Feed flexibility project - BP Refinery

BP Refinery (Kwinana) Pty Ltd

Report and recommendations
of the Environmental Protection Authority

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Summary and recommendations

BP Refinery (Kwinana) Pty Ltd propose to modify a number of their process streams in order to increase plant efficiency, as well as to enable the refinery to process greater amounts of crude oil containing high levels of sulphur. The proposal will give the refinery greater flexibility with regard to the feedstocks it can utilise. The proposal will enable the refinery to ensure its economic viability, as well as to cater for the types of crude oil likely to be available on future world markets.

The proposal includes modifications to and the replacement or expansion of, a number of units within the existing plant. The resultant new technology plant will give the company an opportunity to meet current environmental standards for some aspects of its operations. The company considers that the environmental objectives of the project are to reduce odorous and particulate air emissions, to improve the quality of wastewater discharged to Cockburn Sound, and to meet community expectations with regard to sulphur dioxide emissions.

The level of assessment for the proposal was set by the Environmental Protection Authority at Public Environmental Review, and the proponent finalised its documentation for release for an eight week public review period, which ran from 6 February 1991 to 3 April 1991. A total of six submissions were received by the Environmental Protection Authority.

The principal environmental issues considered by the Environmental Protection Authority for this proposal were emissions of sulphur dioxide, nitrogen oxide and particulates to the atmosphere; wastewater discharge to Cockburn Sound; and solid waste management.

An equally important issue of wider concern to the Authority relates to the emission of hydrocarbons into the atmosphere (and its impact on nuisance odours and photochemical smog formation) from facilities such as refineries and petroleum tank farms. In a recent EPA assessment report (Bulletin 522, Caltex North Fremantle terminal extension) the Authority outlined a strategy to monitor and control hydrocarbon emissions. This strategy will require BP Refinery Kwinana Pty Ltd to control hydrocarbon emissions from its site.

The Authority considers that the emissions of sulphur dioxide are manageable, within the context of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991, so long as BP Refinery (Kwinana) Pty Ltd ("the company", or "BP Refinery Kwinana") does not exceed its maximum proposed sulphur inputs and outputs. This will depend on factors such as the blends of crudes used, the efficient maintenance of process units, and ensuring that upset conditions likely to lead to untoward emissions are absolutely minimised. Should a sulphur recovery unit fail, the Public Environmental Review (PER) shows that there is the possibility of the proposed limits for sulphur dioxide in the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991 to be exceeded, in which case the company have committed themselves to ensuring a rapid response to reducing sulphur dioxide emissions. Should there be any breaches of the Environmental Protection Policy when implemented, the Environmental Protection Authority would take appropriate action.

Emissions of particulates and nitrogen oxides are considered to be manageable, as modelling of refinery emissions indicates acceptable ground level concentrations. The Authority is nevertheless concerned, in general terms, about the role of nitrogen oxide emissions in the potential generation of photochemical smog in the metropolitan area. In this Report, the Authority has proposed a mechanism for dealing with nitrogen oxides.

The quality of effluent discharged via wastewater to Cockburn Sound will be improved as a result of this proposal. BP Refinery Kwinana are planning to upgrade their liquid effluent treatment processes in the future, and this will be subject to further assessment by the EPA.

BP Refinery Kwinana propose to continue managing their solid waste on-site (and to interact with the Health Department, which is responsible for management of waste when taken offsite), to the satisfaction of the EPA. Nevertheless, the EPA considers that the proposal to continue to bury and land-farm solid wastes on-site is environmentally unacceptable, and considers that the company should work with government agencies to achieve an environmentally acceptable solution. The EPA considers that solid waste management is an important issue for the State. The State needs to take a pro-active role, to ensure that

industrial wastes are managed in a manner which promotes recycling, reuse, and treatment, as well as disposal at strategically located landfill sites for (low hazard) industrial wastes, in order to facilitate both industrial development and appropriate environmental management of wastes in Western Australia.

Neither noise nor risks and hazards are considered to be significant environmental issues for this proposal. BP Refinery Kwinana have given commitments to control noise to the satisfaction of the EPA, and to interact with appropriate government agencies on risks and hazards.

The Environmental Protection Authority considers that the feed flexibility project proposal by BP Refinery Kwinana marks a significant milestone in environmental management at the refinery, and commends the company for its initiative. The Authority is keen to see a continued improvement in environmental management at the facility, and considers that developing programmes (such as the proposed Project - Water Effluent Treatment (Project WET)) are strong evidence of this. Nonetheless, issues such as solid waste management need considerably more effort, and the Authority considers that the company needs to work with government agencies to achieve appropriate environmental outcomes.

Recommendation 1

The Environmental Protection Authority has concluded that the proposed feed flexibility project at the BP Refinery in Kwinana is environmentally acceptable.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as; the preservation of the beneficial use of the Kwinana airshed by ensuring that the provisions of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991 are met, the commencement of an atmospheric emission inventory for hydrocarbons and nitrogen oxides; and appropriate management of solid wastes.

Accordingly, the Environmental Protection Authority recommends that the proposal by BP Refinery (Kwinana) Pty Ltd, as outlined in its Public Environmental Review (PER), could proceed, subject to the proponent's environmental management commitments in the PER, responses to issues raised as a result of the environmental review process, and the recommendations of the Environmental Protection Authority.

The revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991 is currently subject to consultations between the Authority and industry, with regard to allowable emission levels of sulphur dioxide for each facility, and with regard to monitoring requirements. The Environmental Protection Authority considers that the feed flexibility proposal should be subject to the obligations on industries which may arise from the forthcoming establishment and implementation of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991, and to the requirement that industries participate in an ambient air quality monitoring programme.

Recommendation 2

The Environmental Protection Authority recommends that BP Refinery (Kwinana) Pty Ltd should conform with all requirements for the establishment and implementation of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991.

As noted in the EPA's assessment of the Caltex proposal for its facility at North Fremantle (Bulletin 522), the EPA is concerned about emissions of non-methane hydrocarbons in the metropolitan area, both from major point sources and from multiple small sources. The EPA and the State Energy Commission of WA are currently planning an airshed study for the Perth metropolitan region, for which a critical component is the development of inventories of emissions of both non-methane hydrocarbons and nitrogen oxides. The BP refinery constitutes a major point source of these substances, which have the potential to promote the

production of photochemical smog in the metropolitan area. Accordingly, the EPA considers the following recommendation to be appropriate.

Recommendation 3

The Environmental Protection Authority recommends that prior to commissioning of the feed flexibility project, BP Refinery (Kwinana) Pty Ltd prepare an atmospheric emission inventory to the satisfaction of the Environmental Protection Authority, and the results of the programme be submitted to the Environmental Protection Authority for consideration.

The purpose of this inventory is to identify and quantify the type and level of atmospheric emissions from point sources, and in the ambient environment, in order to manage them. The initial requirements of this recommendation will be satisfied by the preparation and implementation of an emissions reduction programme (the company has already commenced measures to reduce hydrocarbon emissions), as well as the preparation and implementation of a plan for developing the inventory. This plan will need to be approved by EPA and it will need to address the parameters to be measured, their frequency of measurement, and measurement locations. Its development and implementation will need to be consistent with and complementary to the longer term objectives and requirements of the airshed study.

The Authority is giving consideration to setting a long term target for levels of non-methane hydrocarbons in the immediate vicinity of the facility. The actual target that is eventually set will, however, be subject to the results of the airshed study. The Authority considers that a second, emissions reduction programme (which takes into account the outcomes of the airshed study), agreed between the company and the EPA, may be required to manage this issue in the longer term.

In relation to solid waste management practices at the Refinery, the EPA considers that BP Refinery Kwinana should demonstrate that its solid wastes are managed in a manner which is not detrimental to the environment.

Recommendation 4

The Environmental Protection Authority recommends that BP Refinery (Kwinana) Pty Ltd develop and submit, and subsequently implement, a plan for the management of solid wastes which result from the proponent's on-site operations, to the satisfaction of the Environmental Protection Authority.

