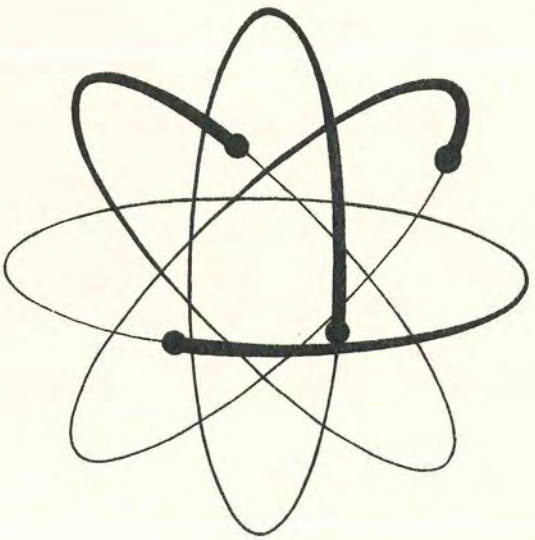
Environmental Assessment Report on PROPOSED YEELIRRIE URANIUM PROJECT



DEPARTMENT OF
CONSERVATION & ENVIRONMENT
WESTERN AUSTRALIA

BULLETIN No 53

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HON. MINISTER FOR INDUSTRIAL DEVELOPMENT

Your Ref.
Our Ref.

The Environmental Review and Management Programme prepared by Western Mining Corporation Limited for its Yeelirrie Uranium proposal has been considered by the Environmental Protection Authority following submissions by the public and Government Departments.

Please find attached the Authority's report and recommendations as requested in your letter of 3 July, 1978.

Colin Porter
CHAIRMAN

P.R. Adams, Q.C.

Professor A.R. Main

17 January 1979

YEELIRRIE URANIUM PROPOSAL

by

WESTERN MINING CORPORATION

REPORT AND RECOMMENDATIONS

by the

ENVIRONMENTAL PROTECTION AUTHORITY

January 1979

DEPARTMENT OF
CONSERVATION & ENVIRONMENT

Western Australia

Bulletin No.

C O N T E N T S

2. INTRODUCTION

Western Mining Corporation Limited proposes to develop a uranium deposit on the Yeelirrie pastoral property in Western Australia. Based on a reject grade of 0.05% U_3O_8 the deposit is estimated to contain 46 895 tonnes of U_3O_8 in mineralised material averaging 0.14% U_3O_8.

Development of the deposit will involve an open cut mine, ore treatment plant, town and ancilliary services and a Company and consequential workforce aggregating some 850 persons.

The Yeelirrie pastoral property is located in a remote arid area of the State in the East Murchison pastoral region. This region is only sparsely populated; homesteads being located on average 30 km apart. The nearest towns are Sandstone (population 25, distance 100 km) and Wiluna (population 60, distance 80 km).

The regional centre is Meekatharra with a population of 830 and located some 160 km to the West.

In accordance with the Commonwealth Government's Environment Protection Administrative Procedures and the requirements of the Western Australian Government, the Company has prepared a Draft Environmental Impact Statement (EIS)/Environmental Review and Management Programme (ERMP) for the project.

The environmental investigations associated with the preparation of this Draft EIS/ERMP had two main objectives:

- to determine that proposed operating procedures are safe in terms of human health, and
- to ensure that the natural environment is protected so far as possible within the constraints of the project.

The practice to be followed in industrial hygiene and waste control for Australian uranium mining and milling operations is specified in the Commonwealth Department of Health's Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1975).

Estimates of radiation levels arising from the Yeelirrie project have been made in the document and compared to the requirements of the Code of Practice.

1. FOREWORD

In considering the Western Mining Corporation Yeelirrie proposal the Authority is well aware of widespread and deeply held concern over the proliferation of nuclear power, carrying as it does increased risks of radiation hazards through accidents to nuclear power plants, the processing, transportation and re-processing of fuel elements, and the possibility of the use and misuse of weapons grade fissile material for military and other purposes.

These wider issues were explored at some length during the Ranger Uranium Environmental Inquiry conducted during 1975 and 1976 under Mr Justice Fox. The first conclusion of that Commission was:

> "The hazards of mining and milling uranium, if those activities are properly regulated and controlled, are not such as to justify a decision not to mine and sell Australian uranium."

The Environmental Protection Authority has not sought to judge afresh these issues, if indeed it is competent to do so; nor does it see any reason to disagree with the principal findings of the Fox Inquiry. The Authority has however closely examined the proposed development at Yeelirrie from the point of view of the impact of such a project on the area, its flora and fauna, and the physiography and people.

3. THE PROPOSAL

3.1 Location/Land Use

The Yeelirrie pastoral lease upon which the orebody occurs is some 3 750 km^2 in area. It is located 550 km inland from the port of Geraldton and 700 km north-east of Perth.

Yeelirrie station is situated in the Murchison topographical region of the State with Meekatharra and Leonora being the principal regional centres. At the present time much of the activity in these towns is directed to servicing the pastoral industry, which as a result of mediocre prices for wool and beef and increased costs is currently experiencing economic difficulties.

3.2 Geology and Land Form

The Yeelirrie uranium deposit occurs in carbonated sediments in the central drainage channel of a wide, flat and long valley flanked by granitic breakaways of low topographic relief (50 - 100 metres). Uranium mineralisation occurs as carnotite in calcrete and kaolinitic clay-quartz. During the development of the present topography, uranium was leached out of the weathered granite of the breakaways and transported in solution via the groundwater to the valley floor where it subsequently precipitated. It occurs as filling in fractures, voids and as a coating on mineral grains. Carnotite is potassium uranyl vandate ($K_2O.\ 2U_3O_8.\ V_2O_5.\ nH_2O$).

3.3 Climate

Yeelirrie is located toward the inland extreme of two separate weather systems. The main influence on the climate is the east-west belt of high pressure systems which lies over the southern portions of Australia throughout the year. During summer this belt of high pressure systems moves southward and the climate at Yeelirrie also becomes influenced by the northern monsoonal system.

Rainfall in the area is variable and unpredictable. It occurs either with the passage of winter cold fronts or as a result of local thunderstorms during summer. Average rainfall is 208 mm annually, but the recorded range lies between 43 mm and 505 mm.

Temperatures are more extreme in the valley than on the plateau, the maximum and minimum temperatures of the valley being 45^0C and -5^0C respectively.

Stable atmospheric conditions occur more frequently in winter as do low level nocturnal inversions.

3.4 Mineral Resources

The Yeelirrie deposit is estimated to contain 46 895 tonnes of uranium oxide (U_3O_8) in 33.81 million tonnes of mineralised material averaging 0.14% U_3O_8 using a cut off grade of 0.05% U_3O_8.

The market value of the total U_3O_8 product would be about US$3 900 million based on 95% extraction and U_3O_8 selling at US$40 per pound. Although not stated in the document it is thought that the vanadium pentoxide (V_2O_5) co-product would return about US$70 million to the producer (V_2O_5 @ US$2 per pound).

3.5 Mining Operation

In the first phase of mining only the material (12.15 Mt) containing more than 0.15% U_3O_8 will be treated. Lesser grade material (9.22Mt) will be stockpiled to be treated in the second phase of mining, with newly mined ore (5.53Mt) containing 0.10% U_3O_8. Economic conditions in the future will determine whether material (6.91 Mt) containing 0.05% U_3O_8 or better is mined and treated. A treatment rate of 1.21 million tonnes per annum is envisaged.

A conventional open cut operation with standard earth moving equipment is considered by the Company as the most practical available method to achieve the degree of selective mining required.

The only alternative mining technique discussed briefly in the EIS/ERMP is the use of a "bucket wheel" excavator. Other possible mining techniques such as 'in situ' leaching have not been discussed.

The deepest part of the open cut is expected to be no greater than 9 metres below original surface.

