Poultry Litter Fired Power Station, Muchea

Blair Fox Generation Pty Ltd

Report and recommendations
of the Environmental Protection Authority

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Summary and recommendations

Blair Fox Generation Pty Ltd proposes to build and operate a poultry litter fired power station at Muchea which will produce electricity from the combustion of up to 108 000 tonnes per annum of poultry litter. This report provided the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal.

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

Relevant environmental factors

The EPA decided that the following environmental factors relevant to the proposal required detailed evaluation in the report:

(a) Stack emissions to air;

(b) Odour emissions; and

(c) Waste management.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

Conclusion

The EPA has considered the proposal by Blair Fox Generation Pty Ltd to build and operate a poultry litter fired power station.

The EPA notes the potential benefits of the proposal in terms of a long term solution to the stable fly problem, the production of green energy, reduced greenhouse emissions and the potential to re-use the ash as a fertiliser.

Air emissions are the main environmental issue associated with the combustion of waste material and the EPA recognises that best practice pollution control equipment is required and is proposed to ensure that emissions are minimised and ambient air quality is not compromised.

The EPA's view is that while the 'energy recovery' option is low in the waste management hierarchy, this is balanced by the positive aspects of the proposal including, the significant step toward a long term solution to the stable fly problem, the production of green energy, reduced greenhouse emissions and the potential for the re-use of the ash as a high value fertiliser.

The EPA has therefore concluded that it is unlikely that the EPA's objectives would be compromised provided there is satisfactory implementation by the proponent of the proponent's commitments and the recommended conditions set out in Appendix 4 and summarised in Section 4.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment and Heritage:

1. That the Minister notes that the proposal being assessed is to build and operate a poultry litter fired power station at Muchea;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Conditions

Having considered the proponent's commitments and information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Blair Fox to build and operate a poultry litter fired power station is approved for implementation. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) that the proponent shall fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;

(b) ensuring incinerator feed (fuel) type and quality;

(c) the characterisation and minimisation of stack emissions;

(d) the management of odour; and

(e) the management of bottom and fly ash.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal by Blair Fox Generation Pty Ltd, to build and operate a poultry litter fired power station.

Blair Fox Generation propose to combust up to 108 000 tonnes per annum of poultry litter. Heat from the combustion process would be used to produce steam and drive a turbine which would generate approximately 11 megawatts of electricity.

The proposal represents a change from the past practice of using poultry litter as a fertiliser in the horticultural industry. Unfortunately, once in the open environment, the litter provides an ideal site for stable flies to breed. To reduce the outbreak of stable fly, restrictions on the use of poultry litter in the horticultural industry have recently been introduced. The proponent, in cooperation with the WA Broiler Growers' Association, has presented this proposal as a solution to the stable fly problem.

The level of assessment was set at Public Environmental Review (PER) in February 2002. The proponent's public review document (Blair Fox, 2002) was released for four weeks public review which commenced on 22 July 2002 and closed on 19 August 2002. Twenty five submissions were received from government agencies and the public. While most submissions had concerns with the proposal, about a quarter (including the Shire of Gingin) were very supportive.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the environmental factors relevant to the proposal. The Conditions and Commitments to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in Section 4. Section 5 provides Other Advice by the EPA, Section 6 presents the EPA's conclusions and Section 7, the EPA's Recommendations.

Appendix 5 contains a summary of submissions and the proponent's response to submissions and is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process and which have been taken into account by the EPA appear in the report itself.

2. The proposal

The proposal is for a poultry litter fired power station at a site approximately 70 kilometres north of Perth on the Brand Highway near Muchea (Figure 1).

The power station would receive poultry litter from farms across the broad Perth region. Delivery would be by covered trucks, which would enter the enclosed litter reception shed and tip onto a concrete floor. A front-end loader would be used to place the litter on to a conveyor which would place it on the stockpile. The trucks would be washed down prior to leaving the site.

As required, front-end loaders would remove litter from the stock pile and place it in the combustor feed hoppers. The poultry litter would then be combusted at 915 to 960 degrees Celsius with a residence times of 2.8 seconds. An automatic control system would activate auxiliary gas burners and restrict poultry feed if the temperature was to drop below 850 degrees Celsius.

The flue gasses would then pass through pollution control equipment (flue gas desulphurisation and baghouse filters) before being exhausted through a 40 metre stack.

Heat from the combustion process would be used to raise steam and drive a steam turbine to produce electricity. The electricity would be exported to the south west interconnected grid.

Process effluent and potentially contaminated storm water would be discharged to two double lined evaporation ponds. Sludge from the ponds would be periodically removed by a licensed contractor. Ash from the proposal has the potential to be reused as a fertiliser.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Section 4 of the PER (Blair Fox, 2002a).

Table 1: Summary of key proposal characteristics

Element	Description
Plant capacity (poultry litter combustion):	up to 108 000 tonnes per annum.
Poultry litter reception and storage shed:	approximately 50 x 120 metres with up to 2000 tonnes storage (enclosed).
Combustor/boiler:	approximately 35 megawatt.
Stack:	approximately 40 metres high.
Steam turbine:	approximately 11 megawatt.
Cooling:	wet surface air cooled condenser and cooling tower.
Blow down water treatment:	reverse osmosis plant.
Power line (export):	approximately 2.7 kilometres long (22 kilovolts).
Groundwater supply:	approximately 550 000 kilolitres per annum.
Evaporation ponds:	two double lined ponds of approximately 50 x 100 metres each.
Other;	truck washdown station, sewage treatment plant, and internal roads.

Since release of the PER, the proponent has confirmed that:

- flue gas desulphurisation equipment will be installed; and
- dioxin emission controls will be installed.

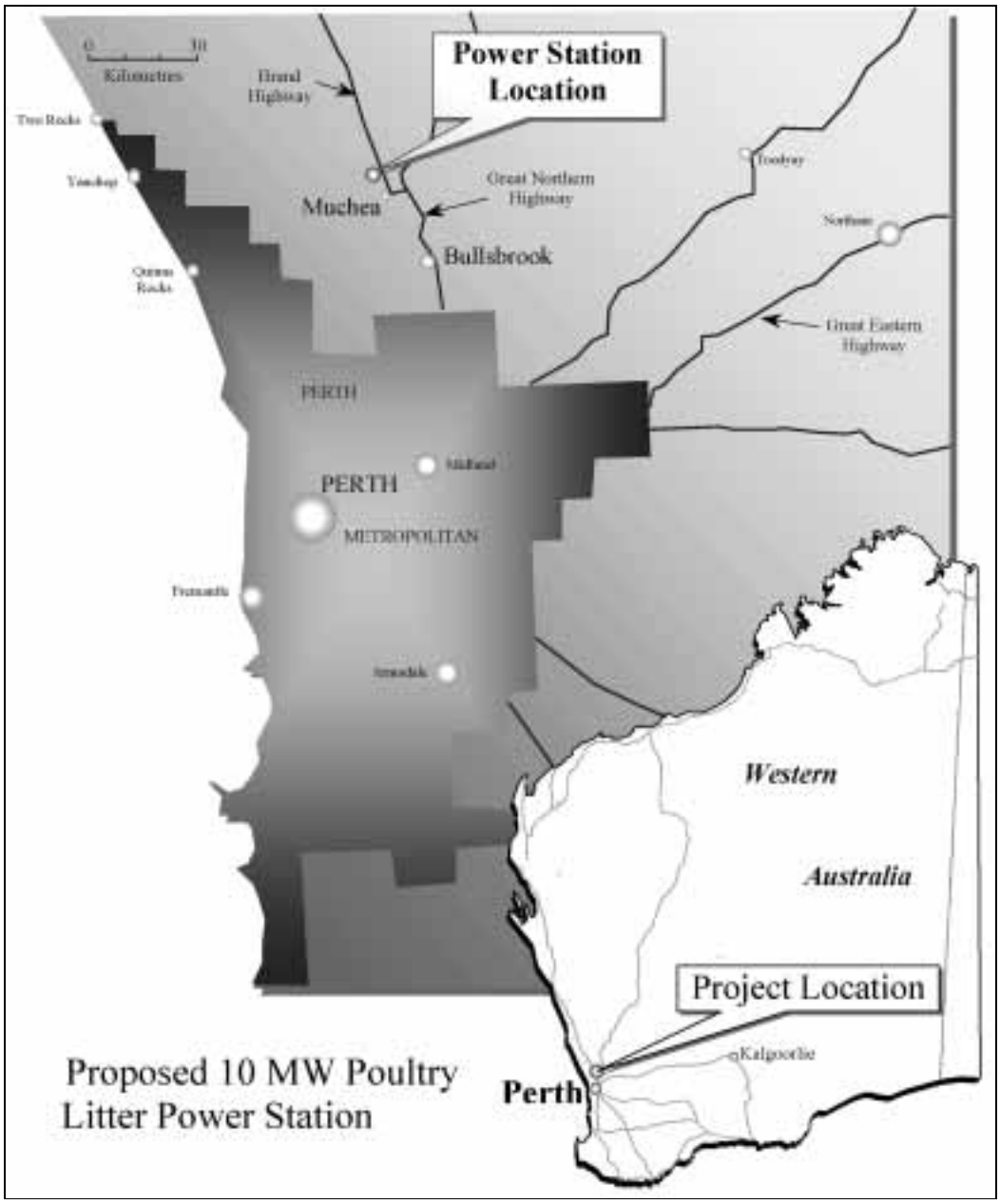

Figure 1: Proposal location

3. Relevant environmental factors

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the relevant factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as greenhouse gases, are very relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following environmental factors relevant to the proposal require detailed evaluation in this report:

(a) Stack emissions to air;

(b) Odour emissions; and

(c) Waste management.

The above relevant factors were identified from the EPA's consideration and review of all environmental factors generated from the PER document and the submissions received, in conjunction with the proposal characteristics.

Details on the relevant environmental factors and their assessment are contained in Sections 3.1 - 3.3. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

3.1 Stack emissions to air

Description

Air emissions are the major issue associated with the combustion of waste and while the combustion of biomass such as poultry litter is considered to have less potential to produce toxic air pollutants than the combustion of municipal solid waste (MSW) or medical waste, it is still important to ensure that implementing a solution to the stable fly problem does not result in an air quality problem.

SO_2

Air quality modelling was undertaken by the proponent to predict the sulphur dioxide (SO_2) Ground Level Concentrations (GLCs) from the proposal alone and in combination with the existing emission source (Tiwest) and to compare them with the National Environment Protection Measure (NEPM) Standard. The predicted GLC for the plant in isolation is about 2% of the NEPM (1 hour) Standard and the predicted cumulative SO_2 GLC is 87% of the NEPM (1 hour) standard.

NO_2

Air quality modelling has predicted that the maximum nitrogen dioxide (NO_2) GLC would be only 5% of the NEPM (1 hour) standard.

HCl

Air quality modelling has predicted that the maximum hydrogen chloride (HCl) GLC would be 22 ug/m^3. There is no NEPM standard for HCl and the proponent has suggested the Californian Reference Exposure Level of 3000 ug/m^3 could be used.

Greenhouse gases

Implementation of the proposal would result in a reduction in greenhouse gas emissions due to the production of power from biomass (instead of fossil fuel) and the prevention of poultry litter decomposing to release methane and nitrous oxide as occurs when it is used as a fertiliser. The reduction from the displacement of fossil fuel power alone, is estimated at around 75 000 tonnes of carbon dioxide equivalents per annum. While combustion will release carbon dioxide (CO_2), CO_2 has about 21 times less impact as a greenhouse gas than methane and about 310 times less impact than nitrous oxide.

Dioxins

Combustion processes have the potential to form dioxins through de-novo synthesis in the flue gas. The proponent has stated that dioxin emissions can meet the most stringent international limit of 0.1 ng/m^3 through the use of GORE-TEX filter material in the bag house. On advice from the Department of Health (DOH), the proponent was requested to undertake a Health Risk Assessment (HRA) for dioxins. The results of the HRA predicted that the cumulative dioxin intake would be below the World Health Organisation's (WHO's) tolerable daily intake (TDI) of 2 pg/kg_{bw}/day.

Emission limits

In Table 16 of the PER, the proponent has proposed a set of emission limits that they believe the proposal should be subject to (Blair Fox, 2002).

Submissions

Submissions related to the air pollution control equipment, the pollutant concentrations in the stack emissions and how these compared to international standards.

Assessment

The area considered for assessment of this factor is the proposal area and surrounding properties including nearby residences.

The EPA's environmental objective for this factor is to ensure that gaseous emissions from the new plant in isolation and in combination with neighbouring sources and background concentrations:

- meet the air quality standards and limits stated in relevant air quality standards/guidelines, including the NEPM for ambient air quality;
- do not cause an environmental or human health/amenity problem; and
- are minimised using best practicable technology.

SO_2

The EPA notes that the predicted plant in isolation SO_2 GLCs show that the plant will have a minimal impact on ambient SO_2 air quality. While the predicted cumulative GLCs are up to 87 % of the NEPM (1 hour), this would be due almost entirely to Tiwest. The modelling assumes that the Tiwest plant is emitting SO_2 at its licence limit of 85 g/s, however recent monitoring data provided to the DEP shows that the actual levels emitted from Tiwest are typically around 10% of the licence limit. Hence the resultant ambient levels would be well below the NEPM standard.

NO_2

The EPA notes that the predicted plant in isolation NO_2 GLCs show that the plant will have only a small impact on NO_2 ambient air quality. Tiwest is not a significant source of NO_2.

HCl

The EPA believes that the proponents suggested ambient criteria of 3000 ug/m^3 is not appropriate and after discussions with DOH recommends a value of 230 ug/m^3 (3min average) to protect from short term irritant effects. For chronic effects, the USEPA inhalation reference concentration (RfC) is 20 ug/m^3 and this is a more appropriate criteria to compare with maximum annual average predictions.

The maximum predicted concentration (3 min average) for HCl is 22 ug/m^3 which is less than 10% of the short term criterion of 230 ug/m^3. The maximum annual average predicted is 0.31 ug/m^3 which is well below the RfC.

Greenhouse gases

The EPA notes that implementation of the proposal would reduce greenhouse gas emissions, as a result of elimination of the hydrocarbons released from the decomposition of poultry litter and the CO_2 savings from generating power from biomass instead of fossil fuel. Using the litter as fuel will also avoid methane production which results from natural breakdown of the litter if it is used as an organic fertiliser.

Dioxins

The EPA believes that hazardous pollutants such as dioxins should be controlled to the maximum extent achievable, irrespective of location, and notes that the latest international standards specify 0.1ng/m^3 which is the same as required in the EPA's Guidance No. 13 *Management of Air Emission from Biomedical Waste Incinerators.* (EPA, 2000).

The Eye Power Station in the UK has a regulatory limit for dioxins of 1 ng/m^3 (Pers. Comm. Mary Simmons, Jan 2001) and Blair Fox have reported stack testing from this facility showed values of up to 0.22 ng/m^3.

The Eye Power Station has only limited pollution control equipment consisting of an electrostatic precipitator. This would not be expected to provide any significant dioxin abatement. The newer Thetford Power Station in the UK is fitted with bag filters and a lime dosing system which, while not specifically intended for dioxin control allows the plant to achieve dioxin emission concentrations of 0.03 ng/m^3 (Pers. Comm. Dirk Withey, Oct 2002).

Since the Blair Fox proposal will incorporate both flue gas desulphurisation and bag filters and since the filters will be the catalytic GORE-TEX filter material that destroys dioxin, the Blair Fox plant would be expected to achieve the Thetford performance or better.

The EPA notes that the HRA predicts that worst case emissions of dioxins from the facility would not cause the WHO TDI to be exceeded. The EPA also notes the DOH advice that "information presented in the PER and confidential version of the HRA suggests that the plant could operate without posing an unacceptable health risk".

Emission limits

The EPA notes that the European Directive 2000/76/EC (EC, 2000) provides one set of standards to which the proposal can be compared.