The Authority considers that any approval for this proposal based on this assessment should be limited to 5 years. Accordingly, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

The Authority notes that during the detailed implementation of this proposal, it could be necessary or desirable to make minor and non-substantial changes to the designs and specifications which have been examined as part of the Authority's assessment. The Authority considers that subsequent statutory approvals for this proposal could make provision for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

1. Introduction

BP Refinery (Kwinana) Pty Ltd have operated an oil refinery at Kwinana, Western Australia, since 1955, under the terms of the Oil Refinery (Anglo-Iranian Oil Company Limited) Act, 1952. The refinery has been a significant part of the industrial scene in Western Australia since its establishment, particularly given its economic and strategic position. The refinery has made significant improvements to its operations in recent years, many of which have had environmental benefits. The commissioning of a sulphur recovery unit in 1989 resulted from environmental pressures on the company, given its long history of sulphur emissions, in the form of hydrogen sulphide and sulphur dioxide, to atmosphere. The implementation of natural gas as a fuel, for economic reasons in 1987, also led to a reduction in sulphur emissions.

The current feed flexibility project will enable the company to take advantage of the more plentiful and lower priced high sulphur Middle Eastern crudes, and therefore remain competitive in the Australian and world markets. At present, high sulphur crudes account for about one third of the throughput at the refinery, and the feed flexibility project will enable this to progressively increase to about two thirds. Sulphur dioxide emissions to the atmosphere will increase, although the current maximum daily emission rate will not change significantly.

The company states that some of the specific objectives of the project are to:

- process more high sulphur crude and reduce dependence on low sulphur crude;
- meet gasoline and diesel fuel product quality specifications;
- increase production of LPG;
- meet community expectations for sulphur dioxide emissions;
- reduce odorous air emissions;
- reduce particulate air emissions; and
- improve the quality of wastewater discharged to Cockburn Sound.

The proposed project will involve the expenditure of more than $50 million.

BP Refinery (Kwinana) Pty Ltd referred the feed flexibility project to the Environmental Protection Authority in July 1990. The Authority determined that the proposal should be assessed at Public Environmental Review (PER) level. This level of assessment is a formal level of assessment under the Environmental Protection Act 1986, and provides for the Minister for the Environment to set legally binding conditions on the project.

The proponent's PER document was released for an eight week public review period on 6 February 1991, and this was completed on 3 April 1991. A total of six submissions were received by the Authority.

The principal issues associated with the proposal are sulphur dioxide, nitrogen oxide and particulate emissions to the atmosphere, wastewater discharge to Cockburn Sound and solid waste management. Other associated issues include the emission of hydrocarbons into the atmosphere, risks and hazards, and noise levels.

2. The proposal

The proposal consists of modifications to, replacement of, or expansions of, eight units on the existing plant. The units involved include the:

- hydrofiner unit;
- propane production unit number 1;
- new straight run gasoline 'minalk' unit;
- new catalytic cracked spirit 'minalk' unit;
- new sour water treatment facilities;

- new sulphur recovery unit;
- residue cracker gas recovery unit and propane production unit number 2; and
- residue cracker unit - particulate emissions.

A new hydrofiner unit of 1800 tonnes per day capacity will supplement the existing hydrofiner (900 tonnes per day), enabling greater throughput. The hydrofiner removes sulphur from diesel fuel components by converting sulphur compounds to hydrogen sulphide, over a cobalt molybdenum fixed bed catalyst at high temperature and pressure. The hydrogen sulphide will be routed to the new sulphur recovery unit.

Propane Production Unit Number 1 removes hydrogen sulphide and odorous mercaptans from liquified petroleum gas by washing with caustic soda, generating odorous spent caustic. Modifications will reduce spent caustic. An amine unit will remove hydrogen sulphide, which will be routed to the sulphur recovery unit. Mercaptans will then be removed by a new LPG Merox (mercaptan oxidation) Extraction Unit, which converts mercaptans to non-odorous disulphides. The caustic in this new unit is to be regenerated and recycled. The net effect will be to reduce the quantity of spent caustic requiring disposal by 31%.

A new straight run gasoline Minalk (minimum alkalinity) unit will reduce mercaptans in gasoline component tankage, by converting mercaptans to disulphides.

A new catalytic cracked spirit minalk unit will convert mercaptans to disulphides in gasoline components. It will replace the existing Catalytic Cracked Spirit Merox Unit, which is currently the major source of phenolic material in spent caustic.

A new sour water stripper will replace two existing inefficient sour water strippers which remove sulphides and ammonia from water destined for Cockburn Sound. More contaminants will be removed, and a dry offgas will be produced, which will be routed to the new sulphur recovery unit.

A new sulphur recovery unit is proposed to operate in parallel with the existing sulphur recovery unit. The new unit will take the increased hydrogen sulphide gas input derived from the new hydrofiner, the propane production unit no.1, and the new sour water stripper. The unit will be capable of taking sufficient hydrogen sulphide gas to produce 35 tonnes per day of sulphur. The sulphur is then sold for processing into other chemicals. Should there be a major shutdown of one of the sulphur recovery units, some backup capacity is available through the other sulphur recovery unit. This capacity is not currently available.

The capacity and efficiency of the Residue Cracker Gas Recovery Unit and Propane Production Unit Number 2 will be increased, enabling more LPG to be recovered, and product quality to be improved.

Particulate emissions from the Residue Cracking Unit will be reduced by the installation of external secondary recovery equipment.

The proponent's environmental management commitments for the feed flexibility proposal are listed in Appendix 1.

The proposal is part of a series of modifications that have been made to the refinery and its operating practices since its establishment. A listing of previous and proposed modifications for the period 1985-1995 is provided at Appendix 2.

3. Public submissions

The Environmental Protection Authority received six submissions on the feed flexibility proposal. These were principally from state government agencies, as well as one from a local action group, and one from Lansstyrelsen Goteborgs och Bohus lan, located in Goteborg (Gothenburg), Sweden. Lansstyrelsen is the regional government for Gothenburg, and incorporates the environmental protection agency which licences four oil refineries, including a BP facility of similar throughput to the Kwinana operation. A listing of those organisations which made submissions is provided at Appendix 4.

The principal issues raised in most submissions were the company's waste management practices, and risks and hazards. Whilst risks and hazards were commented upon frequently, the issue was seen in a positive light. Previous waste management practices were seen as requiring considerable improvement.

The need for tree planting around the site perimeter, and for bunding around storage tanks were also raised.

Lansstyrelsen raised issues relating to atmospheric emissions (hydrocarbons, sulphur dioxide, nitrogen oxides), and liquid effluent.

The questions asked of the proponent, and the proponent's responses, are given in Appendix 3.

4. The existing environment

The BP refinery has been in operation since 1955. Environmental standards over much of that period have not been as stringent as they are nowadays, and the company operated its facility in line with prevailing standards. As a result, the level of pollutants entering Cockburn Sound in the past has been high, and sulphurous emissions to the atmosphere have also been elevated. A considerable pool of oil lies beneath the refinery, because of past management practices.

BP Refinery Kwinana have taken significant steps to ameliorate these environmental impacts in recent years. Information in the PER indicates significant reductions in phenolic, ammonia, sulphide and caustic levels going into Cockburn Sound during the 1980s. The conversion to (low sulphur) natural gas as an onsite fuel in 1987, and the installation of a sulphur recovery unit in August 1989, have significantly reduced atmospheric emissions of sulphur dioxide. In addition, replacement of the flare tip ensured a reduction of hydrogen sulphide ("rotten egg gas") emissions. The company have a significant recovery programme in place for underground oil, and are also fixing up the on-site oily sewer system, to ensure no further additions to the underground oil problem.

BP Refinery Kwinana have historically disposed of their solid wastes by burial and land-farming on their own property, although they have made endeavours to recycle and/or reuse some solid wastes. There has been insufficient monitoring to determine whether these practices have caused environmental problems, but these on-site disposal practices can no longer be considered to be satisfactory. There are difficulties associated with appropriate off-site disposal, particularly the lack of a suitable low-hazard waste landfill site. The government, in conjunction with industry, needs to address this problem in the near future.