For the first two years from the start of mining, saline water totalling 24 000 cubic metres (5.28 million gallons) per day will be pumped from the open cut to the tailings ponds. Water from the open cut is unfit for human or animal consumption.

3.6 Ore Treatment

The proposed plant throughput rate is 1.21 million tonnes of ore per annum. On the basis of the proposed mining programme, the plant will treat prime ore with an average grade of 0.23% U_3O_8 for the first ten years of operations, and then intermediate ore with an average grade of 0.09% U_3O_8 for a further twelve years.

The uranium mineralisation occurs in a carbonated clay-quartz matrix, the high carbonate content of which precludes the economic dissolution of uranium by acid leaching, which is the process more typically employed for uranium ores.

Three treatment circuits are under consideration for the Yeelirrie ore, all employ the following sequence of process:

- reduction of ore to fine particle size;
- leaching of ground ore by sodium carbonate solution;
- recovery of leach liquor by counter current decantation;
- removal of vanadium from leach liquor and subsequent processing to a refined saleable product;
- removal of uranium from leach liquor and subsequent processing to a refined saleable product, and
- recirculation of barren liquor to process.

The final products yellowcake (95% U_3O_8) and redcake (90% V_2O_5) will each be packaged in steel drums each holding 425 kilograms.

3.7 Tailings Disposal

The Company proposes to place tailings in a permanent surface storage situated about 3 kilometres north of the ore body. This three-celled 310 hectare dam is designed to hold 27 million dry tonnes of tailings having a density (dry) of 1.3 t/m^3. It will have eight metre high earthquake resistant earthfill retaining embankments with rock armouring on the external walls and toe for erosion protection. On completion of operations each cell will be covered with 0.6 m of solid and coarse gravel.

The foregoing method of disposal of tailings is preferred by the Company and is one of four methods covered in the report.

The four options considered were:

1. disposal in a permanent surface storage;

2. disposal in excavation other than the open cut;

3. disposal in the open cut progressively with mining, and

4. disposal in the open cut after mining is completed.

The total cost of tailings disposal varies between $7.6 million (Option 1) and $49 million (Option 4).

The storage will be a depository for minewater and various plant wastes as well as tailings.

3.8 Transportation

The most significant of the ingoing supplies during operations will be fuel oil and caustic soda solution. Consideration has been given to the supply of caustic soda solution through Esperance, Kwinana and Geraldton, and thence to Yeelirrie by various rail/road possibilities. Supply through Esperance appears to be most likely.

Yellowcake and redcake will be packaged in 425 kilogram steel drums and, dependent on present State Government/ Company negotiations, will be transported by road on flat topped trucks to the port of Fremantle.

3.9 Town

The Company proposes to establish a town for an estimated workforce of company and non-company personnel of 850 persons. The town will be located on a plateau edged by breakaways 13 km north of the proposed open cut mine.

Because of the expected high cost of on-site construction in Yeelirrie, maximum use will be made of transportable units constructed elsewhere. All houses and single quarters will be cooled with evaporative coolers.

Special attention will be paid to the establishment of

suitable educational, recreational, sporting, religious and medical facilities. Commercial facilities will include shopping complex, post office, tavern/bottle shop and service station.

It is expected that the Company will provide the majority of the houses and facilities in the town, although private investors and operators may provide some of the commercial facilities.

3.10 Water Supplies

Water for the project will be obtained from groundwater reserves in the region. Potable water containing not more than 1 000 mg/l TDS is required for the town and some industrial and metallurgical applications. Process water containing up to 6 000 mg/l TDS is required for the Plant circuit water and road watering.

Potential reserves have been located on the basis of existing bores, some preliminary drilling and geological considerations. A more extensive drilling programme is necessary to prove the reserves and may result in some modification of current plans, particularly with respect to the location of the reserves.

3.11 Land Holdings

The Company holds the lease to the Yeelirrie pastoral property and mineral claims over the uranium mineralisation. When all implications of the proposed operations have been considered the total area required for those operations will be determined and application will be made for a Special Mining Lease.

On the granting of that lease the balance of the Yeelirrie pastoral property will be surrendered to the State Government.

Within the Special Mining Lease a Restricted Area as defined by the Code of Practice will be fenced.

At abandonment of the project the Special Lease will be surrendered to the State Government.

4. ENVIRONMENTAL ASSESSMENT

A total of eighteen State Government Departmental submissions, twenty-eight public submissions and discussions with relevant senior State and Commonwealth scientific officers, have been taken into consideration in the assessment of the Yeelirrie EIS/ERMP. In addition, the Department of Conservation and Environment has held discussions with Western Mining Corporation on environmental issues involved with the project and the results of these discussions were available to the Authority.

4.1 Tailings Disposal

The method for the containment of tailings is considered to be one of the major environmental impacts associated with the project.

The Company has considered four tailings disposal options (see 3.7), and has indicated a preference for Option 1. It has based this preference on the following criteria:

- Low grade ore (0.05% to 0.01% U_3O_8) cannot be economically mined and treated under present operating costs and market conditions, however, economic conditions may be such towards the end of the planned mine life (22 years) that this material can be economically extracted and treated. If tailings are deposited back into the mine pit the low grade material below the pit floor will be made sterile.

- The cost of Option 1, as estimated by the Company, is substantially less than the other options considered.

The Company estimated costs for each option, in summary are:

Option 1	-	Disposal in permanent surface storage	$ 7.6 mill.
Option 2	-	Disposal in excavation other than the open cut	$39.6 mill.
Option 3	-	Disposal in the open cut progressively with mining	
		(a) Backfill to 0.10% outline	$ 7.6 mill.
		(b) Backfill to 0.05% outline	$22.4 mill.

Option 4 - Disposal in the open cut after mining is complete $49.0 mill.

The cost of Option 1 does not include provision for an impermeable membrane below the dam, establishment of adequate monitoring bores in the vicinity of the dam and the likely cost of maintaining this surface structure in perpetuity.

The cost of Option 3(b) has not been offset by profits from treating material won from the 0.10% - 0.05% U_3O_8 halo, under possible future favourable economic conditions.

The geometry of the ore body is such that low grade mineralized material (0.10% - 0.05% U_3O_8) adjacent to the open cut would remain available for extraction if tailings were returned to the open cut. The low grade mineralisation halo appears to have a greater lateral extent than vertical, thus only that part of the mineralization below the floor of the open cut would be sterilised by returning tailings to the pit.

No system of covering and containing tailings stored above the level of the countryside can be guaranteed to last for a very long period of time. The risk that the tailings will be exposed by a dam wall failure caused by unforeseen climatic conditions or earthquakes cannot be discounted.

Based on the information provided the Authority believes that Option 3 (disposal of tailings in the open cut progressively with mining) will result in:

- minimum overall disturbance to the environment during mining;
- minimum long-term impact on the landscape;
- minimum area of exposed radioactive material;
- a significant reduction in the amount of radon released to the atmosphere, and
- avoidance of a permanent surface storage, with its long-term hazard potential and maintenance costs.

It is therefore recommended:

that, all tailings be disposed of in the open cut progressively with mining and covered with approximately three metres of mined waste to approximately restore to pre-existing ground level.

It is important to bear in mind that there are many reasons why the mining operations may stop permanently, indefinitely or for a substantial period of time before the planned termination of activities.

Based on the information presented the Authority sees three possible alternatives in respect to the project life of the Yeelirrie proposal:

1. The Company will implement Phase I of the mining programme to mine 21.37 million tonnes of ore, 12.15 million tonnes of this ore will be of prime grade material which will be fed to the treatment plant in preference to the intermediate grade ore mined concurrently. Market or other conditions may be such at this point that the medium and low grade material will be uneconomic to mine and the operations may permanently stop, or

2. after treatment of the prime grade material, economic and/or other conditions may cause the mine to be placed on a care and maintenance basis for an indeterminate time, or

3. the mining programme may progress through Phase I and Phase II as outlined in the EIS/ERMP.

