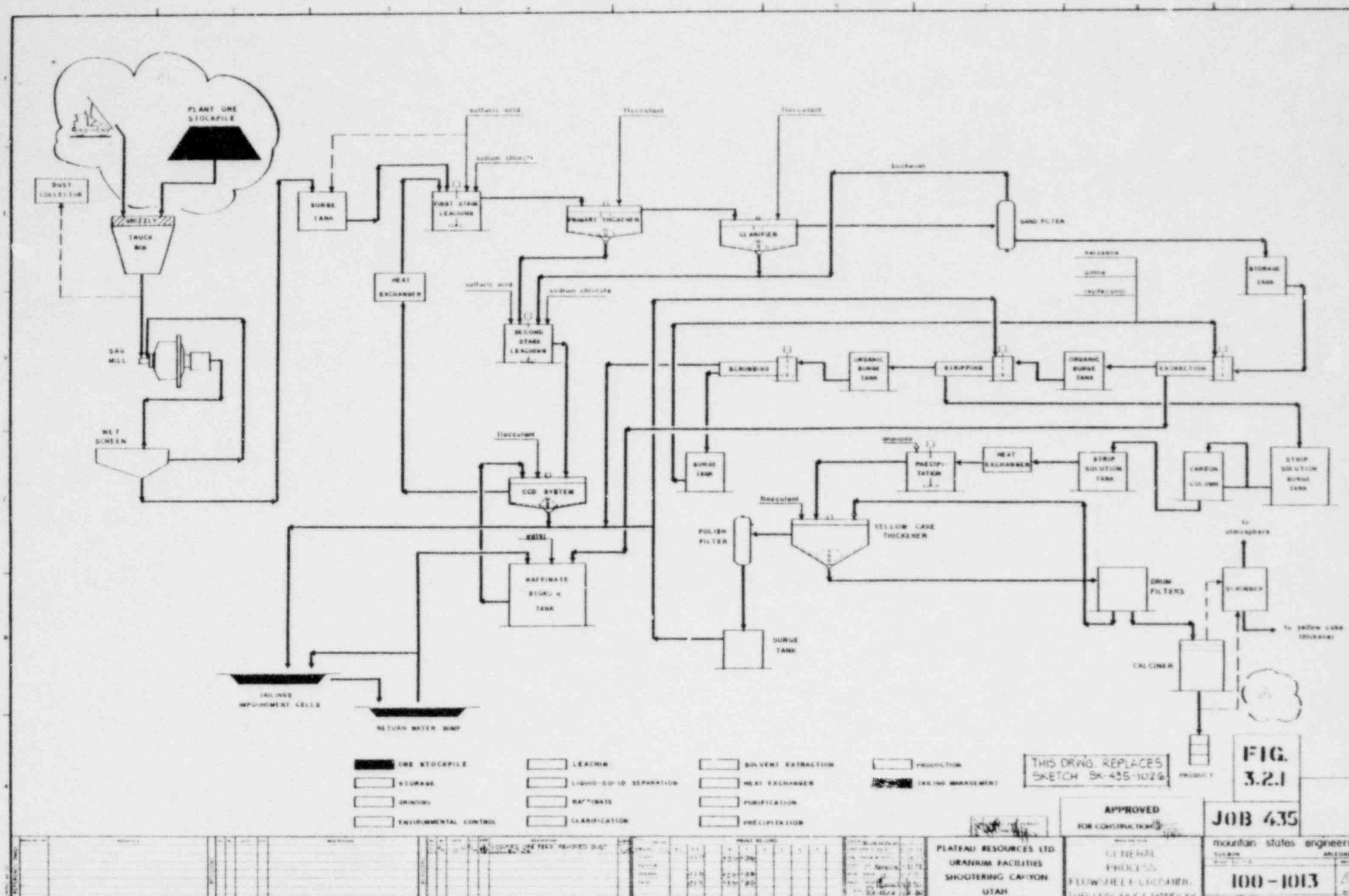

PLANT ORE STOCKPILE
DUST COLLECTOR
GRIZZLY
TRUCK BIN
SAG MILL
WET SCREEN
SURGE TANK
sulfuric acid
sodium chlorate
FIRST STAGE LEACHING
flocculant
PRIMARY THICKENER
CLARIFIER
backwash
SAND FILTER
HEAT EXCHANGER
SECOND STAGE LEACHING
kerosene
amine
isodecanol
STORAGE TANK
SCRUBBING
ORGANIC SURGE TANK
STRIPPING
EXTRACTION
CCD SYSTEM
SURGE TANK
ammonia
PRECIPITATION
HEAT EXCHANGER
STRIP SOLUTION TANK
CARBON COLUMN
STRIP SOLUTION SURGE TANK
POLISH FILTER
YELLOW CAKE THICKENER
to atmosphere
RAFFINATE STORAGE TANK
DRUM FILTERS
SCRUBBER
to yellow cake thickener
SURGE TANK
CALCINER
TAILINGS IMPOUNDMENT CELLS
RETURN WATER SUMP
PRODUCT
ORE STOCKPILE
STORAGE
GRINDING
ENVIRONMENTAL CONTROL
LEACHING
LIQUID-SOLID SEPARATION
RAFFINATE
CLARIFICATION
SOLVENT EXTRACTION
HEAT EXCHANGER
PURIFICATION
PRECIPITATION
PRODUCTION
TAILING MANAGEMENT
THIS DRWG. REPLACES SKETCH SK-435-1026
APPROVED FOR CONSTRUCTION
JOB 435
PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
GENERAL PROCESS FLOWSHEET CRUSHING THRU PRODUCT HANDLING
mountain states engineers
TUCSON ARIZONA
100-1013