Noise levels at the plant are managed in accordance with occupational health and safety requirements, as well as the requirements of the Town of Kwinana. Given the distances between the refinery and residential areas, the current noise levels are not an issue of environmental concern.

The refinery has a hazard management system, which includes formal safety reviews for new facilities (including HAZOP studies), a refinery permit system, and refinery management systems. The refinery is included in the Kwinana cumulative regional analysis for risk. The refinery has its own emergency response capacity, and is making an active contribution to the development of the Kwinana Integrated Emergency Management System (KIEMS).

5. Environmental issues

The Environmental Protection Authority has identified a number of environmental constraints to the proposal. Based on its assessment of the proposal, additional information provided in the public submissions, and in the proponent's responses to questions raised as a result of the assessment process, the Authority recommends as follows.

Recommendation 1

The Environmental Protection Authority has concluded that the proposed feed flexibility project at the BP Refinery in Kwinana is environmentally acceptable.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as; the preservation of the beneficial use of the Kwinana airshed by ensuring that the provisions of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991 are met, the commencement of an atmospheric emission inventory for hydrocarbons and nitrogen oxides; and appropriate management of solid wastes.

Accordingly, the Environmental Protection Authority recommends that the proposal by BP Refinery (Kwinana) Pty Ltd, as outlined in its Public Environmental Review (PER), could proceed, subject to the proponent's environmental management commitments in the PER, responses to issues raised as a result of the environmental review process, and the recommendations of the Environmental Protection Authority.

5.1 Construction stage environmental issues

The principal environmental impacts during the construction relate to noise and dust. BP Refinery Kwinana have made significant commitments to ensure that all construction stage impacts will be managed in accordance with the requirements of the appropriate government agencies, as well as the Environmental Protection Authority. The Authority considers that these commitments are sufficient to manage the issues.

5.2 Operational stage environmental issues

The principal issues associated with the proposal are sulphur dioxide, nitrogen oxide and particulate emissions to the atmosphere, wastewater discharge to Cockburn Sound and solid waste management. Other associated issues include noise levels, and risks and hazards. An issue of wider concern to the Authority is the emission of hydrocarbons into the atmosphere from facilities such as refineries and petroleum tank farms, which are major point sources.

a) Atmospheric emissions

In December 1989, the Authority published a draft Environmental Protection Policy for Sulphur Dioxide and Dust in the Kwinana Region. Currently the Authority is preparing a revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991. The purpose of the (revised) draft policy is to establish ambient air quality standards and limits for sulphur dioxide and particulate concentrations in the Kwinana airshed. This means that the cumulative effect of multiple emission sources in the Kwinana area is taken into account. The basis of the policy is a recognition that it is not sufficient to regulate industry by simply applying standard stack emission concentration limits alone, as the important factor is the effect the pollutant will have on the environment, which in turn is dependent on ambient concentrations in the airshed. These effects relate not only to effects on the natural environment, but also to those on people. It also recognises that the operation of those industries which discharge sulphur dioxide into the atmosphere within the Kwinana Industrial Area comprise a beneficial use to be protected under the policy. The proposed draft standards and limits, and defined policy areas, are provided in Table 1 and Figure 1 respectively.

The policy has yet to be finalised, because consultations between industries in Kwinana, and between industries and the EPA, have not been completed. These consultations relate to the relative "share" (which is related to the emissions from each industry), of the "air space" that may be allocated to each industry, and to monitoring requirements.

Table 1: Proposed Standards and Limits for Sulphur Dioxide and Total Particulates in the Kwinana Region

1-Hour average Sulphur Dioxide Concentrations		
	Standard (Desirable Level) (ug/m^3)	Limit (Never to be Exceeded) (ug/m^3)
Area A	700	1400
Area B	500	1000
Area C	350	700

24-Hour Average Total Suspended Particulate Concentrations		
	Standard (Desirable Level) (ug/m^3)	Limit (Never to be Exceeded) (ug/m^3)
Area A	130	260
Area B	90	260
Area C	90	150

* Sulphur dioxide and particulate matter

The refinery has a history of hydrogen sulphide and sulphur dioxide emissions, which has been the cause of many complaints over the years. The refinery has made a number of changes in recent years to improve the situation. The improvements include a new flare tip and a sulphur recovery unit. Further, the decision by the company to utilise (low sulphur) natural gas as a fuel has had a significant effect on emission levels.

As the feed flexibility project involves a greater throughput of high sulphur crudes, sulphur outputs from the refinery are therefore of considerable interest to the Authority. In its responses to the EPA's questions (Appendix 3), the company notes that "average sulphur dioxide emissions are expected to increase from 18.9 tonnes per day to 25.5 tonnes per day",

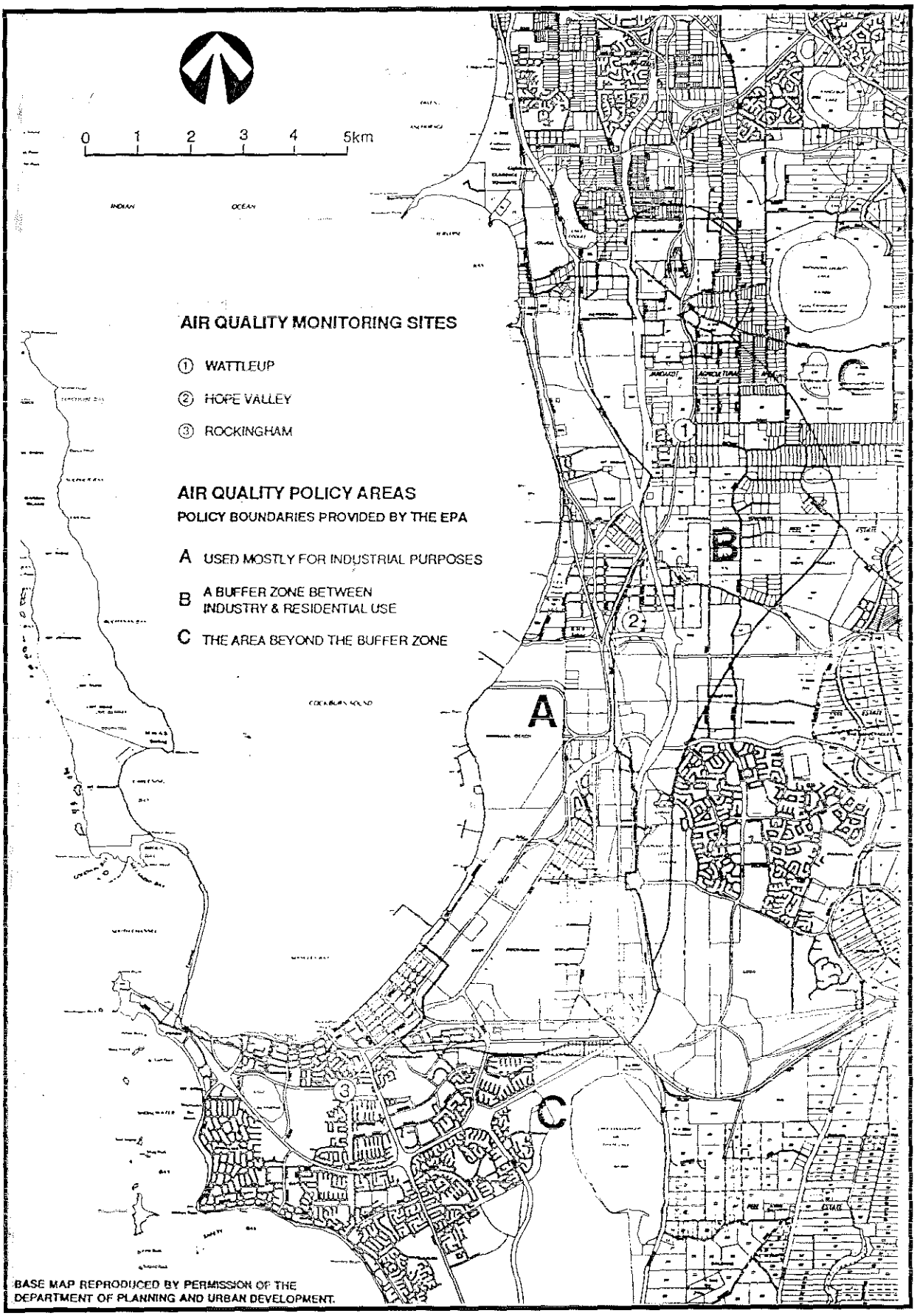


Figure 1. Air quality areas (Courtesy of PER)

as a result of the feed flexibility project. The company also states that the maximum emission rate of sulphur dioxide will be 26.6 tonnes per day, which is slightly less than the current daily maximum emission rate. This results from the fact that on a day to day basis, the maximum throughput of high sulphur crudes will not change, but there will be many more days in the year (compared with the present situation) when a high sulphur crude blend of crudes will be processed.

