PROPOSED SODIUM CYANIDE PLANT

CSBP AND FARMERS LTD
COOGEE CHEMICALS PTY LTD
AUSTRALIAN INDUSTRY DEVELOPMENT CORPORATION

Report and Recommendations by the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
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SUMMARY AND RECOMMENDATIONS

The Environmental Protection Authority (EPA) has assessed the proposal by CSBP and Farmers Ltd, Coogee Chemicals Pty Ltd and the Australian Industrial Development Corporation (the project partners) to construct and operate a 15 000 tonnes per annum sodium cyanide plant at Kwinana, and transport the sodium cyanide as a 30% solution by road to gold mines in the State.

As part of the assessment, a Public Environmental Report (PER) was prepared by the joint partners and released by the EPA for public review for eight weeks. A total of 35 submissions were received.

In addition, the EPA sought specialised advice from Government agencies and expert bodies. The Chairman of the Authority recently visited a plant in Germany which uses the same technology as in this proposal.

During the Authority's assessment of the proposal, it became apparent that there were two key issues involved. These were:

- the risks and hazards associated with the manufacture of sodium cyanide and the implications for the Kwinana area; and

- the potential environmental consequences of transportation and mine-site storage and use of sodium cyanide in solution (liquid sodium cyanide).

The EPA has examined the preliminary risk and hazard analysis for the proposal (Public Environmental Report Volume 2) and has concluded that the individual risk levels fall within the Authority's existing published guidelines and therefore the risk associated with the sodium cyanide plant is so low as to be acceptable to the EPA. The Authority has also received briefings on the findings of a cumulative risk study undertaken for the Kwinana region. Although there is an increase in the overall cumulative risk due to the risk contribution of the proposed sodium cyanide plant, this risk level as it pertains to residential areas is below the guidelines adopted by the EPA and is so low as to be acceptable to the Authority. In addition, the Authority has concluded that the parts of the proposal associated with the construction and operation of the plant to produce sodium cyanide are conditionally environmentally acceptable.

However, the EPA is very concerned about the proposed method of transportation of liquid sodium cyanide. While the EPA recognises the low likelihood of a road accident leading to the discharge of liquid sodium cyanide, it believes that the potential consequences of any such accident constitutes an unacceptable environmental risk within a defined area of particular concern. This area constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas. Within this area not only are the risks higher but also the consequences are significantly greater. Accordingly, the EPA makes the following recommendation:

RECOMMENDATION 1

The EPA recommends that the proposal as put forward in the PER not be approved on the grounds that transportation by road of sodium cyanide in solution through the Authority's defined area of concern is environmentally unacceptable. The defined area of concern constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas.

If, however, the Government decides that the project should proceed then the EPA makes the following recommendations:

RECOMMENDATION 2

The EPA recommends that should the proposal proceed, it should do so subject to:

. the proponents' commitments in the PER and its response to public and Government agency comments; and

. the EPA's conclusions and additional recommendations in this Assessment Report.

RECOMMENDATION 3

The Environmental Protection Authority recommends that the Kwinana region would be an acceptable region, for the location of a sodium cyanide plant, if the proposal proceeds.

RECOMMENDATION 4

The EPA recommends that if the proposal proceeds and the plant is located at the proponents' preferred site at Kwinana then:

. the ammonia pipe needs to be enclosed in a concentric pipe and located underground; and

. site layout needs to be evaluated in a Hazard and Operability Study (HAZOP) for the plant to prevent any possibility of contact between any acid storage and the sodium cyanide process/storage.

RECOMMENDATION 5

The Environmental Protection Authority recommends that if the proposal proceeds then the proponent needs to prepare a construction stage management report to be submitted to the EPA before construction commences and which addresses, among others, the following matters:

. management of stormwater runoff from the site into Cockburn Sound; and

. management of dust and noise from the site.

RECOMMENDATION 6

The Environmental Protection Authority recommends that should the proposal proceed a comprehensive and integrated hazard and risk management strategy should be prepared, to the satisfaction of the relevant Government agencies.

RECOMMENDATION 7

The Environmental Protection Authority recommends that if the proposal proceeds, then the proponents should prepare a waste water management report discussing methods of waste water disposal and management which are acceptable to the Authority. This report should be forwarded to the Authority before the commissioning of the plant.

1. INTRODUCTION

The joint partners - CSBP and Farmers Ltd, Coogee Chemicals Pty Ltd and the Australian Industry Development Corporation (the proponents) - propose to establish a plant within the Kwinana industrial area (see Figure 1) to produce 15 000 tonnes per year of sodium cyanide solution from natural gas, ammonia and caustic soda.

Sodium cyanide is predominantly used as a leaching agent in the gold extraction process. As no sodium cyanide is currently produced in Australia, solid sodium cyanide is imported from overseas. The proponents state in the Public Environmental Report (PER) that if the proposal proceeds then:

- approximately $17 million worth of imports per year would be replaced;
- costs of (liquid) product would be cheaper than current imports for the end user; and
- continuity of supply would be assured for the local users.

Other benefits of the proposal listed in the PER are:

- temporary employment for 100 construction workers;
- 30 full-time positions would be created to operate the facility; and
- indirect benefits would flow on to the Western Australian community.

The total cost of the proposal is $15 million.

The proponents have submitted information about their proposal to the Authority in the form of a Public Environmental Report (PER). The PER went on an eight-week public review period, which finished on 13 February 1987.

The Authority has received 35 submissions on this project, 11 from Government agencies and 24 from private individuals or organisations. Relevant issues or concerns raised in these submissions were summarised and then forwarded to the project partners for their comment (see Appendix 1). The proponents' response to the submissions is included included as Appendix 2 of this Assessment Report. In addition, the proponents provided additional information which has been incorporated in the assessment of this proposal.

The Environmental Protection Authority has assessed the environmental aspects of the project from information provided in the PER, public and Government agencies submissions to the Authority, the proponents' response to comments made in the submissions, further information from a number of organisations and the Authority's own investigations.

During the Authority's assessment of the proposal, it became apparent that there were two key issues involved. These were:

- the risks and hazards associated with the manufacture of sodium cyanide and the implications for the Kwinana area; and
- the potential environmental consequences of transportation and mine-site storage and use of sodium cyanide in solution (liquid sodium cyanide).

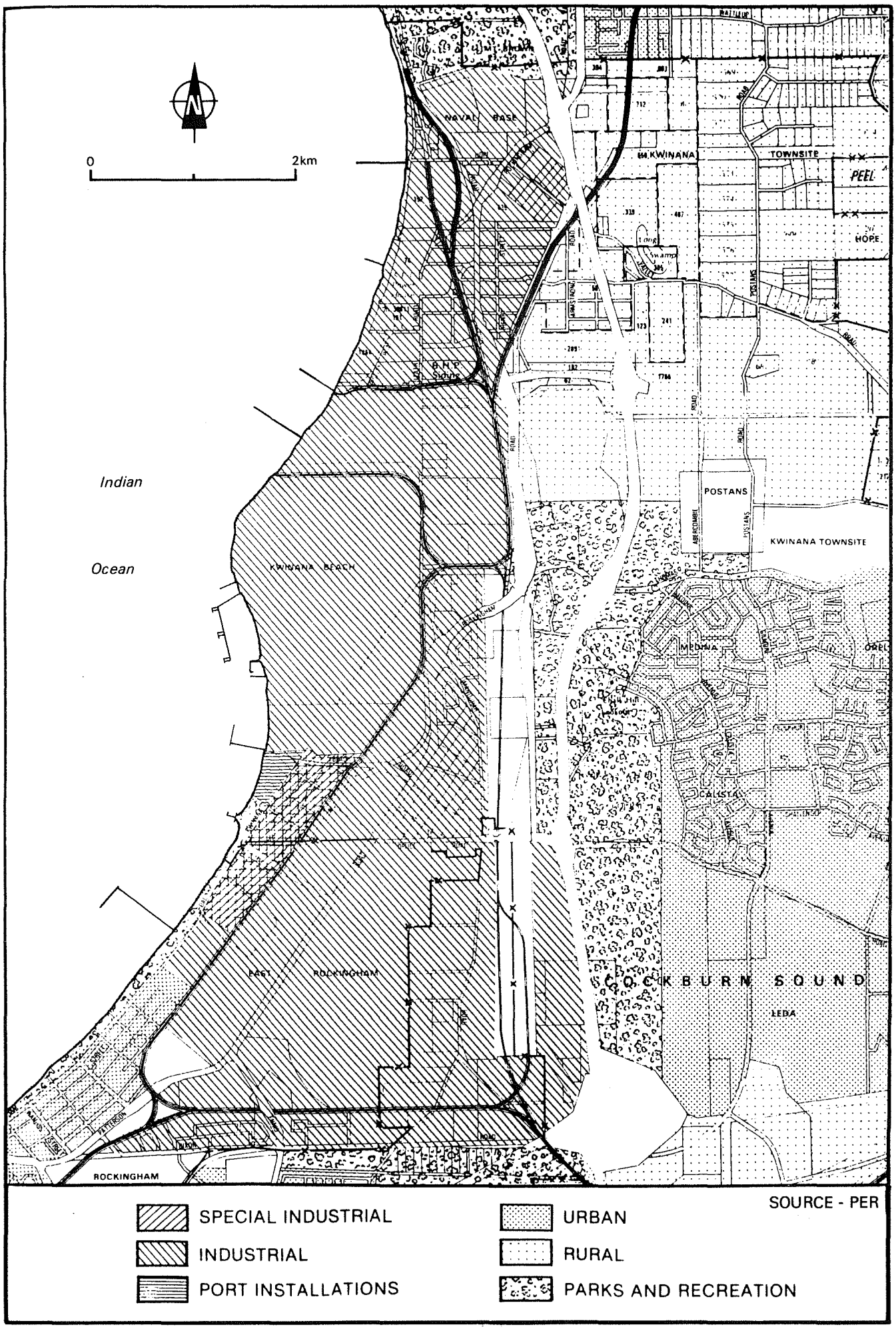

FIGURE 1 KWINANA INDUSTRIAL AREA AND SURROUNDING GENERALISED ZONING

The EPA has examined the preliminary risk and hazard analysis for the proposal (Public Environmental Report Volume 2) and has concluded that the individual risk levels fall within the Authority's existing published guidelines and therefore the risk associated with the sodium cyanide plant is so low as to be acceptable to the EPA. The Authority has also received briefings on the findings of a cumulative risk study undertaken for the Kwinana region. Although there is an increase in the overall cumulative risk due to the risk contribution of the proposed sodium cyanide plant, this risk level as it pertains to residential areas is below the guidelines adopted by the EPA and is so low as to be acceptable to the Authority. In addition, the Authority has concluded that the parts of the proposal associated with the construction and operation of the plant to produce sodium cyanide are conditionally environmentally acceptable.

However, the EPA is very concerned about the proposed method of transportation of liquid sodium cyanide. While the EPA recognises the low likelihood of a road accident leading to the discharge of liquid sodium cyanide, it believes that the potential consequences of any such accident constitutes an unacceptable environmental risk within a defined area of particular concern. This area constitutes that part of the State within 50 km of the Perth GPO plus designated surface and groundwater catchment areas. Within this area not only are the risks higher but also the consequences are significantly greater. Accordingly, the EPA makes the following recommendation:

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RECOMMENDATION 2

The EPA recommends that should the proposal proceed, it should do so subject to:

- **the proponents' commitments in the PER and its response to public and Government agency comments; and**
- **the EPA's conclusions and additional recommendations in this Assessment Report.**

2. DESCRIPTION OF THE PROPOSAL, ALTERNATIVE SITES AND THE EXISTING ENVIRONMENT

2.1 THE PROPOSAL

The proposal in the PER consists of establishing a $15 million plant which would produce 15 000 tonnes per annum (tpa) sodium cyanide solution using

10 000 tpa natural gas, 10 000 tpa ammonia and 10 000 tpa caustic soda. The plant consists of a gas reactor, a cooler, an absorber, a distillation column and an incinerator as shown in Figure 2. The plant layout would be as shown in Figure 3. The sodium cyanide solution would be stored in two steel tanks, each of 2 000 tonnes capacity. These tanks would be sited on concrete supports surrounded by impermeable bunds. It is proposed that the product solution would be diluted to 30% and transported in dedicated road tankers to various gold mines, within the south-west and eastern goldfields.

The PER states that sodium cyanide is an essential part of the gold extraction process and that gold production is expected to increase in WA. Currently 15 000 tpa of sodium cyanide is consumed in WA with the future requirement expected to rise to 20 000 tpa by 1987. This proposal will provide the bulk of the State's sodium cyanide needs in the future.

2.1.1 THE ANDRUSSOW PROCESS

There are four technologies by which sodium cyanide can be manufactured. The proponents have investigated the Shawinigan fluohmic and Andrussow processes in detail and prefer the later technology.

The Andrussow process consists of the following steps as shown in simplified form in Figure 2. These steps are:

- Mixing of gases: natural gas, air and ammonia are mixed in the correct ratio.

- Reaction to produce hydrogen cyanide gas: mixed gases enter a high temperature reactor where hydrogen cyanide is produced using a catalyst.

- Absorption: caustic soda is used to absorb hydrogen cyanide gas in an absorption tower to produce a 30% sodium cyanide solution.

- Incineration: the gas leaving the absorption tower is burnt in a continuously operating incinerator.

2.2 ALTERNATIVE SITES

This section summarises the proponents' statement on site selection. The Environmental Protection Authority's assessment of the site selection process is discussed in Chapter 4.