The Authority believes that the method of tailings disposal should be such as to present the least possible environmental hazard at all stages of mining, so that in the event of premature shut down of the project, the Government is not left with a substantial long-term environmental problem.

It is therefore recommended:

that, no permanent surface storage of tailings be allowed and that after the first five years all tailings should be disposed of in the mine pit leaving no surface storage.

4.2 Plant Decommissioning

No firm details of plant decommissioning are given in the EIS/ERMP document.

It follows from the discussion on tailings disposal that the Company must give early consideration to the formulation of detailed decommissioning procedures. The

procedures should include plans for decontaminating the site, disposal of contaminated plant and materials and details of restoration of the area to as natural a state as possible.

Guidelines would need to be set on the levels of radioactive contamination which would be allowed for various means of disposal of plant and equipment. For example, sale of some plant might need to be prohibited because of risk to prospective buyers, and it is possible that some sections of plant circuitry will be highly contaminated due to the localized precipitation of radium. The disposal of these sections must be carried out under the supervision of the relevant State Authority.

It is recommended:

that, the Company must accept the responsibility for decommissioning and within five years of the start of mine operations develop detailed decommissioning procedures in consultation with the relevant State Authorities.

The Company states that on completion of the project the final position of the Restricted Area boundary will be established inside the Special Mining Lease. The land which is covered by the Special Mining Lease will be surrendered to the State Government.

The Government must consider the likely cost to the State for the long-term maintenance of the 'Restricted Area'.

4.3 Radiation Protection

A Radiation Safety Officer, responsible to the Project Manager, will be appointed to take all necessary measurements in connection with all activities where radiation of any significance may occur and to maintain all necessary records.

Three mechanisms of irradiating humans were considered in the document: ingestion, inhalation and exposure to external gamma rays.

Note: The following quotation is from a paper prepared by Dr G M Watson, Chief, Health and Safety Division, Australian Atomic Energy Commission.

"The radiological hazards of uranium mining

We are concerned here only with delayed effects; there is no possibility of major acute exposure in mining or milling. The serious hazards are two: external wholebody gamma irradiation and the inhalation of radon and its daughter products in the mine atmosphere. There are lesser risks from contamination with particulate radioactive materials, uranium poisoning and uranium mines are not exempt from the hazard of silicosis, but we are concerned mainly with the first two. Of these external gamma radiation will not usually be a serious problem and when it is, it should not be too difficult to control. The inhalation risk is much the more serious and it is this exposure which has caused lung cancer in miners."

Ingestion: The possibility of employees ingesting radioactive substances has been recognised by the Company which will take particular care to clean equipment so as to prevent tracking of radioactive dust into such places as meal rooms and recreation rooms.

The greatest component of radiation dose to the public and a significant dose to workers comes from the bone dose resulting from the estimated consumption of water with relatively high radium content. When the final selection of the domestic water supply source is made it may be necessary to take action to reduce the radium content of water used for human consumption.

External Gamma Radiation: It is calculated that external irradiation of most employees by gamma rays would give a total dose of 2 rem in a year as compared with the maximum permissible dose of 5 rem*.

Workers in the open cut and yellowcake workers will receive up to 3 rem per year assuming normal working hours. To limit the exposure to all these workers their hours of work should be closely watched as increased hours, such as overtime, will inevitably result in higher exposures perhaps exceeding the maximum permissible levels.

It is therefore recommended:

that, the process of ore grade determination in the pit floor and the yellowcake circuits should be automated to the greatest extent possible to reduce gamma exposure to ore graders and yellowcake workers.

Inhalation: It is calculated in the document that the annual dose equivalents to the lung through inhaling

* rem (Roentgen Equivalent Man) - A unit of radiation dose adjusted for biological damage.

long-lived nuclides would reach 1% of the maximum permissible dose for the lungs. The annual exposure to radon daughters on site could reach 0.36 WLM*which is 0.09 of the 4 WLM specified in the Code of Practice.

Attention is drawn to the raised level of radon daughter concentrations during prolonged atmospheric inversions, particularly just before sunrise. The EIS/ERMP states that a meteorological station will be maintained at the mine which will enable inversion conditions to be detected. Monitoring of the radon and its daughters in the mine pit during such atmospheric conditions is essential.

In respect to atmospheric conditions the Authority believes that the recommendations presented on page 149 of Appendix II by R K Steedman and Associates should become mandatory, and therefore recommends:

that,

a) *Under conditions of strong stability and low wind speed (particularly during the winter) the airborne concentrations of gases and dusts may build up and should be continuously monitored. This is particularly important in sheltered areas such as the pit, which is below ground level and naturally inhibits dispersion.*

b) *The presence of the low level shear, which can be estimated from a simultaneous evaluation of the Crusher and Breakaway anemometer records, needs to be considered in the design of the stack and other mine operations.*

c) *Because of the harsh environment, it is desirable to consider heat discomfort in the design of buildings. The degree of discomfort can be determined from existing data.*

d) *In view of some difficulties with the mixing depth calculations, consideration should be given to direct measurement of the vertical atmospheric structure by acoustic sounding. This will be particularly important during the winter periods when the mixing heights are close to ground level.*

e) *Meteorological stations should be operated during the mining operations to enable correlations between the airborne effluent (Rn_{222}, U_{238} and SO_2) concentration levels and the meteorological conditions. These correlations will be particularly important if the working levels rise to high values during the winter period.*

* WLM (Working Level Month) - Special unit of radiation dose inhaled, over a working period of one month.

f) Consideration should be given to providing ground truth measurements to the dispersion calculations for part of the production period. Both summer and winter seasons should be included in verifying the model dispersion estimates.

In respect to the inhalation radiation hazard, associated with emissions from the processing plant, it is recommended:

that, when the final selection of the process circuit has been made, specific details and safeguards on radiation emissions and composition of tailings should be reviewed and included in the Environmental Management Programme, and

the methods advocated for the containment of airborne wastes should be further reviewed when more detail on the process and individual equipment units is available. In particular the Company should provide for:

- *back-up units in case of failure of an operating unit, and*
- *automatic plant shut down in the event of failure of a dust collection unit.*

4.4 Radiation and Dust Monitoring

The Company states in the EIS/ERMP that it will conduct its operations in accordance with the requirements of the Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1975) and in accordance with the requirements of the WA Mines Regulations Act 1976 and the WA Clean Air Act 1971 as amended.

The safety inspection frequency at the mine and treatment plant and the health physics instrumentation to be used are within requirements and guidelines set in the Code of Practice.

The Company also states that consultation with the relevant Statutory Authority will precede the purchase and establishment of monitoring instruments to measure airborne concentration of radioactive materials, surface contamination and external dose rates.

Medical examinations and the maintenance of full medical records as directed under the Code of Practice will be adhered to.

Under present State Legislation surveillance of radiation hazards is conducted by the State X-Ray Laboratory. In

respect to the Yeelirrie operations Laboratory officers would be able to conduct spot checks to check readings made by the site Radiation Protection Officer and to make recommendations regarding the implementation of additional safety measures where required. The Laboratory is not able to examine large numbers of samples, nor is it able to assess the public exposure to radiation through ingestion of trace amounts of radio-active material in water or food stuffs.

It is recommended:

that, in order to ensure that satisfactory radiation safety procedures are being observed, all records maintained by the Radiation Safety Officer (as required under the Commonwealth Code of Practice) must be made available to the appropriate State Authority. It is also considered important that the special provision of the Code of Practice in relation to medical surveillance be strictly observed and employee records made available for Public Health Department scrutiny.

4.5 Transportation of Yellowcake

Section E.2 of the EIS/ERMP examines in detail the transport of yellowcake by road from the plant to the port. It reviews the transport requirements and dose limitations, indicates the likelihood of accidents, examines the consequences of spillage and outlines the remedial measures to be employed.