FIG. 3.2.1

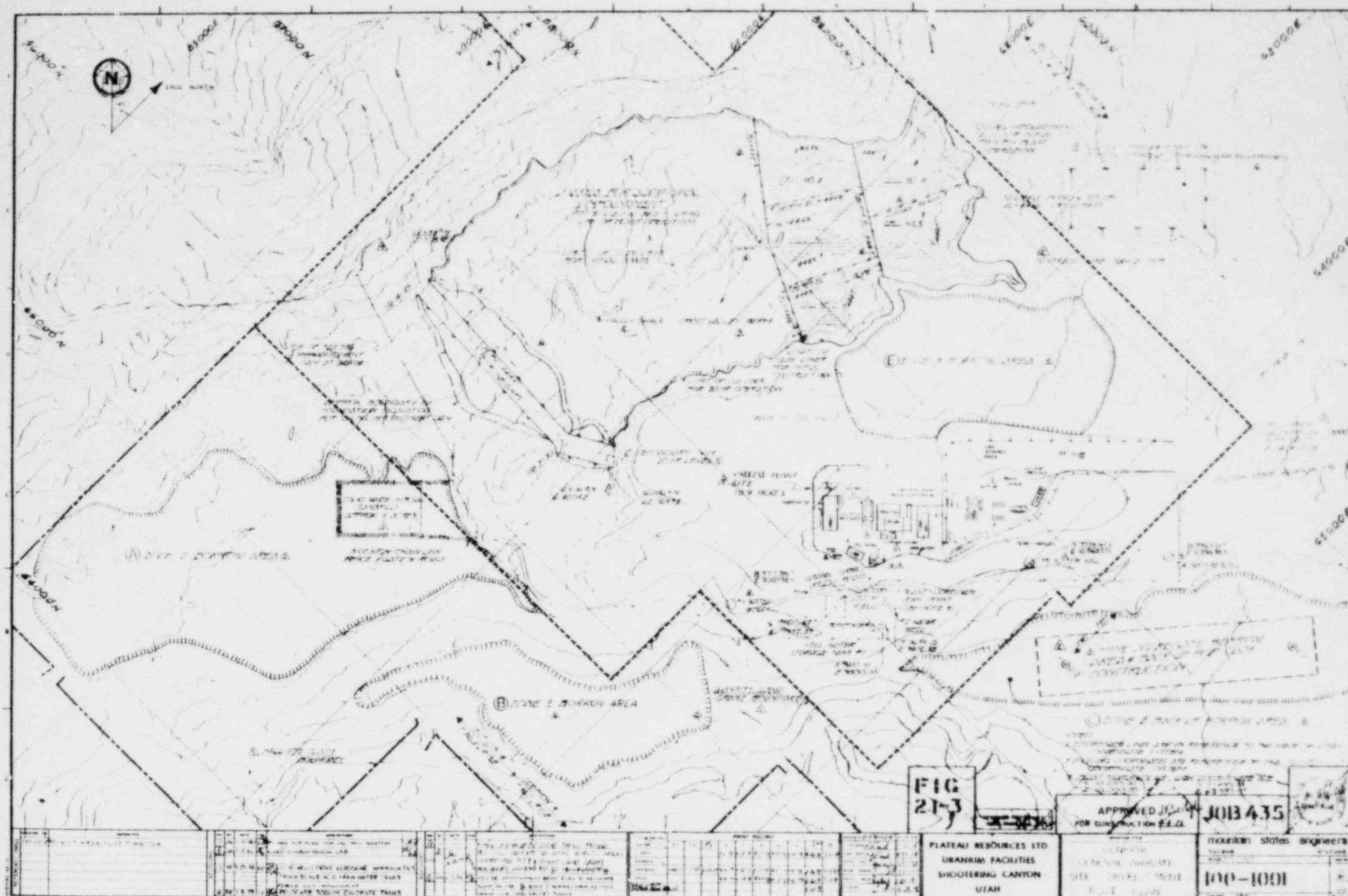