The site review process discussed in the PER consisted of the following methodology:

- compilation of relevant site selection criteria;

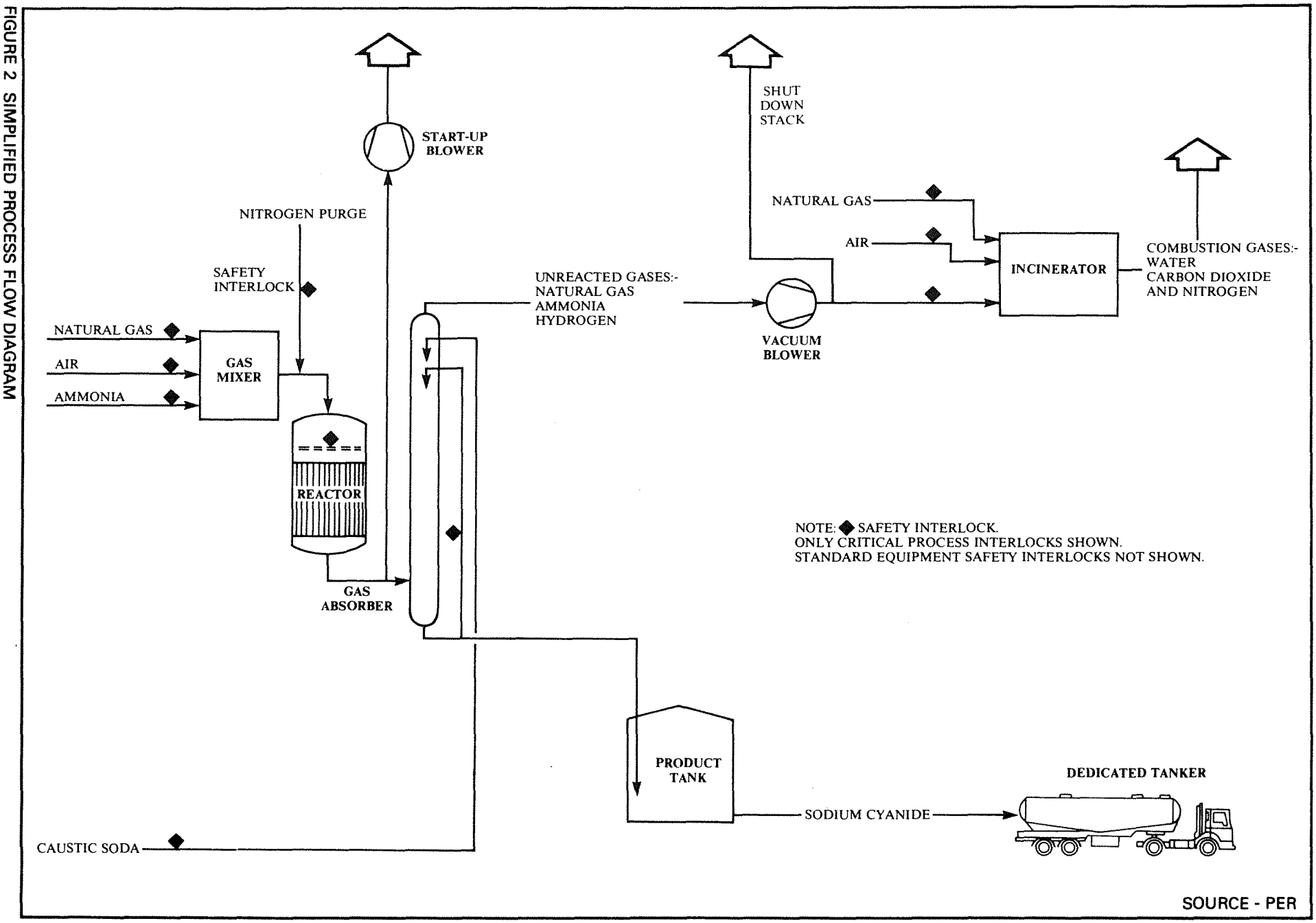
- identification of a number of possible alternative site regions and localities; and

- through an iterative process of elimination, the selection of the appropriate site.

The regional selection criteria identified in the PER were:

- availability of industrial zoned land;

FIGURE 2 SIMPLIFIED PROCESS FLOW DIAGRAM



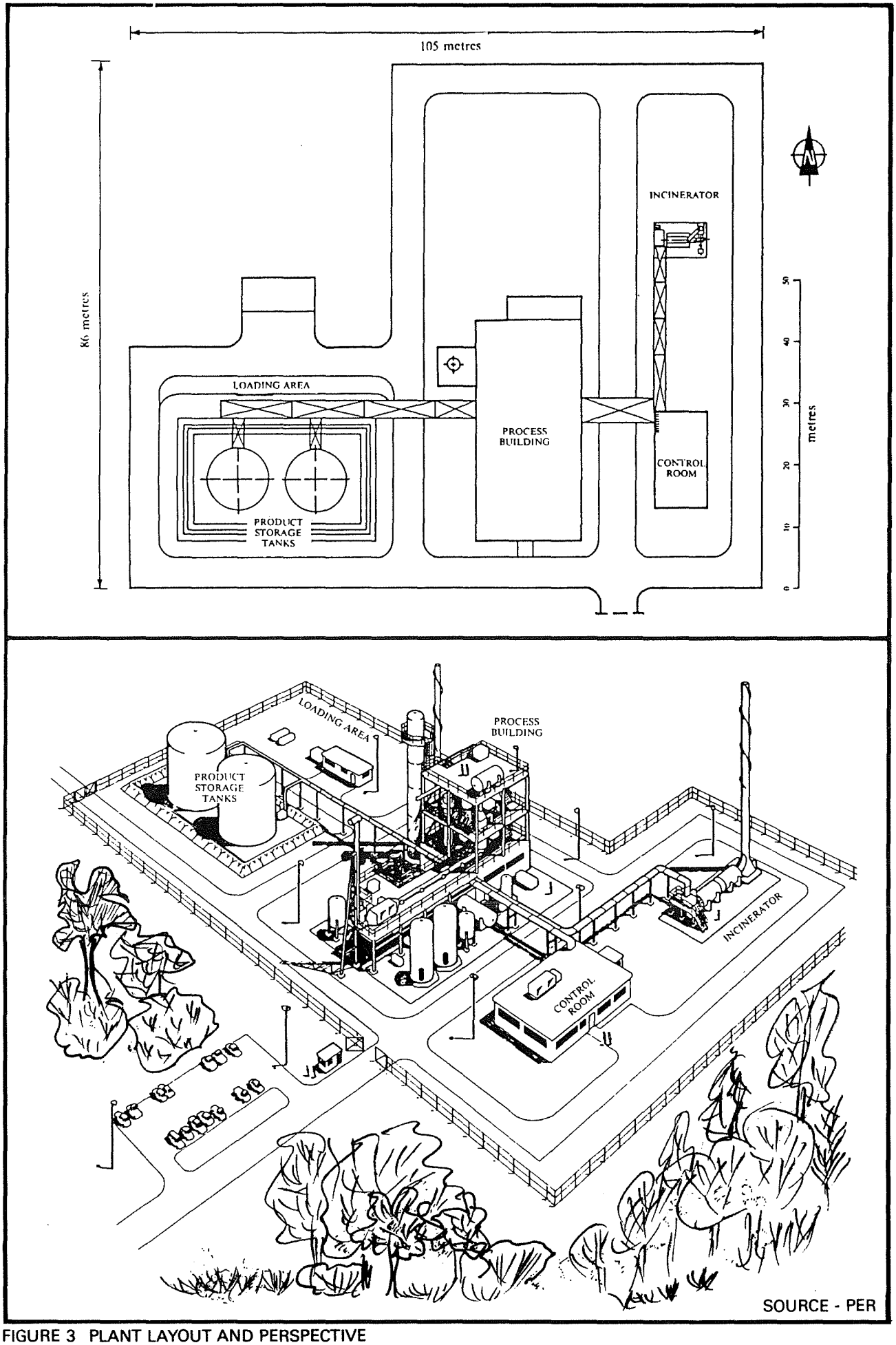


FIGURE 3 PLANT LAYOUT AND PERSPECTIVE

- availability and safe transport of raw materials;
- availability of industrial infrastructure;
- availability of an industrial workforce;
- proximity to markets for the product;
- adequate buffer zone to accommodate any risks and hazards generated by the plant;
- minimisation of development costs;
- availability of markets for by-product eg steam; and
- proximity to CSBP's existing operations in terms of integration of infrastructure.

The PER then identified two regions. These were the Kwinana industrial area and the Kalgoorlie industrial area.

The PER rejected the Kalgoorlie region because while it complied with most of the above criteria, did not have available supplies of raw material such as natural gas and ammonia. The Cremer and Warner Preliminary Risk Analysis report (PER Volume 2) argued qualitatively that the Kalgoorlie site would generate extra potential risk due to the additional storage of up to 1 000 tonnes each of LPG and ammonia on site. The document also stated that the transport risk is also likely to increase due to the carriage of LPG and ammonia from Kwinana to Kalgoorlie. For LPG, two 20 tonne road tankers per day would be required while transportation of ammonia would need two or three 20 tonne road tankers per day. In total, the number of single road tanker movements would increase to 35 per day as versus 24 per day tanker movements for transportation of liquid sodium cyanide to the goldfields from Kwinana (PER Volume 2).

The PER also rejected the goldfields region due to the additional expenditure required if a plant is located there. The document concluded that the Kwinana industrial area was the preferred region for locating the proposed sodium cyanide plant.

The PER did not identify the site selection criteria for the selection of a site within the Kwinana region. However, it identified three sites and discussed their advantages in terms of proximity to raw material and integration within the existing CSBP complex.

The PER while stating that the "exact site within the Kwinana industrial area is yet to be confirmed by the project partners" (PER p 11) concluded that "site 1 is the preferred site" (PER p 13) for the project.

2.3 THE EXISTING ENVIRONMENT

2.3.1 THE BIO-PHYSICAL ENVIRONMENT

The zoning of the surrounding areas of the proposed sodium cyanide plant is as shown in Figure 1. The plant site is a 1.7 hectare triangular block, located towards the northern end of the Becher-Rockingham beach ridge plain.

The meteorological aspects of the site consist of sea breeze/land breeze phenomena reinforced by a katabatic wind from the Darling Scarp. The area experiences strong westerly winter winds while strong easterly winds predominate in summer. The Cremer and Warner Risk Analysis document (PER Volume 2) has taken low night-time winds, average conditions, afternoon strong breezes, and occasional high winds as representative wind conditions in their consideration of the modelling of the gas dispersion characteristics.

The proposed sodium cyanide plant site has generally been cleared of native vegetation although some orginal vegetation does exist in the middle and at the margins of the boundary. The site has recently been planted at the edges with Eucalyptus by CSBP as part of the landscaping for its existing works.

2.3.2 LAND USE, ZONING AND TRAFFIC

2.3.2.1 Land Use

The site is located in the Kwinana industrial area which has been used for industrial development since 1955. The existing land uses within the areas and their proximity to the proposed sodium cyanide plant site are shown in Figure 1.

The PER discusses the population distribution of the surrounding communities to the Kwinana industrial area and concludes that "the nearest major residential area is approximately 2 kilometres inland to the south-east" (PER p 26).

2.3.2.2 Zoning

The proposed site is currently zoned 'industrial' under the Town of Kwinana Town Planning Scheme No 1. Town Planning Scheme No 2 is currently in preparation.

2.3.2.3 Traffic

The site is located in proximity to Kwinana Beach Road and Patterson Road. The possible risk aspects associated with these roads are discussed in Section 4.

3. REVIEW OF SUBMISSIONS

The PER was released to the public and Government departments on 20 December 1986 for an eight week review period, which ended on 13 February 1987.

A total of 35 submissions were received: 11 from Government agencies and 24 from the public. All of these submissions have been analysed and the main issues summarised in Table 1. A detailed list of comments can be found in Appendix 3, which also includes the list of people and Government departments making submissions.

The issues that received most frequent comment were:

- safety (risks and hazards);
- transportation of the product;
- environmental impacts;

TABLE 1. LIST OF ISSUES RAISED IN SUBMISSIONS.

	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	29	30	31	32	33	34	35	
1. CRITICISM OF THE PER										*																										1
2. NO OBJECTION TO PROPOSAL	*			*						*							*																		4
3. OBJECT TO PROPOSAL																				*				*	*			*			*	*	*		*	8
4. SAFETY																																				
4.1 EMERGENCY PROCEDURES/DP		*			*				*																											3
4.2 OPERATIONAL SAFETY/RA		*									*				*				*		*								*		*				7
4.3 AUDITING OR SAFETY		*														*																	*			3
4.4 HANDLING AND STORAGE												*																								1
4.5 TERRORIST ATTACK																		*								*										2
5. TRANSPORTATION																																				
5.1 RAIL VS ROAD												*		*																			*			3
5.2 LIQUID VS SOLID												*				*					*															3
5.3 NUMBER OF TRUCK MOVEMENTS											*	*									*										*					4
5.4 COLLISION AND SPILLAGE												*																							*	
6. ENVIRONMENTAL																																				
6.1 AIR POLLUTION										*	*		*	*	*	*		*	*	*	*		*									*	*			13
6.2 WATER CONTMAMINATION										*					*			*																	*	4
6.3 WASTE			*											*				*			*		*							*			*			7
6.4 DEGRADATION OF THE ENV.																				*			*	*				*	*				*	*		7
7. SITE SELECTION																																				
7.1 ALTERNATIVES																*		*	*	*					*	*	*	*	*	*			*			11
7.2 CUMULATIVE IMPACTS														*							*		*								*		*			5
7.3 COMMUNITY IMPACT																																				2
7.4 SELECTION CRITERIA												*		*			*		*																	
8. PLANT DESIGN/PROC/TECH																																				
8.1 PRODUCTION VS DEMAND														*							*															2
8.2 CHEMICAL NEUTRALISATION					*	*													*			*														4
8.3 PLANT FAILURE																			*																	1

. site selection;

. plant design/process/technology;

. criticism of the PER;

. objection to the proposal; and

. no objection.

Information and comments provided in submissions have been used to assist in the evaluation of the sodium cyanide plant proposal.

4. ASSESSMENT OF THE PROPOSED SITE

The assessment of the site selection process for this proposal can be divided into two parts. These are:

. regional site selection process and the appropriateness of selecting Kwinana rather than Kalgoorlie as the preferred region; and

. site selection process within the Kwinana region and the acceptability of selecting site 1 (rather than site 2 or 3) as the proponents' preferred site.

4.1 REGIONAL SITE SELECTION PROCESS

The Authority has reviewed the regional site selection process, presented by the proponents and summarised in Chapter 2 of this Assessment Report, and has found this process to be adequate and acceptable on the regional level. The Authority believes that it is more appropriate to locate the proposed plant at Kwinana than to transport raw materials to the goldfields region.

RECOMMENDATION 3

The Environmental Protection Authority recommends that the Kwinana region would be an acceptable region, for the location of a sodium cyanide plant, if the proposal proceeds.

4.2 SELECTION OF THE APPROPRIATE SITE WITHIN THE KWINANA INDUSTRIAL AREA

The three sites investigated by the proponents for the proposed sodium cyanide plant are as shown in Figure 4. The Authority believes that the main criteria for site evaluation should be the level of risk generated by a sodium cyanide plant on each site and the effect of this risk on the surrounding area.

The individual risk contours for a sodium cyanide plant on either of the three sites are shown in Figure 4. As discussed in Section 5.2.1 of this Assessment Report, these risk contours have been modelled predominantly on the loss of containment from the ammonia pipe and from the reactor.

The risk contour figures for all of the three sites are low. However, the contours for site 3 impinge on Patterson Road. The Authority concurs with the proponents' assessment that site 3, compared with the other two sites is less appropriate for a sodium cyanide plant.