The Company undertakes to transport yellowcake according to the regulations promulgated by the International Atomic Energy Agency on which Codes of Practice and regulations throughout the world are generally based.

In the event of road transport being selected for the transportation of yellowcake an unsealed road connecting the Yeelirrie townsite with Mt. Magnet and passing in the vicinity of Sandstone will be constructed. This represents a distance of some 260 km and in these areas even relatively small volumes of traffic can cause a rapid deterioration in the running surface of such roads. Under these road conditions it will be necessary to ensure that the load of yellowcake drums is made very secure to avoid accidental spillage.

It is therefore recommended:

that, in order to reduce the risk of yellowcake drums accidentally being dislodged from vehicles travelling on unsealed roads and as an additional safeguard in the event of an accident, the Company adopts the practice used elsewhere in Australia of sealing yellowcake drums into shipping containers at the mine site.

Transportation routes for yellowcake and ingoing supplies of caustic soda solution, sulphuric acid and fuel oil have not been finalised, however, it would appear that Esperance will be used for ingoing supplies and Fremantle for yellowcake export.

4.6 Rehabilitation

The Company makes no commitment in relation to rehabilitation procedures or standards. As stated by Blackwell and Cala (Appendix IV, p.66) rehabilitation procedures should be a part of the mining activity from its inception and the level of disturbance should be minimised. However, the Company states that revegetation will be achieved totally through the processes of natural regeneration.

An area of some 30 km^2 is to be disturbed during the mining operation: an area of this size cannot just be left to revegetate naturally.

Techniques which enhance and promote the development of stable vegetative cover of native plants on tailings and pit areas are available but not discussed in the EIS/ERMP.

It is therefore recommended:

that, the Company must undertake a specific time orientated programme of:

- *vegetation monitoring in the water draw down zone, and*
- *establishing a stable vegetative cover in disturbed areas.*

A discussion of techniques to be utilised in these respects should be included in the Environmental Management Programme.

4.7 Water Supply and Management

The sources of potable and process water have not been fully investigated, the Company has indicated the type of supply that could be anticipated based on a preliminary reconnaissance.

The reconnaissance consisted of a regional groundwater census, some exploratory drilling and geophysics. This

survey has indicated that "potable" water with a salinity between 450 and 1 380 mg/l TDS exists in parts of the alluviated catchment north and north-west of the mine site.

The data presented, and that of an earlier survey by the Geological Survey of WA, suggest that a better quality water is not likely to be found in the region.

Table CXIII, shows that at three sample points nitrate levels are all below the WHO maximum limit of 45 mg/l.

It is well known, however, that East Murchison groundwaters have nitrate levels ranging up to 125 mg/l. In fact it is unusual for groundwater supply in this region to have nitrate levels less than about 50 mg/l.

It is therefore recommended:

that, the Company providesan adequate alternative domestic water supply (ie. rain tanks, haulage from approved source, de-ionisation) for the purpose of providing higher quality water to mothers and infants.

When the final domestic water supply source is selected, the Company should present relevant analytical data including radium, nitrate and fluoride levels to the State Public Health Department for approval.

4.8 Aboriginal Sites

The Yeelirrie pastoral lease has been surveyed by staff of the WA Museum to determine the distribution of Aboriginal Sites of either cultural or archaeological importance.

With the exception of the 'Yeelirrie Pool' site the project operations are clear of all Aboriginal Sites identified by the WA Museum's study team. It is proposed that this Site and seven other Sites will be declared "protected areas" under the Aboriginal Heritage Act (1974).

In Section D. 11.3 the Company states that with education and supervision molestation of the Sites can be avoided. To this end the Company will, through the services of the Environmental Officer, implement any reasonable arrangement as may be requested.

Apart from concern for Sites the project does not appear to have any other impact on Aborigines, as none

are resident at Yeelirrie or dependent on the land.

In respect to the 'Yeelirrie Pool' Site it is recommended:

that, the Company gives special consideration to the protection of the pool and its environs, and should appoint a ranger to supervise the activities of visitors to the area.

The Company should liaise with the relevant staff of the WA Museum in developing an education programme for all employees and their dependents in respect to Aboriginal Sites.

4.9 Regional Resource Commitment

The two principal regional resources which will be committed in part to the project are groundwater and grazing land.

When considered in a regional setting the long-term loss of some 3 500 ha of land committed to the project is not significant in terms of land use. In terms of grazing capacity it represents some 3% of the Yeelirrie pastoral lease.

Direct consumption of potable and process groundwater over the project duration will vary depending upon the process circuit finally adopted. On the basis of available information water requirements will represent some 60% of the commandable potable reserves in the borefields examined and only a small fraction of the reserves of process water (up to 6 000 mg/l TDS) available.

In terms of landform, soils and regolith, Yeelirrie is broadly representative of other areas in the 34 000 km^2 sandstone-Mt. Keith block. From field studies conducted at Yeelirrie there is no evidence to suggest that the fauna and flora which occurs there is unrepresentative of that occurring in other similar landforms throughout the region.

5. CONCLUSION

The Yeelirrie Uranium Project draft EIS/ERMP is specific and detailed in certain environmental aspects, however, it is vague and deficient in areas such as processing plant circuitry, source, quality and treatment of potable water, disposal of tailings and rehabilitation of disturbed areas.

The tailings disposal method, because of the long-term environmental hazards associated with it, is regarded as one of the major impacts of the proposal. In the light of the information presented and the current state of knowledge, particularly as contained in the Fox Report the Authority believes that the only satisfactory long-term method of tailings disposal is by return into the ground. It is also recognised that certain detailed information on processing plant circuitry and the related radiation and dust emissions, and the source and quality of potable water is not available at present, however, the Company has indicated that further investigations on these aspects are planned. It has therefore been recommended in sections 4.3 and 4.7 and in points 6 and 10 in the Summary of Recommendations beginning on page 20, that such information be made available for assessment in the Company's Environmental Management Programme in accordance with Section 8(1)(n) of the Uranium (Yeelirri Agreement Act, 1978 and be made available to the appropriate Authorit

Those Government Department responses which have not been included in our specific recommendations should be given consideration by the Company in its Environmental Management Programme.

The Company has stated in the EIS/ERMP that it will conduct its operations in accordance with the requirements of the Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores (1975) and in accordance with the requirements of the WA Mines Regulation Act 1976 and the WA Clean Air Act 1971 as amended.

Attention is drawn to Section 13 of the Uranium (Yeelirrie) Agreement Act, 1978, in which this undertaking also must include any variations to existing codes of practice, adoption of new codes and other relevant legislation.

The Authority has noted in this respect that the recently enacted Nuclear Activities Regulation Act, 1978, provides a mechanism for the establishment and review of Codes of Practice for various aspects of the nuclear industry, and places reliance on that Act to maintain appropriate standards in the light of accumulating knowledge and changing social demands.

Subject to the recommendations made in this report and to the submission of a satisfactory Environmental Management Programme we see no environmental objection to the mining and processing of uranium at Yeelirrie.