The EPA notes that the pollution control equipment (consisting of flue gas desulphurisation and GORE-TEX bag house filters) represents an enhancement over the controls fitted to the existing plants in the UK.

The proponents suggested emission limits are largely in line with the requirements of Directive 2000/76/EC with the exception of SO_2, HCl and HF. Notably the suggested limit for HCl of 270 mg/m^3 is considerably higher than the Directives 60 mg/m^3, while the limits for SO_2 and HF are 1.5 times the Directives limits.

Given that the Thetford plant in the UK is capable of meeting an emission limit of 30 mg/m^3 for HCl (Pers. Comm. Dirk Withey, Oct 2002), the EPA believes that the proponents suggested limit cannot be justified in terms of best practicable technology but a limit of 1.5 times the Directives limit (ie 90 mg/m^3) for the initial plant Licence would be reasonable and should be met. It should be recognised that allowance of this limit is based on the modelling which shows acceptable ambient concentrations can be achieved, however the EPA still expects the proponent to do its best towards achieving the limit in the Directive.

Table 2 provides emission limits which the EPA believes should be considered for adoption in the DEP's Works Approval and Licence process as acceptable initial emission limits under Part V of the *Environmental Protection Act 1986*.

Table 2: Recommended initial emission limits

Pollutant	Concentration Limit	Averaging/sampling Time
SO_2	300 mg/m^3	0.5 hours
HCL	90 mg/m^3	0.5 hours
HF	6 mg/m^3	0.5 hours
NO_X	400 mg/m^3	0.5 hours
CO	100 mg/m^3	8 hours
total particulates	30 mg/m^3	0.5 hours
total heavy metals	700 ug/m^3	between 0.5 and 8 hours
lead	140 ug/m^3	between 0.5 and 8 hours
mercury	50 ug/m^3	between 0.5 and 8 hours
cadmium	14 ug/m^3	between 0.5 and 8 hours
arsenic	5 ug/m^3	between 0.5 and 8 hours
dioxins/furans	0.1 ng/m^3	between 6 and 8 hours

The EPA also recommends a condition which requires the proponent to demonstrate (within 12 months of commencement of operation) that all feasible options have been considered to reduce SO_2, HCl and HF and that emissions of SO_2, HCl and HF will be able to meet emission limits below the initial limits in Table 2, consistent with best practicable technology and current industry standards.

The EPA recommends that the proponent be required to monitor continuously for particulates, CO, SO_2, HCl and NO_X. The EPA has also recommended a condition which requires the proponent to fully characterise the stack emissions prior to combusting a total of more than 25 000 tonnes of poultry litter. The proponent would thus need to analyse for a suite of compounds, including VOC's, PAH's and heavy metals and if any of these were detected at non trivial levels then further action would be required in the form of mitigation and/or ongoing monitoring.

Waste (fuel) quality

The EPA recognises that emission levels will be related to incinerator feed (fuel) quality. Contamination with other wastes (which may contain plastics or heavy metals) and variations in moisture content could potentially affect emission levels.

The EPA believes a condition is necessary to exclude the possibility of municipal solid waste (MSW), medical waste, biosolids and hazardous waste from being combusted in the facility. However, the EPA is also aware that poultry litter fired power stations in the UK have improved their emission performance by mixing poultry litter with clean biomass such as horse bedding (straw), forestry residues (woodchips), by-products of the food industry (nut husks, coffee grinds), etc (Pers. Comm. Mary Simmons, Jan 2001). Typically a mixture with up to 30% clean biomass is allowed in the UK (Pers. Comm. Dirk Withey, Oct 2002). For this reason, the EPA believes that the conditions should not exclude the option of co-firing clean biomass, but that the initial DEP Licence should restrict the proposal to combusting poultry litter only so that typical emission values for poultry litter alone can be assessed.

Thus, if in the future, the proponent wanted to co-fire a mixture containing alternative clean biomass, they would need to seek approval from the DEP, and the EPA would expect such an approval to involve appropriate trials to confirm emission limits were not compromised. The Licence could then be revised to specify the type and amount of alternative biomass allowed.

To help ensure that only appropriate fuel is used, the EPA recommends a condition requiring the proponent to prepare an Incinerator Feed (fuel) Quality Management Plan which includes:

- incinerator feed acceptance criteria;
- quality control procedures;
- contingency measures; and
- complaints response procedures.

Summary

The EPA is aware that if best practice measures for environmental management are applied at the design stage of a new proposal, significantly better performance than the applicable ambient standard can often be achieved without a significant cost penalty over the life of the project. The EPA thus challenges the proponent to thoroughly examine all feasible options to further minimise emissions during the design phase.

Having particular regard to the:

(a) the incorporation of flue gas desulphurisation equipment and GORE-TEX bag filters;

(b) the air quality modelling results;

(c) the results of the HRA and the DOH advice;

(d) the proponent's commitments;

(e) the recommended conditions; and

(f) the provisions for further control of the proposal via Part V of the *Environmental Protection Act 1986,*

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the proponent's commitments and the EPA's conditions are made legally enforceable and are successfully implemented.

3.2 Odour emissions

Description

Poultry litter is inherently odorous and poultry farms have often been the source of odour complaints in WA. The proposal would have up to 2000 tonnes of poultry litter stored on-site and hence there is potential for odour to affect the amenity of nearby residents.

The poultry litter is proposed to be transported to the site in covered trucks. These trucks would deliver the poultry litter by reversing into the enclosed reception area through automatic doors, where the covers would be removed and the load tipped onto a concrete floor. The truck would then be washed in the truck wash bay prior to leaving the site.

Front-end loaders would move the litter to a conveyor which would stack the litter in the enclosed storage shed. Front-end loaders would also be used to remove litter from the stockpile and place it in the incinerator feed hopper. Combustion air would be drawn from intakes located above the stockpile and any odorous compounds in this air would be destroyed in the combustion process. The shed would, however, have additional ventilation requirements.

The proponent undertook odour modelling which predicts that the odour concentration at the nearest residences would comply with the EPA's criteria in the draft Guidance No. 47 *Assessment of Odour Impacts from New Proposals*.

Submissions

The DEP noted that the EPA's Guidance No. 47 on odour has recently been updated and hence revised modelling was requested.

Submissions related to contingency plans for odour control during maintenance, breakdown or strikes. The proponent advised that the shed could be sealed and deliveries of poultry litter stopped during these circumstances. Submitters also pointed out that the shed ventilation requirements exceeded the combustion air requirements.

Assessment

The area considered for assessment of this factor is the proposal site and surrounding properties including nearby residences.

The EPA's environmental objective for this factor is to ensure that odour emissions from the new plant and background concentrations:

- do not cause an amenity problem; and
- are minimised using best practicable technology.

The proponent provided revised odour modelling (included in Appendix 5) to the requirements of the EPA's Guidance No. 47 *Assessment of Odour Impacts from New Proposals* (EPA, 2002). The revised modelling predicts that the 7 OU/m^3 3min average, 99.9^{th} percentile contour (considered to be a distinct odour level for poultry odours) will not reach the nearest residence. Odour from poultry farms has been well studied in WA and good input data is thus available for modelling. The EPA notes that the revised modelling predicts compliance with the EPA's criteria in Guidance No. 47.

Regulators in the UK have advised that poultry litter fired power stations there have had occasional problems with odour, notably from fuel handling when the litter became wet in the sheds following wet weather (Pers. Comm. Rob McLellan, Jan

2001). While this is expected to be of less concern because of WA's climate, the EPA believes that the proponent should be required to develop poultry litter acceptance criteria which specifies factors (such as moisture) that are important to minimise odour.

The EPA notes that it is important for the proponent to have in place contingency plans to reduce odour if there are substantiated complaints and during periods of plant shutdown. The EPA expects odour to be proactively managed from day one and as such, recommends a condition that requires the proponent to prepare an Odour Management Plan which addresses:

- poultry litter acceptance criteria (moisture content etc),
- fuel handling procedures,
- additional odour control measures which could be employed to reduce odour such as the use of deodorants or the installation of filters on shed ventilation points,
- contingency plans to control odour during periods of plant shutdown (maintenance, breakdown, strike etc), and
- complaints response procedures.

The EPA notes that the facility would require a Licence under Part V of the *Environmental Protection Act 1986* and this Licence could specify maximum storage volumes.

Summary

Having particular regard to the:

(a) the results of the odour modelling;

(b) the covered and enclosable design of the storage area;

(c) the recommended condition; and

(d) the provisions for further control of the proposal via Part V of the *Environmental Protection Act 1986*,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the EPA's condition is made legally enforceable and is successfully implemented.

3.3 Waste management

Description

The proponent has progressed the proposal in conjunction with the WA Broiler Growers' Association as a solution to the stable fly problem.

In the past, poultry manure has been used as a fertiliser in the horticultural industry. Unfortunately once in the open environment, the litter provides an ideal site for stable flies to breed. The adverse impacts of stable flies have increased over time with the encroachment of urban development and other sensitive land uses in proximity to market gardens.

The Minister for Primary Industry and Fisheries established the Stable Fly Management Project in 1996 to develop and implement management practices and other strategies to control stable fly breeding associated with horticultural and agricultural practices. The Stable Fly Steering Project (1998) found that the use of poultry litter in the horticultural industry was the major source of stable fly breeding and was also associated with extremely high levels of house fly breeding.

The DOH has recently banned the use of poultry litter in the horticultural industry for eight months of the year. This results in the stockpiling of poultry litter on individual poultry farms.

Thus, Blair Fox propose to remove poultry litter as a source of stable fly breeding by combusting 108 000 tonnes per annum and recovering the energy in the form of electricity. The proponent advises that the loss of the poultry litter as a fertiliser is compensated by reusing the ash as a high value fertiliser.

Submissions

The Waste Management Board attended an EPA meeting where they provided advice that their preference would be for the poultry litter to be composted but they recognised that there were market impediments and they would not oppose the proposal if it was judged to be environmentally acceptable. The DOH advised that it supports the project as a solution to stable fly provided environmental concerns are addressed.

The Shire of Gingin and other submitters thought the proposal was a sensible solution to the stable fly issue. Several submitters thought that the incineration of poultry litter was too low on the waste management hierarchy and that composting was a better alternative. Several submitters were concerned that the ash may not be suitable for reuse as a fertiliser due to the presence of contaminants such as heavy metals etc.

Assessment

The area considered for assessment of this factor is the proposal site and disposal areas.

The EPA's environmental objective for this factor is to ensure that wastes are managed in a safe manner to protect public health and the environment and in accordance with the DEP's waste management hierarchy as follows

(1) avoidance of waste production;
(2) reuse of wastes;
(3) recycling wastes to create useful products; and
(4) recovery of energy from wastes;
(5) containment of wastes in secure, properly managed structures;
(6) disposal of waste in the long term.

Management hierarchy

The EPA recognises that combustion of poultry litter for 'energy recovery' is low on the waste management hierarchy, but accepts the proponents advice that there is no viable alternative, since reuse of the waste in horticulture is currently banned for eight months of the year and a stable market for large volumes of compost does not exist.

Since the current ban results in significant quantities of poultry litter being stockpiled on individual farms, the EPA does not believe the ban represents a sustainable long term solution to the stable fly issue.

The EPA's view is that while 'energy recovery' is low in the waste management hierarchy, this is balanced by the positive aspects of the proposal including, the significant step toward a long term solution to the stable fly problem, the production of green energy, reduced greenhouse emissions and the potential for the re-use of the ash as a high value fertiliser.

Ash management

The potential for the reuse of the ash as a fertiliser is noted and the ash is used for this purpose in the UK (Pers. Comm. Rob McLellan, Jan 2001). However since the ash may contain traces of heavy metals and dioxin, it will be necessary for the proponent to carry out appropriate tests to determine the composition. The proponent would also need to obtain all necessary approvals for the sale of the ash. Thus, the EPA has recommended a condition requiring the proponent to prepare an Ash Management Plan which includes:

- determining the suitability of the bottom ash for use as a fertiliser;
- outlining the management and disposal of fly ash; and
- contingency plans for the management and disposal of off-spec or contaminated bottom ash.

The proponent has also made commitments to prepare and implement a:

- Waste Management Plan; and
- Hazardous Material Plan.

Summary

Having particular regard to:

(a) the significant benefits in reducing the stable fly problem;

(b) the recovery of energy;

(c) the potential to reuse the ash as a fertiliser;

(d) the proponent's commitments; and

(e) the recommended condition,

it is the EPA's opinion that the proposal can be managed to meet the EPA's environmental objective for this factor provided that the EPA's condition is made legally enforceable and is successfully implemented.

4. Conditions and Commitments

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

In developing recommended conditions for each project, the EPA's preferred course of action is to have the proponent provide an array of commitments to ameliorate the impacts of the proposal on the environment. The commitments are considered by the EPA as part of its assessment of the proposal and, following discussion with the proponent, the EPA may seek additional commitments.

The EPA recognises that not all of the commitments are written in a form which makes them readily enforceable, but they do provide a clear statement of the action to be taken as part of the proponent's responsibility for, and commitment to, continuous improvement in environmental performance. The commitments, modified if necessary to ensure enforceability, then form part of the conditions to which the proposal should be subject, if it is to be implemented.

4.1 Proponent's commitments

The proponent's commitments as set in the PER and subsequently modified, as shown in Appendix 4, should be made enforceable.

4.2 Recommended conditions

Having considered the proponent's commitments and the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Blair Fox Generation Pty Ltd to build and operate a poultry litter fired power station, is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

(a) that the proponent be required to fulfil the commitments in the Consolidated Commitments statement set out as an attachment to the recommended conditions in Appendix 4;

(b) ensuring incinerator feed (fuel) type and quality;

(c) the characterisation and minimisation of stack emissions;

(d) the management of odour; and

(e) the management of bottom and fly ash.

It should be noted that other regulatory mechanisms relevant to the proposal are:

- the proposal is prescribed under Part V of the Environmental Protection Act 1986 and therefore requires a Works Approval and Licence.
- the proposal requires a ground water abstraction Licence from the Water and Rivers Commission.

5. Conclusions

The EPA has considered the proposal by Blair Fox Generation Pty Ltd to build and operate a poultry litter fired power station.

The EPA notes the potential benefits of the proposal in terms of a long term solution to the stable fly problem, the production of green energy, reduced greenhouse emissions and the potential to re-use the ash as a fertiliser.

Air emissions are the main environmental issue associated with the combustion of waste material and the EPA recognises that best practice pollution control equipment is required and is proposed to ensure that emissions are minimised and ambient air quality is not compromised.

The EPA's view is that while the 'energy recovery' option is low in the waste management hierarchy, this is balanced by the positive aspects of the proposal including, the significant step toward a long term solution to the stable fly problem, the production of green energy, reduced greenhouse emissions and the potential for the re-use of the ash as a high value fertiliser.

The EPA has concluded that the proposal is capable of being managed in an environmentally acceptable manner such that it is most unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Section 4, including the proponent's commitments.

6. Recommendations

The EPA submits the following recommendations to the Minister for the Environment and Heritage:

1. That the Minister notes that the proposal being assessed is to build and operate a poultry litter fired power station at Muchea;
2. That the Minister considers the report on the relevant environmental factors as set out in Section 3;
3. That the Minister notes that the EPA has concluded that it is unlikely that the EPA's objectives would be compromised, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4, and summarised in Section 4, including the proponent's commitments.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report.

Appendix 1

List of submitters

Government Agencies:
Department of Health Western Australia
Shire of Gingin
Sustainable Energy Development Office
Water and Rivers Commission

Organisations:
Alliance for a Clean Environment
Conservation Council of Western Australia
Ellen Brook Integrated Catchment Group
Environment Centre of Western Australia
Pollution Action Network
Tiwest

Individuals:
M Blizard
C Cassar
L & M Don
D Douglas
F & M Fewster
D Gale
G Gilby
G & S Grant
M Grundy
D Hawkins
W James
M King
D Munut
P Murphy
B Parker
S & N Vallance
J Williamson
Residents of Muchea

Appendix 2

References

Blair Fox (2002a). *Poultry Litter Power Station, Public Environmental Review*. Blair Fox Generation Pty Ltd, July 2002.