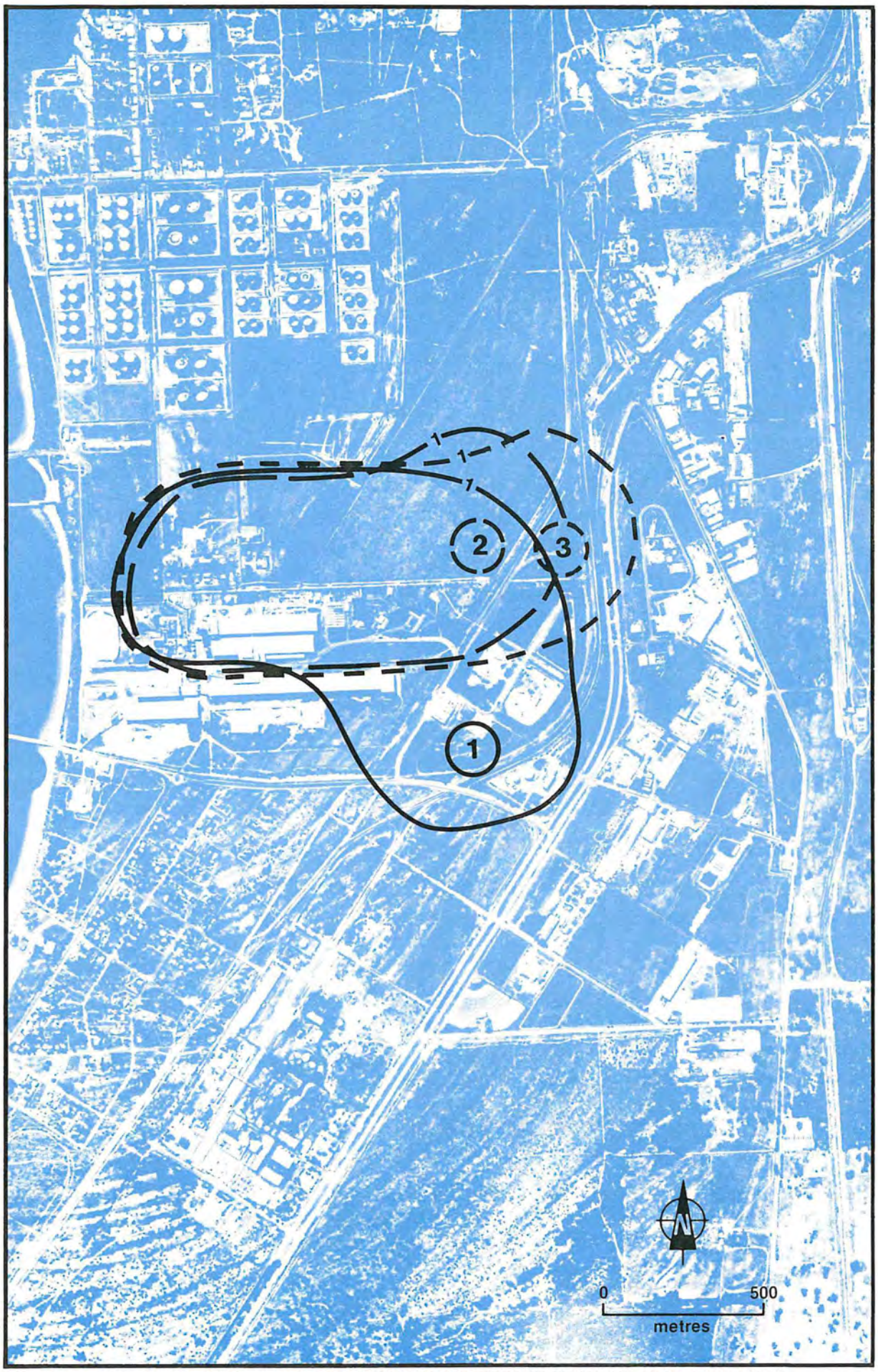


FIGURE 4 ESTIMATED RISK LEVELS FOR ALTERNATIVE SITES IN KWINANA (1 IN A MILLION)
SOURCE - PER

Site 1 is the proponents' preferred site. However, this site has three main disadvantages. There are:

- this site is the one furtherest away from the existing (or proposed) ammonia producing plant. Hence, the length of ammonia pipeline to this site is the longest;

- the site is in the proximity of both Kwinana Beach Road and Patterson Road. However, the difference in the distance between sites 1 and 2 and the two roads does not warrant rejection of site on this matter alone; and

- the proponents' preferred site is flanked by a chlor-alkali plant and a hydrochloric acid plant on the west and a storage depot on the east. All of these contain chemical materials in bulk.

The Authority believes the proponents have two options regarding the site for the proposed sodium cyanide plant at Kwinana. The proponents can either:

- locate the plant at site 2; or

- make site 1 an acceptable site by taking additional safeguards.

If the proponents choose to locate the proposed sodium cyanide plant at site 1, as is their preferred option, then the following actions need to be taken:

- the ammonia pipe from the source and into the reactor needs to be a double concentric pipe which should be located underground. This will significantly reduce the likelihood ofa loss of containment of the ammonia due to a fracture of the ammonia pipe; and

- the proponents need to ensure during site layout design that under no circumstance could acid from the nearby plant or inappropriate chemicals at the storage depot come in contact with sodium cyanide process or storage. The Authority is aware that this design modification can be made and further evaluated in a Hazard and Operatability Study (HAZOP) for the plant (see Section 5.2.3 for discussion of HAZOP).

RECOMMENDATION 4

The EPA recommends that if the proposal proceeds and the plant is located at the proponents' preferred site at Kwinana then:

- **the ammonia pipe needs to be enclosed in a concentric pipe and located underground; and**

- **site layout needs to be evaluated in a Hazard and Operability Study (HAZOP) for the plant to prevent any possibility of contact between any acid storage and the sodium cyanide process/storage.**

5. ENVIRONMENTAL IMPACTS

If the proposal proceeds, then the development of a sodium cyanide plant would generate environmental impacts which include:

. construction phase impacts;

. impacts of risks and hazards;

. other environmental impacts due to the emissions of wastes; and

. occupational health, and amenity impacts.

The proponents, cognizant of the Environmental Protection Authority's (and the community's) desire to have the highest levels of management controls and safeguards and to generate a minimum impact on the Kwinana area, have made a number of commitments to ensure that these objectives would be met (see Chapter 7 of this Assessment Report for list of the proponents' management commitments).

5.1 CONSTRUCTION STAGE IMPACTS

The construction of the project, if it proceeds, would have the following impacts: the generation of dust; discharge of contaminated stormwater (especially grease and oils from construction equipment); and noise.

The proponents' commitments on these matters are as below:

. dust generation would be suppressed by sprinkler water practices;

. construction materials and practices would be in accordance with the requirements of relevant Australian or, in their absence, international codes; and

. noise generated during construction would not exceed those levels deemed acceptable by relevant legislation. Activity would be restricted to standard construction working hours.

The Authority believes that the proponents need to liaise closely with the relevant control agencies, including the Kwinana Town Council, during the construction phase to ensure that no issues arise during that period which could adversely effect the environment or inconvenience the local population. In particular the proponents need to ensure that:

. stormwater runoff is properly filtered for grease and oil before discharge to the Cockburn Sound;

. traffic generation is kept to a minimum; and

. hours of work are further controlled if necessary.

RECOMMENDATION 5

The Environmental Protection Authority recommends that if the proposal proceeds then the proponents need to prepare a construction stage management report to be submitted to the EPA before construction commences and which addresses, among others, the following matters:

. **management of stormwater runoff from the site into Cockburn Sound; and**

. **management of dust and noise from the site.**

5.2 RISK AND HAZARD IMPACTS

As discussed earlier, the manufacture, storage and transportation of sodium cyanide generates risks and hazards. The major hazard identified for the proposal relates to:

- loss of containment of toxic gases; and
- loss of containment of sodium cyanide solution while being handled, stored or being transported to the end user.

The Authority has discussed its involvement in the issues of risks and hazards from industrial projects previously (see DCE Bulletin 257; EPA Risk and Hazard Statement, 14 November 1986).

The Authority believes that quantitative assessment of risk to the community is an important part of the environmental evaluation of such proposals. Historical records show that industrial accidents occur, and that technical safeguards have their limitations. However, with proper planning, review and controls during the plant design, commissioning and operational stages, these risks and hazards can, in most cases, be minimised, managed and made acceptable in the sense that they can be reduced to a level that the community is prepared to tolerate.

The term 'hazard' is used to describe a set of conditions that could lead to a harmful accident. 'Risk' is defined in terms of both the likelihood of a hazard, and the consequences of that hazard, ie "the probability that a hazard, in terms of a specific level of loss or injury to people or property, will occur in a specific period of time" (Pomeroy 1982).

Risk assessment methodology consists of the following elements:

- HAZARD IDENTIFICATION: ie identification of potential hazards or hazard events.
- RISK ESTIMATION: ie determination of the likely severity of consequences of the event and its products with the likely frequency of the event.
- EVALUATION OF RISKS AND HAZARDS: ie guidelines for assessment and an evaluation of risk.

There has been a quantitative and qualitative assessment of risk of the proposed sodium cyanide plant's raw material inputs, processes, operations, and transportation by Cremer and Warner Limited (PER Volume 2). The Authority has been advised by Cremer and Warner Ltd that the Company had undertaken its analysis impartially and completed its assessment independently (see Appendix 4). The Authority has reviewed the Cremer and Warner document and on the basis of that Company's credentials accepts the preliminary analysis as a comprehensive and appropriate assessment of the risks and hazards associated with the proposal on the proponents' preferred site.

5.2.1 HAZARD IDENTIFICATION

The PER lists the hazards associated with the proposal. These are summarised in Table 2. The Cremer and Warner report (PER Volume 2) argues that hydrogen cyanide releases have a very low frequency of occurrence and even if released, would not cause an adverse impact outside the plant boundary. The

Table 2. Summary of hazards due to raw materials and products

LIST OF HAZARDS	PHYSICAL STATE	COLOUR	ODOUR	DENSITY (REL TO AIR)	TOXICITY	TLV-MAX FOR 8 h WORKING PERIOD	IDLH (30 min)	IRRITANT	FLAMMABILITY	MISCELLANEOUS
Ammonia (NH_3)	Gas	Colourless	Pungent	Lighter	Toxic	25 ppm	500 ppm	Yes	Non-flammable. Explosive in enclosed space (flammable from 16-25%)	Liquid ammonia causes cold burns.
Natural gas (methane content 87% +) (CH_4)	Gas	Colourless	Odourless, but mercaptans added	-	Toxic as simple asphixiant	-	-	-	Flammable 5-15%. Explosive in enclosed space when 90% +.	-
Hydrogen cyanide (HCN)	Gas (liquid below 25.7^{0}C)	Colourless	Bitter almonds	Lighter (as gas)	Highly toxic	10 ppm	50 ppm	-	Flammable. Explosive from 5.6-40%.	-
Sodium cyanide solution (NaCN)	Non-volatile liquid	Colourless to pale straw colour	Bitter almonds	-	Rapidly fatal	-	-	Corrosive to skin (presence of sodium hydroxide)	-	Toxic by ingestion or skin absorption. Readily acidified by atmospheric carbon dioxide to produce hydrogen cyanide. Caustic soda prevents this process.
Carbon monoxide (CO)	Gas	Colourless	Odourless	Lighter	Toxic	50 ppm	-	No	Explosive from 12.5-74%	Will enhance toxic effects of hydrogen cyanide.
Hydrogen (H_2)	Gas	Colourless	Odourless	Lighter	-	-	-	-	Wide range 5-75%. Explosive	-
Sodium hydroxide (NaOH)	Liquid	Colourless	Odourless	-	-	2 mg m^{-3}	-	Corrosive to skin		Caustic

Note: TLV: Threshold limit value is the time-weighted average concentration for a normal 8 hour work day and a 40hour week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

ppm: parts per million.

IDLH: Immediately dangerous to life and health.

report hence rejects hydrogen cyanide release as being a significant contributor to the plant hazards, and models its risk generation primarily on the loss of containment of ammonia gas.

Toxic properties of ammonia are as shown in Table 3.
EPA water quality criteria for cyanide are listed in Table 4.

5.2.2 RISK ESTIMATION AND RESULTS

The Cremer and Warner document states that the "consequences and frequencies of all potential events for the (sodium cyanide plant) have been analysed to produce the individual risk contours" (PER Volume 2, p 6-8). Frequencies of major unwanted events considered by Cremer and Warner are shown in Table 5. Consequences of the typical ammonia releases are shown in Table 6. The PER has discussed in detail the safeguards that would be undertaken by the proponents to prevent the occurrence of unwanted events.

Taking historical failure frequencies predominantly dealing with loss of containment of ammonia (see Table 5) and diffusion consequences of a number of possible scenarios, the proponents have estimated the risk levels which would be generated by the proposed sodium cyanide plant at the three sites at Kwinana. These levels are illustrated in Figure 4.

5.2.3 EVALUATION OF RISKS AND HAZARDS

Given that the Environmental Protection Authority has a number of new industrial plants to evaluate, the Authority sought expert advice and recently released a set of guidelines on the "Evaluation of Risks and Hazards of Industrial Development on Residential Areas in Western Australia" (EPA 1986). For new industrial installations, the relevant guidelines for assessment are as below.

"The following are proposed by the Authority, as a guide for the assessment of the fatality risk acceptability of new industrial installations:

. The Authority has taken note of how decisions on risks are taken in other parts of the world. In the light of that knowledge the Authority will classify decisions into three categories. These are as follows:

  - A small level of risk which is acceptable to the Environmental Protection Authority;

  - A high level of risk which in unacceptable to the Authority and which warrants rejection; and

  - A middle level of risk, which subject to further evaluation and appropriate actions may be considered to be acceptable to the Authority.

. An individual risk level in residential zones of less than one in a million a year is so small as to be acceptable to the Environmental Protection Authority.

. An individual risk level in residential zones exceeding ten in a million a year is so high as to be unacceptable to the Environmental Protection Authority.

Table 3. Toxic Effects of Ammonia

General Effect	Exposure period	Concentration in air (parts per million)
Odour detectable by most people.	Any	25
Threshold limit value (TLV).	Maximum for 8-hour working period	25
Noticeable irritation of eyes and nasal passages.	Any	100
Severe irritation of nose and throat.	Any	400
Immediately dangerous to life and health (IDLH).	30 minutes	500
Severe eye irritation - no permanent effect.	<30 minutes	700
Serious coughing; bronchial spasm may be fatal.	30 minutes	1 700
Respiratory spasm; asphyxia rapidly fatal.	Few minutes	5 500

Source: PER, p PER Volume 2)

Table 4. EPA water quality criteria for cyanide

. The 6 month median not to exceed 5 μg/L.
. No single reading to exceed 10 μg/L. This is applicable to the following beneficial uses of water: - maintenance and presentation of aquatic ecosystems; and - harvesting of aquatic life for food and for non-edible uses. Although this criteria is for marine and estuarine waters it is reasonable to consider it applicable to freshwaters in the absence of a criteria specifically determined for fresh waters.

Source: Report of the Working Group established by the Environmental Protection Authority, "Water Quality Criteria for Marine and Estuarine Waters of Western Australia", DCE Bulletin 103, April 1981

TABLE 5 FREQUENCIES OF MAJOR UNWANTED EVENTS CONSIDERED

Case No.	Description of Unwanted Events	Duration (Min.)	Approximate Numbers of Failures Per Year for Each of the Unwanted Events for System Specified ($\times 10^{-6}$ yr^{-1})					
			>10,001	1,001 to 10,000	101 to 1,000	11 to 100	1 to 10	<1
	Ammonia Releases							
1.1	Guillotine failure of liquid ammonia supply pipeline	<2) 10) 30)			X			
1.2	Disruptive failure of liquid ammonia supply pipeline.	10			X			
		30				X		
1.3	Catastrophic failure of ammonia vaporiser.	INST.					X	
1.4	Disruptive failure of ammonia vaporiser:-							
	(i) Below liquid level	10 max.				X		
	(ii) In vapour space	10 max.				X		
1.5	Relief valve emission on ammonia vaporiser outlet line.	10		X				
1.6	Guillotine failure of ammonia line to gas mixer.	10				X		
		30					X	
	Methane Releases							
2.1	Guillotine failure of 45 bara natural gas pipeline.					X		
2.2	Disruptive failure of 45 bara natural gas pipeline.				X			
2.3	Guillotine failure of 14 bara natural gas pipeline.						X	
2.4	Disruptive failure of 14 bara natural gas pipeline.						X	
	Hydrogen Cyanide Releases							
3.1	Guillotine failure of reactor outlet.	INST.						X
3.2	Guillotine failure of line from blower to start-up stack.	5						(Note 1)
3.3	Emission from start-up stack.	5			X			

Note 1: The failure rate for this event is much less than 1.

