Criteria for the assessment of risk from industry — expanded discussion

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Report of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 627
May 1992

ISBN 0 7309 4708 4
ISSN 1030 - 0120

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Summary

This paper supplements the Environmental Protection Authority's Bulletin 611, "Criteria for the assessment of risk from industry", which was published in February, 1992. This paper explains what risk is, the process by which the Authority developed its criteria, and gives more details on when a risk assessment should be carried out. It also summarises comments made in public submissions received for the "Review of the guidelines for risk assessment in Western Australia – Information to assess public input to the Environmental Protection Authority" (December 1990).

"Risk" in this document is taken to mean likelihood of unwanted consequences, such as death, injury, damage to property or damage to the environment, from the realisation of specified hazards. The unwanted consequences are those that result directly from catastrophic industrial accidents, and include those resulting from toxic gas clouds from fires or chemical spills, overpressure blasts from explosions and radiation from fires. They also include the consequences of toxic water run-off from extinguishing chemical fires.

Criteria used in risk assessments should reflect society's "value judgements" about the significance of risks. In Western Australia the Environmental Protection Authority's public consultative process, as used for the review of the criteria, provides a process whereby the values held by the community are reflected in the criteria to be used by the Authority in the assessment of hazardous industrial developments.

The Environmental Protection Authority also provides the opportunity for the community to be informed and to comment on risks associated with specific proposals for hazardous industry. This is achieved through the environmental impact assessment process required under the Environmental Protection Act, 1986. This process may require a proponent of a hazardous installation to carry out a risk assessment if the expected levels of risk approach the criteria for the different land uses. The Authority may require the proponent to make public all or part of the assessment as part of the environmental impact assessment documentation.

The Authority will use the risk criteria as one of the bases for advising the Minister for the Environment as to whether particular proposals are environmentally acceptable.

Criteria for new hazardous industry

Individual fatality risk

(a) *A risk level in residential zones of one in a million per year or less, is so small as to be acceptable to the Environmental Protection Authority.*

(b) *A risk level in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments of between one half and one in a million per year is so small as to be acceptable to the Environmental Protection Authority.*

(c) *Risk levels from industrial facilities should not exceed a target of fifty in a million per year at the site boundary for each individual industry, and the cumulative risk level imposed upon an industry should not exceed a target of one hundred in a million per year.*

(d) *A risk level for any non-industrial activity located in buffer zones between industrial facilities and residential zones of ten in a million per year or lower, is so small as to be acceptable to the Environmental Protection Authority.*

In addition, the Environmental Protection Authority will take cognisance of societal risk in its assessments. The Authority may require that a societal risk study be undertaken as part of the risk assessment of new proposals. The Authority will use a qualitative approach in its assessment of societal risk levels. The approach will be based on the merits of each proposal, rather than on specifically set numerical values.

For existing land uses in the impact area of a hazardous operation where the risk levels are greater than the current criteria for new proposals, then a programme should be developed to alter the land use or reduce the risks so that the current criteria can be met.

In addition to the criteria, the Authority requires the overriding principle of "avoiding avoidable risks" be applied. This principle is applicable to all hazardous operations regardless of whether the criteria are met. In particular it applies to intermittent short term high risk operations which meet the criteria (due to the risks being averaged over a year). The principle means that for particular proposals, alternate locations and technologies which may reduce or eliminate risks should be examined and reasonable options to reduce risks should be adopted.

The quantitative risk assessment should be certified to the Environmental Protection Authority's satisfaction by a competent, reputable and objective analyst accepted by the Environmental Protection Authority and at the proponent's expense.

The risk criteria will help local and state planning agencies develop and implement long term planning strategies involving hazardous industry and surrounding land uses.

1. Introduction

1.1 Purpose of this discussion paper

This paper supplements the Environmental Protection Authority's Bulletin 611, "Criteria for the assessment of risk from industry", which was published in February, 1992. This paper explains what risk is, the process by which the Authority developed its criteria, and gives more details on when a risk assessment should be carried out. It also summarises comments made in public submissions received for the "Review of the guidelines for risk assessment in Western Australia – Information to assess public input to the Environmental Protection Authority" (December 1990).