Given that there will be a 35% increase in average daily emissions of sulphur dioxide, the issue which must be examined in detail is the ability of the company to meet the requirements of the revised draft Environmental Protection Policy. The modelling work carried out on behalf of the company (and reported in the PER), which utilises data (as supplied by the EPA) for other industries in Kwinana, indicates that the requirements of the revised draft policy can be met. It should, however, be noted that the modelling reported in the PER did not include emissions for Alcoa (which currently uses natural gas for fuel). Should Alcoa wish to take up an allocation of air space for sulphur dioxide, this will have a downstream effect on the allocation for all other industries in Kwinana, including the refinery.

BP Refinery Kwinana, along with other industries in Kwinana, will have to comply with the final Environmental Protection (Kwinana)(Atmospheric Waste) Policy and regulations, upon implementation, and in the future.

Regional monitoring results indicate that there have been some exceedances of proposed standards and limits in the draft environmental protection policy since 1986. The modelling work shows that BP Refinery Kwinana and other industries will be able to meet the requirements of the draft environmental protection policy. Should, however, any industry have major upset conditions, then it is possible that breaches of the proposed standards and/or limits would occur. In BP Refinery Kwinana's case the worst case scenario is that one of the sulphur recovery units breaks down whilst the refinery is processing a high sulphur blend of crudes, which would require the rerouting of sulphur dioxide to other units, including the other sulphur recovery unit, and potential shutdowns of various process streams. (The company state that the draft environmental protection policy requirements will not be exceeded if such a failure occurred whilst processing low sulphur crudes). BP Refinery Kwinana have made the following commitments (Appendix 1), in order to manage such circumstances:

"If a Sulphur Recovery Unit suffers an unplanned shutdown, Hydrogen Sulphide rich gas will be directed to the other Sulphur Recovery Unit with any excess gas initially sent to the Refinery fuel gas main. Refinery process unit throughputs will then be adjusted as quickly as is practicable, in order to meet Environmental Protection Authority licence conditions" (Commitment 16)

"BP Refinery Kwinana will ensure that, should emissions of sulphur dioxide from the refinery occur, or be likely to occur, which exceed the requirements of the Draft Environmental Protection Policy for Sulphur Dioxide and Dust in the Kwinana region, then all appropriate operational and management steps will be taken to ensure that sulphur dioxide emissions are reduced to levels acceptable to the Environmental Protection Authority." (Commitment 17)

The Environmental Protection Authority considers that these commitments are sufficient to ensure that breaches, or potential breaches, of draft environmental protection policy requirements in relation to sulphur dioxide will be suitably managed by the company. The Environmental Protection Authority considers that the company's approach is acceptable, given that there will be minimal, if any, impact on residential areas. Nevertheless, any breaches of the requirements of the environmental protection policy (when implemented) will be breaches of the law, and the Environmental Protection Authority will respond appropriately.

Particulate matter emanating from the plant will be reduced by the fitting of external secondary cyclones to the residue cracking unit. The company expect that particulate emissions from the residue cracking unit will be reduced from the current level of about 450mg/m3 to less than 250mg/m3. Particulate emission rates from other sources in the refinery are expected to remain constant at 2.5mg/m3. The company had its own particulate

emissions modelled - the results showed that the maximum predicted 24-hour ground level concentration was 1.2ug/m3, which compares with the proposed standard in the draft environmental protection policy of 150ug/m3 in Area A and 90ug/m3 in Areas B and C (see Figure 1). Whilst the total picture for particulates in the Kwinana area is not known, and given that there remains considerable work (with respect to particulates), to be done on the implementation of the requirements of the draft environmental protection policy, the EPA considers the levels modelled by the company to be acceptable.

The Environmental Protection Authority considers that approval of this proposal be subject to the variations and obligations on industries which may arise from the forthcoming establishment and implementation of the Environmental Protection (Kwinana)(Atmospheric Waste) Policy, including the possible imposition of more stringent emissions limits for sulphur dioxide (because of the potential for one company to claim a share of the air space), and the requirement that industries participate in an ambient air quality monitoring programme.

Recommendation 2

The Environmental Protection Authority recommends that BP Refinery (Kwinana) Pty Ltd should conform with all requirements for the establishment and implementation of the revised draft Environmental Protection (Kwinana) (Atmospheric Waste) Policy 1991.

The installation of the sulphur recovery units (existing and proposed), has improved, and will further improve the environmental performance of the refinery markedly, as well as resulting in a saleable product.

* carbon dioxide and the greenhouse effect

The Government is committed to a 20% reduction in the production of Greenhouse gases by the year 2005, using 1988 as a baseline. The Authority considers that a necessary first step towards the achievement of this goal is to undertake annual audits of emissions and to provide those audits to the Authority, in order that appropriate management programmes can be developed for greenhouse gases. Factors involved in such programmes include increased energy efficiency for industry and private consumers.

Carbon dioxide is one of the principal gases involved. BP Refinery Kwinana's emissions of CO2 are expected to increase from 0.86Mt/a to 0.91Mt/a as a result of the feed flexibility project. The company have committed to providing an annual audit of greenhouse gases to the EPA, and the Authority considers this to be appropriate.

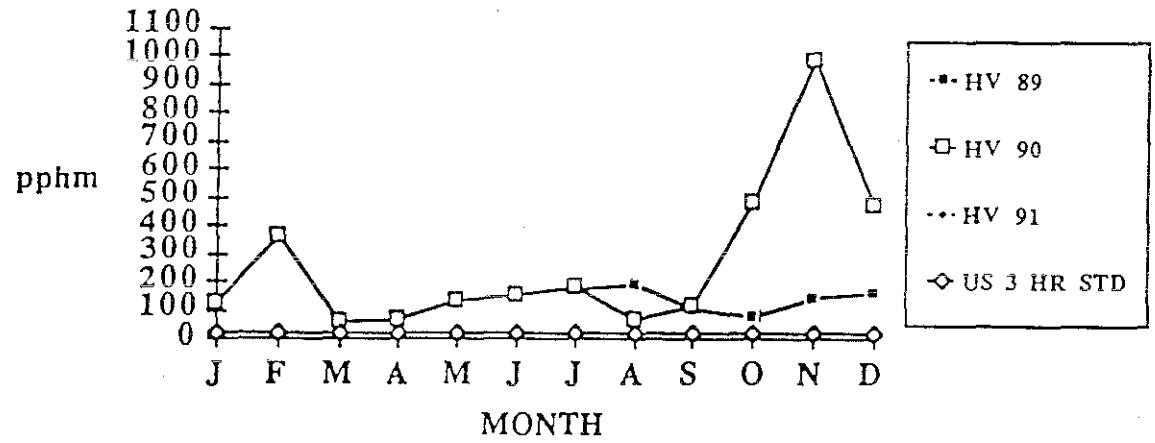
* nitrogen oxides

The feed flexibility project will result in a small increase of emissions of nitrogen oxides (3%), due to an increase in fuel gas consumption (as a result of the new hydrofiner furnace and increased coke combustion in the Residue Cracker Unit catalyst regenerators). The modelling work done for BP Refinery Kwinana indicates that the maximum and the 9th highest 1 hour average ground level concentrations are 178ug/m3 and 112ug/m3 respectively, which are considerably less than the National Health and Medical Research Council's Air Quality Goal of 320ug/m3 or 0.16ppm, 1 hour level not to be exceeded more than once per month. The levels are also less than the Victorian EPA's 1 hour average ground level concentration guideline of 308ug/m3. The EPA considers that these levels are environmentally acceptable.