6. SUMMARY OF RECOMMENDATIONS

Page

1. *that, all tailings be disposed of in the open cut progressively with mining and covered with approximately three metres of mined waste to approximately restore to pre-existing ground level.* 9

2. *that, no permanent surface storage of tailings be allowed and that after the first five years all tailings should be disposed of in the mine pit leaving no surface storage.* 10

3. *that, the Company must accept the responsibility for decommissioning and within five years of the start of mine operations develop detailed decommissioning procedures in consultation with the relevant State Authorities.* 11

4. *that, the process of ore grade determination in the pit floor and the yellowcake circuits should be automated to the greatest extent possible to reduce gamma exposure to ore graders and yellowcake workers.* 12

5. In respect to atmospheric conditions and with regard to the raised level of radon daughter concentrations during prolonged atmospheric inversions, particularly just before sunrise, the Authority recommends:

   that, 13

   a) *Under conditions of strong stability and low wind speed (particularly during the winter) the airborne concentrations of gases and dusts may build up and should be continuously monitored. This is particularly important in sheltered areas such as the pit, which is below ground level and naturally inhibits dispersion.*

   b) *The presence of the low level shear, which can be estimated from a simultaneous evaluation of the Crusher and Breakaway anemometer records, needs to be considered in the design of the stack and other mine operations.*

   c) *Because of the harsh environment, it is desirable to consider heat discomfort in the design of buildings. The degree of discomfort can be determined from existing data.*

Recommendation		Page
8.	*that, in order to reduce the risk of yellowcake drums accidentally being dislodged from vehicles travelling on unsealed roads and as an additional safeguard in the event of an accident, the Company adopts the practice used elsewhere in Australia of sealing yellowcake drums into shipping containers at the mine site.*	15
9.	*that, the Company must undertake a specific time orientated programme of:* . *vegetation monitoring in the water drawdown zone, and* . *establishing a stable vegetative cover in disturbed areas.* *A discussion of techniques to be utilised in these respects should be included in the Environmental Management Programme.*	16
10.	*that, the Company provides an adequate alternative domestic water supply (i.e. rain tanks, haulage from approved source, de-ionisation) for the purpose of providing higher quality water to mothers and infants.* *When the final domestic water supply source is selected, the Company should present relevant analytical data including radium, nitrate and fluoride levels to the State Public Health Department for approval.*	17
11.	*that, the Company gives special consideration to the protection of the "Yeelirrie pool" and its environs, and should appoint a ranger to supervise the activities of visitors to the area.* *The Company should liaise with the relevant staff of the WA Museum in developing an education programme for all employees and their dependents in respect to Aboriginal Sites.*	18
12.	*Those Government Department responses which have not been included in our specific recommendations should be given consideration by the Company in its Environmental Management Programme.*	19

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APPENDIX I

A REVIEW OF PUBLIC SUBMISSIONS RECEIVED ON THE YEELIRRIE ERMP

C O N T E N T S

1. INTRODUCTION

A total of 28 public submissions were received by the State and Commonwealth Departments. All were accepted by the Commonwealth under the Administrative Procedures of its Environment Protection (Impact of Proposals) Act 1974-75.

Many of the submissions were critical of the Company's lack of acknowledgement of recent findings in the USA on the effects of long term exposure to low dose radiation. Others ranged through the national and international implitions of uranium as the first step in the nuclear fuel cycle to areas of concern relating for instance to tailings disposal, conservation of aboriginal sites and radiation safety. The Company's attitude towards tailings disposal and responsibility for the maintenance of the tailings dam after mining terminated was a major point of concern.

Summary tables of submissions form part of this report. The tables note areas of concern, authors' backgrounds, attitudes to the proposal and criticism of the ERMP as a technical document.

2. PUBLIC REVIEW OF THE ENVIRONMENTAL CONTENT OF THE YEELIRRIE ERMP

A review of the 28 public submissions has identified 8 major areas of environmental concern, each of these areas is noted in a number of the submissions. A brief discussion of the eight areas of environmental concern is given in this section of the report.

2.1 Disposal of Tailings

The aspect of the Yeelirrie proposal which has caused most concern among the public (46%) of the submissions received) is the statement by the Company that the proposed method of tailings disposal is a permanent surface storage measuring 1.8 km x 1.7 km with an average height of 8 metres.

The submissions concentrated on three major issues:

- the choice by the Company of the cheapest tailings storage option available with apparent little regard to radiation hazard;
- the potential radioactive contamination of the surrounding area by groundwater seepage and possible dam failure, and

- the burden to the State of ensuring the safe maintenance of the stucture long after mining has ceased.

Specific radiation hazards associated with surface disposal of tailings have been discussed, in particular the likely effects of floods and earthquakes on the structure over a very long period of time. The concentration of radionuclides in the tailings liquor after evaporation and the inadequacy of a 0.6 metre cover of soil to reduce radon emanation from the tailings. Of the four reported options for tailings disposal, Option 3 (disposal in the open cut progressively with mining) or Option 4 (disposal in the open cut after mining) are by far the most acceptable.

2.2 Radiation Safety

Forty-three percent of the submissions indicated some concern in relation to radiation safety at the minesite, townsite or during transport. The concern for radiation safety encompassed a wide range of topics, including:

- the reliability of the results obtained by the dispersion modelling in view of the lack of reliable measured data, this casts doubt on the reported radon concentrations at the minesite;

- the maximum exposure to radon daughters by residents at the proposed townsite in the light of the recommendation by the Ranger Inquiry;

- the adequacy of the proposed radiation monitoring systems, and

- a lack of information on the inherent dangers of exposure to radon and long-term low dose radiation.

2.3 Hydrogeology and Water Quality

Thirty-nine percent of the submissions made comment on hydrogeology, and/or water quality. The disturbance of the groundwater regime as a result of the mine dewatering programme being of major concern. In considering the hydrological work undertaken by the Company, the supply of adequate quantities of potable and process water is questioned.

A number of the submissions also comment on the likelihood of groundwater being contaminated by seepage of tailings liquor containing high concentrations of radionuclides.

2.4 Flora and Fauna

Of the 28% of the submissions concerned with this topic, the majority were specifically concerned with the impact to the native fauna of introducing feral animals to the region, particularly cats.

It was said that the problem of birds using the tailings dams and other ponds involved in the various milling circuits was not given due consideration in the ERMP.

Field survey data on mammals, reptiles and in particular invertebrates was considered to be inadequate.

Comments on flora were generally restricted to the drawdown of the watertable by the mine dewatering programme and the effect this will have on existing vegetation.

2.5 Rehabilitation

The proposal by the Company to carry out very limited rehabilitation and generally let nature take its course is criticised by a number of submissions. The general opinion being that the Company should prepare a comprehensive rehabilitation programme incorporating contouring, stabilisation, seeding and monitoring during and after mining.

2.6 Aboriginal Sites

Twenty-nine percent of the submissions expressed concern in respect to the protection and conservation of Aboriginal Sites and/or Aboriginal land rights in general. The main criticism being that the Company makes no firm commitment to recommendations made by the WA Museum. The proximity of the proposed townsite to one of the Aboriginal Sites is of concern to a number of the submissions.

2.7 Long-Term Commitment and Decommissioning

It was pointed out by a number of submissions that it should not be left up to the State, and in turn the taxpayers, to maintain the tailings dam and the 'restricted area' once mining has closed. A trust fund should be set up for maintenance of the 'restricted area' by future generations.

A number of submissions were also concerned that the Company makes no commitment to decontaminate and decommission the processing plant and townsite once mining terminates.

2.8 Radiation Related Diseases

Twenty-one percent of the submissions expressed concern in respect to the question of responsibility for Yeelirrie employees and residents who contracted radiation related diseases after the mining operation has closed. The general conclusion reached by these submissions was that an adequate study be mounted to monitor the health of all employees after the cessation of mining and that WMC be liable for any compensation.

3. TECHNICAL INADEQUACIES OF THE ERMP

This section discusses the public criticism of the technical aspects of the ERMP itself and attitudes towards the 'Code of Practice' and the State's general environmental assessment and control procedures.

3.1 Criticism of the ERMP Itself

The major criticism of the document was that it did not follow the terms of reference, the example given in almost all cases was that the request by the Department of Environment, Housing and Community Development to discuss prospective markets and the project's relationship to other prospective uranium developments in Australia was not included in the document.

The report also lacked an adequate cost benefit analysis or any information on market research.

Considerations of alternatives to the proposal were very limited and it was the general opinion that the Company has only considered its most economic options.