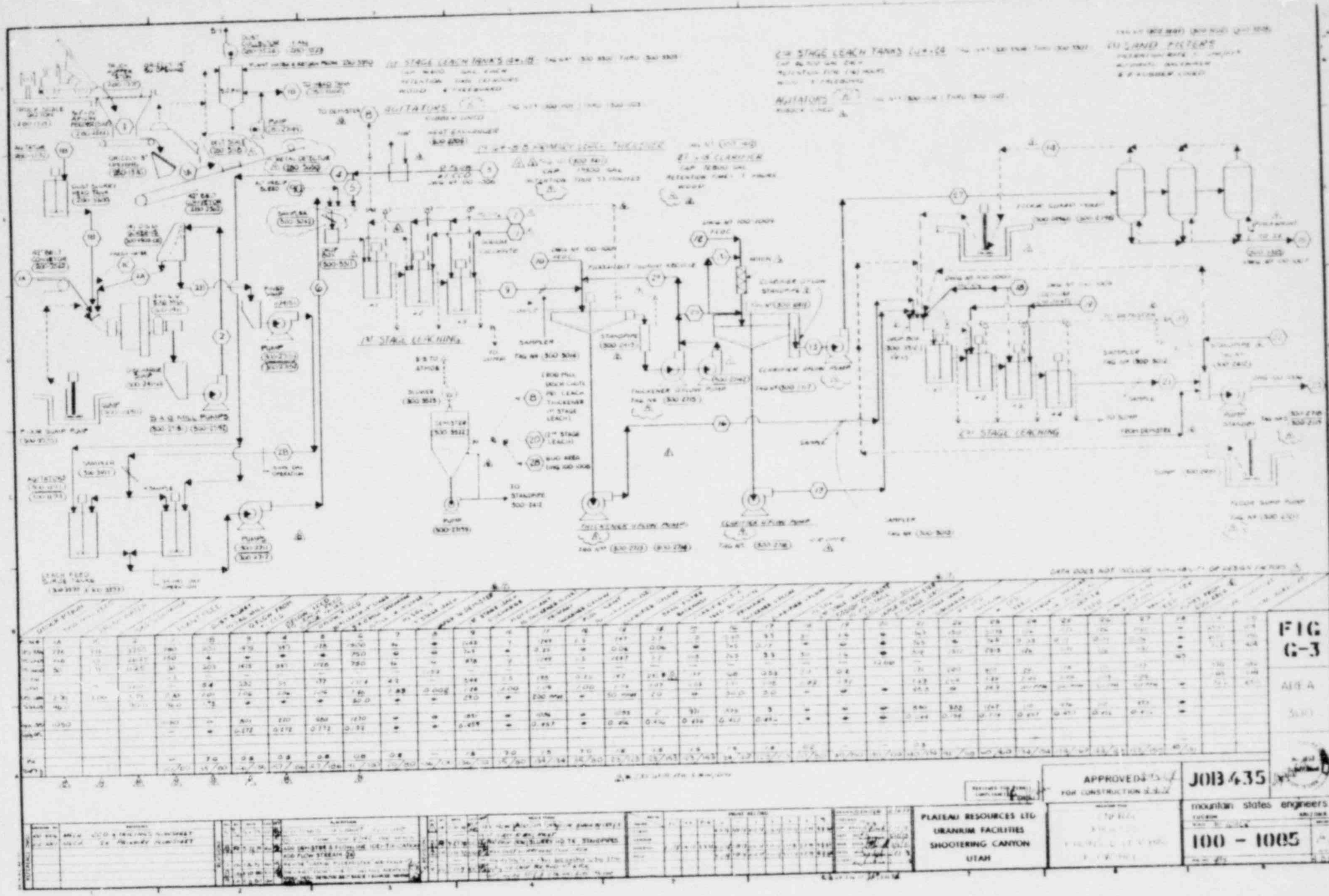
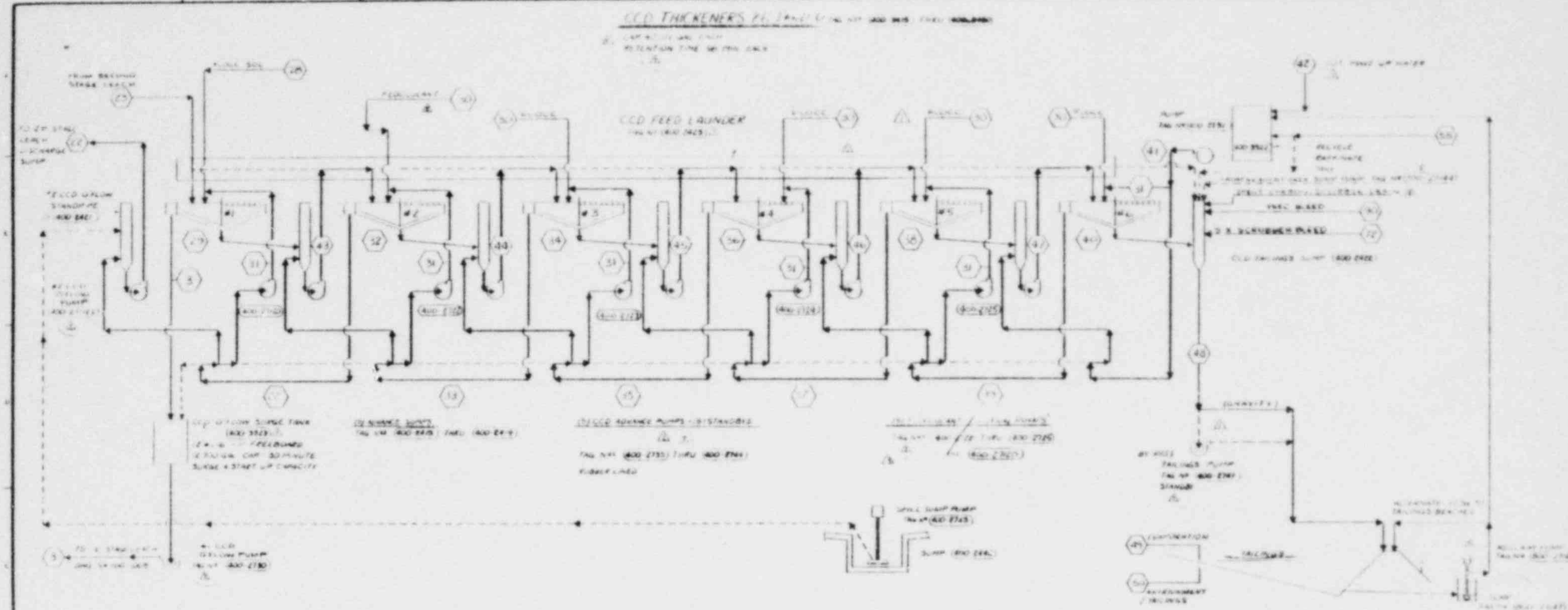