Nevertheless, nitrogen oxides are one of the important contributors to photochemical smog, along with non-methane hydrocarbons (see below). The EPA is currently embarking on a programme with SECWA, to monitor levels of these gases in the Perth metropolitan airshed. The Authority is keen to see nitrogen oxides emissions from all significant sources quantified as part of that programme, including those from the BP refinery.

* non-methane hydrocarbon emissions

The EPA has been monitoring non-methane hydrocarbons at its air quality monitoring station at Hope Valley since July 1989. The data obtained from this station raise concerns regarding the quantity and composition of atmospheric hydrocarbons in the Kwinana region. The concerns are evident when comparisons are made between Hope Valley's non-methane hydrocarbon concentrations and the United States EPA's 3 hour maximum (not to be exceeded more than once per year) standard of 24 parts per hundred million (pphm) - (see Figure 2).



Notes on above figure :- The figure does not show data for 1991 as the monitor has been off-line for maintanence, rebuilding then recalibration. As well as industrial NMHC the monitor has been able to detect atmospheric hydrocarbons released from local bush fires and/or CALM's prescribed burns in the south-west. The large excursions above 200 pphm NMHC are at this stage assumed to be this non-industrial source.

Figure 2. Non methane hydrocarbons maximum 3 hour ambient concentrations, Hope Valley 1989 - 1991

There are two issues of concern to the Authority in relation to non-methane hydrocarbons emissions into the metropolitan airshed:

1. nuisance odours to the public; and
2. photochemical smog.

Nuisance odours are reported to and managed by the Pollution Control Division of the EPA. At present the Authority manages the odour issue by ensuring sufficient attention has been paid to this issue during the design and commissioning stages of a facility (where feasible), and later in response to complaints. Where the source of odours is identified, the EPA has sufficient powers under the provisions of the Environmental Protection Act to manage the issue. The EPA at Kwinana receives a significant number of complaints about odour, which are principally related to hydrogen sulphide, mercaptans and hydrocarbons.

In relation to photochemical smog, nitrogen oxides and non-methane hydrocarbons are both precursors for the formation of photochemical smog. In the presence of sunlight, these chemicals react to form various pollutant chemical species. One of the most important of these is ozone, which is used as an indicator of photochemical smog. Perth's airshed has experienced a significant number (eleven) of high ozone incidents in the period November 1990 to April 1991. An ozone incident is a reading at the EPA's Caversham air quality monitoring station greater than 160ug ozone/m3 for 1 hour, which is the new recommended Victorian standard for ambient ozone levels (and which is based on World Health Organisation (WHO) air quality guidelines). Moreover, there has been an increase (eleven occasions in the period November 1990 to March 1991), in long term exceedances (which are defined as being a concentration above 100ug ozone/m3 for eight hours (which is the WHO recommended guideline)).

* proposed EPA strategy

In order to ensure that photochemical smog does not become a frequent occurrence in the Perth metropolitan area, a suitable control mechanism must be found. World-wide, the most effective mechanism is usually through the control of hydrocarbon emissions, which can most effectively be controlled at source.

The EPA is currently planning a study in conjunction with the State Energy Commission of WA (SECWA) that will provide useful information in the determination of long term strategies to prevent photochemical smog formation in the Perth metropolitan airshed. SECWA is a potentially significant contributor of nitrogen oxides to the Perth airshed through its power generation activities.

An important component of any strategy to control hydrocarbon emissions will include the development of a detailed atmospheric emission inventory covering new and existing industries. This atmospheric emission inventory would require data for major point sources and multiple small sources of hydrocarbon emissions in the Perth metropolitan airshed. These include hydrocarbon storage tanks, hydrocarbon transfer activities (including railcar, road tanker or service station underground tank filling operations) and refining processes.

The EPA expects the inventory assessment of major sources to identify all potential point and diffuse sources of hydrocarbon emissions on a site, and from this information, and knowledge of operational activities, assess emission levels, and evaluate the need or otherwise to take action to prevent and/or control unacceptable emissions.

This programme will also address existing operational procedures (road and rail tank filling and service station underground tank filling operations) and identify operations where vapour control/recovery equipment could be installed.

The EPA response to the inventory assessment programme may require individual tanks or operations within facilities to be fitted with vapour control equipment which limits emissions to to the atmosphere. Methods which may be appropriate include: emission control equipment on storage tanks, carbon adsorption units and/or vapour emission systems using back-venting and/or flares. The Authority would expect these mechanisms or any others proposed by industry to limit hydrocarbon emissions to meet normally acceptable air quality guidelines.

The Environmental Protection Authority is giving consideration to adopting long term targets for non-methane hydrocarbons in the vicinity of sources. The actual target(s) that are eventually set will be dependent on the outcomes of the airshed study, which will quantify the nature and extent of photochemical smog over Perth.

In relation to the control of hydrocarbon emissions at service stations, the EPA is currently developing regulations that will require underground tank filling operations to be carried out in such a manner that vapours are not unnecessarily vented to the atmosphere. This could most effectively be accomplished by the use of currently proven and available back venting technologies.

In order to ensure that the strategy identified above is effective, and equitably applied to various industry groups, the EPA proposes to define, as prescribed premises under Part V of

the Environmental Protection Act, such facilities or operations that could emit unacceptable levels of hydrocarbons to the Perth metropolitan airshed.

The Authority will define the industries affected by this strategy using four criteria:

1. the total storage capacity of a site;
2. the total expected throughput of product at a site;
3. the type of operations occurring at a site; and
4. site location in relation to the Perth metropolitan airshed.

Through this mechanism, site specific conditions would be developed to ensure that the environmental objectives can be achieved.

* the BP refinery

The refinery is a significant source of hydrocarbon emissions, particularly from the Tank Farm and API Separator No 1. BP Refinery Kwinana have indicated in response to questions (Appendix 3) that they are currently initiating a programme of works to reduce hydrocarbon emissions from the refinery. Tanks with floating roofs are being fitted with secondary seals. As part of the proposed "Project WET" (Water Effluent Treatment), losses from the API separator will be evaluated, with the potential for a new separator to be installed. Whether or not a new separator is installed, the unit (old or new) will be covered, which will decrease emissions.

BP Refinery Kwinana will also install a closed tank drainage system as part of the proposed Project WET. An indirect benefit of this project will be a reduction of hydrocarbon emissions to atmosphere.

Eighty percent of product is transported by pipeline from the refinery to terminals at Kewdale and North Fremantle. Thus evaporative losses at the refinery itself are lower than they could otherwise be, but clearly there is still the need to reduce such losses on metropolitan area basis, given that all such losses affect the airshed.

As indicated above, the EPA would implement controls on hydrocarbon emissions within the context of the joint study with SECWA and/or under the provisions of Part V of the Environmental Protection Act. Accordingly, the EPA considers the following recommendation to be appropriate.

Recommendation 3

The Environmental Protection Authority recommends that prior to commissioning of the feed flexibility project, BP Refinery (Kwinana) Pty Ltd prepare an atmospheric emission inventory to the satisfaction of the Environmental Protection Authority, and the results of the programme be submitted to the Environmental Protection Authority for consideration.

The purpose of this inventory is to identify and quantify the type and level of atmospheric emissions from point sources, and in the ambient environment, in order to manage them. The initial requirements of Recommendation 3 will be satisfied by the preparation and implementation of an emissions reduction programme (as noted above, the company has already commenced measures to reduce hydrocarbon emissions), as well as the preparation and implementation of a plan for developing the inventory. This plan will need to be approved by EPA and it will need to address the parameters to be measured, their frequency of measurement, and measurement locations. Its development and implementation will need to be consistent with and complementary to the longer term objectives and requirements of the airshed study.