A number of submissions criticised the availability, cost and length of the ERMP and recommended that future documents be placed in all State Libraries and the cost to be fixed at a maximum of $10 including appendices.

3.2 Inadequacy of Code of Practice

Twenty-nine percent of the submissions recommended that the Commonwealth Department of Health's 'Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores - 1975', should be immediately revised. In all cases the reason for revision being that recent research in the USA (Mancuso et al) indicates that the maximum permissible doses of ionising radiation reported in the Code of Practice should be reduced by a factor of 10 to 20.

The majority of these submissions recommended that the Yeelirrie project should not go ahead until this revision has taken place and the results taken into consideration in assessing the project.

3.3 Broader Issues of the Yeelirrie Proposal

Fifty percent of the submissions indicated that the ERMP should have included discussion on the national and international implications of exporting Australian uranium.

Some of the submissions indicated concern in respect to nuclear weapons proliferation, the possibility of terrorist groups obtaining nuclear weapons, hazards associated with nuclear reactors and the problem of high level nuclear waste management.

4. CONCLUSION

The number of public responses to the Yeelirrie Uranium Project ERMP indicates only a moderate level of public interest. The majority of the detailed submissions came from recognised environmental and conservation groups throughout Australia. The comments expressed in the 28 submissions received indicate a genuine concern for the hazards associated with ionising radiation and the management of radioactive wastes.

TABLE 1

DETAILED BREAKDOWN OF ENVIRONMENTAL ASPECTS OF THE YEELIRRIE ERMP

SUBMISSION NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
All Aspects of Flora	x											x			x														2
All Aspects of Fauna	x					x						x		x									x	x					6
Hydrogeology													x		x							x			x		x		5
Water Quality												x	x		x														3
Mine Dewatering																											x		1
Tailings Disposal	x						x					x	x	x	x	x				x	x	x		x	x		x		13
Mining Sequence																				x							x		2
Atmospheric Studies												x	x									x							3
Radiation Safety - Minesite						x								x															2
Townsite	x					x								x								x							4
General	x				x	x	x			x	x	x	x	x	x						x				x				12
Dust Control					x	x						x			x														4
Aboriginal Sites							x		x			x	x		x		x							x				x	8
Townsite													x		x							x			x				4
Employment	x						x														x	x							4
Proposed Rehabilitation												x	x		x														3
Alternatives Not Fully Discussed								x				x																	2
Public Health	x					x				x			x																4
Long Term Commitment Decommissioning							x				x	x	x								x								5
Respon. for Radiation Related Diseases					x	x					x	x	x								x								6
Inadequacy of Code of Practice		x	x	x							x		x	x							x					x			8
Further Research																													
Lack of Cost Benefit Analysis								x	x				x								x	x		x				x	7

TABLE 2

PUBLIC SUBMISSIONS - YEELIRRIE PROJECT

DETAILED BREAKDOWN OF THE TECHNICAL ASPECTS AND THE STATE'S ENVIRONMENTAL ASSESSMENT PROCEDURES

SUBMISSION NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
Qualifications Relevant to Subm.																x			x		x		x		x				5
Group Affiliations	x			x			x	x				x	x	x	x	x					x		x	x	x		x		14
Based on ERMP	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	26
Not Based on ERMP																	x	x											2
For																													
Against			x	x					x		x							x	x			x					x		8
Defer Pending Research							x			x		x		x	x								x			x		x	8
Request Inquiry								x					x								x								3
Proposed Constructive Recommendations	x													x											x				3
Availability of ERMP							x							x	x							x							4
Terms of Reference Not Followed	x						x	x	x			x	x	x	x						x							x	10
ERMP Too Long							x							x	x														3
Cost	x						x							x	x														4
Time Frame Inadequate																													0
EPA Report Should Be Made Public													x	x															2
Length of Submission No. Pages	8	3	1	2	2	6	4	3	6	2	4	13	6	30	5	3	1	1	1	1	12	13	1	4	4	1	3	2	143
National & Inter. Consequences of Uranium Mining.			x				x		x	x	x	x	x	x	x			x			x	x					x	x	14

TABLE 3

AUTHOR'S BACKGROUND	
Professional Qualifications Relevant to Submission	18%
Group Affiliation	50%
Lay People	32%
RELATION OF SUBMISSION TO ERMP	
Submission Based on ERMP	93%
Submission Not Obviously Based on ERMP	7%

TABLE 4

ATTITUDE TOWARDS THE YEELIRRIE PROPOSAL

For	0%
Against	29%
Request Public Enquiry	11%
Defer Pending Research	29%
Proposed Constructive Recommendations	11%
Non-Committal	20%

TABLE 5

AREAS OF ENVIRONMENTAL CONCERN TO THE PUBLIC

Major Issues Identified	% of Submissions Received
Disposal of tailings	46
Radiation safety	43
Hydrogeology and water quality	39
Flora and Fauna	28
Rehabilitation	11
Aboriginal Sites	29
Long term commitment and decommissioning	18
Radiation related diseases	21

TABLE 6

TECHNICAL INADEQUACIES OF THE ERMP

	% of Submissions Received
Terms of reference not followed	36
ERMP too long	11
Cost of ERMP excessive	14
Availability restrictive	14
Lack of cost benefit analysis	25

APPENDIX II

SUMMARIES OF STATE GOVERNMENT DEPARTMENTAL SUBMISSIONS

C O N T E N T S

1. DEPARTMENT OF LANDS AND SURVEYS

1.1 Yeelirrie Pastoral Lease

The Hon. Minister for Lands has approved a further period of three years, effective from July 1, 1978 during which time the lessee (WMC) is excempt from the lease stocking provisions, but is required to maintain improvements.

1.2 Mining Operations

In the area of post mining rehabilitation, the report appears to be inconclusive and further study on this aspect is required. Certainly relevant conditions would need to be included in the terms of the eventual mining or special lease negotiated, bearing in mind the contention that the mine area will be reverted to the Crown on cessation of mining activities.

1.3 Townsite

The problem posed by adjacent aboriginal sites has been noted and it would appear that eventual reservation of these sites will be needed and fencing of the sites would need to be a condition associated with reservation.

2. STATE ENERGY COMMISSION

The Commission does not have a direct interest in the area. However, their consultant on nuclear matters has reviewed the document and his comments are as follows:

2.1 The effect of the project on both the disposition and quality of the water resources in the vicinity of the mine site is the major impact on the physical environment.

2.2 Much of the water resource of the area is characterised by naturally high dissolved solids and care will have to be taken to minimise any imposed deterioration.

2.3 The current radioactive content (Ra226, Rn222, Pb210) of air and water in the immediate vicinity of the uranium ore body is very high and generally well in excess of maximum acceptable levels for continuous occupancy for people and livestock.

2.4 The proposal to dispose of water from de-watering pits to the tailings pond appears acceptable.

2.5 While the risk of wide dispersal of material from the tailings pond is very small, this may occur in the long term future and it would require action by man at that time.

The alternative of disposal in the worked out sections of the open cut offers better short term and long term radiological protection.

2.6 The outcome of dispersion of water containing substantial dissolved radioactivity beneath the tailings pond may prove contentious, as the area appears to be one of active recharge of ground water systems.

2.7 The treatment of dispersion of radon is well based and should stand up well to scrutiny.

2.8 The gamma dose levels in certain parts of the open cut (eg. ore testing) approach maximum permissible dose levels and will require careful monitoring.

3. WESTERN AUSTRALIAN MUSEUM

The investigation of the fauna of the Yeelirrie area contains few surprises and represents a reasonably thorough investigation of the vertebrate assemblages of the area. The following points should be noted:

3.1 The authors' aversion to specimen collection does cast certain doubts on the validity of some species recorded as well as the completeness of the inventory made.

3.2 There are two areas for which there is a surprising paucity of information. Only one amphibian is recorded whereas several could be expected, while quite a few shrubland birds, suspected to be resident in the area, have not been recorded.