SOURCE: CREMER AND WARNER LIMITED REPORT NO 86158

Table 6. Consequences of typical ammonia releases

DESCRIPTION OF UNWANTED EVENTS	DURATION (MINS)	WINDSPEED (m/s) PASQUILL STABILITY	DISTANCE TO 50% PROBABILITY OF FATALITY	DISTANCE TO 5 % PROBABILITY OF FATALI'
Guillotine failure of liquid ammonia supply pipeline.	<2	1.5 F	307	410
		4.0 D	187	303
(i) Immediate isolation at both ends of pipeline.		7.0 D	154	264
(ii) Automatic system failure - 10 min to isolation of leak.	10	1.5 F	307	410
		4.0 D	187	303
		7.0 D	154	264
(iii) Automatic system failure - 30 min to isolation of leak.	30	1.5 F	307	410
		4.0 D	187	303
		7.0 D	154	264
Disruptive failure of liquid ammonia supply pipe-line.	10	1.5 F	171	244
		4.0 D	103	153
(i) 10 min to isolation of leak.		7.0 D	72	98
(ii) 30 min to isolation of leak.	30	1.5 F	207	375
		4.0 D	142	181
		7.0 D	87	119
Disruptive failure of ammonia vaporiser.		1.5 F	282	370
		4.0 D	232	271
(i) 50 mm hole or connection in liquid space.	<2	7.0 D	140	239
(ii) 25 mm hole or connection in liquid space	5	1.5 F	195	266
		4.0 D	113	192
		7.0 D	95	125
(iii) 50 mm hole or connection in vapour space.	6	1.5 F	177	239
		4.0 D	101	172
		7.0 D	79	106
(iv) 25 mm hole or connection in vapour space.	10	1.5 F	121	164
		4.0 D	63	81
		7.0 D	34	47
Relief valve opening on ammonia vaporiser outlet line.		1.5 F	68	112
	10	4.0 D	<10	29
(i) Lifting light.		7.0 D	<10	18
(ii) Outlet blocked but brine still flowing.	10	1.5 F	95	163
		4.0 D	24	42
		7.0 D	15	30
Guillotine failure of ammonia line to gas mixer.		1.5 F	91	158
	10	4.0 D	23	39
(i) 10 min to isolation.		7.0 D	<10	28
(ii) 30 min to isolation.	30	1.5 F	128	220
		4.0 D	33	54
		7.0 D	25	39

(Source: PER Volume 2)

Where the preliminary risk level in residential zones has been calculated to be in the range one in a million to ten in a million a year, the Authority will call for further evaluation of the risks associated with the project. The Authority may then be prepared to recommend that the project be acceptable subject to certain planning and technical requirements.

A major technical requirement will be the commissioning of a Hazard and Operability Study (HAZOP) at the detailed design stage of the project. Such a study is an effective technique for discovering potential hazards and operating difficulties at the design stage. Significant reductions of hazards, and in the number of problems encountered in operations, as a result of such studies are possible. The Hazard and Operability Study should be undertaken by the proponent with a qualified person, approved by the Authority, who has to certify to the Authority that the study was carried out in a proper manner. This study should explore all feasible ways of reducing risks. The proponent may be required to update the risk analysis, and make the results public." (EPA 1986)

5.2.4 RISK ASSESSMENT

As mentioned in Chapter 1 of this Assessment Report, risk assessment for this proposal falls into two categories. These are:

- risk assessment for the sodium cyanide plant as proposed on the proponents' preferred site at Kwinana; and

- risk associated with the transport of sodium cyanide solution, either at Kwinana, or between Kwinana and the gold mines and at the gold mines themselves in terms of storage and end use.

The risks in the second category ie transport risks will be discussed in Chapter 6 of this Assessment Report.

The Cremer and Warner report (PER Volume 2) has quantitatively estimated the individual risk levels which would be experienced at distances from the proposed sodium cyanide plant at the proponents' preferred site at Kwinana. These levels are illustrated in Figure 5.

Figure 5 indicates that the proposed 15 000 tpa sodium cyanide plant would generate an individual risk level of less than one in a million per year for residential areas. **The Environmental Protection Authority believes that the individual risk levels for people living in residential areas is so small as to be acceptable to the Authority.**

While this risk is very small, the proposal still raises a number of risk related issues. These are:

- the need for the joint partners to develop a detailed emergency procedure for any contingency which may arise from the sodium cyanide plant construction, commissioning and operation stages;

- an ongoing training of plant operations and procedures by which human error could be eliminated or managed; and

- the need for annual auditing of all components within the plant to ensure that proper maintenance and management is being carried out.

FIGURE 5 RISK CONTOURS – SITE 1 (1 IN A MILLION) SOURCE - PER

The Authority is satisfied by the further information provided by the proponents on the management of risks and hazards (see Appendix 2). The EPA believes that the risks and hazards from the proposed plant can be managed if a number of steps are taken. The proponents have already made commitments to undertake most of the risk management steps necessary including:

. a preliminary Risk Analysis (already completed by the proponents); and

. HAZOP analysis study during the design stage to be undertaken before construction commences and submitted to the Authority; and

. a study of emergency procedures.

The Authority believes that the following are also necessary for any integrated hazard and risk management strategy:

. Study of Emergency Procedures;

. a study detailing the management of commissioning stage; and

. an Annual Auditing of risks and hazards.

Accordingly, the Environmental Protection Authority recommends as follows:

RECOMMENDATION 6

The Environmental Protection Authority recommends that should the proposal proceed a comprehensive and integrated hazard and risk management strategy should be prepared, to the satisfaction of the relevant Government agencies.

5.2.5 CUMULATIVE RISK FOR THE KWINANA REGION

In its assessment of the chlor-alkali proposal at Kwinana, the Environmental Protection Authority recommended that "Government requires a study of cumulative risk impact of the Kwinana industrial area" (DCE Bulletin 216 1985). Such a study has now been conducted by the firm Technica Pty Ltd under the guidance of the Western Australian Department of Resources Development. The Authority has been briefed on the findings of the Technica study and is aware that the report on the study's findings is currently being finalised.

The Technica study shows for that the future case which includes the proposed cyanide plant, the cumulative risk levels for residential areas would not exceed the one in a million per person per year risk level. Given this fact, the Authority finds the cumulative risk due to the proposed sodium cyanide plant at the proponents' site at Kwinana to be so low as to be acceptable to the Authority.

5.3 ENVIRONMENTAL IMPACTS FROM THE EMISSIONS OF WASTES

The PER identified a number of waste products being generated from the plant which would require treatment and/or disposal. There include:

. liquid wastes;

. atmospheric emissions; and

. solid wastes.

5.3.1 LIQUID WASTES AND THEIR IMPACTS

The PER document states that the "process will not normally produce liquid wastes" (PER p 18). The proponents propose to collect all wastewater from the plant, runoff stormwater and spills in a special sump. Final disposal may be back into the storage tank for recycling, reused as process water or disposed into Cockburn Sound after appropriate treatment.

The Authority has received a number of submissions expressing concern regarding the discharge of treated liquid waste into Cockburn Sound as well as concerns about atypical conditions which may contaminate groundwater or accidently pollute the Sound due to a spill. The main issues of concern are:

. safeguards regarding the storage of sodium cyanide solution on site including the management of washing areas, the pipe leading to storage area etc;

. collection, treatment and disposal of plant wastewater, stormwater and washdown waters; and

. contamination of groundwater (see Section 6.3.1 of this Assessment Report for discussion of this issue).

The Authority's assessment on the above issues is discussed in Section 5.3.4.

5.3.2 ATMOSPHERIC EMISSIONS AND THEIR IMPACTS

The PER states (p 18) that there would be three potential air emission sources from the proposed plant. These are:

. tail gases from the incinerator;

. discharge gases from the start-up blower; and

. discharge gases from the shut-down stack.

The Authority has reviewed the information provided on these discharges and the pollution control equipment being proposed by the proponents. The Authority believes that atmospheric emissions from the plant would be low and within acceptable standards. The Authority is also aware that the plant would require a works approval and subsequently a licence under the Environmental Protection Act 1986.

The Authority received a number of submissions expressing concern about the possibility of fugitive emissions including hydrogen cyanide from the plant. This matter is discussed in Section 5.3.4 of this Assessment Report.

5.3.3 SOLID WASTE DISCHARGE

The PER states that the plant would not be producing any solid industrial waste. Domestic wastes from the plant would be disposed of in the normal manner (PER p 19).

5.3.4 EPA'S ASSESSMENT ON ENVIRONMENTAL IMPACTS FROM THE EMISSIONS OF WASTES

The Authority believes that while atmospheric emissions and solid waste control measures have been adequately addressed, the proponents have not finalised all of the details for the management of waste water from the site. However, the Authority is aware that these waste water quantities are small and can be managed with minimum impact to the environment.

RECOMMENDATION 7

The Environmental Protection Authority recommends that if the proposal proceeds, then the proponents should prepare a waste water management report discussing methods of waste water disposal and management which are acceptable to the Authority. This report should be forwarded to the Authority before the commissioning of the plant.

The matter of potential fugitive air emissions from the plant needs to be controlled and managed. The Authority is aware that the likelihood of fugitive air emissions can be minimised by appropriate control over the design and construction of the plant. This matter needs to be particularly emphasised during the HAZOP analysis exercise and details discussed in the HAZOP Study to be submitted to the Authority.

5.4 OCCUPATIONAL HEALTH AND AMENITY IMPACTS

The following issues are identified and assessed in this Section:

- Occupational Health and Safety of Plant Personnel

  Matters which could affect the health or safety of personnel in the sodium cyanide plant or in the adjacent industrial installations in the surroundings are matters for the evaluation by the Commissioner of Occupational Health, Safety and Welfare who has this responsibility.

- The Potential of Visual Impact, due to the Plant

  The proponents have given a commitment to "aesthetically design the the industrial complex" (PER p 43). The Authority believes that the landscaping of the proposed sodium cyanide plant needs to be integrated within a landscaping scheme for the whole of the Kwinana industrial area. The Authority is aware that a Kwinana Landscaping Scheme has been prepared and will shortly be implemented. If this proposal proceeds then any such scheme should accommodate the landscaping of the sodium cyanide plant.

6. TRANSPORTATION

6.1 INTRODUCTION

As mentioned earlier, the sodium cyanide proposal consists of producing liquid sodium cyanide which would then be transported to the gold mining areas (see Figure 1) of WA in dedicated tankers. This is a deviation from the practice currently used in Western Australia and the rest of Australia. Currently all sodium cyanide into Australia is imported, mostly from UK and USA, in the form of solid bricketts. Solid sodium cyanide is transported from the harbour facilities off Fremantle and Kwinana. The gold mine sites currently store a quantity of solid sodium cyanide which is batch mixed on

site, diluted to a liquid form and used in the gold leaching process.

The Authority is very concerned about the transport of liquid sodium cyanide within the urban and rural environment of Western Australia. The proposal calls for the movement of 24 dedicated tanker trucks per week, each tanker carrying 40 tonnes of sodium cyanide solution.

The transport routes proposed within the metropolitan region are:

Thomas Road	Kwinana - Byford
South West Highway	Byford - Armadale
Albany Highway	Armadale southward
Albany Highway	Armadale - Kelmscott
Tonkin Highway	Kelmscott - Wattle Grove
Roe Highway	Wattle Grove - Bellevue
Great Eastern Highway	Bellevue eastward
Great Eastern Highway	Midland northward

6.2 ADDITIONAL INFORMATION SOUGHT BY THE EPA

Given that the transport issue is of major concern, the Authority sought additional information and advice on the environmental consequences of transporting sodium cyanide solution within Western Australia. In addition, the Authority investigated the alternatives to liquid sodium cyanide being transported by road. These alternatives are:

- manufacture of solid sodium cyanide by the joint partners. This would mean that solid sodium cyanide would be transported by dedicated trucks; and

- transportation of liquid sodium cyanide from plant site by rail to stations in the proximity of mine sites.

- The EPA enquiries on overseas practices with regard to handling of liquid cyanide.

- The EPA contacted all relevant agencies in other states of Australia and sought information on the advantages and disadvantages of liquid sodium cyanide transportation as well as data on all sodium cyanide transport accidents. Very little information was obtained on the transport of liquid sodium cyanide in other parts of Australia as predominately solid sodium cyanide is presently being used.

- The Authority has sought additional advice from the following state government organisations:

  - the Water Authority of Western Australia;
  - the Department of Mines; and
  - Westrail.

- The Authority sought the views of the following private organisations:

  - the Chamber of Mines; and
  - the Royal Australian Chemical Institute (RACI).

- The Authority also sought additional information from the proponents on the following:

  - the likelihood of a road transport accident on designated routes leading to a spillage;
  - the proponents' safeguards in preventing such an accident; and
  - contingency planning details by the joint partners if such an accident occurs.

- Finally, the Authority contacted a number of mine operators and sought their comments on the adequacy of liquid vs solid sodium cyanide management for the end user.

The Authority believes that it now has adequate information for it to make an assessment of the proposal to transport sodium cyanide solution to the mine sites within the State.

6.3 TRANSPORT ISSUES

The major transport issues are:

- storage and loading of sodium cyanide solution at the Kwinana plant site;

- transport of sodium cyanide solution through the urban environment;

- transportation of sodium cyanide through the metropolitan regional environment;

- alternative material ie solid sodium cyanide being transported;

- alternative transportation; and

- loading, storage and use at the mine site.

6.3.1 STORAGE AND LOADING OF SODIUM CYANIDE SOLUTION AT THE KWINANA PLANT SITE

The joint partners propose to have a 2 x 2 000 tonne liquid storage tanks at the Kwinana site. As discussed in Section 5.3.1 of this Assessment Report, these tanks would be bunded to prevent any likelihood of groundwater contamination.

The Water Authority has informed the EPA that:

"The plant siting is such that minimal risk to water resources is created from any likely polluting spills, leaks or discharges on site. Groundwater flow from the site area is westwards and any pollution of the underlying groundwater resources will not be expected to affect the amenity of the groundwater to any other existing or potential users." (Water Authority submission)

The loading facilities for transportation have not been discussed in the PER. However, the joint partners have provided additional information that these facilities, including washdown area, would be paved and all spills and runoff water would also be contained before being channelled to a sump.

6.3.2 TRANSPORTATION OF SODIUM CYANIDE SOLUTION THROUGH THE EPA DEFINED AREA OF CONCERN

The Authority is concerned about the transportation of sodium cyanide solution from the proponents' plant site through Kwinana-Rockingham area and the outer areas of metropolitan Perth within a certain defined area. This area constitutes that part of the state within 50 km of the Perth GPO plus designated surface and ground water catchment areas.