As a result of the airshed study, the Authority considers it likely that a second emissions reduction programme may be required.

b) Noise

The Authority considers that the need to conform with occupational health requirements, and the distance between the refinery and residential areas make the issue of noise one of minor environmental significance.

The Authority considers that the commitment by BP Refinery Kwinana to manage noise levels at their property boundary according to the requirements of the EPA is acceptable.

c) Risks and hazards

The feed flexibility proposal will not increase the level of risk associated with the BP refinery. The refinery has a hazard management system, which includes formal safety reviews for new facilities (including HAZOP studies), a refinery permit system, and refinery management systems. The refinery is included in the Kwinana cumulative regional analysis for risk. The refinery has its own emergency response capacity, and is making an active and positive contribution to the development of the proposed Kwinana Integrated Emergency Management System (KIEMS).

BP Refinery Kwinana have made a number of commitments relating to their Hazard Management Process and interactions with the appropriate government agencies on risks and hazards, which the Environmental Protection Authority considers to be acceptable.

d) Wastewater management

The quality of refinery wastewater has improved considerably since the Cockburn Sound Study of 1979, which highlighted pollution problems associated with industrial discharges. BP Refinery Kwinana have achieved significant reductions in oil, phenolic and sulphide loads by the installation of sour water strippers, a Merox unit and better control of inputs to the oily water sewer.

The feed flexibility project will itself contribute to an improvement in effluent quality. The company indicate that reductions in average daily levels of hydrocarbons, phenolics and ammonia (Table 5.10, PER) have occurred over the last ten years. The company have also indicated that they intend to make an intensive effort to upgrade the wastewater management system for the refinery, through Project WET. BP Refinery Kwinana have made a commitment to submit a proposal for a modernisation plan to substantially upgrade the refinery's wastewater treatment system within two years of gaining Works Approval for the feed flexibility project. The EPA expects that such a proposal will have the potential to significantly reduce aqueous effluents from the refinery.

e) Solid waste management

The PER gives details of solid wastes which are currently produced as a result of existing operations, as well as those which will result from implementation of the feed flexibility project. BP Refinery Kwinana are currently carrying out some trials for the reuse or recycling of some of the waste streams. Most solid wastes are disposed of on-site, in a company designated Waste Management Area.

The Authority is concerned that there has been insufficient characterisation of the solid waste streams in the past, in terms of waste types, chemical composition and leachability. There appears also to have been insufficient monitoring to determine whether past disposal practices have caused environmental problems on-site. This is an unsatisfactory situation.

The EPA would prefer to see a waste management regime which can demonstrate unequivocally that waste management practices are environmentally acceptable. The EPA recognises that there are difficulties associated with appropriate off-site disposal in the near-term, particularly given the lack of a suitable low-hazard waste landfill sites, which could be utilised for industrial wastes. This issue needs to be addressed urgently by government in consultation with industry.

The EPA considers that BP Refinery Kwinana's commitment to manage wastes to the satisfaction of the EPA is an important commitment on the part of the company. Meantime, the EPA considers that BP Refinery Kwinana should demonstrate that its solid wastes are managed in a manner which is not detrimental to the environment.

Recommendation 4

The Environmental Protection Authority recommends that BP Refinery (Kwinana) Pty Ltd develop and submit, and subsequently implement, a plan for the management of solid wastes which result from the proponent's on-site operations, to the satisfaction of the Environmental Protection Authority.

Appendix 1

Environmental management commitments made by BP Refinery (Kwinana) Pty Ltd

BP Refinery (Kwinana) Pty Ltd

ENVIRONMENTAL MANAGEMENT COMMITMENTS

GENERAL

1. BP Refinery Kwinana will adhere to the Project as assessed by the Environmental Protection Authority and will fulfil the commitments made below.

2. The modifications will be constructed and operated according to relevant Government statutes and agencies requirements, including those of the following:

   - Environmental Protection Authority
   - Water Authority of WA
   - Health Department of WA
   - Department of Occupational Health, Safety and Welfare
   - Town of Kwinana

3. The Hazard Management Process applied to the project will be consistent with guidelines established by the Safety Coordinator, Explosives and Dangerous Goods Division, Department of Mines.

CONSTRUCTION

4. All construction materials and practices will be in accordance with the relevant Australian standards and/or BP Codes of Engineering Practice, whichever is the most stringent.

5. Noise levels will comply with the requirements of the Department of Occupational Health, Safety and Welfare, as they relate to the construction workforce and the public, and with the requirements of the Environmental Protection Authority.

6. Dust suppression watering practices will be adopted to minimise dust generated during construction activities. Dust levels will comply with the requirements of the Department of Occupational Health, Safety and Welfare and the Environmental Protection Authority.

7. Close liaison will be maintained with local authorities to ensure that noise, dust and traffic impacts are minimised.

8. BP Refinery Kwinana will update emergency procedures and response plans prior to commissioning. These procedures and response plans will be consistent with Department of Mines guidelines and be available for review by the Environmental Protection Authority and Department of Mines.

9. An Audit of the Hazards Management Process carried out in accordance with guidelines agreed with the Safety Coordinator, Department of Mines; will be completed prior to commissioning and made available to the Department of Mines.

10. Upon completion HAZOP studies and Piping and Instrument Diagrams will be made available to the Environmental Protection Authority and the Department of Mines.

OPERATIONAL

11. BP Refinery Kwinana will design and operate the plant so as to control noise generation and noise levels at the boundary of the Refinery at all times to the satisfaction of the Environmental Protection Authority.

12. Ongoing control of dust will be implemented to ensure that dust levels do not affect the workforce or the public, and satisfy the Department of Occupational health, Safety and Welfare and the Environmental Protection Authority.

13. The Refinery will undergo regular preventative maintenance to minimise unplanned shutdowns due to plant failure.

14. All solid waste will be disposed of in accordance with the statutory requirements of the Health Department of WA and be to the satisfaction of the Environmental Protection Authority.

15. All employees will be trained in the safe work practices and emergency procedures appropriate to their role in the operation of the Refinery and the handling of associated materials.

16. If a Sulphur Recovery Unit suffers an unplanned shutdown, hydrogen sulphide rich gas will be directed to the other Sulphur Recovery Unit with any excess gas initially sent to the Refinery fuel gas main. Refinery process unit throughputs will then be adjusted, as quickly as is practicable, in order to meet Environmental Protection Authority licence conditions.

17. BP Refinery Kwinana will ensure that, should emissions of sulphur dioxide from the Refinery occur, or be likely to occur, which exceed the requirements of the Draft Environmental Protection Policy for Sulphur Dioxide and Dust in the Kwinana region, then all appropriate operational and management steps will be taken to ensure that sulphur dioxide emissions are reduced to levels acceptable to the Environmental Protection Authority.

18. Routine shutdowns of the Sulphur Recovery units will be planned to coincide with those of the Hydrofiners and Residue Cracker units, the major sources of hydrogen sulphide, in order to minimise sulphur dioxide emissions and meet Environmental Protection Authority licence conditions.

19. In the advent of an unplanned shutdown of the new Refinery Sour Water Stripper, sour water will be directed to the existing Sour Water Stripper and process unit throughputs adjusted, as quickly as is practicable, to meet the reduced capacity of the old unit and Environmental Protection Authority licence conditions.

OTHER COMMITMENTS

20. BP Refinery Kwinana will modify its pollution control operations so that environmental impacts are reduced to a level acceptable to the Environmental Protection Authority.

21. BP Refinery Kwinana will cooperate with the Environmental Protection Authority to assist in achieving the air quality standards and limits as proposed in the Draft Environmental Protection Policy for Sulphur Dioxide and Dust in the Kwinana region.

22. BP Refinery Kwinana will submit reports as required to the Environmental Protection Authority documenting the results of monitoring programmes, and will immediately advise the Environmental Protection Authority of any unplanned events, as they occur, that may adversely impact upon the surrounding environment.

23. BP Refinery Kwinana will engage Technica Ltd to update the Refinery database for the Kwinana Cumulative Risk Analysis within 12 months of approval of this Project and provide the results to the government agency responsible for the cumulative risk study.