3.3 An important consideration not discussed in this report is the present conservation status of the major faunal habitats of the Yeelirrie area. It should be established whether those faunal habitats which will be detrimentally affected by the Yeelirrie development are adequately represented in existing or recommended reserves.

4. MAIN ROADS DEPARTMENT

The Draft ERMP/EIS is considered to be somewhat deficient in its treatment of transportation. It would appear from the report that road transport will figure prominently in the project and consequently there will be a need for road upgrading, but many aspects of the transport problem are not defined in sufficient detail to enable comprehensive comment to be made. The following comments are submitted on matters relating to transport in the order of which they appear in the report.

4.1 Section B 10.6 states that "the road between Leonora and Leinster would be sealed . . . ." However, there are no definite plans to seal this section of road and no time scale can be put on it. If sealing is to take place major funding contributions by the Companies involved would be necessary.

4.2 The report states that the major items will be transported in bulk by road for the most part, with caustic soda, fuel oil and ammonia being carried by special transporters. Yellowcake and redcake products are to be shipped out as a backload in drums on pallets. However, it is not clear which vehicles are intended to be used for backloading. This needs clarification as, on p. E 11, it is stated that special truck and trailer combinations will be required for yellowcake transport. Overall, transport of yellowcake and redcake seems to require special vehicles, and this point should be clarified by

the Company.

4.3 It would appear that road transport is preferred, as the Company makes a point of the fact that substantial new trans-shipment facilities would be required at railheads if the State Government stipulated rail shipment in part.

It must be pointed out that there is also a very large implied cost in the use of road transport. Access from either Perth, Geraldton or Leonora by road would almost certainly involve major road upgrading and would require major financial contributions from the Company. More detailed investigation is required as the cost of road improvements is a very important factor in selecting the transport route and mode for the Yeelirrie project.

4.4 Although the report states that the roads in the area are lightly trafficked, it must be pointed out that in these areas even relatively small volumes of traffic can cause a rapid deterioration in the running surface of unsealed roads.

4.5 Section E.2 is of particular importance, as stated before it is most likely that the vehicle used to transport yellowcake and redcake will have to be a special purpose vehicle as backloading would seem to be impracticable.

With respect to driver exposure it is suggested that this would be more than the 9.6 hours shown in Table E.11 as the vehicle cannot be left unattended in public places. It is considered necessary that a crew of two be planned, to alternate driving duties to maintain alertness and increase safety. It is also considered that air conditioned vehicles would be essential in this case.

On p. E 12 it is not clear whether special crews are to be used for the transport of yellowcake. However, on p. E 13 it is stated that crews will be instructed on procedures to be followed in the event of an accident. It is considered that adequate instruction will not be possible

with casual drivers and that a special permanent driving staff will need to be engaged to ensure a proper level of safety.

No mention is made in the report of properly identifying vehicles carrying radioactive material.

4.6 In relation to protection of animals a reduced speed limit of 80 km/h is proposed in App. 2 p.53. Although such a limit may be possible between the town and the mine, if properly enforced, it would be generally impractical elsewhere and could not be supported by this Department.

5. DIRECTOR GENERAL OF TRANSPORT WA

We have restricted our comments to those sections dealing specifically with transport (Sections C5 and E2).

5.1 Section C.5.1 states that yellowcake and red-cake would be carried as backloading, but does not specify the nature of the forward loads on the same vehicles. The possibilities of contamination require the forward loads to be restricted.

5.2 The desirability of avoiding intermodal transfer operations needs to be viewed in relation to overall safety consideration, including the relative safety records of the two modes where rail is an alternative to road.

The NAASRA Economics of Road Vehicle Limits Study did not contend that heavy combination vehicles have "an outstanding road safety record in remote area transportation" it acknowledged that they had been operating for a number of years without apparent safety problems.

If combination vehicles carrying radioactive materials were allowed to operate through the towns of Geraldton, Kalgoorlie or Esperance, their operation would need to be carefully controlled and subject to close monitoring.

5.3 One must question the implicit assumption that the level of residual loose contamination acceptable in restricted areas of mills is acceptable after clean-up of any spillage of yellowcake in areas to which the public has access (p. E 14). What happens if the spillage is in a township or major town ?

6. WESTRAIL

6.1 Because of the relatively low tonnages over the estimated life of the project we see little prospect of special rail constructions being undertaken to service Yeelirrie.

6.2 In view of the special transport arrangements recommended by the IAEC for the movement of redcake and yellowcake it is unlikely that rail transport would be desirable, especially for the low tonnages involved.

7. TOWN PLANNING DEPARTMENT

The following comments are submitted for your consideration:

7.1 It is difficult to ascertain from the report that the site selected for the proposed town is the best available. Alternatives within 30 km of the mine should have been examined and documented. A good site south of the mine should not be discounted.

7.2 In due course, the design of the townsite should be referred to the Townsites Committee.

7.3 On the question of tailings disposal, it appears that option 4 - disposal in the open cut after mining is completed - would be preferable.

7.4 There is a lack of information on ore handling once it leaves Yeelirrie. The Company argues that this depends on Government policy, but it is absolutely

vital if the project is to proceed that both ore handling and its transport are safe, and that accidents cannot occur.

7.5 The 'Statement of Benefits' resulting from the project is largely couched in vague terms and should be much more explicit.

8. DEPARTMENT OF FISHERIES AND WILDLIFE

The document is thorough and comprehensive and the information provided is in a form which permits objective assessment. The following comments are forwarded for your information:

8.1 Terms of Reference

There is preoccupation with vegetation as distinct from floristics in the Section on existing environment.

8.2 Flora

Since the environmental study was timed inappropriately for good botanical collecting, the Company should make a further commitment to providing a total flora a soon as possible.

8.3 Fauna

Waterfowl will be attracted to the new sources of water, the tailings pond will have water with pH of 10 to 11 and contain significant quantities of radionuclides. There should be a commitment to investigate this problem and take alleviating action should this be necessary.

8.4 Rehabilitation

The Company makes no commitment in relation to rehabilitation procedures or standards. It appears that revegation will be achieved totally through the processes of natural revegetation. The Company should make a commitment to the establishment of a stable vegetative cover in disturbed areas and discuss techniques to be utilised.

8.5 Disposal of Tailings

Of the four options discussed, Option 3 should be favoured as it provides the minimum overall disturbance of the environment and avoids the need for a permanent surface storage facility. No comment is made regarding the decommissioning of the plant.

9. PUBLIC HEALTH DEPARTMENT

We offer the following comments as a preliminary assessment of the radiological hazards associated with the Yeelirrie Project:

9.1 External Gamma Radiation

The major source of worker exposure to radiation seems to be from work in the open cut area. It is recommended that the process of ore grade determination in the pit floors should be automated to the greatest extent or the time spent by the ore graders in the pit considerably limited.

The hours worked in the pit by ore graders, pit equipment operators and ore workers should be closely watched. Increased hours such as overtime will result in exposure perhaps exceeding the maximum permissible levels.

It is recommended that as far as possible the yellowcake circuits be automated to reduce gamma exposure to yellowcake workers. There is a risk in this type of operation of accumulation of radioactive material in areas unsuspected of causing problems - eg. precipitation of high radium content material in process tanks or pipes, resulting in high radiation levels.

9.2 Tailings

The tailings disposal option adopted is considered likely to prove to be satisfactory, except that the tailings dam wall should be constructed so that future maintenance is likely to be unnecessary. The outer walls should be contoured and the top should be consolidated.

9.3 Plant Decommissioning

No firm details of plant decommissioning are given. A full and detailed plan for decommissioning should be given towards the end of the useful life of the plant. This should include plans for decontaminating the site, disposal of contaminated plant and materials and details of restoration of the area.

Guidelines would need to be set on the levels of radioactive contamination which would be allowed for various means of disposal of plant and equipment.