This paper will help the community make informed comment on proposals for hazardous industries or developments near to hazardous industries.

It will help proponents of hazardous installations by detailing the risk criteria applicable for Western Australia, and will help state and local planning agencies prepare long term planning strategies involving hazardous industry or industrial estates, and surrounding land uses.

1.2 General

A full understanding of the risks that hazardous developments introduce is required, so that decisions can be made by comparing the expected level of risk against community accepted criteria. This understanding starts with a definition of the words risk and hazard as they relate to hazardous industrial developments.

"**Risk**" is used in this document to mean the likelihood of unwanted consequences, such as death, injury, damage to property or damage to the environment, from the realisation of specified hazards.

"**Hazard**" is used in this document to mean an object or situation which has the potential to cause such unwanted consequences.

For example, a tank in which petrol is stored is a hazard, with the potential to leak and to catch fire with the possible consequences of damaging people or property. Risk is the likelihood of damage occurring (expressed in terms of events per unit time).

In this document the unwanted consequences referred to are those that result directly from catastrophic industrial accidents, as opposed to natural hazards (such as earthquakes or floods), or the continuous emissions of pollutants from industries. The unwanted consequences considered include those resulting from toxic gas clouds from fires or chemical spills, overpressure blasts from explosions and radiation from fires. They also include the consequences of toxic water run-off from extinguishing chemical fires.

When a hazard is introduced, such as a large storage tank of hazardous material, there is a chance that the hazard may be realised, such as the tank failing. The reasons for failure are diverse, and may be human error in the design, faulty materials of construction, poor operation such as overfilling the tank, or poor maintenance. The greater the consequences of failure, the greater the number of checks and balances necessary to minimise the chance of failure. There will, however, always be a possibility of failure and hence there may be a residual risk to nearby land users.

Residual risk is the small risk that remains after all the safety controls have been implemented. The safety controls include those of meeting regulatory requirements, standards and the principle of "avoiding avoidable risks".

Hazardous installations are necessary because the products and services they provide benefit society. Large hazardous installations provide jobs, foreign exchange and products we all use.

Not all hazardous installations are large. Many small operations also pose some risks to the community. Some of these include: Liquefied Petroleum Gas (LPG) storage in petrol stations and in small factories, chlorine storage at swimming pools, hospitals, water and wastewater treatment plants; and chemical storage, including solvents, flammable goods and some agricultural storage facilities. Each of these operations provide benefits to the community, through either a low polluting fuel, disinfection of drinking water, to supply of goods to the community. Most small facilities, however, will not require a site specific risk assessment, as they can be controlled through appropriate regulations.

The community needs to know that hazardous installations are designed and operated so that the expected level of risk meets some accepted community standard or criterion. Specifically, people need to know why the proposed site was chosen in favour of some alternative site, why certain technologies were chosen, and that the checks and balances on safety precautions have been made. They need assurance that the risks are low enough to be acceptable, and that there are emergency plans to minimise the consequences of an industrial accident.

Buffer zones around hazardous installations effectively reduce the risk by not allowing inappropriate development in relatively high risk areas. Buffer zones are also important in designing emergency response management systems.

The environmental impact assessment process in Western Australia provides an opportunity for people to find out about risks from new hazardous industry and to have their say before the Environmental Protection Authority reports to the Minister for the Environment on the project.

During the environmental impact assessment process, developers of large potentially hazardous industries are required to undertake a preliminary risk analysis (PRA) for their project to ensure the risk to the public is small enough to meet the relevant risk criteria. The results of the risk assessment also will provide guidance to planning authorities and developers of land which is potentially affected by hazardous industries (eg buffer zones).

A "yardstick" is required to determine whether the results of the risk assessment are acceptable. This document provides that "yardstick" by outlining both specific risk criteria and qualitative risk considerations.