24. BP Refinery Kwinana will continue to participate in and contribute to the development of the Kwinana Integrated Emergency Management System.

25. Regular internal safety and environmental audits will be conducted to assess the effectiveness of BP Refinery Kwinana's commitments to safeguard and protect the workforce, public and the environment.

26. BP Refinery (Kwinana) Pty Ltd will, within two years of the issue of Works Approval for this Project, submit to the Environmental Protection Authority a modernisation plan to substantially upgrade the Refinery wastewater treatment system.

27. The following management systems will be developed prior to commissioning the units constructed or modified as part of this Project:

    - manual of hazardous material data sheets
    - written operating procedures
    - routine maintenance, startup and shutdown, and emergency procedures
    - incident reporting/investigation systems
    - equipment testing/inspection schedules
    - alarm and trip testing procedures and schedules
    - periodic auditing programme.

28. BP Refinery (Kwinana) Pty Ltd will provide an accurate estimate of greenhouse gas emissions to the Environmental Protection Authority each year.

29. Reports will be provided to the Environmental Protection Authority quarterly on progress of the development of the Project and annually on the operation of the new plant after commissioning. Reporting will include advice to the Environmental Protection Authority on the fulfilment of any Ministerial Conditions; and commitments given by BP Refinery (Kwinana) Pty Ltd.

30. BP Refinery (Kwinana) Pty Ltd will be responsible for decommissioning the Refinery and rehabilitating the site and its environment, to the satisfaction of the Environmental Protection Authority.

31. BP Refinery (Kwinana) Pty Ltd will, at least six months prior to decommissioning, prepare a decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority.

Appendix 2

History of, and proposed modifications to, the BP Refinery at Kwinana 1985 - 1995

ENVIRONMENTAL IMPROVEMENTS 1985 - 95

AIR QUALITY

1986	Improved steam control to flare
1987	New flare tip for H_2S incineration
1988	Infra-red control of flare steam
1988	Closed system for LPG stench
1989	Roofs on caustic tanks
1989	Sulphur Recovery plant
1990	VOC testing
1991	Straight run gasoline minalk
1991	Secondary seals on tanks
1992	Second Sulphur Recovery plant
1992	Cat Cracker particulate controls

LIQUID EFFLUENT

1986	Source control study
1986-	Mechanical seals replace glands
1987	Jetty sump pumps upgraded
1988	Caustic reuse
1989	Caustic treatment via solutiser
1989-	Titanium bundles replace grass for salt water
1989	Marine impact studies
1991	Chromate antifoulant eliminated
1991	Minalk replaces cracked spirit merox
1991	Effluent diffuser studies
1991	Effluent continuous samplers
1991-4	Water effluent treatment project

GROUNDWATER QUALITY

1985-	Major increase in oil monitoring and recovery
1987-	Sewer lining and repair
1988-	Enclosed systems for tank drainage
1989	Tankscan surveys for tank leaks
1990	New 'state of the art' recovery system
1991-	Continuing experiments with new monitoring systems
1991-	Involvement in bio-remediation research

WASTE MINIMISATION

1985-	Bio-remediation of oily sludges
1986-	Replacement of drummed chemicals with bulk
1987-	Attempts to find uses for spent catalyst
1989	Waste disposal permit system established
1991-	Hydrofiner catalyst to Taiwan for metals recovery

OTHER

1985-90	Tree planting
1990-	Environmental awareness workshops
1990-	Community liaison initiatives
1989/91	International audit team visits

In addition to the above environmental activities, a variety of plant improvements made primarily for commercial or safety reasons will have had environmental benefits (eg. Hazop reviews, energy conservation activities, remote tank gauging and process control systems).

Appendix 3

EPA questions to the proponent, and the proponent's responses

BP FEED FLEXIBILITY PROJECT
EPA QUESTIONS TO THE PROPONENT

Sulphur Inventory

1. The Environmental Protection Authority and industry are currently considering the draft "Environmental Protection Policy for sulphur dioxide and dust in the Kwinana region". The PER (Table 5.2) indicates that a total of approximately 9700 tonnes sulphur dioxide per annum will be emitted.

   (a) What sulphur content of crude oil feedstock is assumed for this figure?
   (b) Are short term and/or long term variations of overall sulphur content of crude oil feedstock expected?
   (c) Outline, in numeric terms, the effect increases of sulphur content of crude oil will have on SO_2 emission rates.
   (d) What will BP Refinery do to ensure no increases in SO_2 emissions?
   (e) Does BP have plans to decrease SO_2 emissions in the short or long term, and if so, could these be indicated?
   (f) What are the quantities and proportions of sulphur expected to end up in;
      - SO_2 emissions
      - product (as disulphides and/or other compounds)
      - wastewater
      - sulphur (from sulphur recovery units)?

2. How do the proposed SO_2 emissions compare with modern or modernised operations in:

   - the United Kingdom
   - the United States of America
   - continental Europe

   in numeric terms on a per tonne, per percentage sulphur content, crude oil feedstock basis?

3. The sulphur recovery units are stated to have efficiencies of 95%. The Environmental Protection Authority understands that tail gas units (SCOT units) have been added to sulphur recovery units in many refineries around the world, to increase sulphur recovery to at least 99%. Does BP propose to install SCOT units, and if so, over what time frame?

4. Given that 77% of SO_2 emissions came from the residue cracking unit (PER Table 5.2), what is the scope for reduction of these emissions from the residue cracking unit?

Hydrocarbon Emissions

5. The PER states that the major two sources of hydrocarbons are from the tank farm and the API separator, although the EPA recognises that there are other sources of hydrocarbon emissions from existing and proposed developments on site. Could BP outline any programme that it has in place or proposes to put in place, to monitor and manage these emissions, to meet currently accepted national and international air quality guidelines for hydrocarbon emissions (including (as measured) non-methane hydrocarbons, and other species including but not limited to benzene, toluene, chlorobenzene etc)?

6. What measures are taken to manage hydrocarbon emissions during transfer operations (eg ship-shore, tank-road tanker). Are there plans in hand to improve the situation, and if so what are they?

Nitrogen Oxide Emissions

7. How does BP intend to manage and reduce its NO_X emissions? Does BP intend to install a selective catalytic reduction unit on its residue cracking unit?

Wastewater Treatment

8. Does BP have a programme to reduce and manage releases of petroleum hydrocarbons, phenolics, sulphides and ammonia to Cockburn Sound?

9. How do the proposed release rates and total quantities of liquid effluent contaminants compare with modern or modernised operations in;

   - the United Kingdom
   - the United States of America
   - continental Europe

   in numeric terms, for similarly sized refineries?

10. Could the spent caustic directed to Tank 3 and Tank 74, and from the Jet Merox Unit, be used as makeup for fresh caustic?

Solid Waste Management

11. Apart from the on-site management of solid wastes, does BP have a long term plan to manage the contaminated solid wastes resulting from its processes, and if so, could the plan be briefly explained?

12. Can BP outline its plans for the reduction and/or reuse/recycling of solid wastes. Why is BP seeking off-site disposal for some wastes (eg for alkylation plant fluoride deactivation pellets), but not for others?

FEED FLEXIBILITY PROJECT

RESPONSE TO EPA QUESTIONS

1(a) The sulphur content of crude oil feedstock, on which the maximum emission of 26.6 tonnes per day of sulphur dioxide is based, is 1.02% sulphur. Refinery internal operations vary widely from day to day, depending on product demands, international crude oil markets and refinery equipment availability. The crude oil feedstock sulphur content can vary from 0.2% to over 2.5%, **BUT** the refinery's impact on SO_2 emissions to the environment will be limited to 26.6 tonnes per day. Unlike many refineries BP Kwinana is not linked by pipeline to any crude oil supply. It has to compensate for this disadvantage by being a flexible refinery which can react quickly to changes in oil markets. However, BP Refinery Kwinana is committed to minimising its environmental impacts and will limit sulphur dioxide emissions to 26.6 tonnes per day.