6.3.2.1 Transportation of Sodium Cyanide Solution within the Metropolitan Urban Area

The concern here is the one raised by many submissions, including Rockingham Council, regarding the incident where liquid sodium cyanide may be spilled in the Kwinana-Rockingham area or within an urban environment where the spill could affect populated areas.

The Authority has received the following information on this issue:

- "The worst possible situation, as far as HCN (hydrogen cyanide) evolution is concerned, might be if the 40 tonnes (liquid sodium cyanide) were spilt onto a hot road surface such that all the HCN (in the) liquid was vapourised immediately."(RACI submission)

- "The greatest hazards exist in the metropolitan area and decreases eastwards" (Mines Dept submission)

- "In (the metropolitan) area a liquid spill would pose a greater threat than would a solid spill". (Water Authority submission)

- "Storm or road drains in the metropolitan area commonly discharge to compensating basins which may be an appreciable distance from the site of a spill. These basins are designed to allow rapid infiltration to the water table and, in the case of a major sodium cyanide spill, a similarly rapid infiltration could be expected owing to the mobile nature of sodium cyanide solution." (Mines Dept submission)

- "Liquid (sodium cyanide) ..... will either soak in immediately or travel down road drains to the nearest stream. In this situation the clean up will have a more significant environmental impact depending on how quickly it can be undertaken." (Water Authority submission)

- "1 tonne of spilt NaCN (sodium cyanide) solution (30%) may need 4 to 10 tonnes of sodium hypochlorite solution (10%) for effective oxidation." (Mines Dept submission)

- "As sodium cyanide solution is uncoloured and thus is not distinguishable from water by eye there could be advantages in including an organic fluorescent dye in every tanker load. This will serve to mark any contaminated area and allow appropriate concentration of rehabilitation measures." (Mines Dept submission)

- "The following remedial action would be required at sites subject to any potential contaminant infiltration to groundwater in order to protect the public:

  a) Pumping from all bores within 500 m of an infiltration site should be stopped.

b) Washdown at the spill site should be undertaken with sodium hypochlorite solution.

c) Any storm drain suspected of having carried sodium cyanide should be traced and washed through with sodium hypochlorite to the compensating basin.

d) The roadsite contaminated area and the drainage discharge site should be repeatedly covered so that each absorbs twice the quantity of sodium hypochlorite solution required to oxidise the spill.

e) If the volume of sodium cyanide spilt is such that contamination of groundwater is likely, a multiport monitoring bore should be sunk in the centre of the spill area and another within 5 m of the road drain discharge. If sampling at the water table, the base of the aquifer, or at some intermediate depth shows that cyanide is present, an appropriately designed recovery bore should be sunk within three months and the contamination pumped out. Complete recovery is unlikely to be achieved by reason of the molecular and dynamic dispersion that will take place but the direct injection of sodium hypochlorite into the aquifer after pumping should complete the process of decontamination through dispersion and oxidation. Depending on circumstances, some continued monitoring may be required both at the roadside site and the stormwater discharge." (Mines Dept submission)

Given the above information, the EPA sought some quantification on the likelihood of a major tanker accident leading to a spill occurring. The proponents' consultant Kinhill Stearns Ltd undertook this review and have provided data shown in Table 7.

Table 7 concludes that:

- the overall probability of a spill occurring in the metropolitan area is 8.97×10^{-4} per annum (one per 1 100 years);

- the overall probability of an uncontrolled spill occurring in the metropolitan area is 1.79×10^{-4} per annum (one per 5 600 years); and

- the overall probability of an uncontrolled spill occurring in any water collection area is 6.52×10^{-5} per annum (one per 15 300 years).

The Authority agrees that the frequency of the likelihood of an accident leading to a spill, is not very high. However, the Authority is still concerned about the consequences of such a spill.

The Authority's assessment of these issues are discussed in Section 6.4.

6.3.2.2 Transportation of Sodium Cyanide Solution Through Areas adjacent to Urban Areas but within 50 km of the Perth GPO

This area constitutes an area outside urban Perth but one which through water catchment. groundwater and surface flow still affects the metropolitan population centre.

The main concern is the scenario where a tanker spill reaches a pond, wetland, lake, dam or contaminates a groundwater extraction or usage area.

Table 7. Summary of accidents statistics

ROAD SECTION	DISTANCE (KM)	AVERAGE DAILY VEHICLES	NO OF ACCIDENTS PER ANNUM	ACCIDENTS/ MILLION VEHICLE KM	TANKER LOADS NO PER ANNUM	PROBABILITY OF ACCIDENT PER ANNUM	PROBABILITY SPILL PER ANNUM	SPILLAGE NOT CONTROLLED PER ANNUM	UNCONTROLLED SPILL IN PUBLIC WATER COLLECTION AREA
1	22.0	2 287	26	1.416	1 250	3.89×10^{-2}	2.60×10^{-4}	5.19×10^{-5}	4.13×10^{-5} (Note 1)
2	6.0	8 888	21	1.079	1 250	8.09×10^{-3}	5.40×10^{-5}	1.08×10^{-5}	N/A
3	38.0	6 362	50	0.567	125	2.69×10^{-3}	1.80×10^{-5}	3.59×10^{-6}	3.12×10^{-6} (Note 2)
4	6.0	24 437	125	2.336	1 125	1.58×10^{-2}	1.05×10^{-4}	2.10×10^{-5}	N/A
5	12.0	18 629	128	1.569	1 125	2.12×10^{-2}	1.41×10^{-4}	2.82×10^{-5}	N/A
6	12.0	14 631	39	0.608	1 125	8.21×10^{-3}	5.47×10^{-5}	1.09×10^{-5}	N/A
7	40.0	20 556	187	0.623	875	2.18×10^{-2}	1.45×10^{-4}	2.91×10^{-5}	9.45×10^{-6} (Note 3)
8	2.3	31 303	218	8.296	250	4.77×10^{-3}	3.18×10^{-5}	6.36×10^{-6}	N/A
9	34.0	7 872	151	1.546	250	1.31×10^{-2}	8.76×10^{-5}	1.75×10^{-5}	1.13×10^{-5} (Note 4)
						1.35×10^{-1}	8.97×10^{-4}	1.79×10^{-4}	6.52×10^{-5}

Note 1 - includes 17.5 km of Peel Groundwater Area
Note 2 - includes 33 km of surface catchment
Note 3 - includes 13 km of surface catchment
Note 4 - includes 22 km Swan Groundwater Area

Assumptions

1. The frequency of tanker accidents per million kilometres travel is the same as the frequency of general vehicles accidents.
2. The average fatality frequency for all road sections considered is representative of road tanker accidents of sufficient intensity to cause a leakage.
3. The probability of an uncontrolled spill is one in five accidents involving leakage.
4. The probability of an uncontrolled spill occurring in a public water collection area is calculated by factoring of the route lengths where the routes fall in a public water collection area.

SOURCE KINHILL STEARNS 1987

The Authority has received the following information on this issue:

- "The probability of tanker accident resulting in a significant spill is expected to be quite low, particularly if the integrity of the tankers is assured in most rollover situations. However, the consequences of such an accident could be quite disastrous if the spillage made its way into any fresh surface or groundwater resources." (Water Authority submission)

- "Areas away from Perth present the Authority with greater concerns in that these areas contain both surface and groundwater catchment areas. In addition transportation routes will vary with demand and hence will not always be readily known.

  Many of the areas are isolated and response times are going to increase to the extent that pollution of an underground catchment becomes a very real risk. Infiltration may reach the groundwater table before clean up can be addressed." (Water Authority submission)

- "Infiltration (from a spill in the metropolitan region) would take place where soils were sufficiently permeable and the sodium cyanide solution would follow a complex flow path controlled by breaks in massive laterite or the presence of root channels within the laterite profile. Given a sufficient volume of infiltration, contamination might reach the water table at depths of between 10 and 40 m. Thereafter down-gradient movement would be extremely slow. Substantial lateral movement may, nevertheless, be possible above the water table through deflection by impermeable clay bodies. On relatively steep slopes or near streams which are the sites of bedrock outcrops it is just possible that the contaminant could ultimately re-appear to the surface." (Mines Dept submission)

- "If the 40 tonne load of liquid sodium cyanide is spilt into an acidic pond or lake where the water was at pH 3, the NaOH content would be neutralised by a body of water 1 metre deep and 63 m x 63 m square, allowing HCN evolution, at a relatively slow rate. Note that the solution concentration of cyanide in such a contaminated lake would be quite high enough to kill most animals in the lake (10 000 mg/L cf 'acceptable' stream level of 0.04 mg/L)." (RACI submission)

The Authority's assessment of this issue is discussed in Section 6.4.

6.3.3 ALTERNATIVE MATERIAL - MANUFACTURE AND TRANSPORTATION OF SOLID SODIUM CYANIDE

The Authority has received a number of submissions on this issue. In general, the following points have been raised:

- solid sodium cyanide would be safer to transport as there are already standard and effective procedures for clean up in case of accident; and

- in the event of a sodium cyanide tanker accident with an acid containing tanker, solid sodium cyanide would have less consequences.

The Authority has reviewed the current practice of solid sodium cyanide transportation within the state and finds this to be inappropriately managed. There have been four spillages of solid sodium cyanide, over the last three years

(see Table 8). These appear to arise mainly from incorrect loading and securing of loads in trucks.

Table 8. Road transport incidents involving solid sodium cyanide.

DATE	LOCATION	QUANTITY AND DETAILS	CONSEQUENCES	REASON/ COMMENTS
2 Mar 84	Cloverdale	1 x 200 L drum - fell from moving vehicle	Drum split - some cyanide on road	Badly secured load
9 Oct 84	4 km south of Beacon	4 x 50 kg packages - fell from vehicle carrying 24 packages	1 package split and 10-20 kg of cyanide on road	Several breaches of Regulation
4 Sept 86	Gt Eastern Highway Kalgoorlie turnoff from Coolgardie	23 drums in load - some fell from semi-trailer	7 drums burst - some cyanide spilt	Incorrect fixing of load
3 Nov 86	40 km North of Nullagine	160 drums fell	Few split - little cyanide spilt	Trailor overturned (trailer also carrying acid)

(Source: Department of Mines Reports).

On the matter of the consequences of a liquid vs solid sodium cyanide spill, the Authority has received the following advice:

- "From a chemist's point of view, <u>if</u> a spill occurred ....., <u>then</u> liquid sodium cyanide would be considerably more dangerous than solid sodium cyanide. This is because the spilt liquid is more difficult to contain, more difficult to recover or neutralise and more likely to evolve hydrogen cyanide vapour." (RACI submission)

- "The dangers associated with an accident-related spill of solid sodium cyanide are considered to be somewhat less than for the transportation of this chemical in liquid form. However, any hazards associated with a spill of the solid would be exacerbated if rain were to fall during or immediately after an accident. This could cause dissolution and potentially enable the cyanide to move outside the site of the accident." (Mines Dept submission)

- "Overall the Authority would prefer to see this product being transported in its solid state." (Water Authority submission)

The EPA sought the joint partners response on the possibility of producing solid sodium cyanide at Kwinana. The proponents have informed the Authority that:

- Currently the technology does not exist for the proponents to manufacture solid sodium cyanide. This is due to the fact that Western Australia's natural gas has contaminants which prevents the solid crystalisation process from proceeding.

- The joint partners are undertaking extensive research which is likely to see a technical breakthrough in the near future. The proponents would then manufacture solid sodium cyanide at Kwinana.

- The project will become non-viable if the product must be transported as a solid. This would result in the joint partners losing approximately $2 million in costs.

The Authority has reviewed the current practice of solid sodium cyanide transportation within the State and finds this to be inappropriately managed. The Authority also notes the rationale, provided by the proponents, on the short-term technical problems associated with manufacturing solid sodium cyanide.

6.3.4 ALTERNATIVE TRANSPORTATION

The EPA notes the current trend towards utilising rail for transporting hazardous materials. Westrail has informed the Authority that currently it transports a large tonnage of dangerous/hazardous goods throughout the rail network. The Authority is also aware of the excellent safety record of rail transport in Western Australia. A similar safety trend is being experienced overseas. A major study for the liquid fuels Trust Board in New Zealand by Netherland organisation for applied scientific research (TNO) have shown that for non-stop rail transport through the city area, the frequency of occurence of an accident in Netherland was 0.1×10^{-10}/100m as compared with 0.8×10^{-7}/100 m for road transport. In New Zealand the figures were 0.52 - 0.78×10^{-13} for rail vs 0.12 - 0.28×10^{-9} for road transport (TNO 1982). Thus rail appears to be much safer than road transport.

The Authority's views on this issue are discussed in the Conclusion (Chapter 8).

6.3.5 STORAGE AND USE AT THE MINE SITE

The advice to the EPA on this issue is as below:

- "The Chamber of Mines is not aware of any of its member companies which have taken a final decision to accept or decline a shift to liquid sodium cyanide. This will depend upon:-

  (i) anticipated commerial benefits;

  (ii) continuity and dependability of supply;

  (iii) perception of safety of handling of liquid vs solid cyanide; and

  (iv) perception of relative hazards of transport of liquid vs solid cyanide.

  Decisions will be made having regard to each of these factors. Note that the last two factors relate to individual perception and the Chamber does not believe an entirely objective determination can be made with respect to these aspects." (Chamber of Mines submission.)

- "The storage of liquid sodium cyanide, as has been the case with solid sodium cyanide, is not expected to cause any untoward problem. It is proposed that each mine site utilizing bulk liquid sodium cyanide storage will adopt procedures for storage similar to those required for flammable liquids (for example, each tank will be provided with an impervious bund of 100% capacity) with normal supervision by the SME and EDG Inspectorate of this Department.

  Appropriate occupational health precautions would have to be taken when handling either solid or liquid sodium cyanide." (Mines submission)

In addition, the proponents have undertaken a survey of some of the mines in the eastern goldfields. The conclusion of this survey was that there are benefits in having liquid sodium cyanide at the mine sites. The following environmental benefits are listed in the proponents correspondence to the Authority:

- "opportunity to minimize stocks of solid cyanide held on site, which in the case of the larger mines can be up to 500 tonnes. Whilst the mines may still wish to hold stocks of solid sodium cyanide to back-up a liquid sodium cyanide supply, there is no doubt that a local source of supply will enable some reductions in inventory;

- clear safety advantages in not having to handle containers of solid sodium cyanide; and

- elimination of the problem of disposal of containers for solid sodium cyanide - the Mines Department require the mines to crush and bury all such empty containers".

The EPA's comments on this issue are discussed in Section 6.4.

6.4 EPA ASSESSMENT OF THE PROPONENTS' PREFERRED TRANSPORTATION OPTION

The proposal currently being assessed by the Authority entails the transportation of 50 000 tonnes of 30% sodium cyanide solution by dedicated 40 tonne road tankers from the proposed site at Kwinana to gold mining areas of the State.

The Authority believes that there are three matters regarding the transportation issue which require assessment. These are:

- Can the storage and loading of liquid sodium cyanide at the Kwinana site be environmentally managed as to prevent any likelihood of contaminating groundwater or polluting the Cockburn Sound?