The preliminary risk analysis, which uses the risk criteria detailed in this document, is one element of several elements which may be used to minimise risks. The other elements include:

- a hazard and operability study (HAZOP);
- a fire safety study;
- emergency plans and procedures;
- a final hazard analysis;
- a construction safety study; and
- hazard audits.

Appendix 1 shows diagrammatically the interrelationship between these elements. The above elements may be required as a result of the environmental impact assessment process and by the Department of Mines as part of "Hazard Control Plans" for major hazardous industries.

2. Community consultation

Criteria used in risk assessments should reflect "value judgements" of society about the significance of risks. In Western Australia the Environmental Protection Authority's public consultative process, as used for the review of the criteria, provides a process whereby community values are reflected in the criteria to be used by the Authority in the assessment of hazardous industrial developments.

In May, 1987, following public consultation, the Environmental Protection Authority published details of the requirements and approach to be adopted to evaluate risks and hazards (EPA Bulletin 278, "Risks and hazards of industrial developments on residential areas in Western Australia"). Bulletin 278 has to date been the reference document for assessing the acceptability of risks imposed on the community through new hazardous industry in Western Australia.

In 1990, in order to ensure the criteria continued to meet the evolving expectations of the community, the Environmental Protection Authority decided to review and extend the existing guidelines. As part of the review process the Authority published the document "Review of the guidelines for risk assessment in Western Australia - Information to assess public input to the Environmental Protection Authority" (December 1990). This document examined issues such as individual risk, societal risk, injury risk, ecosystem risk, and whether the risk criteria for existing industries should be different to those for new industries.

Wide community consultation was undertaken and international, interstate and local submissions were received from government agencies, specific companies, industrial groups, consulting firms, community groups and individuals. The principal issues covered in the submissions were:

Band vs single criteria

- support for the expansion of the criteria to encompass various land uses
- support for single value criteria
- support for criteria with bands, given the broad confidence limits of risk assessment results
- difficulties with criteria for different land uses, given the confidence limits
- specific comments on relative values of proposed criteria for different land uses
- suggestions for criteria for land uses not proposed.

Different criteria for different land uses

- strong support for protection of buffer zones
- support for stricter criteria for non-hazardous uses in buffer zones.

Societal risk

- societal risk is a difficult concept, but it should be developed and used for land planning and emergency planning requirements
- societal risk is too imprecise
- there should be no societal risk study requirements without criteria.

Injury and environmental risk criteria

- injury and environmental risk concepts were supported, but there were concerns about the uncertainties and the inclusion of effects resulting from long-term pollution.

Risk criteria for intermittent risk.

- support for ALARP (as low as reasonably practicable) procedures for high risk intermittent operations and for risk assessments in general.

Existing industry

- existing industry should meet the same criteria as new industry
- only industry upgrades should need to conform with new criteria
- a plan to implement risk reduction programmes for existing industry is required
- cost implications should be considered in reviewing existing industry
- existing industry should be allowed a factor of 10 in implementing the criteria.

Other

- the roles of government agencies (including local government) in risk assessment should be clarified
- guidelines for preliminary risk analyses should clarify the scope, assumptions and methodology used in the study, and PRAs should be publicly available
- consultants should be accredited
- auditing of industrial plants is required
- more education of the community by industry and government is required.

The submissions supported the need to expand the criteria and to investigate development of criteria for ecosystems.

The Environmental Protection Authority gave careful consideration to all the public submissions and subsequently published new risk criteria in Bulletin 611, "Criteria for the assessment of risk from industry", in February, 1992. The Authority will use the criteria as one of the bases for advising the Minister for the Environment as to whether particular proposals are environmentally acceptable.

3. Types of risk

3.1 Individual fatality risk

Individual fatality risk is the likelihood that a person will die.

People continually (knowingly and unknowingly) expose themselves to, or have imposed upon them, the risk of death.