FIG 21-3
ZONE 2 BORROW AREA
APPROVED FOR CONSTRUCTION
JOB 435
PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
mountain states engineers
100-1001



1st STAGE LEACHING
2nd STAGE LEACHING
AGITATORS
RUBBER LINED
SAND FILTERS
SAMPLER
DEMISTER
PUMP
THICKENER O'FLOW PUMP
CLARIFIER O'FLOW PUMP
FLOOR SUMP PUMP
LEACH FEED SURGE TANK
TO STANDPIPE
APPROVED FOR CONSTRUCTION
JOB 435
FIG G-3
PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
mountain states engineers
100 - 1085



COUNTER CURRENT DECANTATION & TAILINGS

DATA DOES NOT INCLUDE VARIABILITY OF DESIGN FACTOR

FLOW #	3	22	25	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	71	72	90
TPD TOTAL	1975	1671	2996	5	1560	225	125	1530	1427	1530	1515	1530	1527	1530	1440	1530	1910	100	3033	3053	3054	3052	3034	1534	870	1104	118	18	[illegible]
TPD SOLIDS	*	—	765	*	765	*	*	765	*	765	*	765	*	765	*	765	*	*	766	768	764	765	769	766	—	766	*	*	*
TPD H2O	1475	1671	2231	5	765	228	125	765	1427	765	1415	765	1424	765	1440	765	410	100	2274	2275	2289	2287	2265	789	870	405	118	18	[illegible]
[illegible]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
GPM	231	236	396	1.6	167	0.37	20	169	[illegible]	169	227	170	227	170	227	170	224	20	408	410	410	410	410	214	144	193	133	2.5	1.9
SPG. GRAV.	1.06	1.05	1.25	1.0	1.52	2.00	1.04	1.51	1.04	1.50	1.04	1.50	1.04	1.50	1.04	1.50	1.04	2.00	1.28	1.28	1.28	1.28	1.28	1.45	1.00	1.26	1.08	1.03	1.06
% SOLIDS	*	*	26.9	*	50.0	*	*	50.0	*	50.0	*	50.0	*	50.0	*	26.2	*	*	25.2	25.2	25.2	25.2	25.2	49.2	*	65	*	*	*
U_3O_8 LB/D	801	188	1167	*	467	*		270	191	170	91	150	41	94	13	97	2	*	1165	961	811	185	96	82	*	82	2	1	*
* U_3O_8 GPL	0.272	0.154	0.174	*	0.272	*		0.32	0.066	0.046	0.081	0.081	0.014	0.014	0.005	0.006	0.002	*	0.155	0.066	0.022	0.014	0.006	0.004	*	0.011	0.010	0.008	*
PH	0.2	0.8	[illegible]	7.0	0.6	7.0		0.8	1.0	1.0	1.2	1.2	1.4	1.4	1.3	1.3	1.3	7.0	0.7	0.8	1.3	1.3	1.5				1.5		7.0
TEMP °F	106/135	91/98	60/60	60/80	106/135	35/80	91/91	91/98	85/110	85/110	85/110	85/110	86/112	88/112	49/116	45/116	44/121	72/72	106/116	91/91	65/85	69/85	56/88	—	—	—	49/144	70/88	64/107