Blair Fox (2002b). *Final Response to Comments from Public Submissions*. Blair Fox Generation Pty Ltd, November 2002.

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EPA (2000). *Guidance Statement for Management of air emissions from biomedical waste incinerators.* Environment Protection Authority Guidance Statement No. 13, March 2000.

EPA (2002). *Guidance Statement for Assessment of odour impacts from new proposals*. Environment Protection Authority Guidance Statement No. 47, March 2002.

McLellan, R., (January 2001). Inspector, United Kingdom Environment Agency.

Simmons, M., (January 2001). Inspector, United Kingdom Environment Agency.

Withey, D., (October 2002). Inspector, United Kingdom Environment Agency.

Appendix 3

Summary of identification of relevant environmental factors

PRELIMINARY ENVIRONMENTAL FACTOR	RELEVANT AREA	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY AND PUBLIC COMMENTS ON PER DOCUMENT	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
POLLUTION				
Stack emissions	Proposal site and surrounding areas.	Plant emissions to air under normal operating conditions are predicted to be: Nitrogen oxides (NOx) Sulphur dioxide (SO_2) Carbon monoxide (CO) Hydrogen chloride (HCl) Hydrogen fluoride (HF) Particulates There is also potential for dioxins and other compounds to be emitted.	**Government**: The Department of Environmental Protection (DEP) had questions regarding the pollution control equipment and the emission levels to be achieved and the dispersion modelling. The Department of Health (DOH) advised that the proponent s suggested criteria for HCl was inappropriate. **Public:** Submissions related to the pollution control equipment to be fitted and the emission levels to be achieved.	**Considered to be a relevant factor.**
Greenhouse gases	Proposal site and surrounding areas.	Greenhouse gas – the production of electricity from poultry litter (biomass) and the prevention of poultry litter decomposing (when used as a fertiliser) means an overall reduction of around 90, 000 tonnes of CO_2 equivalents per year	**Government**: The DEP sought further information on emissions from transport and producing replacement fertilisers. The Waters And Rivers Commission (WRC) notes the benefits in reducing fossil fuel based greenhouse emissions. **Public:** Submissions related to how the transport emissions affected the greenhouse emissions and the source of information used in the calculations.	**Considered to be a relevant factor. It will be assessed under the factor Stack Emissions.**

PRELIMINARY ENVIRONMENTAL FACTOR	RELEVANT AREA	PROPOSAL CHARACTERISTICS	GOVERNMENT AGENCY AND PUBLIC COMMENTS ON PER DOCUMENT	IDENTIFICATION OF RELEVANT ENVIRONMENTAL FACTORS
Odour	Proposal site and surrounding areas.	Poultry litter is inherently odorous and the storage of large quantities has the potential to impact on the amenity of nearby residences. The main sources of odour from the plant would be fugitive emissions from the storage/process shed. The shed would be semi enclosed and combustion air would be drawn from the shed. The combustion process would destroy odorous compounds.	**Government**: The DEP noted that the combustion air required is less than the ventilation requirements of the shed, and sought further information on contingency plans to reduce odour if it became a problem. The EPA's guidance note on assessing odour has also been updated and further information on odour predictions to suit the new guidance was sought. **Public:** The CCWA requested information on what would happen if the plant is forced to close down through power failure or strike action.	**Considered to be a relevant factor.**
Noise	Proposal area and surrounding properties including nearby residences.	The facility has numerous operational noise sources which include a steam turbine, fans, pumps and mobile equipment. Construction noise would also be present during the construction period. The adjacent Tiwest is required to meet a level of 40 dB(A) at nearest residences. This level is above the assigned level of 35 dB(A) in the noise regulations. The proponent has undertaken screening noise assessment that indicated that plant levels would be around 10 dB below the Tiwest level of 40 dB(A).	**Government**: The Shire of Gingin noted that it is critical that the plant be designed to meet the noise regulations. **Public:** The CCWA and other submitters would like to see cumulative noise modelling and a noise monitoring program.	The proponent has committed to model the final design to demonstrate compliance By meeting a level of 5 dB below the assigned level the plant would not be "significantly contributing" to any exceedance and as such cumulative modelling is not considered warranted. The proponent has advised that they will commit to a noise monitoring program. **Factor does not require further EPA evaluation**

Waste/hierarchy/ alternatives	Proposal site and disposal areas.	The facility is designed to process 108,000 tonnes per annum of poultry litter.	**Government:** The Waste Management Board would prefer to see poultry litter composted, but would not oppose the proposal if it can meet environmental objectives. The DOH supports the project as a solution to stable fly, provided environmental concerns are addressed by the proponent. The WRC would prefer to see poultry litter recycled to a value added compost over energy recovery. SEDO would support the highest value use of a resource and noted that the proposal should be compared with composting. SEDO supports best practice and notes that a fluidised bed combustor is used in Scotland for combusting poultry litter. **Public:** The Pollution Action Network (PAN) and other submitters question why technologies for composting are not considered. Pan asked if the proponent had received approval to sell the ash as a fertiliser. Several submitters were concerned that the ash may contain dioxins and heavy metals which would make it unsuitable for use as a fertiliser.	**Considered to be a relevant factor. It will be assessed under the factor Waste Management.**

Surface and Groundwater	Proposal site.	The proposal requires 550 000 kilo litres of ground water per year. Cooling water would be treated in a reverse osmosis plant to recover water for process use. Storm water from areas subject to contamination would be directed to lined evaporation ponds.	**Government**: The DEP sought further information on boiler blowdown and process effluents. The WRC advised of some of its development requirements and noted that a production ground water licence would depend on the results of a hydrogeological survey. The DOH noted that it did not support on-site effluent disposal unless there was a minimum of 0.5 metres above groundwater. The Shire of Gingin notes that the water allocation required for the power station is very small. **Public:** The CCWA, EBICG and other submitters were concerned over the use of water given the current water restrictions. The CCWA believes that groundwater monitoring is essential.	Information requested has been provided. The proponent has advised that exploration drilling has been undertaken and they are confident of obtaining a licence. The proponent has advised that the required clearance will be obtained, by drainage if necessary. Noted. The proposed ground water extraction would require a WRC licence which would take into account sustainable yields. Proponent has committed to ground water monitoring. **Factor does not require further EPA evaluation.**
SOCIAL SURROUNDINGS				
Health Risk	Proposal site and surrounding areas.	The proponent undertook a Health Risk Assessment (HRA) for dioxins emitted from the proposal, the results of which predict the plant would not cause the World Health Organisations (WHO) recommended tolerable daily intake to be exceeded.	**Government**: The DEP had several questions and comments regarding the HRA methodology and the deposition modelling. The DOH advised that information presented in the PER and the confidential version of the HRA suggests that the plant can operate without causing a unacceptable public health risk. **Public:** A submitter asked numerous questions about the HRA and its methodology.	**Considered to be a relevant factor. It will be assessed under the factor Stack Emissions.**

Stable fly	Areas where poultry litter used as fertiliser.	Proposal will help control stable fly by removing a major source of stable fly breeding.	**Government**: The Shire of Gingin and other submitters believed the projects stable fly benefits are understated in the extreme. **Public:** A submitter asked numerous questions about the HRA and its methodology.	**Not considered to be a relevant factor. It will be discussed generally in the assessment report.**
Other	Community.	Potential for adverse public reaction to industrial development it a rural area. Proponent carried out a community consultation program.	**Public**: Several submitters were concerned that extensive community consultation had not been carried out. Several submitters were concerned about the devaluation of surrounding properties.	Proponent and EPA process has provided adequate opportunity for public comment. The loss of amenity that could lead to devaluation is addressed under Air emissions, odour, noise. **Factor does not require further EPA evaluation.**

Appendix 4

Recommended Environmental Conditions and Proponent's Consolidated Commitments

Statement No.

RECOMMENDED CONDITIONS AND PROCEDURES

STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED (PURSUANT TO THE PROVISIONS OF THE ENVIRONMENTAL PROTECTION ACT 1986)

POULTRY LITTER FIRED POWER STATION, MUCHEA

Proposal: The construction and operation of a 108 000 tonnes per annum poultry litter fired power station, Muchea, as documented in Schedule 1 of this Statement.

Proponent: Blair Fox Generation WA Pty Ltd

Proponent Address: Suite 1, 164 Beaufort Street, PERTH WA 6000

Assessment Number: 1412

Report of the Environmental Protection Authority: Bulletin 1083

The proposal referred to above may be implemented subject to the following conditions and procedures:

Procedural conditions

1 Implementation and Changes

1-1 The proponent shall implement the proposal as documented in Schedule 1 of this Statement subject to the conditions of this Statement.

1-2 Where the proponent seeks to change any aspect of the proposal as documented in Schedule 1 of this Statement in any way that the Minister for the Environment and Heritage determines, on advice of the Environmental Protection Authority, is substantial, the proponent shall refer the matter to the Environmental Protection Authority.

1-3 Where the proponent seeks to change any aspect of the proposal as documented in Schedule 1 of this Statement in any way that the Minister for the Environment and Heritage determines on advice of the Environmental Protection Authority, is not substantial, the proponent may implement those changes upon receipt of written advice.

2 Proponent Commitments

2-1 The proponent shall implement the environmental management commitments documented in Schedule 2 of this Statement.

2-2 The proponent shall implement subsequent environmental management commitments which the proponent makes as part of fulfilment of the conditions in this Statement.

3 Proponent Nomination and Contact Details

3-1 The proponent for the time being nominated by the Minister for the Environment and Heritage under Section 38(6) or (7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal until such time as the Minister for the Environment and Heritage has exercised the Minister's power under Section 38(7) of the Act to revoke the nomination of that proponent and nominate another person as the proponent for the proposal.

3-2 If the proponent wishes to relinquish the nomination, the proponent shall apply for the transfer of proponent and provide a letter with a copy of this Statement endorsed by the proposed replacement proponent that the proposal will be carried out in accordance with this Statement. Contact details and appropriate documentation on the capability of the proposed replacement proponent to carry out the proposal shall also be provided.

3-3 The nominated proponent shall notify the Department of Environmental Protection of any change of contact name and address within 60 days of such change.

4 Commencement and Time Limit of Approval

4-1 The proponent shall provide evidence to the Minister for the Environment and Heritage within five years of the date of this Statement that the proposal has been substantially commenced or the approval granted in this Statement shall lapse and be void.

Note: The Minister for the Environment and Heritage will determine any dispute as to whether the proposal has been substantially commenced.

4-2 The proponent shall make application for any extension of approval for the substantial commencement of the proposal beyond five years from the date of this Statement to the Minister for the Environment and Heritage, prior to the expiration of the five year period referred to in Condition 4-1.

The application shall demonstrate that:

- the environmental factors of the proposal have not changed significantly;
- new, significant, environmental issues have not arisen; and
- all relevant government authorities have been consulted.

Note: The Minister for the Environment and Heritage may consider the grant of an extension of time limit of approval not exceeding five years for the substantial commencement of the proposal.

Environmental conditions

5 Compliance Audit and Performance Review

5-1 The proponent shall prepare an audit program in consultation with, and submit compliance reports to, the Department of Environmental Protection which address:

- the implementation of the proposal as defined in Schedule 1 of this Statement;
- evidence of compliance with the conditions and commitments; and
- the performance of the environmental management plans and programs.

Note: Under Sections 48(1) and 47(2) of the *Environmental Protection Act 1986*, the Chief Executive Officer of the Department of Environmental Protection is empowered to audit the compliance of the proponent with the Statement and should directly receive the compliance documentation, including environmental management plans, related to the conditions, procedures and commitments contained in this Statement.

Usually, the Department of Environmental Protection prepares an audit table which can be utilised by the proponent, if required, to prepare an audit program to ensure that the proposal is implemented as required. The Chief Executive Officer is responsible for the preparation of written advice to the proponent, which is signed off by either the Minister or, under an endorsed condition clearance process, a delegate within the Environmental Protection Authority or the Department of Environmental Protection that the requirements have been met.

5-2 The proponent shall submit a performance review report every five/six years after the start of the operations phase, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority, which addresses:

- the major environmental issues associated with the project; the targets for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those targets;

- the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best practicable technology;

- significant improvements gained in environmental management, including the use of external peer reviews;

- stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and

- the proposed environmental targets over the next five years, including improvements in technology and management processes.

6 Incinerator feed (fuel)

6-1 The proponent shall combust a fuel which consists of not less than 70% poultry litter. The remainder of the fuel mix may be alternative clean biomass, the type and maximum percentage of which will be specified in the Licence.

6-2 The proponent shall not combust municipal solid waste, medical waste, biosolids or hazardous waste in the facility.

6-3 As part of the Works Approval application, the proponent shall prepare an Incinerator Feed (fuel) Quality Management Plan to ensure that conditions 6-1 and 6-2 are complied with, and the poultry litter criteria acceptance are met with respect to contaminants in the feed that can change the stack emission levels and constituents. The Plan shall include:

1 incinerator feed acceptance criteria;
2 quality control procedures;
3 contingency measures in the event that the criteria in 6-3(1) are not met including the management of the off-spec feed and additional pollution control actions; and
4 complaints response procedures.

6-4 The proponent shall implement the Incinerator Feed (fuel) Quality Management Plan, required by Condition 6-1, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

6-5 The proponent shall make the Incinerator Feed (fuel) Quality Management Plan, required by Condition 6-1, publicly available, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

7 Stack emissions

7-1 Within 12 months of the commencement of operation, the proponent shall demonstrate that all feasible options have been considered to reduce SO_2, HCl and HF and that emissions of SO_2, HCl and HF will be able to meet emission limits below the initial limits recommended in Table 2, consistent with best practicable technology and current industry standards.

7-2 Prior to combusting more than 25 000 tonnes of poultry litter, the proponent shall present results of stack testing undertaken to fully characterise all constituents in the stack emissions, including minor emissions.

7-3 As part of the Works Approval application, the proponent shall submit an air toxics (particularly dioxins) management plan to address :

1 monitoring and analytical procedures;
2 contingency measures/management procedures to deal with exceedances above the limit; and
3 complaints response procedures.

8 Odour

8-1 Prior to the commencement of operation, the proponent shall prepare a Odour Management Plan, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

This Plan shall include:

1 poultry litter acceptance criteria;

2 fuel handling procedures;

3 additional odour control measures which could be employed to reduce odour such as the use of deodorants or the installation of filters on shed ventilation points;

4 contingency plans to control odour during periods of plant shutdown; and

5 complaints response procedures.

8-2 The proponent shall implement the Odour Management Plan, required by Condition 8-1, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

8-3 The proponent shall make the Odour Management Plan, required by Condition 8-1, publicly available, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

9 Ash

9-1 Prior to the commencement of operation, the proponent shall prepare an Ash Management Plan, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

This Plan shall include:

1 determining the suitability of the bottom ash for use as a fertiliser;
2 outlining the management and disposal of fly ash; and
3 contingency plans for the management and disposal of off-spec or contaminated bottom ash.

9-2 The proponent shall implement the Ash Management Plan, required by Condition 9-1, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

9-3 The proponent shall make the Ash Management Plan, required by Condition 9-1, publicly available, to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

10 Decommissioning Plans

10-1 Prior to construction, the proponent shall prepare, and subsequently implement, a Preliminary Decommissioning Plan, which provides the framework to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

The Preliminary Decommissioning Plan shall address:

1 rationale for the siting and design of plant and infrastructure as relevant to environmental protection, and conceptual plans for the removal or, if appropriate, retention of plant and infrastructure;

2 long-term management of ground and surface water systems affected by the evaporation ponds;

3 a conceptual rehabilitation plan for all disturbed areas and a description of a process to agree on the end land use(s) with all stakeholders;

4 a conceptual plan for a care and maintenance phase;

5 management of noxious materials to avoid the creation of contaminated areas.