The self exposed risk is referred to as a voluntary risk and includes decisions by a person on smoking, alcohol consumption, types of sport played and the decision to drive a car. Each of these actions has an associated risk which people voluntarily and usually unconsciously accept when weighed against the perceived benefits.

Imposed risk is referred to as an involuntary risk and is one which the person has little choice. Involuntary risks vary from the risks from being struck by lightning to the imposition of risks from some human activities. It is the risks from hazardous industries (which are a human activity), with which this document is concerned.

Although the imposed risk from a hazardous installation is regarded as involuntary, the community does have the opportunity to voice their opinions through various mechanisms, including the environmental impact assessment process. The nature of the environmental impact assessment process offers an opportunity for developers to reduce risks from proposals.

3.2 Societal risk

There are two components to societal risk. Firstly, the number of people exposed to levels of risk is important. Secondly, society is more averse to incidents which involve multiple fatalities or injuries than to the same number of deaths or injuries occurring through a large number of smaller incidents.

An example of individual fatality risk is the likelihood that a particular person may have a fatal accident whilst driving and an example of societal risk is the total number of people within a community that may die as a result of road accidents.

The second component of societal risk can be illustrated by the difference in public reaction to the number of fatalities resulting from car crashes over a period of time and multiple fatalities resulting from a bus crash. The latter may result in a devastating shock to the local community which suffered the losses. It may also shock the country. The initial reactions of grief and sympathy from such a disaster turn to those of anxiety and to demands for actions to reduce the risks of such events.

Multiple fatality incidents have occurred with hazardous industries, notable examples include Bhopal (1984) and Mexico City (1984). The reactions nationally and internationally were similar to those described above, with detailed enquiries into the causes of the accidents, what actions would be taken to lower the likelihood of recurrence, and an expectation that similar installations would be regulated stringently.

A common element in the Bhopal and Mexico City disasters was the large numbers of poorly protected people in the area immediately surrounding the installations, many of whom were killed or injured. The number of casualties from a major incident directly corresponds to the number of people in the impact area. There is therefore a need for planning authorities to recognise the importance of buffer zones around hazardous industries, and for planning controls on the type of land uses allowed in such buffer zones, with an emphasis on controlling population densities.

Planning controls, as with the formulation of emergency response plans, can be assisted by the results of societal risk studies. Such studies can provide information on the frequency and the number of people who may be potentially affected by an accident for different planning scenarios involving different population densities.

3.3 Injury risk

Injury risk is the likelihood that a person will be injured.

Injuries from an incident vary in their severity and the effects may be either immediate or delayed. Typically the effects include irritation, sensitising, delayed, acute and chronic effects.

Society is concerned about the risk of injury as well as the risk of death, particularly if the consequences of a hazardous event may involve injury alone, or a large number of injuries compared with fatalities.

3.4 Environmental risk

Environmental risk is the likelihood that part of an ecological system or heritage will be damaged.

Damage to the environment includes damage to a rare or unique part of the natural environment or widespread damage to the broader environment. Broad scale environmental damage could be defined by the loss or damage of a certain area of land, area of habitat or of the loss of plants or animals. This damage may be caused by the disturbance of the balance of an ecosystem, whereby certain species flourish to the detriment of another due to the change, and may be either immediate or delayed.

Similarly, the environmental damage may also be defined as the loss or decrease in numbers of rare or endangered plants or animals.

The potential damage to the natural environment will depend on the type, fragility and numbers of the species, together with damage of their habitat and the effect that damage may have on their survival.

Risk of damage to people is a subset of environmental damage and is addressed through individual, injury and societal risk considerations.

Damage to heritage includes damage to buildings of significant architectural or historic interest or to Aboriginal sites of cultural significance.

4. Risk criteria

There is a public expectation and a corporate responsibility that where possible, regardless of calculated risk levels and criteria, "avoidable risks should be avoided".