* INCLUDES ADSORBABLE URANIUM

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FIG G-4

AREA 400

PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH

mountain states engineers

100 - 1006

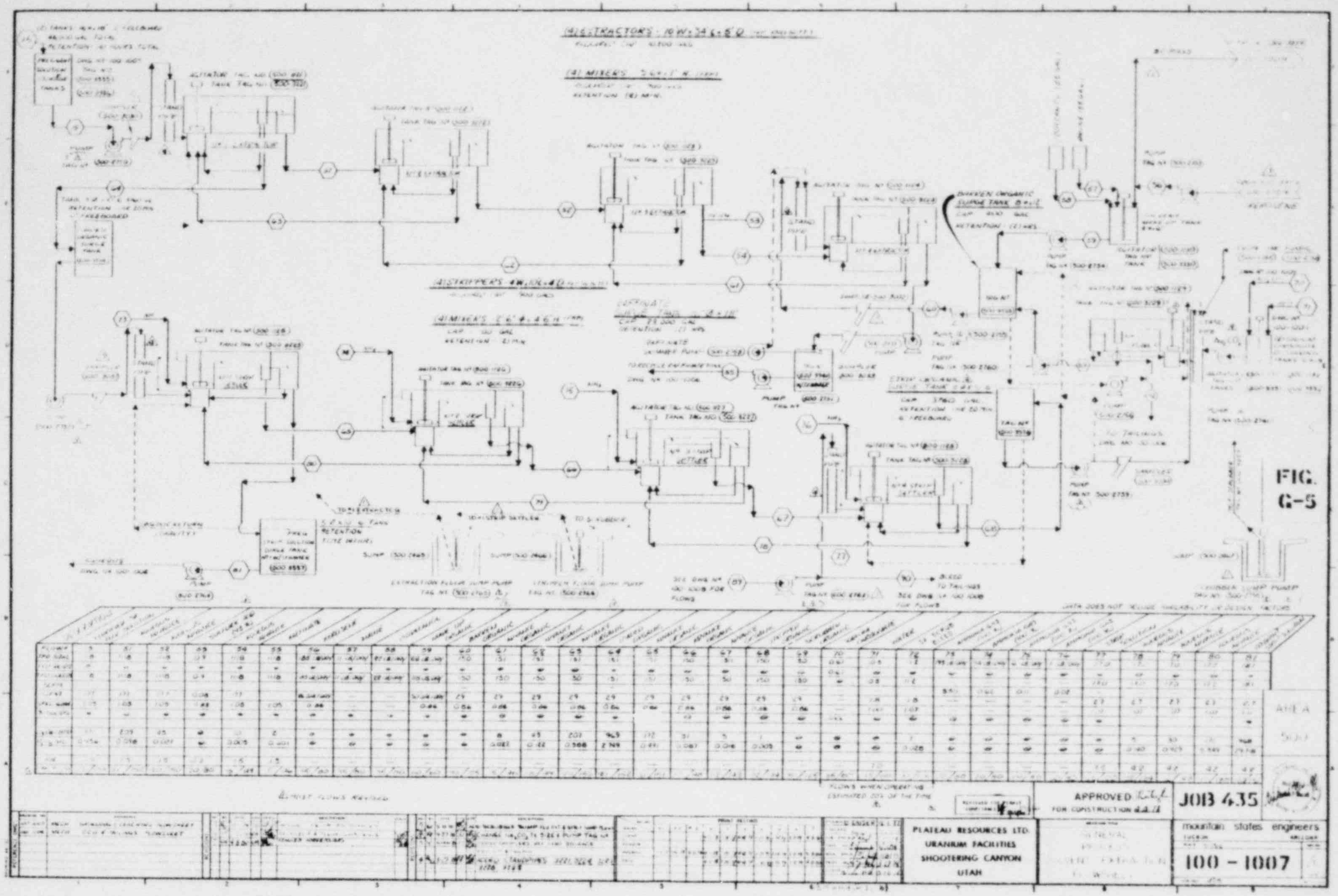

FIG.
G-5
(4) EXTRACTORS
(4) MIXERS
(4) STRIPPERS
(4) MIXERS
BARREN ORGANIC SURGE TANK
SUMP (500 2465)
SUMP (500 2466)
PUMP
APPROVED
FOR CONSTRUCTION
JOB 435
PLATEAU RESOURCES LTD.
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
mountain states engineers
100 - 1007
AREA
500