10-2 At least 12 months prior to the anticipated date of closure, or at a time agreed with the Environmental Protection Authority, the proponent shall prepare a Final Decommissioning Plan designed to ensure that the site is left in an environmentally acceptable condition to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority.

The Final Decommissioning Plan shall address:

1 removal or, if appropriate, retention of plant and infrastructure in consultation with relevant stakeholders;

2 long-term management of ground and surface water systems affected by the evaporation ponds;

3 rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s); and

4 identification of contaminated areas, including provision of evidence of notification and proposed management measures to relevant statutory authorities.

10-3 The proponent shall implement the Final Decommissioning Plan required by Condition 10-2 until such time as the Minister for the Environment and Heritage determines, on the advice of the Environmental Protection Authority, that the proponent's decommissioning/closure responsibilities have been fulfilled.

10-4 The proponent shall make the Final Decommissioning Plan required by Condition 10-2 publicly available, to the requirements of the Minister for the Environment and Heritage on advice from the Environmental Protection Authority.

Procedures

1 Where a condition states "to the requirements of the Minister for the Environment and Heritage on advice of the Environmental Protection Authority", the Chief Executive Officer of the Department of Environmental Protection will obtain that advice for the preparation of written advice to the proponent

2 The Environmental Protection Authority may seek advice from other agencies, as required, in order to provide its advice to the Chief Executive Officer of the Department of Environmental Protection.

Notes

1 The Minister for the Environment and Heritage will determine any dispute between the proponent and the Environmental Protection Authority or the Department of Environmental Protection over the fulfilment of the requirements of the conditions.

2 The proponent is required to apply for a Works Approval Licence for this project under the provisions of Part V of the *Environmental Protection Act 1986*.

Schedule 1

The Proposal (Assessment No. 1412)

The proposal is for the construction and operation of a poultry litter fired power station. The plant will combust up to 108 000 tonnes per annum of poultry litter and clean biomass.

The plant site is District Swan Suburb Muchea Location 1809 (Brand Highway, Muchea) – In Certificate of Title Volume 1070 Folio 936.

Table 1: Key Proposal Characteristics

Element	Description
Plant capacity (poultry litter combustion):	up to 108 000 tonnes per annum.
Poultry litter reception and storage shed:	approximately 50 x 120 metres with up to 2000 tonnes storage (enclosed).
Combustor/boiler:	approximately 35 megawatt.
Stack:	approximately 40 metres high.
Steam turbine:	approximately 11 megawatt.
Cooling:	wet surface air cooled condenser and cooling tower.
Blow down water treatment:	reverse osmosis plant.
Power line (export):	approximately 2.7 kilometres long (22 kilovolts).
Groundwater supply:	approximately 550 000 kilolitres per annum.
Evaporation ponds:	two double lined ponds of approximately 50 x 100 metres each.
Other;	truck washdown station, sewage treatment plant, and internal roads.

Table 2: Recommended initial emission limits

Pollutant	Concentration Limit	Averaging/sampling Time
SO_2	300 mg/m^3	0.5 hours
HCL	90 mg/m^3	0.5 hours
HF	6 mg/m^3	0.5 hours
NO_X	400 mg/m^3	0.5 hours
CO	100 mg/m^3	8 hours
total particulates	30 mg/m^3	0.5 hours
total heavy metals	700 ug/m^3	between 0.5 and 8 hours
lead	140 ug/m^3	between 0.5 and 8 hours
mercury	50 ug/m^3	between 0.5 and 8 hours
cadmium	14 ug/m^3	between 0.5 and 8 hours
arsenic	5 ug/m^3	between 0.5 and 8 hours
dioxins/furans	0.1 ng/m^3	between 6 and 8 hours

Figures (attached)

Figure 1 – Plant Layout

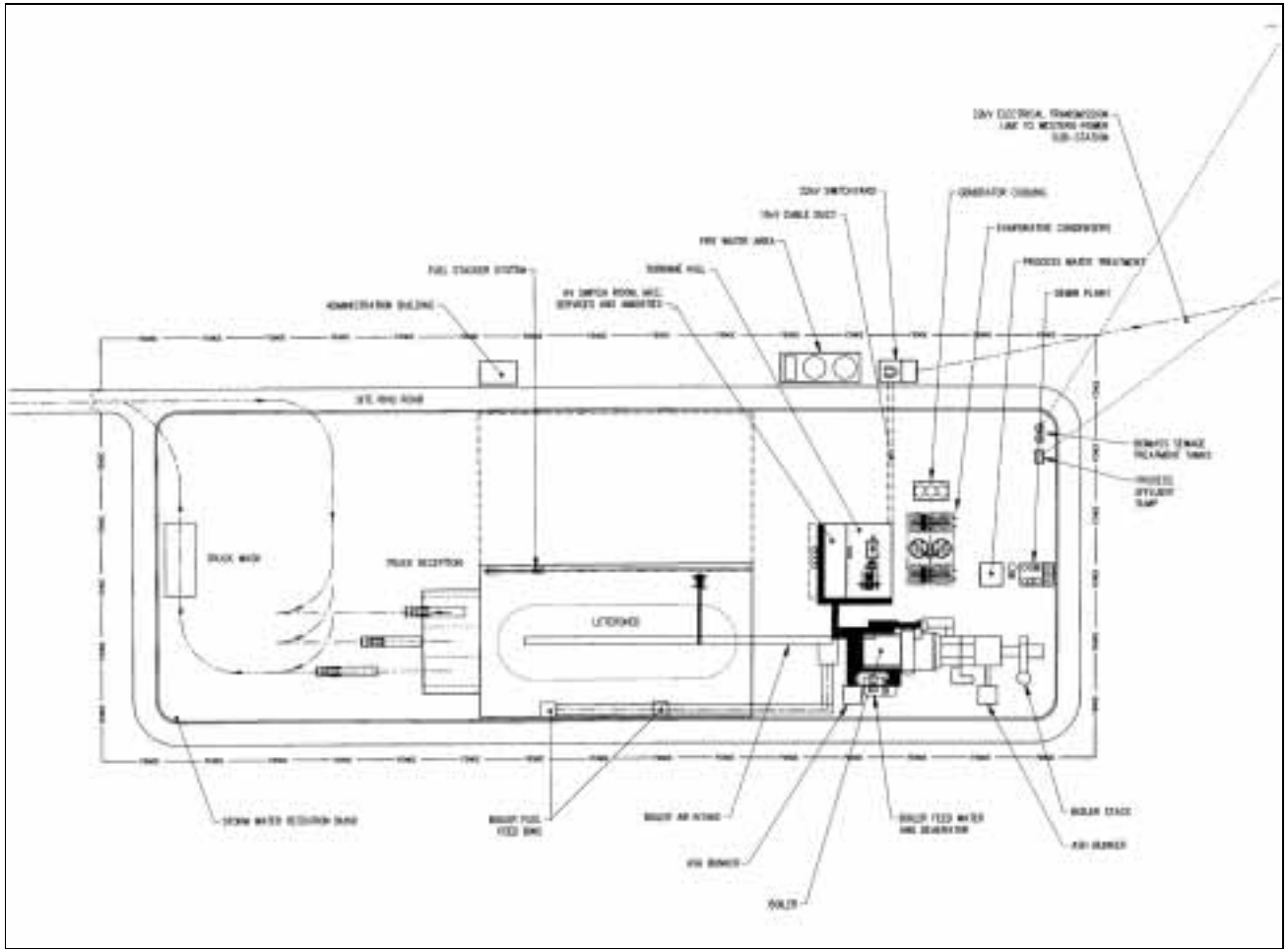

Figure 1: Plant layout

Schedule 2

Environmental Management Commitments

December 2002

Poultry Litter Fired Power Station,
Muchea (Assessment No. 1412)

Blair Fox Generation Pty Ltd

Environmental management commitments

No	Topic	Action (Commitment)	Objectives	Timing	Advice From
1	**General Environmental Management**	1. The proponent will develop an EMP for the construction phase of the Project. 2. The Construction EMP will be implemented at the site during the construction period by the Proponent and the contractors undertaking the construction activities. 3. The Proponent will prepare an Environmental Management Plan (EMP) for the site. 4. The EMP will be implemented at the site during operations. 5. The Proponent will prepare an Environmental Management System (EMS) for the operations of the poultry litter power station prior to commissioning. 6. The Proponent will implement the EMS during the commissioning and operation of the poultry litter power station	To ensure that any potential environmental impacts associated with the construction and operation of the Project are minimised or ameliorated.	Design Construction Design Operation Design Operation	DEP
2	**Vegetation**	1. Clearing will be minimised 2. Fencing will be used to protect Vegetation Communities. 3. Weed control will be undertaken annually on site.	To maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.	All phases	1. Shire of Chittering 2. The Chittering Valley Landcare Group 3. The Ellenbrook Integrated Catchment Management Group
3	**Groundwater Management**	The Proponent will prepare a Ground Water Management Plan as a component of the site EMP, which will be submitted to the DEP prior to commissioning.	To ensure that ground water abstraction will not lead to unacceptable impacts on wetland other users and any contamination is detected.	Design	WRC
4	**Groundwater Management**	The Proponent will implement the Ground Water Management Plan.	As for commitment 3	All phases	WRC
5	**Surface Water**	1. The Proponent will prepare a Surface Water Management Plan as a component of the site EMP, which will be submitted to the DEP prior to commissioning.	To ensure that receiving water bodies are protected from contamination.	Design	WRC
6	**Surface Water**	1. The Proponent will implement the Surface Water Management Plan.	As for commitment 5	Operation	WRC
7	**Sulphur Dioxide**	The proponent will develop an EMP for the commissioning phase	Ensure that emissions meet the air quality	Design	DEP

No	Topic	Action (Commitment)	Objectives	Timing	Advice From
	Nitrogen Oxides **Particulates** **Hydrogen fluoride** **HCL emissions**	of the Project. The commissioning EMP will detail a testing program for the boiler stack emissions. The commissioning EMP will be submitted to the DEP for approval prior to the commencement of commissioning.	standards requirements of the National Environmental Protection Measure (NEPM) and adopted by the EPA. Ensure that emissions are below the maximum permissible levels. To minimise emissions.		
8	**Sulphur Dioxide** **Nitrogen Oxides** **Particulates** **Hydrogen fluoride** **HCL emissions**	As soon as possible following commissioning of the plant, the stack testing program for the boiler stack (developed in conjunction with DEP) will be implemented to verify that the emissions are within the specifications described in this document.	As for commitment 7	Operation	DEP
9	**Heavy Metals** **Dioxin and furans**	The proponent will develop an EMP for the commissioning phase of the Project. The commissioning EMP will detail a stack testing program for the boiler stack. The commissioning EMP will be submitted to the DEP for approval prior to the commencement of commissioning.	Ensure that any emissions of heavy metals meet acceptable standards. To minimise emissions of heavy metals.	Design	DEP
10	**Heavy Metals** **Dioxin and furans**	As soon as possible following commissioning of the plant, the stack testing program for the boiler stack (developed in conjunction with DEP) will be implemented to verify that the heavy metal emissions are within the specifications described in this document.	As for commitment 9	Operation	DEP
11	**Greenhouse gases**	1. The proponent will employ energy efficiency in Plant design and operation. 2. The poultry litter power station will apply for accreditation with the Australian Greenhouse Office 3. The proponent will calculate greenhouse emissions and report to the DEP.	To minimise greenhouse gas emissions in absolute terms and reduce emissions per unit product to as low as reasonably practicable. To mitigate greenhouse gases emissions in accordance with the Framework Convention on Climate Change 1992, an in accordance with established Commonwealth and State policies including Environmental Protection Authority Interim Guidance No 12 'Minimising Greenhouse Gases'.	All phases	AGO
12	**Dust**	1. The proponent will prepare a Dust Management plan as a	Ensure that the dust levels generated by	Design	DEP

No	Topic	Action (Commitment)	Objectives	Timing	Advice From
		component of the EMP for the site. 2. The Dust Management plan will be implemented.	the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards	Construction	
13	**Noise**	1. The proponent will develop an EMP for the commissioning phase of the Project. The commissioning EMP will detail a Noise Management Plan. 2. When the design is finalised, the proponent will submit to the DEP the results of detailed noise modelling to confirm that 35 dB(A) is met at the nearest residence under worst case conditions. 3. A noise design criterion is that the external noise from any building, or item of equipment outside a building, will be less than 85 dB(A) at 1 metre. 4. The Noise Management Plan will be implemented.	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring that noise levels meet statutory requirements specified in the *Environmental Protection (Noise) Regulations 1997* .	Design	DEP
14	**Noise**	1. A noise monitoring survey will be undertaken once the Plant is operational to ensure that noise levels meet the regulations. 2. Should noise emissions from the proposal, when implemented, cause annoyance to nearby residences, the proponent is committed to using its best endeavors to remedy the situation.	As for commitment 13	Operation	DEP
15	**Hazardous Materials**	1. The proponent will prepare a Hazardous Materials plan as a component of the EMP for the site, which will be submitted to the DEP prior to commissioning. 2. The Hazardous Materials Plan will be implemented.	Ensure that any hazardous materials to be used on site are transported and stored and used in a safe and environmentally acceptable manner.	Design Operation	DEP
16	**Waste Management**	The Proponent will prepare a Waste Management Plan based on the principles of Reduce, Recycle and Re-use. The Waste Management Plan will be a component of the site EMP, which will be submitted to the DEP prior to commissioning.	Where possible, waste should be minimised, reused or recycled.	Design	DEP
17	**Waste Management**	The Waste Management Plan will be implemented.	As for commitment 16	Operation	DEP
18	**Visual amenity**	1. The buildings and civil works will be consistent with Shire of Chittering guidelines for building materials.	Visual amenity of the area adjacent to the project should not be unduly affected by	Design	Shire of Chittering

No	Topic	Action (Commitment)	Objectives	Timing	Advice From
		Chittering guidelines for building materials. 2. In the longer term, the screening trees and shrubs to be planted around the facility.	the proposal	Construction	

Appendix 5

Summary of Submissions and
Proponent's Response to Submissions

Blair Fox Generation WA

ASSESSMENT NO.1412

Final Response to Comments from Public Submissions

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Managing Director
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Air Emissions

1. The DEP notes that worst-case emissions rates are modelled which are much higher than the emissions expected during normal operation of the plant. This is an obviously conservative approach. However the DEP would prefer the modelling to be more representative (ie using the maximum expected emission rates). Could the proponent provide this revised modelling?

   Answer
   A revised draft modelling report has been prepared using typical maximum emission rates. A draft of this report is enclosed. The maximum predicted ground level concentrations of sulphur dioxide, nitrogen dioxide, PM10 and hydrochloric acid from the Project together with any contributions from the Tiwest synthetic rutile plant are all below their respective criterion levels.
   Some aspects of the modelling cannot be finalised until the detailed design of the facility has been completed.

   A final modelling report incorporating outcomes of the detailed design will be provided prior to an application for a works approval being submitted.

2. The DEP notes the meteorological data for use in the Ausplume model has been obtained from the DEP meteorological monitoring station at Caversham; this data-set is considered representative of meteorological conditions at the project site. However, please provide some comment on what differences may be expected between the sites, and any bias this may introduce into interpretation of predicted impacts. For example, being further inland lower wind speeds will be expected, with what effects on the assessment?

   Answer
   It is probable that Muchea, being further inland than Caversham, experiences slightly lower average wind speeds. This is unlikely to have any significant effect on the maximum predicted short-term ground level concentrations but may cause 24-hour and average concentrations to be slightly under-estimated. Since the maximum predicted 24-hour and average concentrations of the modelled contaminants are less than half of their respective criterion levels, the effect of possibly lower wind speeds at the site than assumed will be much less than this margin.