This means that for a proposed hazardous installation, developers should consider alternate sites and/or alternate technologies which may reduce or eliminate the risks. For proposed developments in the impact area of an existing hazardous installation, developers should consider alternative sites. All feasible options to reduce risks should be adopted.

4.1 Individual fatality risk criteria

In 1987, the Environmental Protection Authority adopted an individual fatality risk level of one in a million per year (1×10^{-6} per year) for residential areas, as a risk level so small as to be acceptable to the Authority. It also adopted an individual fatality risk level of ten in a million per year (10×10^{-6} per year) for residential areas, as a risk level so high as to be unacceptable to the Authority. When the risk level in residential zones was in the range one in a million to ten in a million a year, the Environmental Protection Authority called for further evaluation of risks associated with the project.

In practice, the Environmental Protection Authority required risk levels to comply with the one in a million value. More than four years experience by the Environmental Protection Authority in implementing this criterion indicates that this level is practical, workable and appropriate.

The one in a million criterion assumes that residents will be outdoor at their homes, exposed to the risk 24 hours a day and continuously day after day for the whole year, and do nothing to avoid being harmed. In practice this is not the case and the calculation of risk is therefore deliberately conservative.

This paper establishes individual fatality risk criteria for other land uses.

It is desirable when examining other land uses to account for variations in people's vulnerability to hazardous effects, duration of exposure to risk at any particular location by any one individual, and the ability to take evasive action. These variations, detailed below, determine the actual level of risk to individuals.

Vulnerability — People in hospitals, children at school or old aged people are generally more vulnerable to hazardous effects than the average population.

Presence — The proportion of time spent by an individual within the impact area of a hazardous industry may be less than that which was assumed for the calculation of the individual risk value for a location (namely 24 hours a day, every day of the year).

That person's actual risk would be proportionally lower according to the time spent in the impact area. Account needs to be taken of the situation where a person may work and/or recreate and/or sleep in the impact area. Presence factors could apply to land uses such as industrial, commercial, entertainment and sporting complexes and open space.

Protection — The protection a person has, can take, or is available to that person will affect the actual risk to that person.

Inherent protection

The inherent protection provided to a person through the design of a building (height, materials — limited use of glass within an explosion hazard impact area, ventilation — ability to turn it off and seal a building quickly) may reduce the actual risk for that land use.

Self actuated protection

Whether a person is likely to be indoors or out-of-doors, and, if out-of-doors, how easily they could seek shelter. For example, it would be difficult for a person to find shelter at a beach, garden centre or football ground compared with a person already sheltered at a cinema, office block or home.

Externally available protection

Emergency response schemes can effectively protect people by providing early warning of an event, providing advice on the correct evasive action to take and also by providing aid after an accident.

The Environmental Protection Authority will use the following risk criteria to assess a proposed development of a potentially hazardous nature, and for providing advice on land use planning in the vicinity of existing hazardous installations:

Individual fatality risk

(a) *A risk level in residential zones of one in a million per year or less, is so small as to be acceptable to the Environmental Protection Authority.*

(b) *A risk level in "sensitive developments", such as hospitals, schools, child care facilities and aged care housing developments of between one half and one in a million per year is so small as to be acceptable to the Environmental Protection Authority.*

(c) *Risk levels from industrial facilities should not exceed a target of fifty in a million per year at the site boundary for each individual industry, and the cumulative risk level imposed upon an industry should not exceed a target of one hundred in a million per year.*

(d) *A risk level for any non-industrial activity located in buffer zones between industrial facilities and residential zones of ten in a million per year or lower, is so small as to be acceptable to the Environmental Protection Authority.*

The list of sensitive developments given in criterion (b) above is not considered to be exhaustive and may include other developments where an individual's risk relative to the normal population may be increased due to variations in vulnerability, presence or protection.

The calculated individual fatality risk values are a summation of all risks resulting from fires, explosions, and toxic gas releases. Where several hazardous industries or activities exist in a region, the individual fatality risk value to be used in comparing risk levels with the criteria (apart from the fifty in a million industrial risk target) is the cumulative risk of existing industry, combined with the assessed risk of the proposed new industry.