FIG. G-5

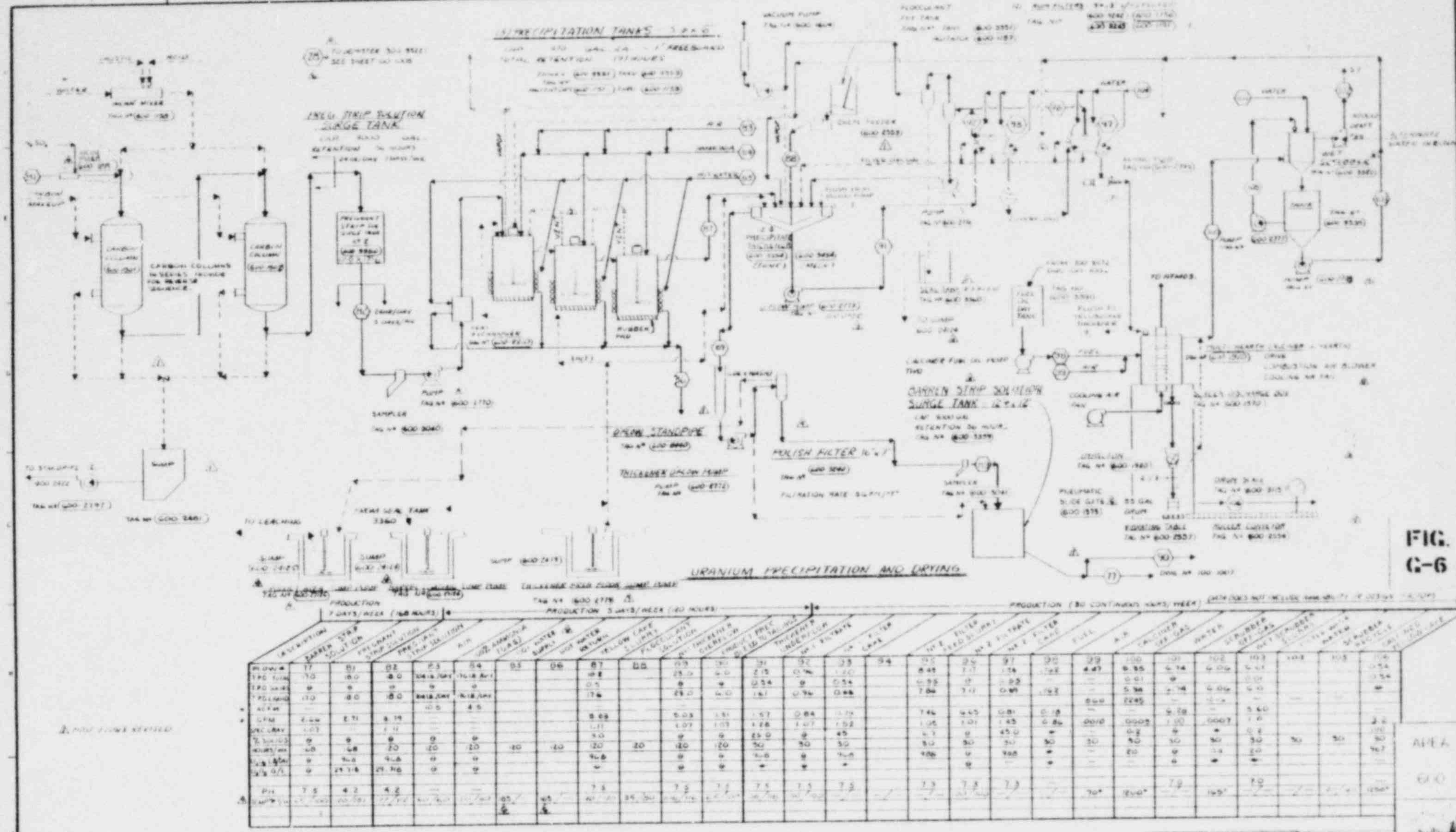

FIG. G-6

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AREA 600

SX PRIMARY FLOWSHEET