9.4 Plant Operation

No detailed plans are given for radiation surveillance of the plant. The duties and position of the Radiation Safety Officer are not fully specified. It is essential that the Radiation Safety Officer be properly qualified and responsible only to the Plant Manager. This officer should be appointed well in advance of the proposed commencement of mining.

9.5 Medical Surveillance

It is important that the special provision of the Code of Practice to medical surveillance be strictly observed and employee records made available during and at the end of the project for Public Health Department scrutiny.

We consider that further information is required from the Company on the following aspects:

9.6 Particulates

To what extent will the suspension of particles be influenced by the fact that stockpiles will be rather steeply sloped, be loosely packed and will be above ground level ?

The release rate for uranium oxide from the yellowcake stream amounts to 57 kilograms/annum. To what extent can the uranium release be minimised ? The dust release from the mill constitutes a major dust source term. To what extent can the dust from the mill be reduced ?

The doses to workers at the mine and mill are not estimated in the same manner as the estimate of

population exposure. What is the appropriate conversion of this into equivalent dose ?

9.7 Radon Gas

The measured emanation rate of 3.4% seems low. Is the low emanation rate representative of the whole of the ore body ? Is there a disequilibrium factor ?

There seems to be a conflict in the models upon which calculations of radon release from the ore body and stockpiles and from the tailings dam are calculated.

The radon release at the tailings pond and cooling ponds will depend on the amount of build-up of radon in the process. What is the residence time of ore in the process from input to discharge as waste ?

The rate of radon release from the tailings dam will depend on a number of factors including water temperature, wind velocity and turbulence.

9.8 Ingested Radioactivity

The greatest component of radiation dose to the public and a significant dose to workers comes from the bone dose resulting from the estimated consumption of water with relatively high radium content. What action can be taken to reduce the radium content of water ?

10. DEPARTMENT OF MINES

The document has been reviewed by the Geological Survey, the Assistant State Mining Engineer and the Engineering Chemistry Division; their comments follow:

10.1 The need for further pilot plant testing to confirm the final commercial process is clearly underlined. The Engineering Division has been involved with some work for WMC aimed at confirming the advantages of pre-roasting. WMC has assessed an overall extraction rate of 95% of the contained uranium. It is possible that this recovery will not be achieved if the pre-roasting step is omitted.

10.2 The report releases little detail on the vanadium

circuit or on the "red cake" precipitation method.

10.3 The methods advocated for the containment of airborne wastes should be further reviewed when more detail on the process and equipment units is available, in particular the Company should provide for:

- back up units in case of failure of an operating unit, and
- automatic plant shut down in the event of failure of a dust collection unit.

10.4 The report does not contain definition on the ultimate disposal of scrap plant items.

10.5 The recommendations on page 149 Appendix II in respect to Meteorological conditions should become mandatory.

10.6 The Company should adopt a more positive attitude to revegetation.

10.7 Attention is drawn to "Total Dust" at page D 76 which quotes a maximum dust concentration of 15 mg/m^3 the limit of inert or nuisance dust. It is unlikely that dust generated at Yeelirrie will be classed in this category as the free silica content of the ore will vary between 14% and 38%.

10.8 The preferred method of tailings disposal (Option 1) appears suitable. It is considered that no tailings or overburden should be stacked on top of any mineralised material in the open cut having a grade of 0.05% or better.

10.9 Until such time as detailed information on:

- the quantity and composition of process liquor entering the dam;
- the amount os seepage from the dam, and
- changes in composition of the liquor in the dam

is available, Government should retain the option of requiring the Company to provide for an impermeable membrane below the tailings dam.

10.10 Considerably more investigation is required to prove the adequacy of the water resource.

10.11 Under present circumstances of supply, marketing WA vanadium will not be easy and the recently announced Coates Vanadium Project at Wundowie could be faced with stern competition from the Yeelirrie by-product.

11. DEPARTMENT OF AGRICULTURE

Observations and comments have been consolidated under the following headings:

11.1 Vegetation and Flora

Although mining operations will totally destroy the vegetation of many hectares of ground, the impact of such loss on the vegetation of Yeelirrie Station is not enormous. The most significant loss, which may be exceedingly difficult to re-establish, will be the phreatophytic vegetation.

The flora review is conspicuously deficient. The botanical significance of the species found is not evaluated. The impact of mining on the flora is probably less than that on the vegetation, but in the absence of a species list, however incomplete, very little can be said.

11.2 The Effect of Mining and the Management of the Mining Area

The Company must be firmly committed to a specific time orientated programme of:

- vegetation monitoring in the draw down zone;
- revegetation contingency plans to take effect during "good" rain seasons;
- a programme of general conservation and good land husbandry, and

- adequate provisions in respect of the discharge of saline water, should be made so there will be no deterrent to revegetation of the area once mining ceases.

12. PUBLIC WORKS DEPARTMENT

The comments which have been made are primarily directed at the impact the project will have on surface and groundwater resources of the area.

12.1 Water Resources

The water resources of the area are meagre, the quality very variable and generally brackish to saline. The limitations of the water resources of the region make it important to ensure that these resources are not knowingly diminished or degraded still further.

The open cut mine will have a major impact on the landform, surface drainage and groundwater levels over an area of some 150 km^2. When considered within the regional setting and the isolated location of the mine these changes can be accepted.

12.2 Cooling and Evaporation Ponds

It is concluded that the cooling and evaporation ponds must be constructed and lined to prevent pollution of the underlying groundwater. Adequate monitoring points must be established in the vicinity of the ponds to ensure pollution is not occurring and if such should occur remedial action must be taken.

12.3 Tailings Disposal

The proposed method of tailings disposal is acceptable in principle, subject to the final approval of the dams which will control seepage and prevent pollution of the groundwater. Adequate monitoring points must be established.

Investigations completed so far have given general indications of the soil and ground parameters however, further investigations are necessary to determine construction methods.

12.4 Water Supplies

The sources of water have not been fully investigated. The consultants have indicated the type of supply that could be anticipated, this advice is based on preliminary reconnaissance.

13. BUREAU OF METEOROLOGY, WA

The sections dealing with the general and meso-climate present data and draw conclusions which are essentially in agreement with the records and experience available to this office.

The air quality section is less satisfying primarily because it lacks any reliable measured data relating to stability categories and mixing depths. This tends to place in question tha results of the dispersion modelling.

We recommend that observations of mixing depths be made with an acoustic sounder if improved confidence in the dispersion estimates is required.

14. DEPARTMENT FOR COMMUNITY WELFARE

We are in agreement with the description of the nature of the Yeelirrie Development and the social consequences of remote township development. We endorse the view that single man employment should not be excessive and that the community must be as self-contained as possible. However, by definition large numbers of families will be resident at Yeelirrie and it is felt that the report underestimates the social needs of these families.

Closed-town development implies that the town infrastructure be provided by the Company, however, this Department has particular statutory responsibilities in the areas of child, family and community welfare and as such should be involved in the planning, development and/or operation of services in these areas.

Recommendations

14.1 A family and children's service centre be developed which would include:

- day-care centre;
- family support services such as Marraige Guidance Counselling, Child Health, Community Welfare field officer, and

14.2 In recognition of the high unemployment rate of aborigines in the region we suggest that consideration should be given to the development of an employment scheme utilising aboriginal contract teams from Wiluna and Meekatharra. These schemes have been successful in the Pilbara.

14.3 We accept the necessity for a caravan park, but suggest that prior experience in other remote mining communities has shown that significant numbers of families will be in "permanent" residence at the park.

In view of this:

- the caravan park should be located in easily accessible proximity to shopping, leisure, recreation, etc.;
- individual toilet, shower and laundry facilities be provided for at least 50% of the bays, and
- facilities for children and families be provided such as those operated by the Department for Community Welfare at Roebourne and Karratha Caravan Parks.

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