3. The DEP notes that the report of air dispersion modelling for the HRA should present model results for the base case, proposal in isolation, and for the cumulative impacts to clearly show the impact of the proposal. Could the proponent provide this information?

Answer

The maximum predicted ground level concentrations across the receptor grid from modelling sulphur dioxide, nitrogen dioxides, PM10 using the maximum emissions rates under normal operating conditions in Table 3 are summarised in Table 1.

Table 1 Maximum predicted ground level concentrations for typical emission rates

Source	Sulphur dioxide ($\mu g/m^3$)	Nitrogen dioxide[(a)] ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	HCl ($\mu g/m^3$)
Averaging time = 3 minutes				
PLFPS	-	-	-	22
Tiwest	-	-	-	0
Criterion	-	-	-	230
Averaging time = 1 hour				
PLFPS	12	12	-	-
Tiwest	500[(b)]	1	-	-
Cumulative	500[(c)(e)]		-	-
Criterion	572[(d)]	246[(d)]	-	-
Averaging time = 24 hours				
PLFPS	5	-	1	-
Tiwest	85	-	7	-
Cumulative	106			
Criterion	229[(d)]	-	50[(d)]	-
Averaging time = 1 year				
PLFPS	1	1	-	-
Tiwest	24	0	-	-
Criterion	57	62	-	-

[(a)] Conservatively assumes that 50% of NOx from both Tiwest and the proposal is or becomes NO2.

[(b)] Occurs within Tiwest boundary. Maximum outside Tiwest boundary is 467 $\mu g/m^3$.

[(c)] Occurs within Tiwest boundary. Maximum outside Tiwest boundary is 467 $\mu g/m^3$.

[(d)] Exceedences allowed by NEPM Standard not taken into account.

[(e)] Details of the modelling parameters and assumptions are shown in Appendix 1.

It should be noted that the sulphur dioxide concentrations from Tiwest are based on an assumed continuous emission rate at the licence limit. The predicted concentrations may therefore be over-estimated since the actual emissions are likely to be considerably below

the regulatory limit.

All of the maximum predicted concentrations are below the relevant criteria. The maximum predicted concentrations from the PLFPS in isolation are less than 10% of the relevant criterion for all contaminants.

The predicted CCD/F air concentrations and particle depositions are shown in Table 2.

Table 2 Summary of maximum predicted CCD/F air concentrations and particle depositions

Maximum predicted value at any receptor grid	Results from previous (Calpuff) modelling	ISC3-Prime modelling and revised assumptions		
		PLFPS	Tiwest	Total
Airborne vapour phase (fg I-TEQ/m3)	0.051	0.0403	0.0488	0.0699
Airborne particle phase TEQ (fg I-TEQ/m3)	0.22	0.0473	0.0437	0.0728
Total airborne (fg I-TEQ/m3)	0.276	0.0876	0.0925	0.139
Total particle deposition TEQ (pg I-TEQ/m2/yr)	86	79.8	99.2	156

The results from the revised dioxins modelling are broadly consistent with the original results. The maximum predicted airborne vapour concentrations are 37% higher than previously; the maximum predicted airborne particle concentrations are 67% lower than previously; and the maximum predicted particle depositions are 81% higher than previously. The health risk assessment using the original Calpuff predictions showed that for the 'worst-case' emissions modelled with the lifestyle of a 'high-end' individual, the resulting exposure for adults is 0.358pg TEQ/kgBW-d and for children is 0.317pg TEQ/kgBW-d, compared to the WHO Tolerable Daily Intake (TDI) of 1 to 4pg TEQ/kgBW-d. In other words, the predicted impacts were, at worst, 215% lower than the criterion. The differences in the predicted dioxins levels from the ISC3-Prime modelling are considered to be too small to affect the conclusion from the original Health Risk Assessment that health impacts are below relevant criteria.

4. The DEP requests detailed information on the combustion temperatures and residence times that would be achieved. Could the proponent provide this information?

Answer

Start-up will be achieved using gas. Change-over to poultry litter will occur once the furnace temperature is above 850 ^{o}C. Hot gases will be retained at temperatures of 915 ^{o}C to 960 ^{o}C for a period of approximately 2.8 seconds to allow complete combustion of the litter. Suitable low temperature visual and audible alarms will be fitted.

The combustion conditions will be tightly controlled via the monitoring of O2, CO, temp and PM. These parameters will be continuously monitored as they are required control parameters that ensure high quality combustion efficiency and therefore operation or, in the case of PM immediate detection of a bag-house failure.

If the combustion temperature drops below the target temperature, for example because of a non homogenous supply of poultry litter with a very high moisture content then operator and automatic controls will come into play that act to fire the gas burners to maintain the combustion temperature above 850 ^{o}C. In this scenario the automatic feed of litter to the combustion zone will also be automatically regulated.

The plant will have an ongoing strategy of presenting a homogenous moisture content to the boiler to maintain efficient operation and this will centre on the pre mixing of poultry litter with a front end loader prior to deliver to the fuel deliver feed system. Pre mixing of the poultry litter to present a homogenous moisture content is considered best practice with regards the operation poultry litter power stations.

In the situation where there was a complete loss of furnace temperature and the system need to be closed then the automated litter feed system would be shut down and gas burners will be activated to ensure complete combustion of the remaining poultry litter prior to shutting down.

5. The DEP notes that the units of measurement used in the PER document are often not appropriate to the magnitude of the quantities reported which makes the argument needlessly confusing and difficult to follow. For example, reporting heavy metals concentrations in grams per cubic metre results in figures such as "0.0000027", when units of micrograms per cubic metre would be both more appropriate and conventional.

   Answer

   Familiar, uniform and consistent units of measurement within the relevant sections of the PER were used to assist the non expert reader who may be confused by unfamiliar units.

6. The DEP and Department of Health WA (DOH) notes that in Table 6 the proponent has proposed the use of the CAPCOA 1993 level for HCl of 3 mg/m^3, the DEP and DOH believes that this is not appropriate for public exposure. The values agreed between the DOH and the DEP for HCl are 0.7 mg/m^3 (peak) and 0.23 mg/m^3 (3min).

   Answer

   The maximum predicted ground level HCl concentration is well below 0.23 mg/m^3 (3min).

7. The DEP notes that Table 6 does not mention HF emissions but these are considered in Table 16.

   Answer

   Table 16 lists those HF emissions which were requested at a late stage in the process by the DEP. We were able to find some information on the expected HF emissions from "FEC

Ltd, Use of Poultry Litter for Power Generation - Monitoring of Glanford Power Station. ETSU Report B/MI/00421/REP (1995). In the Glanford report summary, HF was measured as 0.6mg/Nm3 = 0.0006g/Nm3. This is well below Australian emission limits for HF of 0.05g/Nm3 from plants other than alumina smelters (limit = 0.02g/Nm3) (A Summary of Air Pollution Prevention Regulations in Effect in Australia and New Zealand October 1998, Clean Air Society of Australia and New Zealand Inc)

8. The DEP notes that VOC's and PAH's are not mentioned. Given the organic nature of the fuel, what will be the expected emission of volatile organic compounds (VOC) and PAH? Can the proponent provide further information and would the proponent commit to sampling a suite of compounds to determine whether they are present in non trivial amounts during commissioning?

Answer

Section 9 of the PER (Proponent Commitments) provides the framework for the development of the EMP for the commissioning phase of the project. The EMP will be developed with advice from DEWCP and will contain a stack testing program. While we have no information that leads us to believe that VOC's and PAH's are of concern we will be happy to comply with any request to include VOC's and PAH's in the program. However we have obtained the ETSU Report BM/04/00056/REP/3, January 1999 which includes summaries of the following reports: FEC Ltd, Use of Poultry Litter for Power Generation - Monitoring of Glanford Power Station. ETSU Report B/MI/00421/REP (1995). FEC Ltd, Use of Poultry Litter for Power Generation - Monitoring of Eye Power Station. ETSU Report B/FW/00235/REP (1995). Two measurements of VOCs from the Glanford plant were reported. These were 4mg/Nm3 and 3mg/Nm3 and below the UK (HMIP) limit of 20mg/Nm3. Measurements of VOCs have been reported from the Eye Plant. When burning poultry litter only, the emission was 0 to 0.24mg/Nm3.

9. The DEP notes that the proposed SO_2 and HCl emission limits do not meet the EC/USEPA best practice emission limits.

Answer

Table 14 in the PER shows that the Proposals maximum emission limits are all within the AEC/NHMRC limits and are mostly consistent with the limits that applied to the UK Eye plant, with the exception of Hydrogen chloride. However, while the expected operating range is within EC and US EPA limits the Licence limits are not. This is best explained by considering the context of the plant and the fact that the US and EC limits typically apply to much larger power projects that are often 10 times larger than the proposal and have mass emission rates that are much higher. For example, although the US EPA emissions limit for HCl from municipal waste combustion units is referred to in the PER, this proposal in the US would actually be eligible for an exemption from this limit as it would be classified as a "small power production facility" (CFR60.50b clause (e)) and has a capacity of less than 80 MW (45FR17, 959, March 20, 1980 pursuant to Section 201 of the Public Utility Regulatory Policies Act of 1978). The general application of less stringent emissions limits for small facilities is further supported by the air emission modelling for this proposal which demonstrated that the maximum predicted ambient HCl level from the proposal is less than 10% of the relevant criterion and the maximum predicted ambient SO2 levels from the proposal is about 2% of the relevant criteria.

10. The DEP, Tiwest and other submitters note that there is some ambiguity in the PER but that it appears the proponent has committed to making provision for flue gas desulphurisation equipment but will install the equipment only if the proposed emission limits (which are not best practice) are not met. Could the proponent please clarify exactly what will be done?

Answer

The Proponent will install a Flue Gas Desulphurisation System and will operate it as necessary to ensure compliance with the relevant licence limits. This is covered in Section 7.3 of the PER.

11. The DEP notes that the proposed emission controls focus on end of pipe solutions. Are there other solutions (such as the injection of limestone into the combustion zone) that could be used?

Answer

In-combustor sulphur capture is typically only used for fluidised-bed systems. Wet or dry stack scrubbing is generally used for other combustion systems such as the Flue Gas Desulphurisation System as detailed in the PER. We have no independently validated information regarding the effectiveness of injecting limestone directly into the combustion zone. We have verbal advice that injecting limestone into the combustion bed will be less effective than the proposed scrubbing system (there will always be material that does not come into contact with the limestone) and will create a range of additional engineering issues (heat distribution etc). This introduces the risk that such a technology may reduce combustion efficiency and increase other emissions.

12. The DOH note that the levels recommended for irritant acidic compounds have been derived for each specific chemical substance. The effect of acidic compounds on exposed individuals can be additive and account needs to be made of this when reviewing the results of any air monitoring data that is collected for assessment. That is, while ambient air levels for each acidic compound may be within the respective guidelines, it is possible that exposed individuals could experience some irritation if air levels are elevated for a number of irritant substances simultaneously. Could the proponent comment on this matter?

Answer

HF and HCl are acidic emissions. An interim guideline for the short-term human exposure to HF in "DEP Review of Existing Swan Valley Brickworks" (September 2000) is 600 $\mu g/m^3$. The additive effects of two gases having a similar health effect can be estimated from the hazard quotient – the sum of the ratios of each contributing contaminant to its respective criterion. The maximum predicted 3-minute average HF concentration is 49 $\mu g/m^3$. For HCl and HF, the hazard quotient is: 22/230 + 49/600 = 0.17 Since 0.17 is less than unity, it would be expected that a combined exposure to HCl and HF should not cause an adverse health effect.

13. The Conservation Council of WA (CCWA) notes the potential to cause serious air pollution and points out that there are many things that could go wrong (operator error, equipment failures, contaminants in the waste etc). The CCWA would like to see cumulative modelling and believes a air monitoring plan should have been presented with the PER. Could the proponent comment on this matter?

Answer

Results from the cumulative modelling are presented in Section 7 of the PER. Section 7.3 (Air emissions monitoring and management commitments) details air emission monitoring commitments that will form part of the EMP. The EMP will be developed in consultation with the EPA Service Unit, DEWCP and other appropriate regulators. It is premature to develop the EMP at this stage.

14. The Environment Centre of WA (ECWA) provided background information on dioxins. Given the hazardous nature of dioxins and furans, and noting that they are produced through natural causes as well as from anthropogenic sources, the ECWA is firmly of the opinion that they should be treated much like nuclear compounds and radiation: there is no reason to add any more of them into the biosphere than we already have, and every reason to remove as

much as we feasibly can. Therefore, ECWA believes that, economic imperatives notwithstanding, this proposal should not proceed without twin doubly redundant baghouses, i.e.: two parallel sets of twin baghouses placed in series; an imperative that any filter failure be sufficient cause to force switching to the reserve baghouse complex; and that such switchover happen within a maximum time parameter. Could the proponent comment on this matter?

Answer

The power station will comply with its licence requirements which meet world's best practice standards for dioxin emissions control. Remedia is designed to meet these emission standards using a single compartmentalized baghouse. Remedia is a passive dioxin destruction system that is always working, unlike adsorbent methods that are subject to failure because of mechanical injection system breakdowns. The Remedia bags are constructed from expanded PTFE fibre, an extremely durable fibre developed by W.L.Gore and used in filtration process for over a decade. This fibre has proven to be very durable in service and routinely achieves 4+ years life in pulse jet cleaned baghouses. The integrity of the bags will be continuously monitored. We are unaware of any power station in the world that has two parallel sets of twin baghouses placed in series. This is not a standard practice anywhere and in view of the discussion above, cannot be justified for this proposal.

15. The Ellen Brook Integrated Catchment Group (EBICG) is concerned that the PER is not clear in terms of air emissions controls. There is a strong lack of commitment to provide anything other than 'best endeavours to remedy situations' upon a breach of conditions or regulations. Could the proponent comment on this matter?

Answer

The power station has been developed to minimise environmental impacts and will set new air emission control benchmarks in Australia. It will be the first in Australia to have

particulate control, dioxin control and a flue gas desulphurisation system. This is in spite of the fact that the plant's emissions, without any control, would not be in excess of those from many of WA's coal fired power stations. The plant will have its licence limits enforced by the relevant regulators and the proponent is committed to meeting its licence limits. If the power station breaches its regulations, the Regulators have provisions to enforce such conditions. The proponent has proposed licence limits for a range of emissions that set new standards of accountability in Western Australia.

16. PAN believes the Muchea site is not ideal, being adjacent to the Tiwest plant, already a significant source of air pollutants. We would ask for some clear data on the range of emissions from Tiwest, rather than the data as presented which uses licence information. Could the proponent provide this data?

Answer

Tiwest's emission data is available on request from Piers Goodman, Tiwest Chandala facility phone 9571 9333. Tiwest have advised that their emission data will also be available in the 2002 National Pollution Inventory.

17. PAN and other submitters would like to see some modelling indicating how weather conditions at different times of the year impact on the dispersion of pollutants. Temperature inversions could be a problem restricting the mixing of air. In terms of the contribution of emissions to smog formation, the Tiwest plant was used for monitoring during the Perth Photochemical Smog Study and detailed information could well be available. Could the proponent comment on this matter?

Answer

Meteorological conditions which cause elevated ground level concentrations of elevated emissions are implicitly taken into account in the dispersion modelling. We are not aware of

detailed meteorological data collected by Tiwest. The use of the Caversham meteorological data set has been endorsed by the DEP – amongst other reasons, because its quality in terms of continuity and accuracy of raw and derived data is known to be high.

18. PAN notes the PER refers to the Eye chicken litter plant in Britain, for information on emission levels of pollutants. This plant is now almost 10 years old and we would appreciate details of how more modern facilities and those proposed for the US, England and Scotland, are approaching the problem of pollution control (Westfield, Fife, Benson, Minnesota for instance). The new European Council Directive 2000/76/EC on the Incineration of Waste will come into place in December 2002. PAN asks that the plant meet the emissions limits and monitoring requirements of this Directive. Will the proponent commit to meeting these requirements?