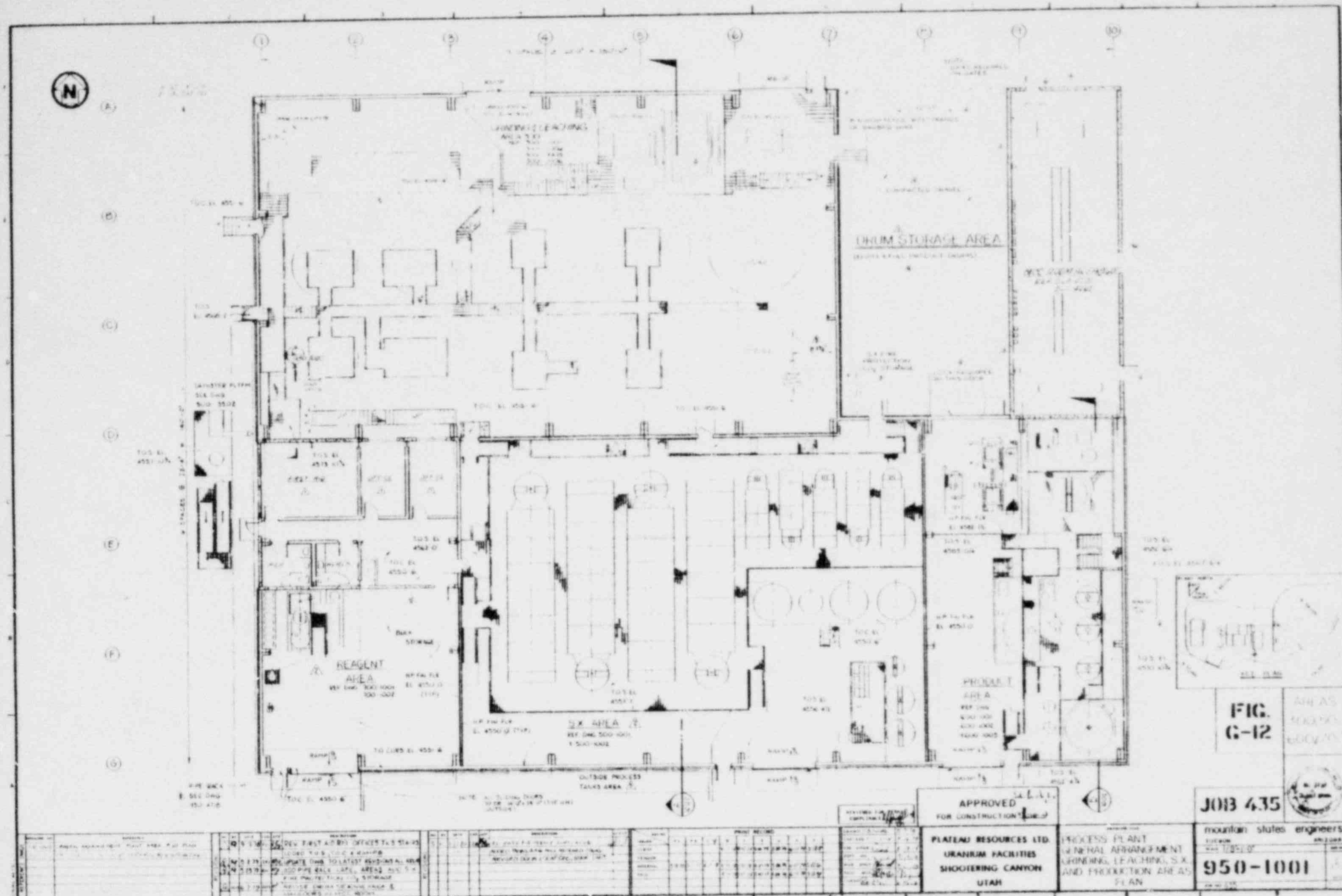
PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH

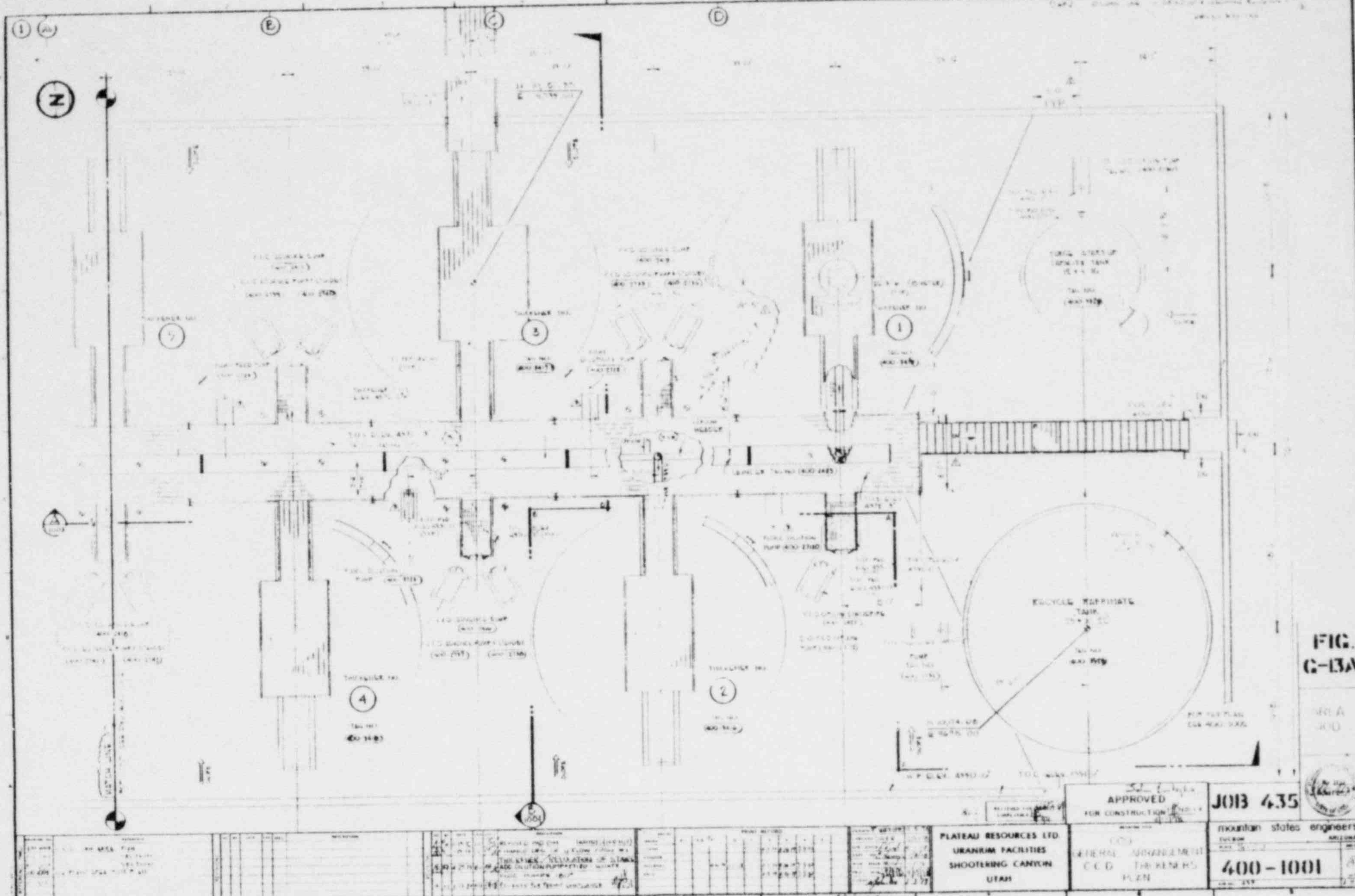
GENERAL
PROCESS
CONCENTRATE PRODUCT
FLOW SHEET