4.2 Societal risk

Elements of a societal risk study can be used to help formulate emergency management plans for a hazardous industry or an industrial estate. Societal risk studies also may help in long term planning for areas around hazardous industries, particularly to control population densities in those areas.

Societal risk may help identify incidents which have the greatest impact on the potential for loss of life and for which priority should be given for implementing risk reduction measures.

The Environmental Protection Authority may require that a societal risk study be undertaken as part of the risk assessment of new proposals. Population groups to be considered in such a study include those associated with the hazardous industry, neighbouring industries, commercial activities, schools, hospitals and residential areas.

The Environmental Protection Authority's experience with societal risk indicates that more research is needed before societal risk is addressed through the establishment of criteria. The Authority will use a qualitative approach in its assessment of societal risk levels. The approach will be based on the merits of each proposal, rather than on specifically set numerical values.

4.3 Injury risk

Relying entirely on fatality risk criteria does not account for the following factors:

- the community's concern about risk of injury as well as risk of death; and
- consequences of a hazardous event may involve injury alone, or a large number of injuries compared to deaths.

It may therefore be appropriate in some circumstances that risk criteria also be set in terms of injury, that is, in terms of levels of risk that may cause injury to people but will not necessarily cause death. If such circumstances arise, criteria would need to account for the number of people affected, the nature of the injury (including whether the injury sustained is immediate or delayed), and the severity and type of debilitation.

While general injury risk criteria can be established, a complex set of criteria would be required to address all of the community's concerns about the variation in the nature of injury that may occur.

The Environmental Protection Authority considers that more experience is needed before injury risk is addressed through the establishment of criteria.

4.4 Environmental risk

Criteria for protecting the environment should reflect the community's views on acceptable levels of environmental damage.

For environmental risk criteria to be established, not only must the environmental damage be defined but it also must be presented together with the likelihood of that damage occurring. This complex task is made more difficult due to the wide range of personal opinion on priorities of various aspects of environmental protection (or acceptable level of risk of environmental damage). Ultimately the level of risk judged to be acceptable will depend on the value placed on the potentially affected area or system.

The Environmental Protection Authority considers that more experience is needed before environmental risk is addressed through the establishment of criteria.

5. Existing industry and intermittent high risk operations

5.1 Existing industry

The specific risk criteria and qualitative risk considerations detailed in this paper apply to proposed hazardous industrial developments. They also need to be taken into consideration by planning authorities when examining proposed land use developments near existing hazardous industry.

Some existing hazardous industries have been established, or land use developments have occurred, at a time before there was a full recognition of the hazards associated with the industries, or before there were methods available to quantify the associated risks. Additionally, acceptable risk criteria may change in the future with development of safer technologies, or with changes in community expectations.

These past and possible future changes may result in land uses being subject to risks in particular areas which are greater than those considered acceptable. Where such land uses are identified a programme should be developed to alter the land use or reduce the risks so that the current criteria can be met.

5.2 Intermittent high risk operations

The risks from a hazardous industry are normally presented as annual frequencies, that is, as the likelihood of unwanted consequences occurring within a year. If the risks were presented as daily frequencies, there would be times when the risks are either higher or lower than the annual average daily value.

Several industrial operations increase the risk levels above the average value (including those of plant start-up or shut-down and for the import or export of hazardous substances). No separate criteria have been established for risks associated with these intermittent hazardous operations.

The principle of "avoiding avoidable risks" should be used during these operations. This principle encompasses additional safety management through equipment and trained staff, and takes into account considerations of increased emergency preparedness and timing of the operation to minimise the impact of an incident.

6. Requirements for evaluation of risk

The Environmental Protection Authority requires risk assessment for all hazardous industrial developments, which in the opinion of the Authority are likely to increase the levels of risk to values approaching the criteria in this paper. As a rule of thumb, approaching the criteria means

within about an order of magnitude (one tenth) of the risk criteria. Similarly, planning authorities need to carefully consider proposed developments in the buffer zones for hazardous industry, which may be exposed to similar risk levels.