Answer

The 10MW Westfield Fife plant, commissioned 1999, has a fabric filter. The 38.5MW Thetford plant, commissioned 1998, has a fabric filter and flue gas desulphurisation system. The Benson Minnesota plant has not been built. The proposed European Council Directive 2000/76/EC on the Incineration of Waste is inappropriate for use, it is still under consultation and has not been transposed into national legislation. Plants treating animal waste are excluded from the scope of the proposed Directive. Furthermore, air emission modelling for the proposal has demonstrated that the maximum predicted ambient levels of contaminants are less than 10% of the relevant criterion (see Table 1).

While the proposed European Directive limits appear to be extremely stringent, they are subject to various exemptions and extended phase-in periods. Notwithstanding, the proposal may still meet the limits for particulates and hydrogen fluoride. The continuous monitoring protocols in the European Directive are primarily designed for mixed and hazardous waste incinerators where the variability of the feedstock can lead to process and emission control difficulties, resulting in excessive emissions. These problems are much less likely for a consistent feedstock, as is the case for the proposal.

19. PAN notes that Table 16 states that Blair Fox will install flue gas desulphurisation, fabric filters and dioxin scrubbing technology. The following Table mentions that 'provisions' will be made to install flue gas desulphurisation and fabric filters. What does this actually mean – will the company install or not?

Answer

The Proponent will install a Flue Gas Desulphurisation System and will operate it as necessary to ensure compliance with the relevant licence limits. This is covered in Section 7.3 of the PER.

20. Tiwest and several submitters requested all monitoring data be made publicly available. Would the proponent commit to this?

Answer

The Proponent is committed to meeting its regulatory and community obligations and will report the required monitoring data to the National Pollution Inventory, the Department Of Environmental and Water Catchment Protection, the Office of the Renewable Energy Regulator, the Office of Energy, and The Sustainable Energy Development Authority. This information will be made publicly available.

21. Several submitters note the proponent has stated in the PER that it will operate under the States strictest emission criteria and will set new environmental benchmarks for power generation. It also states that it is committed to developing a safe, efficient, modern plant with best practice in technology and operation. There are a number of specific aspects to the PER that do not adequately address these points. There does not appear to be any detailed description of the combustor / boiler unit. In fact, only four pages of the

document were allotted to the description of the proposal (Pages 18 – 21), of which only one page contained 'Design Details'. This is a very important issue. The design and operation of the combustor is of great importance when trying to assess how effective the combustor will be in destroying any components of the fuel feed. It can also have a great effect on other components of the exhaust gases, particularly dioxins and furans, which if combustion and flue gas handling is not performed under relatively strict conditions, very significant amounts of dioxins and furans can reform in the exhaust gas stream. Could the proponent provide these details?

Answer

See question 15 above for additional information. The technology is off the shelf and is a standard biomass steam cycle power station that combusts poultry litter. This is not new technology - there are a large number of biomass boilers in Australia combusting sugar cane waste (bagass), sawdust and other wood waste products. Furthermore, in the UK, poultry litter is used to generate renewable electricity at a number of facilities with other plants under development. Steam is generated in a boiler designed to combust the poultry litter fuel in an efficient and environmentally clean manner. High pressure steam is expanded in a steam turbine producing mechanical power before being condensed in a water cooled condenser and returned to the boiler to complete the closed circuit system. The steam generating boiler is of conventional design following established technology for burning biomass materials. Above the firebed there is a large water wall combustion chamber followed by a long radiant section to enable the gases to be substantially cooled before coming into contact with the convection surfaces. The configuration is designed to ensure low gas velocities. Start-up will be achieved using gas. Change-over to poultry litter will occur once the furnace temperature is above 850 ^{o}C. Hot gases will be retained at temperatures of 915 ^{o}C to 960 ^{o}C for a period of approximately 2.8 seconds to allow complete burnout. Suitable low temperature visual and audible alarms will be fitted.

22. Several submitters note there is mention of a facility in the Eye region of the United Kingdom, but it appears that the document

does not specifically state that the proposal will be based on this facility. Is there a specific reference facility that the proponent can use to demonstrate to the community that it is truly capable of performing in the manner that it suggests ?

Answer

The proposed power station is based on the proven Eye process (the 38.5MW Thetford and 13.5MW Glanford poultry litter power stations are also based on the same process), however the plant will contain additional technology such as flue gas desulphurisation, fabric filters and dioxin control. While the desulphurisation technology and fabric filters are used at the 38.5MW Thetford poultry litter power station it is believed that dioxin control is not fitted. The proponent is committed to meeting all licence limits and the plant will be subject to regulatory control.

23. A submitter notes there is no mention of any specific Anti Pollution Control Devices (APCD's) (apart from the Gore-tex Filter Bags) that are suggested the proponent *will* install. There is reference to 'provisions' being made to install these devices, but the commitment by the proponent seems to be a little vague as to whether the units will actually be installed. If the proponent had confidence in the performance of their proposed facility, they should be in a position where they would be able to assess whether the proposal would require any of the devices, and a suitable unit would be selected from the variety that are available. The Major Inputs listed in Section 4.3 Table 3 does not appear to contain any chemicals, such as lime or activated carbon, that would be used in some of these APCD's. This does not seem to show that the proponent fully understand the importance of minimising emissions from the facility. It also does not sound like 'best practice' or a 'performance benchmark'. Could the proponent comment on this matter?

Answer

See Question 10 and 15 above.

24. A submitter notes there is a great number of issues that require to be addressed with regards to the emissions from the proposed facility. Most of the information that is presented is from a facility that performs a similar function, but is not stated as being the reference facility. This would not provide the community with a high level of confidence that the information presented is of any real use in determining whether the proposed facility will perform in a similar fashion.

Answer

See Question 10 and 15 above.

25. Several submitters pointed out a number of anomalies in the data, a number are listed below:

In Section 4.3 Table 5 shows that the gas flow is 98,000 – 112,000 m^3/hr and a particulate concentration of 6 mg/Nm^3. In the Executive Summary Table PER1, it shows a gas flow of 98 – 112 m^3/hr and a particulate concentration of 60 mg/Nm^3.

In Section 7.2.3 Table 16 in the footnote it states that mg/m^3 means milligrams per second.

Answer

Noted

26. A submitter notes that in Section 7.1.3.2, Table 9 compares the proposal with a facility in the UK. The projected Heavy Metal emissions for the proposal were calculated from data from a CSIRO Report on the Poultry Litter Ash multiplied by the TSP

(Total Solid Particulates ?). This approach is rather simplistic. There are a number of heavy metals and their compounds that have very appreciable vapour pressures at the exhaust conditions and as such may be present in the flue gas as vapour and hence may not be filterable by any fabric filters. This concept could also have resulted in Heavy Metal results for the ash being lower than actual due to loss of volatile Heavy Metals when it was generated. It was very curious to inspect the origin of the Heavy Metal concentration data which was named as being the CSIRO Report (Appendix 7) to find that the data was actually sent to the CSIRO, via facsimile, by the proponent. Does the proponent have an explanation for this ?

Answer

Table 9 of the PER shows measured heavy metals (vapour plus particulate fractions) concentrations from UK plant. These were thought to overestimate the particulate fraction of heavy metals emissions because the UK plant uses an ESP (which was noted as performing poorly around the time of the measurements) in contrast to the baghouse proposed for the Poultry Litter Fired Power Station. Therefore the UK data was not considered representative of the proposal for modelling. Heavy metal vapour emissions are more likely to be higher when an ESP is used to control particulates because ESPs operate at higher temperatures than baghouses which operate at around 200C. The only heavy metals with appreciable vapour pressures at this temperature are mercury and lead. All heavy metals will be monitored following commissioning of the proposal. Western Australian poultry litter was analysed for heavy metals by Coogee Chemical's consultants Australian Environmental Laboratories in November 2000. Coogee Chemicals provided these results directly to the CSIRO and ourselves. These results were re-faxed to the CSIRO in December 2000 when a formal letter of advice on their letter head was requested.

27. Several submitters thought there were a number of issues raised by the proponents suggested emission limits. A number of proposed limits that are significantly above the EC Waste Incineration Directive (SO_2, HCl, HF, Particulates – See Table 1

Attached.). The proponent attempts to justify this by stating that this proposal is relatively insignificant when compared to other plants that the EC and USEPA limits are typically applied to, in fact ten times smaller. The USEPA 40 CFR Part 60.50b Standards of Performance for Large Municipal Waste Combustors states that a combustor is Large when it combusts more than 250 tonnes per day, this proposal is for 300 tonnes per day. There is some suggestion that the worlds largest combustor is a 2000 tonne per day facility in the Netherlands, which is hardly 10 times the size of the proposed facility. It would also appear that the EC Directive covers any incineration plant regardless of size. Could the proponent comment on this matter?

Answer

See Questions 9 and 18 above. The project is not an incinerator; it is a biomass power station and therefore within the PER parallels were being drawn with typical power stations which are often many times the size of the proposal. The proposed European Directive limits are subject to various exemptions and extended phase-in periods. Although the US EPA emissions limits for municipal waste combustion units is referred to in the PER, this proposal in the US would be eligible for an exemption from these limits as it would be classified as a "small power production facility" (CFR60.50b clause (e)) and has a capacity of less than 80 MW (45FR17, 959, March 20, 1980 pursuant to Section 201 of the Public Utility Regulatory Policies Act of 1978). This may be in recognition of the wider social and environmental benefits of energy recovery from waste combustion verses incineration solely for the purpose of reducing waste volumes for disposal.

28. A submitter believes the recommended emission limits do not provide any real confidence that the proponent is committed its own statement of wanting to operate under the States strictest emissions criteria or to operate a plant to best practice. The submitter suggests that the proponent conduct a search of the worlds emission limits for combustion facilities and other facilities that involve high temperature processes and submit this for public comment such that the public can specify which limits are most suitable for the proposed facility. There are a number of typical

emissions that have not been considered (PAH's, VOC's, TOC, BTEX etc) and require to be investigated and suitably considered. Could the proponent comment on this matter?

Answer

See Question 15 above.

29. A submitter notes that the proponent proposes, as its emission control technology, for Oxides of Nitrogen that it will use Low NOx Burners. Is this only during startup ? It would appear from Table PER 1 that there is no imported fuel, and Natural Gas is only to be used during startup. Will the Poultry Litter be introduced into the combustor through a burner ? Is the proponent aware that it is usual for approximately 25% of the nitrogen present in a fuel to be converted to NOx in the exhaust (unless the combustion temperatures are above the thermal NOx barrier where the generation of NOx increases dramatically) ?

Answer

Gas will be used as required see question 4 above. Poultry litter will not be introduced to the boiler through a gas burner. We are aware that nitrogen present in the poultry litter will be converted to NOx.

30. Several submitters noted the proposed monitoring of the facility was remarkably deficient when compared with the EC Directive. It is proposed that the only continuous measurements that will be recorded will be temperature, oxygen, carbon monoxide, and carbon dioxide. It would appear that along with these, the EC Directive requires the continuous monitoring of NOx, Particulates, TOC, HCl, HF, SO_2 and water vapour. Then there is the issue of the continuous sampling and periodic determination of dioxins and furans, which is required to be performed every fortnight in Belgium (Worlds Best Practice). The German Standard (17^{th} BimSchV) also

suggests that Mercury and its compounds should be continuously measured, as should SO_3. Could the proponent comment on this matter?

Answer

See question 27 above - While the proposed European Directive limits appear to be extremely stringent, they are subject to various exemptions and extended phase-in periods. The continuous monitoring protocols in the European Directive appear to be designed for mixed and hazardous waste incinerators where the variability of the feedstock can lead to process and emission control difficulties. These problems are much less likely for a consistent feedstock, as is the case for the proposal. The proponent has committed to a detailed stack testing program for the boiler stack. The contaminants measured will include:

- Sulphur dioxide;
- Hydrogen chloride;
- Hydrogen fluoride;
- Nitrogen oxides;
- Heavy metals (arsenic, lead, mercury, cadmium);
- Dioxins and furans; and
- Particulates.

Other parameters which will measured on a continuous basis include temperature, oxygen, carbon monoxide and carbon dioxide.

We are not aware of any power plant having continuous monitoring for Hg or SO3.

31. A submitter notes there is a brief discussion on various APCD's, but there is nothing specific as to which type of unit will definitely be installed. Has the proponent investigated what is considered Worlds Best Practice in terms of APCD's ? Are any of the components that the proponent has investigated listed in the USEPA's Maximum Achievable Control Technologies (MACT's) ?

Answer

The power station has been developed to minimise environmental impacts and will set new benchmarks in Australia with regards air emission control. It will be the first in Australia

to have particulate control, dioxin control and a flue gas desulphurisation system. This is in spite of the fact that the plant's emissions, without any control, would not be in excess of those coming from many of WA's coal fired power stations. Section 7.2.2 discusses the list of world's best practice APCDs that are being considered for installation in the power station. Equipment will be chosen from this list.

Remedia was selected as a best available technique for waste gas treatment. "Integrated Pollution Prevention Control Draft Response reference Document on Best Available Techniques in Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector 2001", EC Technologies for Sustainable Development European IPPC Bureau 2001

Odour

32. The DEP and other submitters noted that combustion air is to be drawn from the storage shed, however the combustion air required is less than the ventilation requirements of the shed and certainly insufficient to maintain a negative pressure. Could the proponent comment on this?

Answer

The modelling of odour does not assume that a negative pressure will be maintained inside the shed. The modelling explicitly takes into account odour emissions from the shed when ventilation rates will be in excess of the combustion air requirements of the boiler.

33. The DEP asks if the proponent could provide information to demonstrate that the transport of poultry litter will not cause an odour problem to residents along the route?

Answer

Poultry litter will be transported in trucks and the load will be covered with a suitable membrane. Current practice in WA is to transport poultry litter in trucks and to date the industry has not received any complaints about the odour from the loads.

34. The DEP and DOH asks if the proposed odour management does not provide acceptable results, what other techniques would the proponent use (such as chemical treatment, activated charcoal filters) to control odours?

Answer

Additional available controls are: covering part of the storage stack with a suitable membrane; rejecting poultry litter loads with high moisture contents; forced ventilation to assist in the further drying of the litter stack; storing less litter in the storage shed (the current situation is that no more litter than is contained on a large poultry farm is held on site); aerating the poultry litter stack; fitting charcoal filters to forced ventilation units and rejecting litter that is overly odorous.

35. The DEP notes that the air quality assessment states (Table 12) that predicted odour concentration is never higher than 4.5 OU/m^3, yet the report in Appendix 5 plots a 7 OU/m^3 contour. Could the proponent explain this?

Answer

The 4.5 OU/m^3 was the maximum 1-hour 99.9 percentile odour concentration predicted at any residence. All of the residences were outside the 7 OU/m^3 1-hour 99.9 percentile contour.

36. The DEP notes that the EPA Guidance for assessment of odour impacts has been revised and now refers to a three-minute averaging time for odour impacts. The odour modelling results as presented do not provide sufficient detail to allow an extrapolation from one averaging time to the another. Could the proponent provide a repeat analysis or reinterpret the results with appropriate justification?

Answer

The analysis has been repeated using a revised source emission rate estimate and comparing the predicted odour

concentrations to the 7 OU/m^3 3-minute average 99.5 percentile criterion (see revised draft modelling report). The extent of the contour is larger than previously and approaches, but does not encroach, the nearest residence.

37. The DEP, DOH and CCWA requests information on what would happen if the plant is forced to close down through power failure or strike action. The DOH notes that there would need to be an action plan to remove litter in accordance with the Health Poultry Manure Regulations 2001. Could the proponent provide details of contingency plans or backups to control odour?