- Are the environmental and risk consequences of a liquid sodium cyanide and road tanker accident in the urban and metropolitan regional areas of the state acceptable given that the likelihood of a major accident may not be very high?

- Can the unloading, storage and usage of liquid sodium cyanide at the mine sites be managed in an environmentally acceptable way?

The Authority's conclusions are that the storage and loading at the Kwinana site and unloading, storage and usage at the mine sites can be environmentally managed in an acceptable way. The joint partners have provided details of such a mangement programme (see Section 7.2 of this

Assessment Report). The Authority believes that with appropriate monitoring and auditing, both at the plant site and at the mine sites, these concerns can be controlled.

On the second matter, the Authority concludes that irrespective of which routes are chosen between the point of manufacture at Kwinana and the end user at the mine site, sodium cyanide solution needs to transported through a range of location types, including industrial areas, urban areas, adjacent to recreational areas, country townships, agricultural and grazing areas, near water courses, wetlands, water catchment areas etc.

While the likelihood of an accident leading to a major spill resulting in large number of fatalities or an environmental catastrophe is not very high, the potential consequences of such a spill within populated areas or within the Authority's defined area of concern ie within 50 km of the Perth GPO plus designated surface and groundwater catchment areas would be unacceptable to the Authority.

The consequences of a major event due to transporting sodium cyanide solution in the Authority's defined area of concern could be as below:

- a significant quantity of 30% sodium cyanide solution discharges onto a road or into a wetland via drainage;
- potential evolution of hydrogen cyanide gas vapours if road temperature is high or if a wetland has acidic properties.
- immediate draining to lower ground, especially along gutters and into stormwater system/puddles along the side of the road or drainage system;
- no emergency response system, including action by the driver, will prevent the liquid seeking its own level;
- some puddles of concentrated sodium cyanide may form, depending on the nature of the surface and its contours. There may be a danger to the public from the evolution of hydrogen cyanide gas;
- if sodium cyanide solution comes in contact with weakly acidic sewer flow then hydrogen cyanide gas may evolve;
- ecological consequences for the groundwater and water bodies receiving a significant quantity of sodium cyanide will be severe; and
- clean-up of solution will be difficult, possibly requiring up to 4-10 times the quantity of oxidant to that of sodium cyanide released.

Sodium cyanide can be "neutralised" with alkaline hypochlorite or other agents when on the surface as solid or solution, but once it penetrates the soil and/or enters the groundwater it is difficult to neutralise. In the latter case, high costs of treatment or removal of contaminated soil could be incurred.

Details on degradability of sodium cyanide are scarce, but due to its extreme toxicity considerable damage to life may occur if large quantities are released to the environment. Therefore, the more mobile the liquid sodium cyanide spill is, the worse the consequences.

Given the above the Authority concludes that while the likelihood of an accident involving dedicated tankers is low, the environmental consequences of such an accident, resulting in total loss of containment of liquid sodium cyanide would be unacceptable.

7. ENVIRONMENTAL MANAGEMENT AND MONITORING

The environmental assessment process in Western Australia places a high priority on the management of environmental impacts and the monitoring of both the management programme and the impacts to ensure that appropriate steps are taken to ameliorate and minimise impacts.

7.1 ENVIRONMENTAL MANAGEMENT OUTLINED IN THE PER

The PER states, in Chapter 7, that the potential impacts of the sodium cyanide plant at Kwinana would be minimised and managed in the following ways:

. "The plant site will be attractively landscaped, and buildings will be aesthetically designed and clad in neutral colours so as to be compatible with the surrounding industrial setting.

. The plant design will ensure that normal emissions of nitrogen oxides will be well within the NHMRC recommended guidelines.

. Duplication of all critical equipment and a high level of automation will ensure operational stability.

. The plant will normally produce no liquid wastes.

. The process and storage areas will be bunded so that any washings, stormwater runoff or spills will be collected in a dedicated sump. Subject to analysis, the sump contents will either be metered to the storage tanks, or chemically neutralised to achieve the NHMRC and World Health Organization standards with respect to cyanide content for drinking water. These small quantities of treated water will either be used as process water on CSBP's Kwinana works or disposed of in accordance with the relevant authorities' requirements.

. Storage of sodium cyanide will be in accordance with the Explosives and Dangerous Goods Act, 1961, and approved by the Chief Inspector of Explosives and Dangerous Goods.

. A fire protection system will be incorporated in the plant in accordance with the requirements of the plant design and the Western Australian Fire Brigade. The plant personnel will be trained in the appropriate fire-fighting techniques. In addition to the fire-fighting capability of CSBP's Kwinana works, the fire-fighting cooperative established by the industrial operators in the Kwinana district will be available for emergency assistance.

. Security around the plant will be ensured by chain-link boundary fences.

. Transport of the product will be by dedicated road tankers designed to withstand a roll-over without leakage. Transport routes will be to the Water Authority's recommendation so as to avoid important underground waterbodies. A two-way radio system will maintain contact between the road tankers and the CSBP Kwinana works to enable immediate notification

of any accidents or breakdowns. Tanker drivers will be properly trained and certified. An emergency crew will be available at all times while the tankers are on the road.

- Adequate supplies of neutralising chemicals will be maintained at the plant and at the main delivery areas for use in emergencies.

- All employees will be trained in the safe work practices and emergency procedures appropriate to the operation of the plant and handling of all associated materials.

- On-site emergency facilities at CSBP's Kwinana works will continue to include a fire tender and an ambulance at all times, and an occupational health sister during normal working hours.

- A detailed procedures manual will be prepared from information supplied by the licenser, Roehm GmbH, covering all process work, including start-up, shut-down, plant testing, inspection and emergency action. The procedures manual will be available prior to commissioning for review by the relevant authorities, if required.

- The project partners will arrange for a process observer from the licenser, Roehm GmbH, to be at the plant during the early stages of its operation, both before official hand-over and for a short time afterwards.

- A full Hazard and Operability Study will be undertaken prior to plant commissioning."

7.2 WASTEWATER MANAGEMENT REPORT

At the time that the PER was released, no decision had been made by the proponents regarding the details of the wastewater disposal operation.

As discussed in Section 5.3.4, this matter needs to be addressed in a wastewater management report which should be submitted to the EPA prior to the beginning of construction of the sodium cyanide plant at Kwinana (Recommendation 7).

7.3 ASSESSMENT OF THE MANAGEMENT STRATEGY

The Authority is satisfied with the management strategy safeguards proposed or recommended in relation to sodium cyanide production, and believes that once these are implemented then they would make the proposed plant environmentally acceptable. However, the Authority does not believe that road transportation of liquid sodium cyanide within the Authority's defined area of concern would be acceptable.

8. CONCLUSION

This Assessment Report is submitted to provide an environmental input to decision making on the proposed sodium cyanide plant at Kwinana. In preparing this report, the Authority has considered a range of documentation, and has been assisted by contributions from the public and from other Government agencies. In addition, the Authority sought additional advice from a range of organisations on the transport issue.

The Authority is very concerned about the transport of sodium cyanide in road tankers from the Kwinana region to the final destination points at gold mine site. While the EPA recognises the low probability of a road tanker accident which would result in a significant liquid sodium cyanide spill, it considers that the potential conseqences of such an acccident to be an unacceptable risk within the metropolitan area and its surrounds including surface and groundwater catchment areas.

The Authority has concluded that the transportation of sodium cyanide in solution through its defined area of concern is environmentally unacceptable.

In making this conclusion the EPA is aware that other transportation options exist.

In terms of the location of a sodium cyanide plant the Authority has concluded that Kwinana is a satisfactory location for such a plant and that the proponents' preferred site in Kwinana (site 1) can be made to be environmentally acceptable.

The Authority has been impressed with the capacity and competence of the principal partner in the project, CSBP, to manage industrial plants from an environmental viewpoint.

The major problem with this particular proposal is the road transport of liquid sodium cyanide through the built-up areas of the metropolitan area. Should an alternative method of transportation through the EPA's defined area of concern be proposed to the EPA and found to be environmentally acceptable, then the Authority considers that the balance of the proposal could proceed subject to:

- the proponents' commitments in the PER and response to public and Government agency comments; and

- the EPA's conclusions and additional recommendations in this Assessment Report.

APPENDICES

APPENDIX 1

EPA'S QUESTIONS TO THE PROPONENTS

ENVIRONMENTAL PROTECTION AUTHORITY
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone (09) 222 7000

The General Manager
CSBP & Farmers Ltd
40 The Esplanade
PERTH WA 6000

Attention Mr Steve Fitzpatrick

Your Ref:
Our Ref: BP:dc
Enquiries:

SODIUM CYANIDE PROPOSAL

The EPA is undertaking its assessment of your Company's Sodium Cyanide proposal at Kwinana requests a response on the following questions which includes a summary of issues raised by public submissions as well as information required by the Authority. A number of submissions, including submissions from Government agencies, local government councils and from major organised voluntary groups have already been forwarded to you for comment. The company's comments on those submissions plus the answer to the following questions will assist the EPA in expediting the finalisation of its assessment.

1. The matter of the site selection process needs clarification. Could you compile a list of relevant site selection criteria which you applied to the identified alternative sites and then the process by which sites were eliminated and the preferred site selected. It would be appreciated if this information could be presented in a table or matrix form with some explanation of the methodology adopted and the criteria chosen.

2. The PER states (pp 19-21) that storage of sodium cyanide solution will be in 2 x 2 000 tonne steel tanks bunded to prevent seepage into the ground. Will the pipe leading to the storage area be also suitably protected so that a pipe spill will be collected and not discharged into the groundwater? Has provision been made to extract and treat any contaminated groundwater, due to an accident.

3. Is there any possibility of a spilled NaCN solution reaching Cockburn Sound?

4. What neutralizing agents will be used to treat any spilled NaCN solution, either in the Kwinana worksite or due to a tanker spill.

..2

5. Will all the washdown, stormwater etc coming in contact with the NaCN plant be collected and checked for cyanide? If some waters are found to have high cyanide level, would these be treated before being disposed of or can these be used as process water?

6. Could you please list and discuss the contingencies which could arise from the plant at Kwinana and for which you will be making plans in terms of remedial measures?

7. Please discuss the ongoing monitoring and auditing programme to maintain the environmental and safety features of the plant. Also discuss the training of operators and other plant personnel as well as the programme for commissioning the plant.

8. Please list the plant management structure and discuss who will be responsible for environmental and safety management of the plant.

9. Please provide details of NaCN solution transport vessels including their safety features. Also list the normal transport procedures and the contingency planning and safeguards being proposed.

10. Could you discuss the likelihood of an accident from road transport vs rail transport. Also discuss the difference in likelihood of releases from liquid vs solid road transport?

11. What is the cost difference between manufacturing sodium cyanide in solution to solid sodium cyanide. Discuss any problems associated in obtaining the technology to produce solid sodium cyanide.

12. What are the consequences of a liquid sodium cyanide transport accident as compared with a solid sodium cyanide spillage, either in an urban environment or in a rural/water catchment area.

13. What is the sodium cyanide breakdown or decay rate due to:

    . microbial action;
    . hydrolysis; and/or
    . radiation - eg UV, IR etc?

14. Could you describe the likely storage system of liquid sodium cyanide of the end-user at a mine and contrast it with the existing system of solid sodium cyanide?

15. If a liquid sodium cyanide transport accident occurs in an urban environment and the solution enters the stormwater drainage system, then how will this contingency be managed? Is there a likelihood of HCN evolving?

16. Could you please list countries where the transport of liquid cyanide is permitted?

R.A. Field.

R A FIELD
DIRECTOR
EVALUATION DIVISION

4 March 1987

APPENDIX 2

PROPONENTS' ANSWERS TO THE EPA'S QUESTIONS

CSBP

19 March 1987

The Chairman
Environmental Protection Authority
BP House
1 Mount Street
PERTH WA 6000

ATTENTION: Mr Ross Field - Manager,
Evaluation Division

Dear Sir,

Proposed Sodium Cyanide Plant

Thank you for your letter of 4 March requesting additional information on the above project. The information requested is set out in the attachment to this letter. It draws together information previously given to you in both written and verbal form and, where possible, further data is supplied in order to provide comprehensive responses to your questions.

It is apparent that the proposed transport of sodium cyanide solution from the plant to the mines is perceived in some quarters as a significant environmental issue. In this context it is important to reiterate that in the opinion of Cremer and Warner and the project partners, the proposed transport arrangements are safe and acceptable. Detailed explanations for this opinion are set out in the attachment.

Furthermore it should be clearly stated that the project will become nonviable if it is a condition of approval that the product must be transported as a solid. The time delay and increased capital expenditure required to develop the appropriate solids technology would quickly render the project nonviable and would result in the loss of approximately $2 million in costs to date.

The project partners believe that the project is environmentally sound and an important development for the State, and request that it be allowed to proceed without further delay.

.../2.

CSBP & FARMERS LTD
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As requested, also attached is a copy of the management commitments made in respect of the proposed sodium cyanide plant as contained in the PER.

Please advise if your officers require any further information to assist in finalising the assessment of this proposal promptly.

Yours faithfully,
CSBP & Farmers Ltd

Terence L Grose
Manager - Commercial Division

SRF075f:GK5

Sodium Cyanide Project
Response to EPA's Questions of 4 March 1987

Q1. We note your request for clarification of the site selection process used and offer the following information.

The site selection criteria used for the proposed plant are identified in section 3.2.1 of the Public Environmental Report (PER) and the site selection process is discussed in sections 3.2, 3.3 of the report.

The relevant criteria used to select the region and the site are as follows:

- availability of industrial-zoned land, ensuring compatibility with surrounding land use;
- availability and safe transport of raw materials (pipelines are generally the safest means of transporting hazardous materials);
- availability of industrial infrastructure, including services such as water and power in commercial quantities, drainage and road access;
- availability of an industrial workforce;
- proximity to domestic markets for the product, i.e. the State's gold producers;
- access to shipping for export markets (anticipated as being likely in the future)
- compliance with the EPA recommendations with regard to imposed risk to surrounding areas;
- minimization of development costs (e.g. suitable site conditions);
- provision for expansion;
- availability of markets for by-products, such as steam, power etc.;
- proximity to existing CSBP operations, enabling use of the company's considerable engineering and technical expertise during construction and operation of the proposed plant.

The table below details the methodology used to assess the suitability of the Kalgoorlie and Kwinana regions for the plant site;

REGIONAL SITE SELECTION ANALYSIS

Criteria	Kwinana Region	Kalgoorlie Region
Suitable Industrial Land Availability	A	B
Raw materials availability	A	B

Industrial infrastructure availability	A	C
Industrial workforce availability	A	A
Proximity to markets	C	A
Access to shipping for export	A	C
Low risk to surrounding areas	A	B
Development costs	A	C
Provision for expansion	A	A
Markets for by-products	A	D
Proximity to proponents' existing operations	A	D

NOTE: A - No constraint
B - Moderate constraint
C - Significant constraint
D - Major constraint

It was concluded therefore that Kwinana is the preferred region. The factors mitigating against Kalgoorlie are the non-availability of raw materials in a convenient, safe and economic form together with the risk associated with supply of these materials, the availability and cost of existing infrastructure, markets for by-product steam and proximity to existing CSBP operations.