The requirement for risk assessment is part of the environmental impact assessment process detailed in the Environmental Protection Act, 1986. For a hazardous industry proposal this may involve a formal report on the risks, such as a quantified risk assessment (referred to as a preliminary risk analysis), to be undertaken and presented to the Authority. The report should identify all hazards, quantify the consequences and the likelihood of their occurrence and compare these with the criteria in these guidelines. Regardless of meeting the criteria the assessment should identify reasonable means to reduce the risk levels in conformity with the principle of "avoiding avoidable risks". All proposed safeguards and their effectiveness in reducing and managing risk should be detailed.

The Environmental Protection Authority will usually require the proponent to make public all or part of the risk analysis as part of the environmental impact assessment documentation package. Key findings of the risk analysis should also be published in the environmental documentation describing the proposal submitted to the Environmental Protection Authority.

The quantitative risk assessment should be certified to the Environmental Protection Authority's satisfaction by a competent, reputable and objective analyst accepted by the Environmental Protection Authority and at the proponent's expense.

The Environmental Protection Authority may seek an independent audit of the risk analysis.

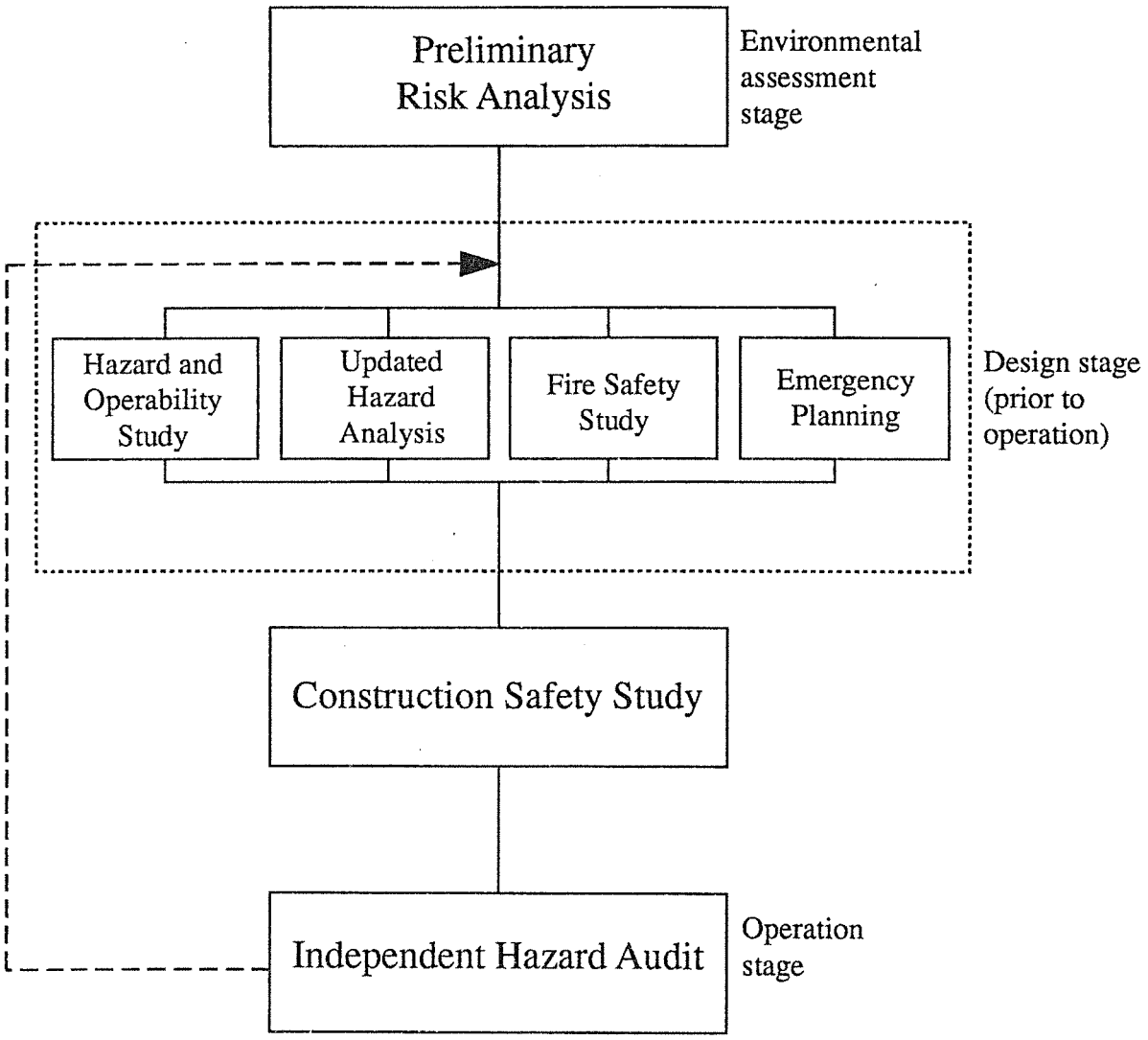
The Environmental Protection Authority issues guidelines to help the proponent carry out a preliminary risk analysis. The nature and extent of the preliminary risk analysis required will depend on several factors including the size of the project, the types of risk associated with the project and population densities in surrounding areas.