Answer

We believe that under the Health Poultry Manure Regulations 2001 poultry litter would not need to be removed from the purpose built, enclosed poultry litter storage shed. The Regulations identify the facility as an approved litter handling facility. However, if there was a need under the Regulations to remove poultry litter from the purpose built enclosed poultry litter storage shed it would be directed to another suitable licensed facility.

38. The CCWA requests information on what would happen if the plant is forced to close down through power failure or strike action. Could the proponent provide details of contingency plans or backups to control odour?

Answer

If the plant is forced to close down and odour is an issue then the storage shed will be sealed and poultry litter will remain on farms.

Greenhouse Gas Emissions

39. The DEP notes that the comparison of the proposal with composting or the direct use of the litter as a fertiliser does not take into account the greenhouse gas emissions from the manufacture of man made fertilisers to replace the poultry litter. The greenhouse gas from transport is also not taken into account. Could the proponent provide this information?

Answer

It is not envisaged that the additional manufacture of fertilizer will be required as the ash from the process is a high nutrient fertilizer that will displace the equivalent chemical fertilizers. This is because the key nutrients contained in the raw poultry litter, other than nitrogen, are retained within the ash. Combustion concentres the nutrients in the ash increases the fertilizer value by making available trace elements that would have otherwise been so diluted as to be effectively unavailable from the application of raw poultry litter: poultry litter goes from a low value soil conditioning agent/fertilizer to a high value fertilizer that is similar in analysis to Super Potash 4:1 that has a current market value of around $250 per tonne. This is comparison to the current market for poultry litter where a stable market does not exist.

In addition, the current Health Department requirements that for 8 months of the year poultry litter must be conditioned/composed, prior to spreading, significantly reduces the nutrient value of poultry litter and its desirability in the market. This is because poultry is most valuable as fertilizer when it is spread immediately on removal from the poultry sheds. If it is stored or composted nutrients are lost through natural process. For example, 45-55% of nitrogen within poultry litter is lost to the atmosphere during the composting process and there is the risk that phosphates can wash into streams or dams or leach into groundwater during the storage or composting process. See Appendix 2 of the PER.

The greenhouse gas intensity of transporting the poultry litter to

the facility is 315 equivalent tonnes per annum. This is compared to the greenhouse gas savings of over 81,000 tonnes per annum from the facility. GH intensity methodology is based on *National Greenhouse Gas Inventory: Analysis of Trends and Greenhouse Indicators 1990 to 2000 Australian Greenhouse Office, 2002.*

The power station reduces greenhouse gas emissions in the transport sector by:

- Reducing the total distance that poultry litter is transported as it directed to a single facility (average 50km from all farms) instead of the current situation where litter is being transported from as far as Margaret River and Geraldton.

- Providing contract certainty to transport contractors - this will enable them to invest in modern, efficient transport equipment. Contract certainty and a single destination facility will also facilitate the economies of scale into the transport equation with litter carried in larger loads than would otherwise be possible.

- Reducing the bulk density of the fertilizer, which has around 8% of the bulk density of the poultry litter. This reduces not only the dollar cost of transporting fertilizer but also greenhouse gas intensity of the transport component.

40. The Sustainable Energy Development Office (SEDO) notes the proposal would have greenhouse benefits as it would be utilising a renewable and carbon dioxide neutral source of fuel (or nearly so), and in addition it avoids the greenhouse gas emissions of a fossil fuel power station. From this perspective there are obvious environmental advantages associated with the project.

Answer

See question 42 below.

41. The Water and Rivers Commission (WRC) notes that the Australian Federal Government policy requires 2 per cent of electricity generation in Australia to be from renewable or specified waste product energy sources by 2010. Poultry litter is classified as a renewable energy source (ie. it comes from sawdust and/or other plant and animal produced sources that can be regrown and hence recycle carbon as opposed to fossil fuel sources that increase the quantity of greenhouse gases in circulation). Electricity generated from the power source will replace that supplied by burning fossil fuels. It will replace WA's CO_2 emissions by some 81,000 tonnes per year (when compared with a coal produced option). In addition 16,000 tonnes of CO_2 equivalents per year are replaced through eliminating nitrous oxide emissions from the manure. This represents approximately 3% of Australia's requirements in 2004 or 31% of the WA requirements. The phosphorous and other mineral nutrients contained in poultry manure are recoverable both when directly used as fertiliser and from the proposed Muchea operation. This is not possible from landfill. They are also recoverable from a composting operation, nitrogen excepted to some extent. Composting would also produce methane, which may not be captured. Composting is a relatively high cost supply of nutrients. It is probable the supply of compost from 108,000 tonnes of manure would be too large an increment for the WA market to clear at an economic price to enable a viable financial operation without subsidy or increase in the cost of product. In summary the WRC believes the proposal is an advantageous one from the viewpoint of minimising fossil fuels based greenhouse gas emissions by replacing them with renewable fuels. The benefit is in excess of 100,000 tonnes per year CO2 on the proponents' calculations. Approximate estimates place this in the order of about 30 per cent of WA's renewable requirements for 2004. It also reduces the greenhouse gas emissions associated with distribution of product and retains the mineral nutrients associated with the material. Could the proponent comment on this matter?

Answer

We agree with the WRC that the proposal is advantageous with regards greenhouse gas emissions and carries many benefits that can't be exactly quantified at this stage (eg see question 39 above). The inability to deal accurately with all the GH benefits has resulted in a conservative estimation of the greenhouse

gas savings produced by the proposal.

42. Several submitters noted that it would appear that the generation of renewable energy is an important component of the project for the proponent. There are a number of issues that were raised, but more importantly, a number that were omitted. It would appear that the Poultry Litter will be transported to the facility from a variety of distances. Can the proponent provide details as to the location and distances from the proposal of the source of the poultry litter? Can the proponent provide a CO_2 Equivalent for each tonne of Poultry Litter that will be delivered to the facility in terms of transportation cost? The proponent makes a claim in Section 3.1 Table 1 that the Greenhouse Gas emission from composting will be greater than the combustion of the poultry litter. Can the proponent provide the data that was used to derive this statement? Does the proponent make any allowances for the intrinsic loss of CO_2 equivalents by destroying a valuable fertiliser? (ie What is the CO_2 Equivalents that are required to produce a fertiliser of similar performance to poultry litter?)

Answer

Poultry litter will be delivered to the facility from all of Perth's poultry farms. The average distance to all of the poultry farms is approximately 50km. The individual addresses of all Western Australians poultry farms can be obtained by writing to the Western Australian Broiler Grower's Association.

The greenhouse gas intensity of transporting the poultry litter to the facility is 63g/t/km. This equates to 315 equivalent tonnes per annum. This is compared to the greenhouse gas savings of over 81,000 tonnes per annum from the facility. GH transport intensity methodology is based on *National Greenhouse Gas Inventory: Analysis of Trends and Greenhouse Indicators 1990 to 2000 Australian Greenhouse Office, 2002.*

The power station reduces greenhouse gas emissions We are unsure what is meant by "*Can the proponent provide a CO_2 Equivalent for each tonne of Poultry Litter that will be delivered to the facility in terms of transportation cost?"* We believe that it is likely that the intent of this question has been more broadly

addressed in the answer to question 37 above.

Poultry litter is classified as a renewable energy source. The litter originates from organic sources (waste sawdust, straw and digested feed) which take up CO_2 from the atmosphere during the growth phase. Combusting the litter for power generation, although releasing CO_2, simply completes the carbon cycle. This is unlike CO_2 emitted from fossil fuel burning whereby below-ground, stored carbon is added to the atmosphere in the absence of a return mechanism for uptake. The proposed power station will therefore produce electricity for WA on a sustainable basis, displacing the CO_2 that would otherwise be emitted from producing the equivalent amount of electricity from fossil fuels.

When the poultry litter decays in the field (composted or broad acre spreading) an equivalent amount of CO_2 is given off during its decomposition as is emitted during the combustion of the litter.

The greenhouse benefit of the proposal is further enhanced when N_2O emissions from biological decomposition of poultry litter when used as a fertiliser is taken into account. This process is estimated to contribute about 18,000 tonnes per annum of equivalent CO_2 emissions (after allowing for a greenhouse warming potential of 310 for N_2O). Taking into account N_2O emissions that occur during combustion of the poultry litter, the additional greenhouse gas benefit of the proposal compared to the existing situation is conservatively estimated to be more than 16,000 tonnes per annum of equivalent CO_2 emissions. All calculations regarding the production of N_2O follow the methodology laid down National Greenhouse Inventory – Work Book 6.1 For Livestock and AGO Technical Guidelines Generator Efficiency Standards Version 1.2 Jan 2001. It is not envisaged that the additional manufacture of fertilizer will be required as the ash from the process is a high nutrient fertilizer that will displace the equivalent chemical fertilizers.

43. A submitter asks the proponent to provide the source of the information that the proposal will provide less NOx than composting?

Answer

See the National Greenhouse Inventory – Work Book 6.1 For Livestock and the AGO Technical Guidelines Generator Efficiency Standards Version 1.2 Jan 2001.

44. A submitter noted that the proposal would make a useful contribution to WA's unacceptably low production of renewable energy. Does the proponent want to comment on this issue?

Answer

The Renewable Energy (Electricity) Act, 2000 was created to ensure that an additional 9,500 gigawatt hours (GWh) of energy (or 2% of all electricity sales) be generated by new renewable energy sources by 2010. WA is in danger of losing a significant proportion of this renewable energy development, estimated to be $6 billion, to the Eastern States. Furthermore, all the jobs associated with the development (much of the development is concentrated in regional WA) of this renewable electricity will be lost to the East. There is opportunity for WA to leverage off this Federal legislation and develop WA's renewable energy industry, creating employment in Regional WA and serve WA's commitment towards reducing GHG emissions. The current status in Western Australia is that we have installed 8% of our renewable energy target and the State is in danger of not meeting its renewable energy targets.

Surface and Ground Water

45. The WRC notes that on page 10 of the Executive Summary under 'Surface water quality/ Environmental management', it should state that the building floor level should be 1.2m above the Average Annual Maximum Groundwater Level, rather than 1.2m above the ground level. Does the proponent want to comment on this matter?

Answer

Noted.

46. The WRC advises that:

- The use and storage of chemicals should be in accordance with the Commission's Water Quality Protection Note on Toxic and Hazardous Substances - Storage and Use.
- The construction of roads associated with this development should be in accordance with the Commission's Draft Best Management Practises for Road Construction.
- All car-parking areas should have oil/grease traps prior to the outfall of stormwater runoff.
- All solid wastes should be kept in weatherproof conditions before being disposed off site at an approved facility
- The evaporation ponds should have a low permeability lining such as a synthetic lining at least 0.5mm thick, or a low permeability soil liner conforming to the Commission's Water Quality Protection Note - Low hazard wastewater containment with non-synthetic clay liners. Installation must be such that de-sludging can occur without liner damage.

Will the proponent adhere to this advice?

Answer

The Proponent will comply with the above advice.

47. The WRC notes the proposal is located within the Lake Mungala sub area of the Gingin Groundwater area. The proponents have applied for a groundwater licence for 550,000kL/a but have been issued with an exploratory licence subject to the approval of a Hydrogeological Report to prove that the aquifer can sustain this allocation. The issue of a production licence is not guaranteed, and subject to the findings of the Hydrogeological report. Does the proponent have a contingency plan if the licence won't be issued?

Answer

We have recently undertaken exploration drilling and are optimistic that we will be able to secure the required water allocation.

48. The DEP asks whether an off the shelf sewage treatment plant will be used?

Answer

Yes it is intended to use a suitable BioMax system.

49. The DEP requests further information on the constituents and likely concentrations of the chemicals in the RO retentate, boiler blowdown and process effluents?

Answer

The information requested is contained in table 5 of the PER. Some additional comments

Boiler water blowdown

It is likely that there will be some dosing of the boiler water to prevent scaling within the tubes. Typically phosphate is added, perhaps at about 25% of the total circulating solids level. The total level of solids in the boiler water is always kept very low and the addition of water treatment chemicals (ie phosphates) will also be very small compared to the level of solids in the bore water. See BORE WATER CONSTITUENTS below.

RO Retentate
The RO retentate consists of a reject stream from the water treatment plant. This stream is simply a concentrated stream of the total salts already present - the table indicates it is concentrated 36 times. See BORE WATER CONSTITUENTS below.

Truck washdown will consist of bore water with some chicken litter that is to be collected in the evaporation ponds. See BORE WATER CONSTITUENTS below.

Stormwater will include any dust or material washed from the site

Cooling Tower
There may be a need to add some chemicals to the cooling tower such as a biocide (such as sodium hypobromite) or corrosion inhibitors. Dosing levels are low. These will be incorporated into the cooling tower blowdown and directed into the evaporation ponds.

BORE WATER CONSTITUENTS

Species	Units	Detection Limit	Shallow Bore 16/06/2002	Deep Bore 16/06/2002	Drinking Limit
Aluminium - Filterable	mg/L	<0.010	2.1	0.016	
Arsenic - Filterable	mg/L	<0.005	<0.005	<0.005	0.007
Barium - Filterable	mg/L	<0.005	0.053	0.096	0.7
Boron - Filterable	mg/L	<0.005	0.011	0.016	0.3
Copper - Filterable	mg/L	<0.005	<0.005	<0.005	2
Iron - Filterable	mg/L	<0.1	1.1	<0.1	0.3 [a]
Manganese - Filterable	mg/L	<0.005	0.031	<0.005	0.1 [a]
Alkalinity as CaCO3	mg/L	<1	19	110	
Bicarbonate as CaCO3	mg/L	<1	19	77	
Calcium - Filterable	mg/L	<1	4	30	
Carbonate as CaCO3	mg/L	<1	<1	34	
Chloride	mg/L	<10	100	40	250 [a]
Conductivity at 25^0C	µS/cm	<10	395	325	
Fluoride	mg/L	<0.2	0.3	0.3	1.5
Hardness as CaCO3	mg/L	<5	43	83	
Magnesium - Filterable	mg/L	<1	8	2	
Nitrate as NO3	mg/L	<1	<1	<1	50
Nitrite as NO2	mg/L	<1	<1	<1	3
pH			5.3	9.2	
Potassium - Filterable	mg/L	<1	1	3	
Silica as SiO2	mg/L	<0.002	19	15	
Sodium - Filterable	mg/L	<10	60	40	
Sulphate	mg/L	<5	<5	<5	250 [a]
Total Dissolved Solids by Evaporation	mg/L	<10	250	200	
Total Dissolved Solids by Sum of Ions	mg/L		215	241(?)	
Total Dissolved Solids from EC	mg/L		202	166	
Sum Cations	meq/L		3.79	3.48	
Sum Anions	meq/L		3.15	3.54	
Cation/Anion Balance	%		9.2	-0.8	

50. The DEP asks what permeability can be achieved with “Nylex Millennium Flexible”?

Answer

1 mm thick Nylex Millennium Flexible Polypropelene water vapour rate of 0.083 wvt gm/m2/d (Haxo 1989 and revised 1992)

51. The DOH notes that the site is within a floodplain but the frequency of flood events is not given. The DOH does not support development within a 1:10 event frequency. The DOH notes that the water table can be at ground level. This is not suitable for on-site effluent disposal systems. The DOH does not support rezoning which result in the intensification of land uses with onsite effluent disposal unless the site is suitable for achieving long term on-site disposal. Irrespective of the type of on-site wastewater disposal system proposed, the land should have a minimum depth to the water table from the natural ground surface of at least 0.5 metres. It does not appear that this site can satisfy these requirements. Water table clearances can be achieved by site drainage, but building up is not a suitable alternative. Could the proponent comment on this matter?

Answer

The Power Station site will be built up to a level of 1.2m above the existing ground level and the site will be designed for a 1:100 event. The planting of trees around the power station and to a lesser extent the operation of water supply bores to the west of the power station are expected to establish the peak water table height at least 0.5 metres below the natural ground surface. This will be further evaluated and if necessary the existing surface drainage from the site will be improved to achieve the minimum 0.5 metres water depth.