A combination of environmental and economic considerations led to site 1 - CSBP's chemicals area, being selected as the preferred site. This took into account the risk analysis by Cremer and Warner together with all the other criteria referred to in section 3.2.1. of the PER.

The key criteria are:

. availability and safe transport of raw materials;

. availability of industrial infrastructure and industrial workforce.

. off site risk to individual members of the public

. availability of markets for by-product steam

. minimization of development costs

Given that all three Kwinana sites met the EPA recommendations for risk criteria, and that the plant will have minimal environmental impact at any of the three sites, the final site selection was largely determined by the relative economic attractiveness of the three sites.

Q2. It is our intention that sodium cyanide solution pipework leading to the

storage area will be protected so that any spillage can be contained.

The arrangement of the plant and layout of pipe racks is being progressed at the moment by our engineering contractors. Whether the product pipeline to storage is located on an overhead rack or at ground level or below (in a U shaped culvert) is yet to be determined, however the design philosophy is to contain and collect any sodium cyanide spillage thus preventing any discharge which could lead to groundwater contamination. This will be done by:

1) minimizing piping runs in the layout where practical;

2) paving under pipe racks with drainage of the paved areas to treatment sump(s);

3) providing spray box protection on pipe flanges where flanged pipe is used although we expect to use fully welded steel pipe for most of the product sodium cyanide piping.

It is extremely unlikely that an accident could result in contamination of groundwater. If for some reason this did occur, the salient feature of sodium cyanide is that it is biodegradable in the environment and does not accumulate. It breaks down in the soil and groundwater to harmless products. Reference is made to this feature in the response to question 13 below. It should be noted that monitor bores already exist in the Chemicals area around the proposed site.

Q3. On the question of the possibility of spilled sodium cyanide solution reaching Cockburn Sound, we believe this is very unlikely.

Our philosophy for the design and operation of the plant is to minimize any potential for in-plant spillages of sodium cyanide by:

1) use of appropriate design standards, minimal pipe runs, high integrity pipework and quality control of the pipework installation;

2) careful consideration of layout and design of pipe racks as discussed in answer 2 above, and by use of paving in process areas which will drain to a waste water collection sump(s) for subsequent use and/or neutralization. Our priority will be to use contaminated waste water in the absorption system as process water, or as dilution water in the product storage. As a last resort waste water will be detoxified before disposal/use elsewhere on CSBP's Kwinana works; and

3) The application of carefully considered maintenance and operating procedures.

In the unlikely event that spilled sodium cyanide solution did reach the works drainage system without detoxification, it would almost certainly be diluted to safe levels in the drain by existing liquid effluents before reaching the outfall into Cockburn Sound.

Q4. The neutralizing agents used to treat any spilled sodium cyanide solution where this is the preferred course of action, will be either sodium hypochlorite solution or hydrogen peroxide with copper catalyst (which can be obtained as a proprietary formulation).

At this stage the hydrogen peroxide route is the preferred course of action within the plant. This technology is guaranteed by the process licensor, Roehm, as safe and effective. For offsite incidents, sodium

hypochlorite solution would be the preferred neutralizing agent.

Q5. On the question of treatment of wash down water etc., it is proposed to collect and analyse all wash down water before deciding the end use, as discussed in question 3. High cyanide waters would be preferentially used either as process water in the caustic absorption stream or added to the product tanks in a controlled manner. If for some reason, the waste waters could not be used in this manner, they would be processed in the treatment plant to reduce the cyanide level to NHMRC drinking water standards before final disposal.

Q6. The risk assessment of the proposed plant by Cremer and Warner examined all aspects of the plant for potentially hazardous events, including pipelines for feeding materials to the plant and transport of the finished product. The potential hazards identified will be reviewed and appropriate contingency measures incorporated into existing on-site and off-site emergency procedures for Kwinana Works. These potential hazards will also be taken into consideration in the detail design of the plant and the HAZOP review.

Q7. On the question of the monitoring and auditing programme for this plant, once the requirements for routine testing and monitoring are defined by the licensor, a programme of routine analysis and testing will be established to ensure that the plant is operating according to design and that any emissions or effluents comply with statuatory regulations.

Accordingly the environmental aspects of the sodium cyanide plant operation will be incorporated in the existing Environmental Management and Monitoring Programme at CSBP's Kwinana works and the results reported as required to the relevant regulatory authorities. For example, this would include frequent testing of the incinerator stack for hydrogen cyanide, oxides of nitrogen and carbon monoxide, as discussed in the PER.

Similarly, an auditing programme would be instituted in accordance with the International Safety Rating System now used at all CSBP works, details of which were described in section 4.3 of Vol.2 of the PER. In addition, CSBP would undertake to notify the process licensors of any proposed design changes and to subject such changes to a HAZOP procedure using internal expertise.

CSBP already has in operation systems for:

a) identification of plant hazards
b) control of access to plant
c) control of maintenance (permits to work)
d) control of modifications
e) maintenance of plant integrity (adherence to design standards etc.)
f) incident reporting and action to prevent recurrence

CSBP has undertaken to train all employees in safe work practices and emergency procedures appropriate to the operation of the plant and handling of all associated materials. This is standard CSBP practice.

The programme for training of personnel and commissioning will involve the training of key operating personnel by the process licensor in Germany prior to start up. These CSBP personnel will then train the balance of the operating and maintenance team and will be supervised by the licensor,Roehm. Also we are planning to use a process simulation package to assist with training.

In the case of CSBP's chlor-alkali plant, personnel are currently undergoing detailed training prior to commissioning. In the course of this programme key operating personnel received training at an overseas plant. A similar comprehensive approach will be employed with the sodium cyanide plant.

Q8. In regard to the plant management structure and environmental and safety management, it is proposed that for management purposes the plant will be incorporated into CSBP's chemicals division with its established management structure. The day to day plant management will be by a plant superintendent with assistance from a plant chemist and a plant engineer. The plant superintendent will report to the Operations Manager - Chemicals who will in turn report to the Manager - Chemicals Division. Safety and environmental management would be the primary responsibility of the plant superintendent, plant chemist and plant engineer. Monitoring of the plant performance would be carried out by the Environmental and Loss Control section of the Operations Department at Kwinana. The Environmental Superintendent would maintain liaison with the relevant authorities in respect of compliance with any conditions of environmental or statuatory approvals.

Cremer and Warner examined the proposed management structure and also CSBP's general approach to health and safety management in section 4.3 of their report and concluded that the company's systems and procedures were adequate and that CSBP should attain a position as a recognised leader in industrial safety.

Q9. As described in the PER, design of the road tankers would be covered by AS2809, specifically AS2809-1 and AS2809-4. The tankers will be of approximately 20 tonne capacity and two would be coupled together to form a 40 tonne capacity B-train. The tanks will be of a pressure vessel standard and able to withstand roll over without leaking.

The Department of Mines will have to approve the design of the tankers together with the transfer procedure at the mines and the mine receival tanks.

The design detail of the tankers has not been finalised yet but the relevant design codes (AS2809, AS1210) and the vehicle standards regulations which will influence the tanker design are as follows;

1. The sodium cyanide solution is designated a Class 6.1 material by the ACTDG (Australian code for the transport of dangerous goods) and is required to be transported by a type 1 or a type 2 tank:

   Type 1 >25 PSIG pressure (maximum allowable working pressure)
   Type 2 14.2-25 PSIG " " " " "

   We expect to be operating the tank up to a maximum of 25 PSIG (172kPa)
   i.e. Type 2 tank

2. The transport of sodium cyanide solution by road tanker is covered by:

   1) A.S.2809 Road tank vehicles for dangerous goods
   2) A.S.1210 Unfired pressure vessels code
   3) (Vehicle standards regulations 1977), Road Traffic Act 1974-1981

3. The arrangement of the tank on the transporter is covered in A.S.2809.1 General requirements. This qualifies the vehicle standards regulations (to which the transporter will comply). The sections in A.S.2809.1 which we need to design to are:

   1) Sec. 2.1 Tanker design - stability, clearances etc.
   2) Sec. 2.3 Fire extinguishers
   3) Sec. 2.5 Auxiliaries - Safety equipment, operator instructions
   4) Sec. 2.6 Signs, notices, markings (HAZCHEM)

4. The design of the tank itself is covered by Section 2 of A.S.2809.4 - Tankers for toxic and corrosive cargoes. This section covers the type 1 and 2 tanks and we need to comply with:

   1) Sec.2.2 Tank design - (in which AS1210 is called up) design pressure, materials, baffles, manhole, valve protection.

   2) Sec.2.3 Valves & fittings - Shut-off valves, pressure relief devices, outlet connection.

   For additional discussion on road transport refer to Sections 3.5, 4.5.1, 4.6.2, 6.2.5 and Appendix B of Volume 1 of the PER, Sections 4.3.5 and 5.5 of Volume 2.

Normal Transport Procedures

At the design capacity of the plant, movement of up to 50,000 tonnes per year of 30% sodium cyanide solution will be required resulting in some 24 tanker loads per week.

Transport would be carried out by a transport operator approved by Australian Gold Reagents Pty. Ltd. The tanker drivers will be specifically trained by CSBP in safe work practices and procedures to be followed in the event of an incident.

Tankers will be dedicated to the transport of sodium cyanide solution and will carry appropriate HAZCHEM signs. The road tankers will be licensed and will be regularly checked for road-worthiness and integrity of the tank and equipment. In addition CSBP will regularly maintain the tankers and the transport operator will service the transport rig.

The tankers will carry in addition to Hazchem panels, fire extinguishers and emergency procedure guides, protective clothing, face shields, first aid kits, and wash water.

Emergency procedures will be developed in liaison with the Water Authority, local Councils, and the normal emergency services (Police, Fire Brigade, State Emergency Service, St.Johns Ambulance).

In the event of a spillage in a remote area, the most effective way to control the situation may be removal of the earth from the affected area for subsequent neutralization and disposal. Neutralising chemicals and/or earthmoving equipment required for dealing with major spillages will be available at remote locations yet to be agreed with the Emergency Services and local Authorities.

As discussed above, the tankers will be provided with special protection to prevent leakage in the event of a rollover, so the chances of a spillage are very small.

Q10 In order to obtain further information on the level of transport risk, CSBP has requested Kinhill Stearns to carry out an analysis of the road transport risk. It is understood that only limited data on tanker incidents is available but it is hoped that a useful evaluation will be available shortly.

As you are aware the road transport option has been carefully considered by CSBP in conjunction with Government Deparments and Cremer & Warner. It is believed that the proposed transport arrangements provide a high degree of safety and facilitate control of the product because of the direct plant to mine site nature of the operation. The conclusion reached by Cremer & Warner in its assessment report (section 5.5, page 5-9) was that the transport by road of liquid sodium cyanide is an acceptable practice.

CSBP does not have data available to enable comparison of the relative risk levels of road and rail transport. In considering the relative merits of the two forms of transport, CSBP considered the fact that rail transport would involve additional handling because almost all gold mines in W.A. lack direct rail access. As a result, it would be necessary to establish a number of regional depots with product being handled several times. In addition, the use of rail would deny CSBP the ability to control the quantity of product transported on any one train and the control over the products transported in adjoining rail cars.

While none of these issues necessarily rules out rail transport, it is considered that they make rail transport less attractive.

In the second part of your question, you asked for comments on the difference and likelihood of releases during transport of liquid and solid sodium cyanide. As CSBP has not at this stage carried out an evaluation of the transport of solid sodium cyanide, it is difficult to provide any definitive response to this question. There are however a number of points which can be made.

A major feature of the transport of solid sodium cyanide is the amount of handling it entails. The solid sodium cyanide is imported into Fremantle in container loads of drums or bulka bags. Some containers are taken direct to the mine site while the remainder are broken up into smaller loads before being transported to the mines. The containers are not designed to pressure vessel standards and therefore would be likely to burst open on impact where a liquid tanker would be unaffected. It is understood that the normal transport arrangements do not involve specially designed trucks and that it is not unknown for solid sodium cyanide to be spilt in the event of an accident. Cremer & Warner concluded (section 5.5 of its report) that the proposed custom-designed road tankers would reduce the chance of a spillage compared to the existing arrangements. Finally, by using normal trucks, there is a potential lack of control over the cartage of other products along with the sodium cyanide. Should these other products include acid for example, the result of an accident could be catastrophic.

Q11 As noted in the covering letter, further work is required to fully develop an appropriate solids technology and thus at this stage the cost differential between solids and liquids plants is not identifiable.

It is anticipated that Roehm will develop the necessary solids technology by 1988, however, at this stage an appropriate technology is not readily available. As a result it is clear that the construction of a solids

plant instead of the plant proposed would involve substantial delays and additional costs. It is evident that this would render the project nonviable.

It should be noted that when the project partners undertook their original assessment of appropriate technology they travelled extensively overseas and reviewed a substantial number of alternatives. Their conclusion was that the Roehm technology chosen provided the most environmentally acceptable plant and that the transport and use of liquid product also presented environmental advantages.

Q12 It is believed that the most likely consequence of a liquid sodium cyanide transport accident is that the tanker would remain intact. As discussed, in the answer to question 10 above, Cremer & Warner concluded that the likelihood of a spillage from a custom-designed road tanker is less than that from other goods vehicles.

In the improbable event of a spillage from a tanker, the established emergency procedure will be brought into operation. This could involve either patching a leak or providing a spare tanker into which the load would be transferred.

With the solid sodium cyanide spillage most of the material can be recovered provided conditions are dry. In the event that conditions are wet, then the solid may dissolve and form liquid sodium cyanide. Such liquid does not have the same stability provided by the excess caustic soda contained in the liquid product we propose to transport, and thus would be more likely to evolve hydrogen cyanide.

The Water Authority has given special attention to the consequence of an accident involving the release of 40 tonnes of cyanide solution into a water catchment stream and thus into a water course and a dam. In a worst case analysis, it concluded that by the time the sodium cyanide solution reached the outlet of the dam, it would have been sufficiently diluted so as not to pose a threat to the health of people drinking water reticulated off the dam. In addition the effect of the normal oxidation and breakdown of the cyanide would further diminish its impact.

Q13 Our understanding of the breakdown or decay rate of sodium cyanide in the environment is as follows:

Sodium cyanide breaks down in the environment by a variety of processes including volatilization, biodegradation, oxidation, precipitation, absorption and photo decomposition. Cyanides and cyanide-yielding compounds are found well distributed in the total earth surface environment.

Free cyanide is a very reactive ion forming insoluble and very slowly soluble complex compounds. Simple cyanides including sodium cyanide have been applied at rates of 280 kg nitrogen per hectare to aerobic soils as fertilisers with no hazardous effects. This is equivalent to nearly one tonne of sodium cyanide (100%) per hectare.

A copy of a paper by W.Fuller entitled "Cyanides in the environment with particular attention to the Soil" is attached for your information. This paper discusses the decay of cyanide in saturated anaerobic and unsaturated aerobic soils. In aerobic soils, cyanide is converted to nitrates or fixed metals through formation of complexes. In anaerobic soils, cyanide will denitrify to gaseous nitrogen compounds which diffuse to the atmosphere.