The Authority would expect the risk analyst to make recommendations in the preliminary risk analysis to ensure safe operation of the plant, and further expects that the proponent will take up these recommendations as commitments.

The preliminary risk analysis, being part of the environmental impact assessment documentation, will be assessed, together with any public comment by the Authority. The Authority will make recommendations to the Minister for the Environment on the environmental acceptability of the project. The Minister will then decide, in consultation with other relevant decision makers, whether the project may be implemented, and if so, under what conditions.

Appendix 1

Requirements for hazardous industry proposals


Preliminary Risk Analysis
Environmental assessment stage
Hazard and Operability Study
Updated Hazard Analysis
Fire Safety Study
Emergency Planning
Design stage (prior to operation)
Construction Safety Study
Independent Hazard Audit
Operation stage

Appendix 2

List of those who made written submissions on the "Review of the guidelines for risk assessment in Western Australia — Information to assist public input to the Environmental Protection Authority", December, 1990

Submissions were received from:

Health Department
Department of Local Government
Main Roads Department
Department of Mines
Department of Occupational Health Safety & Welfare
Department of Planning and Urban Development
Radiological Council of Western Australia
Department of State Development
Water Authority of Western Australia

Esperance Port Authority

Environment Protection Authority (Victoria)
National Task Force on Hazardous Industries and Land Use Safety Planning
County Emergency Planning Officers' Society (United Kingdom)
County of Fairfax (Virginia USA)
Health & Safety Executive (United Kingdom)
Ministry of Housing, Physical Planning and Environment, Netherlands Government
Pollution Control Department (Singapore)
Somerset County Council (United Kingdom)

City of Bayswater
City of Bunbury
City of Fremantle
Shire of Harvey
Shire of Kalamunda
Town of Kwinana
City of Cockburn, Town of Kwinana, City of Rockingham, Local Authorities' Environmental Review Committee

Chamber of Mines and Energy of Western Australia Inc
Confederation of Western Australian Industry
Conservation of Rockingham's Environment
Conservation Council of Western Australia Inc
The Institution of Engineers, Australia (Environmental Engineering Panel)
BHP Engineering Pty Ltd
BP Refinery (Kwinana) Pty Ltd
The Commonwealth Industrial Gases Ltd
CSBP & Farmers Ltd
Dominion Mining Ltd
ICI Australia Operations Pty Ltd
Dames & Moore Pty Ltd
Technica Ltd
O'Dwyer, C
Quin, E