1(b) Both short-term and long-term variations in the sulphur content of crude oil feedstock are expected at BP Refinery Kwinana. Currently the Refinery processes both low and high sulphur crude oil feedstocks. The high sulphur crudes make up about one-third of crude oil throughput at the present time. As outlined in the PER, the Feed Flexibility Project will enable an increase in the amount of high sulphur crude processed at the Refinery. It is expected that about two-thirds of the crude oil feedstock at the Refinery will be high sulphur crude following the Feed Flexibility Project.

1(c) As the Refinery currently processes high sulphur crudes and the sulphur dioxide emission rates reported in the PER have been calculated for this case, no increase in maximum daily sulphur dioxide emissions is predicted following the Feed Flexibility Project, in fact a slight reduction in maximum daily emissions is predicted. Average sulphur dioxide emissions are expected to increase from 18.9 tonnes per day to 25.5 tonnes per day following the Feed Flexibility Project.

1(d) In order to ensure no increase in maximum daily sulphur dioxide emissions following the Feed Flexibility Project, the Refinery is building a second Sulphur Recovery Unit.

1(e) BP Refinery Kwinana has already taken all practicable means of reducing sulphur dioxide emissions by replacing fuel oil with natural gas, desulphurisation of Refinery fuel gas and installation of a Sulphur Recovery Unit. No firm plans are in place to further reduce sulphur dioxide emissions in either the short or long-term. As technologies are developed to further reduce sulphur dioxide emissions, these will be examined to determine their viability.

1(f) The sulphur content of the incoming feed will be distributed as shown below following the Feed Flexibility Project.

	Tonnes/day Sulphur	% of Total	
Sulphur content of liquid effluent	0.025	0.02%	mainly as sulphides
Sulphur emissions to atmosphere	12.800	10%	as SO_2
Sulphur sold from recovery units	48.640	38%	as liquid sulphur
Sulphur sold in oil products	66.530	51.98%	as organosulphides
Total	128.00	100%	

2. Predicated sulphur dioxide emissions from BP Refinery Kwinana following the Feed Flexibility Project are compared with other refineries in the BP Group, for which data is available, in the table below.

Sulphur emissions to atmosphere from refinery operations as a percentage of total sulphur intake.

Refinery	Annual T/Put (bbl x 10^6)	Sulphur Intake (tonnes S/day)	Sulphur Emissions	
			(% of S intake)	(Tonnes/day)
Ferndale (USA)	25.15	90	3	2.7
Lima (USA)	60.91	75	5 (licence limit 13)	3.75 (9.75)
Grangemouth (UK)	65.50	95	12	11.4
Lavera (France)	54.47	230	16	36.8
Vohburg (Germany)	39.06	130	7	9.1
Gottenburg (Sweden)	30.00	40	14	5.6
Kwinana (W.A.)	35.00	128	10	12.8

The predicted sulphur dioxide emissions following the Feed Flexibility Project are lower than the UK and Western European refineries as a percentage of sulphur intake. The USA refineries sulphur dioxide emissions are lower. It is important to note that of the refineries listed in the table above only Kwinana has a Residue Cracking Unit. This is the source of most (77%) of the sulphur dioxide emissions from the Refinery.

The reason that Kwinana has a Residue Cracking Unit is that there is now very little demand for fuel oil in WA, but a relatively large demand for gasolene. Hence it is necessary to convert residue (fuel oil) to gasolene.

3. The Sulphur Recovery Unit efficiencies quoted in the PER are the design efficiencies. By optimising operating conditions, the existing Sulphur Recovery Unit efficiency averages 97%. The installation of a tail gas unit would not significantly decrease sulphur emissions from the Refinery. There are no plans to install a tail gas unit at the Refinery.

4. Currently there is no economically viable technology available to reduce sulphur dioxide emissions from the Residue Cracking Unit. As sulphur reduction technologies are developed these will be examined to determine their viability.

5. BP Refinery Kwinana is currently implementing a program of works to significantly reduce hydrocarbon emissions from the Refinery. Evaporative losses from tanks with floating roofs are being reduced by installing secondary seals. Losses from the API Separator will be reduced as part of the works programmed for Project WET (Water Effluent Treatment). The API Separator may be replaced with a new API Separator which will be covered, or the existing API Separator will be covered.

   Every seal, valve and flange in the Refinery is monitored regularly for fugitive hydrocarbon emissions. If a leak is detected, the equipment is tagged and repaired within seven days, as specified in the Refinery licence.

   A closed tank drainage system is being installed. This will reduce hydrocarbon emissions to atmosphere. A Waste Minimisation Study is currently being conducted to reduce hydrocarbon inputs to the oily water sewer and promote recovery at source. Hydrocarbon emissions to atmosphere will reduce as a result. The sewer repair programme will reduce hydrocarbon leakage to ground and will also have some air quality benefit.

   No Refinery in the BP Group, including UK, USA and Sweden, has total hydrocarbon emission limits.

6. Operating practices minimise hydrocarbon emissions during transfer operations. Most (80%) of the light products are exported from the Refinery by pipeline to the Fremantle and Kewdale terminals. Therefore hydrocarbon emissions during transfer operations are not significant compared to other refineries where most product is exported by ship or road tanker. The Feed Flexibility Project will have no effect on transfer operations from the Refinery.

7. BP Refinery Kwinana minimises NOx emissions by burning natural gas as a fuel source. The Feed Flexibility Project will have no impact on NOx emissions from the Refinery. Dispersion modelling has shown that ground level concentrations of NOx (expressed as NO_2) due to BP Refinery Kwinana NOx emissions are well below current National or International Air Quality Standards.

   No Refinery in the BP Group has a Selective Catalytic Reduction Unit and BP Refinery Kwinana has no plans to install one. This technology is not economically viable.

8. As outlined in the PER, BP Refinery Kwinana is planning to significantly upgrade the wastewater treatment facilities at the Refinery. This upgrade will significantly reduce the loading of hydrocarbons, phenolics, sulphides and ammonia to Cockburn Sound. BP Refinery (Kwinana) Pty Ltd will, within two years, submit to the Environmental Protection Authority a modernisation plan to substantially upgrade the Refinery wastewater treatment system.

9. The design of the proposed wastewater treatment facilities has not been finalised. At this stage of the project it is not possible to supply information on final wastewater quality. BP Refinery Kwinana is committed to installing "state of the art" facilities at the Refinery and it is expected that final wastewater quality will meet current international standards (e.g. U.S. EPA).

10. BP Refinery Kwinana currently re-uses as much as possible of the spent caustic. The spent caustic directed to Tank 3, Tank 74 and from the Jet Merox Unit cannot be re-used because of possible precipitation of sulphates.

11. Solid wastes at BP Refinery Kwinana are managed by waste minimisation which includes:-

. Reduction of waste at source by choosing clean technology and process/equipment modifications to reduce or eliminate waste generation; or reduce the toxicity of waste.

. Recycling of wastes both within and outside the Refinery. Recycling and reuse of wastes minimises the quantity for disposal. Waste segregation is a priority at the Refinery.

. Good plant operation and housekeeping and economy in the use of chemicals results in minimisation of wastes for disposal.

. Treatment of waste to minimise environmental impacts. This may include deoiling/dewatering of wastes prior to disposal. Stabilisation and solidification are treatment processes designed to improve waste handling and reduce the leachability of contaminants.

The waste minimisation programme at BP Refinery Kwinana is continuously reviewed to minimise waste production and ensure that all reasonably practicable steps are taken to dispose of wastes in an environmentally sensitive manner.

12. BP Refinery Kwinana is currently investigating the possibility of recycling residue cracker catalyst into speciality cement products. Recycling/reuse options for other wastes are continuously sought. Offsite disposal of wastes from the Refinery is difficult in Western Australia because of the lack of suitable facilities.

Appendix 4

List of organisations which made submissions

Health Department of Western Australia

Department of Mines

Department of Planning and Urban Development

Western Australian State Emergency Service

CORE (R and C O'Dwyer)

Lansstyrelsen Goteborgs och Bohus lan, Sweden