We also refer you to Section 5.4 of the Boddington Gold Mine ERMP, January 1985, which discusses the behaviour of cyanide in the environment. It is noted that free cyanide occurs only rarely in nature because of its high reactivity. The principal fates of free cyanide are:

(i) reaction with sulphur to form thiocyanate
(ii) release to the atmosphere and subsequent dispersion
(iii) complexing with metal ions
(iv) metabolism by micro-organisms
(v) oxidation to cyanate and, ultimately, to carbon dioxide (CO_2) and ammonia (NH_3)
(vi) reaction with organic matter and/or hydrolysis to ammonia and formate.

A current study at Murdoch University (Hoecher W.[1987] "Degradation of cyanide" Honours thesis) is looking at cyanide decomposition by hydrolysis and by oxidation with air with carbon catalyst as occurs in carbon-in-leach plants. Initial results from laboratory tests show that half of the cyanide is decomposed by hydrolysis in 8 hours at 100°C at pH 10.5, whilst oxidation of cyanide with air and carbon is quite rapid, even at 18°C half the cyanide is lost in 24 hours.

Q14 The likely storage system of liquid sodium cyanide at the mine will consist of combination of horizontal steel tanks (approximately $60m^3$ capacity) to suit the mines' requirements, bunded to the regulations of the Department of Mines. The tanks would be fitted with the normal design features including a receival point, level indication, overflow line, venting and discharge line. CSBP would recommend safety hoses and showers at each receival facility.

Customers will receive $20m^3$ or $40m^3$ deliveries as standard, possibly smaller quantities can be arranged depending on the design of the tanks. The method of discharge can be either by air padding of the road tanker using compressed air or by pumping out of the road tanker with a centrifugal pump. Compressed air is normally available at the mines as they use it for air sparging, instrumentation etc.

The preferred method will be decided following discussions with the Mines Department and the individual mines. In either method of discharge, there will be no contact by mines personnel with the solution.

Solid sodium cyanide, on the other hand, is stored in large compounds at the mines (in drums or bulka bags). The drums or bags are brought to a dissolving pit or above ground tank by forklift or utility and manhandled into a tipper above the pit. The containers are locked into the tipper and the operator tips them over using a lever. The container is then washed by in-situ sprays, and the solid sodium cyanide dissolved by agitation. The solution is then transferred by pump to a holding tank generally as a 10 to 15% sodium cyanide solution from where the solution is reticulated to the process area. The dissolution of solid cyanide from drums or bulka bags is dusty and the operator normally wears a cannister type respirator and gloves. Hydrogen cyanide fumes can be generated in the dissolving pit if the dissolving water is not kept alkaline.

Q15 You refer to the management of a liquid sodium cyanide transport accident in an urban environment where the solution enters a stormwater drainage system. This is very unlikely as road tankers will not be using routes through urban environments. In the improbable event that such a spillage did occur remedial action would immediately be taken based on plans previously drawn up in consultation with the Water Authority. According to

the prevailing circumstances, one option would be to add sodium hypochlorite to the drain to neutralize the cyanide. Another option, if isolation of the spilled liquid was difficult, would be to dilute the spilled liquid with large quantities of water and to monitor pH of the mixture adding caustic as necessary and possibly some sodium hypochlorite solution. There would be very little likelihood of HCN evolution because of stabilising of the product with caustic soda at manufacture. Urban drains would most likely contain run off stormwater or run off water from home reticulation systems and would tend to be neutral or slightly alkaline because of the predominance of limestone soils in the metropolitan area. These types of contingencies will be considered with the relevant Authorities when formulating off-site emergency procedures.

Q16 Transport of liquid sodium cyanide is permitted and occurs in:

Holland
West Germany
Belgium
France
South Africa
Spain

There are other countries where liquid sodium cyanide transport is not precluded but because of market conditions it does not take place.

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APPENDIX 3

REVIEW OF SUBMISSIONS

THE PER WAS RELEASED TO THE PUBLIC AND GOVERNMENT DEPARTMENTS ON 20 DECEMBER 1986 FOR AN EIGHT WEEK REVIEW PERIOD, WHICH ENDED ON 13 FEBRUARY 1987.

A TOTAL OF 35 SUBMISSIONS WERE RECEIVED - 11 FROM GOVERNMENT AGENCIES AND 24 FROM THE PUBLIC. ALL OF THESE SUBMISSIONS HAVE BEEN ANALYSED AND THE MAIN ISSUES SUMMARISED IN TABLE 1 OF THE ASSESSMENT REPORT (SEE CHAPTER 3). THIS APPENDIX MAKES A DETAILED LIST OF COMMENTS RAISED IN THE SUBMISSIONS TO THE EPA.

1. CRITICISM OF THE PER

Although generally perceived to be a well written document providing coverage on the general operation of the plant and its environmental consequences there were some who believed that the PER was not a comprehensive document for such a plant and that many of the questions arising from the original Notice of Intent still remain unanswered. Some also believe that the technical information in the PER is very minimal and, in places, inaccurate.

2. NO OBJECTION TO PROPOSED PLANT

A small number of submissions had no objection to the construction of a sodium cyanide plant as proposed and there were a few who did not object to a sodium cyanide plant but preferred it was situated elsewhere.

3. OBJECT TO PROPOSED PLANT

These submissions made clear objections to the construction of a sodium cyanide plant. Some submissions protested this plant and all other noxious industries at Kwinana.

4. SAFETY

4.1 DETAIL EMERGENCY PROCEDURES/DISASTER PLAN

A number of submissions raised the point that these procedures should be developed and details about them provided so that in the event of an accident there would be prompt and effective action. It was suggested that the company should identify the responsibilities of government agencies and have these on the advisory list in any cases of emergency.

4.2 OPERATIONAL SAFETY/RISK ANALYSIS

A training programme was recommended for all operators at the plant as it is an essential component in eliminating human error and it was asked how this would be done, that is, will they be sent to an operational plant or will training be on modelled plant situation? Also mentioned was the possibility of employing a company doctor, fulltime or parttime and perhaps a medical/health practioner to be on duty outside normal working hours.

4.3 ANNUAL AUDITING OF SAFETY

It was thought that operation of the plant should be subject to annual engineering audits and results published and that gaseous emissions from the incinerator will need to be monitored closely. A suggestion was made that there be an independent alarm system inside the stacks. Also that there be visible biological indicators in the surrounding area and that the concentration of hydrogen cyanide (HCN) be measured in the residential areas and published to allay fears held by the public. In general, monitoring and management, were seen as essential components in the operation of the plant.

4.4 HANDLING AND STORAGE OF HAZARDOUS CHEMICALS

While endorsing the procedure outlined in the PER, namely, the absorption system and storage will be bunded so that spills and runoff water will be contained before being channelled to a sump, there was the question raised as to the level of facilities that will be required on individual minesites who receive, store and use the product and whether the small new operators have the capital or commitment to invest in expensive protection structures.

4.5 TERRORIST ATTACK

Two submissions raised concern over the possibility of a terrorist attack and that the sodium cyanide plant would be a prime target for this type of threat.

5. TRANSPORTATION

It was clear that the majority of concern with the sodium cyanide plant was in regard to transport.

5.1 ROAD VS RAIL

A number of people were of the opinion that the hazards associated with transporting sodium cyanide by road in solution form are totally unacceptable. These people believe that transportation by road seems inappropriate as the existing rail system is considered to be one of the most economical and safe transport sytems. Also, transport by road is considered to be a high risk especially entry onto Patterson Road.

5.2 LIQUID VS SOLID

It is considered more hazardous to transport sodium cyanide in solution than it would be to transport solid sodium cyanide in briquette form. The reasons for this are that collision of a NaCN tanker with another vehicle containing an acid formulation would have serious potential for generation of HCN gas in lethal quantities on any crowded highway. Also a liquid spill would be almost impossible to control whereas there is already a standard and effective procedures for clean-up spillage of solid sodium cyanide briquettes. The question was asked at what point would it be more advantageous to produce solid NaCN? Another submission stated that the market was already attuned to solid NaCN and therefore not be a marketing problem.

5.3 NUMBER OF TRUCK MOVEMENTS

It was said that the frequency of transportation was directly proportional to the number of traffic accidents. These accidents result in loss of life and/or damage to the environment. It was felt that the increase in tanker movements would decrease traveller safety. A suggestion was made that warning vehicles precede the tankers and a vehicle with neutralising agents accompany them. The question was asked would, the increase in production to 20 000 tonnes increase tanker movements and will the 30 tanker movement per day be over 24 hours or the normal day shift 8 hour period. The idea to re-route hazardous vehicles through City of Cockburn was not agreed with.

5.4 POSSIBLE COLLISION AND SPILLAGE

There was great concern expressed about the possibility of a tanker containing NaCN solution being in an accident particularly with another vehicle containing an acid formulation. This would cause the generation of HCN gas in lethal quantities on any crowded highway. Such a collision is thought to be plausible considering the number of chemical bearing vehicles in the Kwinana area. It is believed that a liquid spill would be almost impossible to control and effectively clean up. The general opinion was that cartage and spillage of liquid NaCN load will be haphazard and dangerous. One suggestion made was that there should be double packing to attempt to prevent spillage in the event of an accident. Also suggested wsa shifting a small amount at one time thereby decreasing the magnitude of the impact.

6. ENVIRONMENTAL

6.1 AIR POLLUTION

There was a general belief among those who made submissions that cyanide will add to the atmosphere. Of particular concern was the release of NO_2 and the belief that it should be prevented, that is, to justify that burning ammonia NO_2. Prevailing winds exacerbate the air pollution condition meaning that pollutants from Kwinana not only affect the residents there but also those as far north as Mosman Park. A number of people were of the opinion that pollution in the Kwinana area is already bad enough and that the sodium cyanide plant will only add to the problem.

6.2 WATER CONTAMINATION

Some submissions thought that the potential for contamination of rivers and water catchments was not adequately addressed. It was considered necessary to know the location of all water courses, both artificial and natural and these to be clearly defined in case of a spill. One submission suggested the possibility of Lignite Activated Water, a new process, which reduces the amount of chemicals going into the environment. Also that water used on-site should stay in the process cycle. Transportation of liquid NaCN across areas containing significant water resources was of concern to a number of people.

6.3 WASTE

Sodium cyanide is considered to be a dangerous poisonous compound which is difficult to dispose of safely. How much waste would be generated was one of the questions asked. There was the question raised as to where the sodium cyanide went after it has been used as a leaching agent and the concern that there may be dangerous dumping grounds generated by this waste. One submission suggested that the Andrussow process was endorsed as it avoids generation of solid wastes.

6.4 DEGRADATION OF THE ENVIRONMENT

It is believed that accidents will result in loss of life and/or damage to the environment. Some said that it will ruin a natural sheltered bay and spoil the beaches while others believed that by not protecting the environment now there would not be any left for the future.

7. SITE SELECTION

A number of the submissions objecting to the proposal opposed the construction of the plant at the suggested location, that is, at Kwinana. It was said not it was situated and that the geographically wrong plant was in the proximity of fault zone.

7.1 ALTERNATIVES

The general opinion was that this industry could be more suitably located elsewhere. An alternative site suggested was Kalgoorlie as it would be situated where the demand was and is away from residents, also that it should be 100 miles from any township. Other alternatives mentioned included Geraldton, Bunbury and Esperance where CSBP and Farmers Ltd also have fertiliser works and where natural gas is more readily available than at Kalgoorlie. Site 2 should be considered as the risk contours are less than site 1. Site 1 was considered to have the least visual impact and it was asked whether aesthetics were considered before safety?

7.2 CUMULATIVE IMPACTS

Many people believed that site 1 adjacent to the hydrochloric acid plant would be courting a disaster and that if sited too close any accident would be catastrophic. Another concern was that there are too many chemical plants too close to residential suburbs and that each new industry in the Kwinana industrial area increases the overall risk.

7.3 EFFECT ON THE COMMUNITY

One submision pointed out that quite often benefits accrue to the developers while the costs accrue to the local community. A suggestion made to offset this situation was that the company should provide some amenity to the community so that many more people other than those employed at the plant would benefit from the proposed plant. It was also suggested that the area should be rezoned Special Industry and Hazardous. One problem associated with the plant was the possible health risk to the community caused by emissions from it. These included sore eyes, sore lungs and other associated illnesses.

7.4 SELECTION CRITERIA

A number of comments were made concerning the site selection process and the criteria used. Many thought that monetary gain had been the first consideration, that is, the the pressure of economics was greater than any other factor. Along these lines was the suggestion that the site had been chosen due to political expediency. It was stated that the distance/ proximity of the plant to residential areas was not used as a criteria. The wisdom of creating a cyanide plant where it has to be transported for use was also questioned. It was suggested that it should be combined where there is less distance to be transported in its dangerous state.

8. PLANT DESIGN/PROCESS/TECHNOLOGY

8.1 PRODUCTION VS DEMAND

It was stated in the PER that the sodium cyanide plant would produce 15 000 tonnes of NaCN per year, yet it was predicted that Western Australia's

requirement would be 20 000 tonnes per year by 1987. If the expected usage was 20 000 tonne in 1987 could the company produce this amount.

8.2 CHEMICAL NEUTRALISATION

A number of submissions made comments on the proposed chemical neutralisation unit and stated that details of this unit were required. Generally what was required was to know what is the neutralising agent going to be and was it going to be placed in strategic places en route or just at Perth and its destination. One suggestion was that a vehicle with neutralising agent should accompany the NaCN tanker. Another suggestion was the use of Lignite Activated Water which reduces the amount of chemicals being emitted into the environment.

8.3 PLANT FAILURE

There was concern that with the plant designed with computer co ordinated interlock systems and emergency shut-down procedures, what would happen when the power fails. The question was raised as to whether there is a standby electric generator and manual shut-off valves.

APPENDIX 4

CREMER & WARNER LTD LETTER TO THE EPA REGARDING THE INDEPENDENCE AND QUALIFICATIONS OF THE RISK CONSULTANTS

File : E&D Sodium Cyanide

CREMER and WARNER

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YOUR REF:

DATE: 10th December 1986

The Chairman,
Environmental Protection Authority,
Department of Conservation and Environment,
1 Mount Street,
Perth, W.A. 6000.

Dear Sir,

This letter is to advise you that Cremer and Warner Limited has completed its Preliminary Risk Analysis for the proposed Sodium Cyanide Plant for CSBP and Farmers Limited, Coogee Chemicals Pty Limited, and the Australian Industry Development Corporation.

Cremer and Warner are an independent firm of Consulting Engineers, entirely owned by the Directors. The company is a member of the Association of Consulting Engineers who maintain a strict code of ethical and professional standards. Directors and members of staff also uphold the ethical standards of the professional institutions of which they are members, in particular, the UK Institution of Chemical Engineers.

The study was carried out by Mr. V. Harker and others in Cremer and Warner's London office. The results are presented in our Report No. 86158 completed on 10th December 1986. The Risk Assessment is based upon plant design and operation information supplied by Roehm GmbH of West Germany and CSBP and Farmers Limited, and impartial analysis by Cremer and Warner who maintain internal Quality Assurance measures to ensure objectivity, high technical standards, and independence in carrying out a Risk Assessment.

Yours faithfully,

D.G. BLACKBURN
DIRECTOR, PROCESS AND SAFETY GROUP