mountain states engineers

TUCSON ARIZONA

109-1008


GRINDING LEACHING
DRUM STORAGE AREA
REAGENT AREA
SX AREA
PRODUCT AREA
OUTSIDE PROCESS TANKS AREA
FIG. G-12
JOB 435
APPROVED FOR CONSTRUCTION
PLATEAU RESOURCES LTD.
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
PROCESS PLANT
GENERAL ARRANGEMENT
GRINDING, LEACHING, S.X.
AND PRODUCTION AREAS
PLAN
mountain states engineers
950-1001


RECYCLE RAFFINATE TANK
THICKENER NO.
APPROVED
FOR CONSTRUCTION
JOB 435
PLATEAU RESOURCES LTD.
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
CCD
GENERAL ARRANGEMENT
C.C.D. THICKENERS
PLAN
mountain states engineers
400-1001
FIG.
G-13A

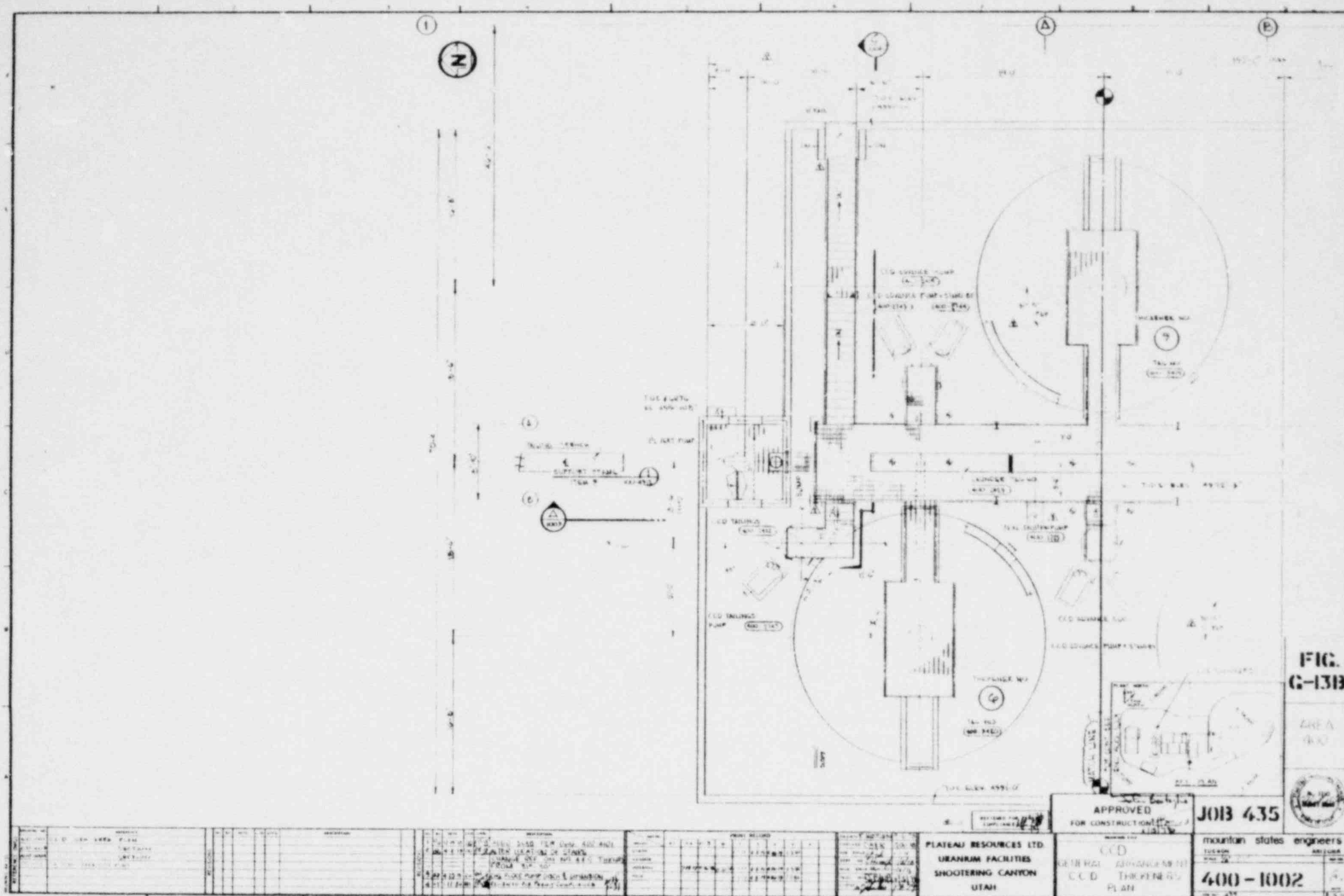
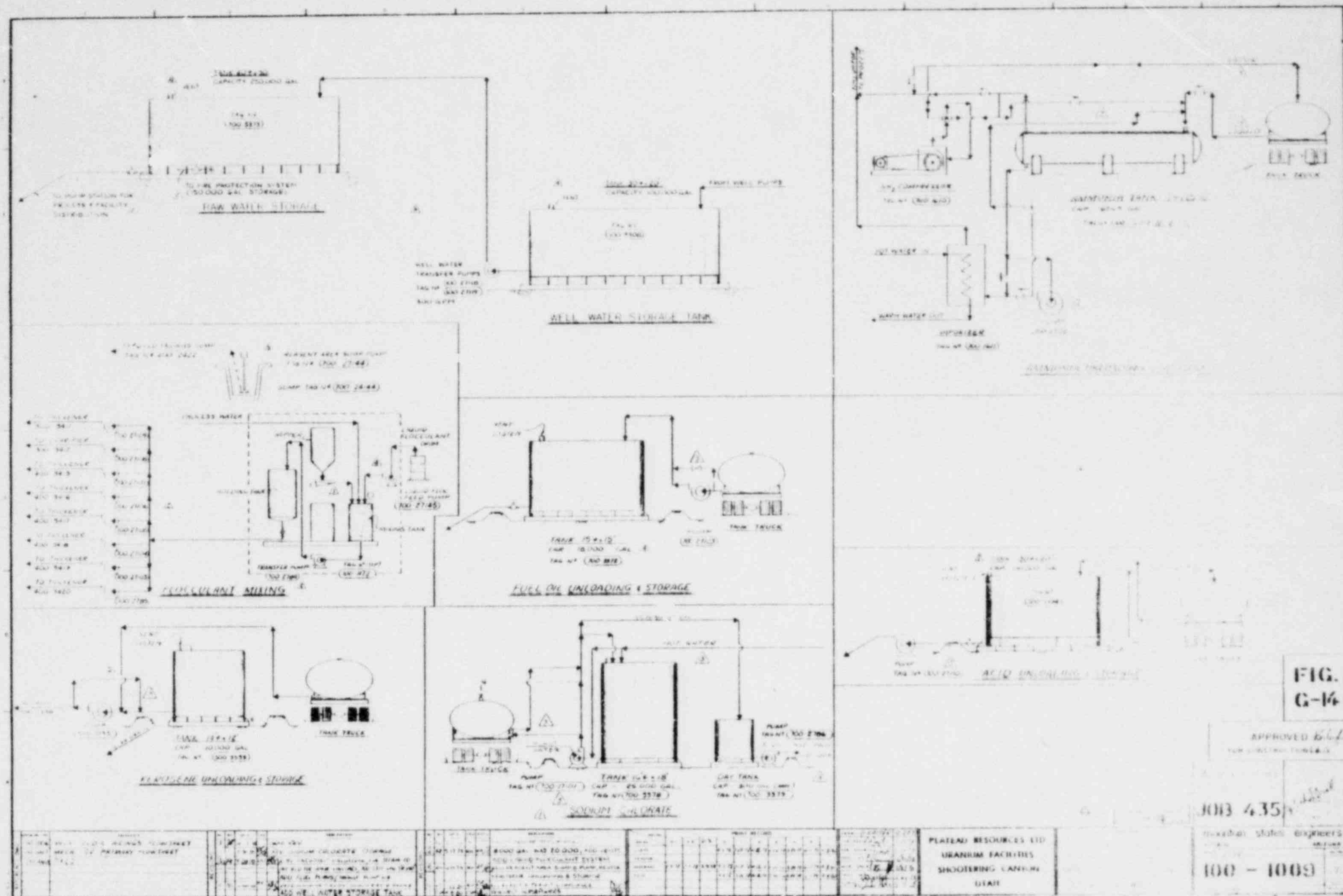


FIG. G-13B
AREA 400
APPROVED
FOR CONSTRUCTION
JOB 435
PLATEAU RESOURCES LTD.
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
CCD
GENERAL ARRANGEMENT
C.C.D. THICKENERS
PLAN
mountain states engineers
400-1002
THICKENER No. 4
THICKENER No. 9
CCD TAILINGS PUMP
CCD ADVANCE PUMP


RAW WATER STORAGE
WELL WATER STORAGE TANK
FLOCCULANT MIXING
FUEL OIL UNLOADING & STORAGE
KEROSENE UNLOADING & STORAGE
SODIUM CHLORATE
ACID UNLOADING & STORAGE
TANK TRUCK
PLATEAU RESOURCES LTD
URANIUM FACILITIES
SHOOTERING CANYON
UTAH
APPROVED
JOB 435
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100 - 1009
FIG. G-14