52. The DOH asks how the sewage from 125 construction workers will be handled?

Answer

The average construction force on site is expected to be 30 at anyone time with number reaching a peak of 70 for at most a couple of weeks. Sewerage will be handled by the installation of those systems recommended by the local Shire such as the Biomax system.

53. The DOH notes that wastewater is proposed to be used to irrigate

landscaped areas. No consideration has been given to the disinfection of the wastewater or reuse health and safety requirements. Effluent reuse schemes require the approval of the Executive Director Public Health. Could the proponent comment on this matter?

Answer

The proponent is committed to seeking all relevant approvals prior to the implementation of any grey water reuse strategy. We understand that the DOH is currently drafting relevant guidelines.

54. The Shire of Gingin notes the water allocation required for the power station is very small in comparison to other projects that exhibit far less community and environmental benefit. The Shire of Gingin, being in the Gingin groundwater area, has a position on the Gingin Water Resources Advisory Committee. This Committee assesses all applications for groundwater extraction for commercial enterprise in the Gingin groundwater area, including a portion of the Shire of Chittering. It is fair to say that the majority of water allocated through the Committee process is for the purpose of irrigated horticulture, and is allocated in quantities far in excess of that proposed for the power station. The Waters and Rivers Commission advocate the "best use" principle for water allocation, that is, a use that generates positive environmental, social and economic outcomes. Clearly, the power station project satisfies each component of this triple bottom line, and for this reason has Council's unequivocal support. Does the proponent want to comment on this matter?

Answer

See 55, 57 and 59 below.

55. The CCWA noted the large use of groundwater and the potential to deplete local supplies that the farming community depends on. The CCWA believes that it is essential to monitor groundwater levels

before and after construction and to take immediate action if problems occur that could impact rural water supplies or result in vegetation loss. Could the proponent comment on this matter?

Answer

The proponent has established a monitor bore in each of the superficial and Mirrabooka aquifers at a representative site near the middle of the lease. Water levels are being routinely monitored in each bore to establish the background range of water levels prior to establishing a production wellfield. If a production licence is obtained additional shallow monitor bores will be installed near the lease boundary prior to abstraction to monitor the extent of impact on the water table. The proponent will carry out regular monitoring, review and reporting of aquifer water levels and water quality, as would be required by a production licence. If unexpected adverse effects occurred on the aquifer or on other users or vegetation in the area the proponent would act promptly to remedy these problems. The WRC would reserve the right to reduce the amount of water allocated if adverse impacts occurred.

56. The CCWA notes that poultry litter is high in phosphorous and the potential for this to impact on groundwater. The CCWA and other submitters believe bunding of the site and sealing of work areas and regular groundwater monitoring is essential. Could the proponent describe the measures to be incorporated?

Answer

The developed area of the site will be built up to a height of 1.2 m above ground level. The plant is designed to ensure that all liquid process wastes and stormwater runoff are retained on site and disposed of in a controlled manner. The following outlines the measures have therefore been built into the design of the plant in order to achieve this outcome:

Poultry litter will be stored on a concrete floor inside an enclosed shed. It should be noted that the current practice with is to spread it on farm land where it may leach into ground

water.

No more poultry litter will be held at the facility than is currently stored on a single large poultry farm.

Cooling tower blowdown water will be treated in a reverse osmosis (RO) plant to recover water for use. The blowdown water flow-rate from the evaporative condenser or cooling tower will be approximately 12m^3/h. The plant will comprise a microfiltration unit, a reverse osmosis (RO) plant and an RO permeate concentration plant. Retained stormwater, RO plant retentate, boiler blowdown water and other process effluents will be discharged to evaporation ponds.

All site bunding and elevations have been sized to anticipate a rainfall event of 77 mm per day (the maximum value since 1935).

Onsite roads and carparks will be sealed and curbed and the truck washdown bay designed to be consistent with DEP's Washdown Guidelines (fit for use).

Evaporation ponds will be lined according to DEP guidelines and sludge removed regularly by a licensed contractor.

Sewage effluent will be treated on site and irrigated on amended soil also located on site, as indicated earlier in this document.

Any chemicals to be stored onsite in sealed drums to DEP standards and bunded where appropriate in order to ensure containment in the event of a spillage from the general stormwater drainage system.

Monitoring bores will be established.

57. The EBICG notes that 550,000 KL of water per year is necessary for this proposal. Can the proponent demonstrate that this is sustainable given that groundwater levels have been dropping over the last 30 years?

Answer

Studies by CSIRO and WRC have confirmed that the main reason for declining water levels in the centre of the Gnangara Mound is below-average rainfall since 1969. However, the proposed power station site is located on cleared farmland on

the eastern edge of the mound where the water table has not declined significantly. At the end of August 2002 the water table was only 0.49 metres below ground level in the shallow exploration bore near the middle of the lease, a site that appears to be representative of the majority of the lease. The clearing of vegetation for farming on the eastern side of the Gnangara Mound has increased rainfall recharge to balance the reduction due to below-average rainfall. The proponent's site is an area of loss of groundwater due to evapotranspiration from the water table associated with the shallow depth to water. Abstracting groundwater from this area will lower the water table slightly, which will allow greater rainwater recharge and less loss from evapotranspiration.

58. Several submitters thought it was inappropriate to use 550,000 kl of water when there is current water restriction in place. Could the proponent comment on this matter?

Answer

See 54, 55 and 57 above.

59. A submitter wanted more information on the significance of groundwater extraction and whether it could threaten the expansion of the Town of Chittering?

Answer

The Town of Chittering is about 20 km north from the proposed power station site. It is estimated that the drawdown of the water table at Chittering due to abstraction for the power station would be well under 1 millimetre (0.001 metres).

60. A submitter wanted to know if the "amended soils" were red mud?

Answer

No, amended soils are not red mud.

61. A submitter asked about the method of sludge removal?

Answer

Sludge will be removed by a licensed contractor who typically vacuums the ponds using suitable equipment.

62. A submitter noted that phosphate leaching was a known source of water pollution and saw the proposal as a way of removing a significant source (poultry litter) from the environment while producing a much more manageable replacement for superphosphate. Does the proponent want to comment on this?

Answer

We agree with the above statement and also note that the ash has a much lower bulk density than litter and therefore can be supplied at a lower nutrient cost than the original poultry litter. This has the added benefit of reducing greenhouse gas emissions though increased efficiency.

Noise

63. The Shire of Gingin notes that it is critical that the design of the plant and equipment is such that noise emissions satisfy Environmental Protection Authority statutory requirements. The power station is ideally located, in an environmentally sound position, and in an area that should minimise adverse off-site impacts on adjoining property owners. Given that the site is adjacent to the Brand Highway, which is a recognised north-south heavy haulage route, the additional impact of vehicle movements delivering poultry manure to the plant would be negligible. It is Council's view that potential noise emissions are not an issue, given the intended location of the facility. Does the proponent want to comment on this matter?

Answer

Noted.

64. The CCWA and other submitters would like to see cumulative noise modelling and believes the proponent should commit to a noise monitoring program and to reduce noise levels if any exceedences are found. Will the proponent make this commitment?

Answer

The predicted noise levels at the nearest residence are 30 dB(A) compared to a criterion of 35 dB(A). The cumulative noise in this instance is 36.1 dB(A) – a difference if 1.1 dB(A). It is likely that background noise in the area is higher than 35 dB(A) and therefore noise from the proposal would not be distinguishable from background. The proponent considers that it is not justified to undertake cumulative noise modelling since this would largely involve a complicated and expensive study of Tiwest's noise emissions. The proponent will,

however, commit to a noise monitoring program to verify the predicted noise levels at residences from the proposal.

65. A submitter noted that the plant operating hours seemed appropriate.

Answer

Noted.

Stable fly

66. The Shire of Gingin notes the adverse impacts of stable fly have increased significantly, as irrigated horticulture has progressed into areas traditionally used for livestock purposes. A growing population in Perth, together with urban sprawl, has forced the horticulture industry to move further out from the urban fringes. Increased population growth has acted as a catalyst for a general increase in chicken consumption and, therefore, an increase in chicken production and waste generation. It is the long term management of this industry waste which requires resolution, an outcome which will be achieved by virtue of the power station. Does the proponent want to comment on this?

Answer

Residents and livestock in the Shire will benefit from the reduction in stable and house flies associated with the power station's alternate use of poultry litter.

67. The Shire of Gingin and other submitters believe that the benefits listed in the Public Environmental Review are understated in the extreme. Whilst benefits will accrue to the Shire of Chittering, the public health benefit throughout the State will be substantial, particularly for those Local Authorities in close proximity to the Perth metropolitan area which have experienced increasing investment in intensive irrigated horticulture operations. Clearly, the construction of the Renewable Energy Power Generation Plant will improve public health, as the combustion of poultry litter will largely eliminate a waste product which has been scientifically proven as the pre-disposing factor in stable fly breeding. Does the proponent want to comment on this matter?

Answer

We are aware that our conservative analysis has resulted in the undervaluing of the benefits of the project. This compounding effect has taken place because the project has benefits at so many levels and a conservative approach to the analysis has been taken at every level resulting in a understated overall picture.

68. Several submitters stated that they had been subject to outbreaks of stable fly and saw the proposal as sensible solution to the problem. Does the proponent want to comment on this matter?

Answer

See 66 above.

69. A submitter stated that they had contacted the Director of Population Health WA who said “the stable fly problem no longer exists”…….”we are very proud that measures put into place by the Department, have proven to be highly successful”…..”since these measures, the rate of public complaint via telephone etc, has reduced from 2000 per annum down to only 2 in total last year”…..”of these 2, none were attributable to poultry litter…..it was vegetative matter that was the source”. Could the proponent comment on this matter?

Answer

We received a formal response from the Director of Population Health WA

Hi Matthew
thanks for your mail and I am happy to respond

I confirm the statement made that the regulatory measures put into place to restrict the use of raw poultry manure during the months of September -May have reduced the stable fly problem significantly to this point in time. However there needs to be ongoing monitoring and

surveillance by both the Department of Health and local government . I believe the poultry Litter Power Generation project will stand on its merits as a measure to utilise poultry litter on a long term basis.

I trust that this advice is of assistance to you
kind regards
Michael

Michael P.Jackson
Executive Director
Population Health

Alternatives

70. In general terms, SEDO would support the highest value use of the resource, based on a full life cycle cost benefit analysis, which includes environmental and social aspects. In this case, the production of electricity via incineration should be compared with the alternative uses of the poultry litter, such as composting and methane production via anaerobic digestion. Could the proponent provide further information on this issue?

Answer

Because a stable market does not exist for large volumes of composted poultry litter and the anaerobic digestion of poultry litter on the MW scale is unproven it is impossible to undertake a meaningful cost benefit analysis. The issue raised is covered in detail in Section 3 of the PER. Also see question 39 above.

71. SEDO supports best practice and notes a fluidised bed combustor was commissioned in Scotland by Energy Power Resources Ltd in May 2001 who claim it is recognised by the Scottish EPA as best practice for disposal of poultry litter. Could the proponent comment on this matter?

Answer

The Scottish EPA have been misquoted. The actual statement is “The Scottish Environmental Protection Agency (SEPA) strongly supported the project, seeing it as an example of "best practice" in dealing with the disposal of poultry litter”. SEPA are not promoting fluidised bed technology as best practice (this was the first example of fluidised bed poultry litter station) but are instead promoting renewable energy generation from poultry litter (with an ash product that could be used as a

fertilizer) as best practice.

72. PAN notes that the PER informs us that the alternatives for dealing with the chicken litter are composting, for which there are no stable markets, landfill, composting to a stage where fly breeding no longer occurs, or combustion to raise steam for electricity generation. PAN and other submitters ask why technologies for composting are not considered and point to the production of high grade, pasteurised, pelletised organic fertiliser with technology such as that used by Perdue AgriRecycle in Delaware?

Answer

The poultry industry has spent many hundreds of thousands of dollars on composting trials however, composting technology is not the limiting factor it is the lack of a stable market for large volumes of composted poultry litter.

73. A submitter believes that the proposal will require the proponent to secure the supply of the poultry litter, from the broiler growers, to justify the capital investment in the facility. These waste supply contract should be very carefully considered by the relevant authorities as they effectively lock the broiler growers into a long term contract, which in some cases have 'put or pay' clauses, which effectively hinders the development of any other methods of treatment. These other methods of treatment may be entirely more suitable and have better environmental outcomes that the proposal at hand, but the will not be able to be implemented as the supply of the waste has effectively been locked up in long term contracts.

Answer

Poultry litter supply contracts are in place with the broiler growers. The broiler growers have vigorously supported the proposal and have:

- funded the projects development to the tune of $1M
- agreed to purchase electricity from the plant under long term contracts
- agreed to own 30% of the power station.

Waste and by-product Management

74. The WRC notes that this proposal has been compared to the principles described in the WAste 2020 recommendations, specifically the goal of resource recovery. One of the key outcomes of this goal is "producers and suppliers accepting Extended Producer Responsibility for reduction, re-use and recycling of wastes generated from their products and services." (WAste 2020 sector action plans, April 2001). When considering management of poultry litter the WRC believes it would be preferable to see this material recycled to a value added compost over energy recovery. This is based on the principles of the waste management hierarchy, which ranks the recovery of energy from waste as a lower end use. The nutrient value of this waste stream is best suited to composting which would provide a higher value and more sustainable use for this waste given the nutrient deficient soils in and around Perth. Strategically the WRC believes this proposal should be considered in light of the other alternatives and the costs and benefits considered over a full life cycle including the energy requirements for substitution of fertilizer for poultry litter use on market gardens. Could the proponent comment on this matter?

Answer

See questions 39, 70 and 72 above.

75. The DOH note that ash generated during operation of the plant (at a rate of 1.2 tonnes per hour) is proposed to be sold as fertiliser. The CSIRO report indicates that heavy metals will not be a public health exposure risk and the information provided on the Gore-Tex filter system suggests that dioxins/furans should be destroyed and reduced in fly ash. However, no information was provided to indicate the levels of dioxins/furans in ash or whether those levels may present a risk to exposed individuals who purchase the ash as a commercial fertiliser product. The DOH recommends that the proponent be required to have representative samples of ash

tested for dioxins/furans and metals to confirm suitability of the by-product for commercial sale as fertiliser. Will the proponent make a commitment to undertake this testing?

Answer

The proponent has always intended to seek the necessary approvals regarding the marketing of the ash and is happy to makes a commitment that representative samples of ash are tested for dioxins/furans and metals to confirm suitability of the by-product for commercial sale as fertiliser.

76. PAN notes that Table 4 states that the ash will be sold as a fertiliser. Has the proponent received approval for the sale of the ash as a fertiliser and established any commercial arrangements for the sale of the fertiliser? Does the ash comply with EU limits on dioxins?

Answer

Ash from the current operating poultry litter power stations is recognized as a nutrient rich fertilizer and is successfully sold in the UK and elsewhere. The fertiliser conforms to all applicable regulations in those countries where it is being sold.

The ash from the WA proposal will be analysed and all necessary approvals will be sought from the relevant regulatory bodies prior to providing it as a fertilizer to the market.

77. PAN asks whether chicken litter is a 'waste' or a resource, comprising valuable nutrient and organic matter that can be used in other ways. There are increasing amounts of compost coming into the market place, including that produced from municipal waste. Without a State policy on compost production, with no standards for compost and no strategy for market development, it is difficult to be certain that the incineration of the chicken litter is truly 'sustainable'. Could the proponent comment on this matter?

Answer

Without a State strategy on composting it is difficult to comment more fully however, poultry litter is a valuable sustainable energy resource enabling the poultry litter power station to generate renewable electricity while at the same time concentrating the nutrients and trace elements into an effective fertilizer product. This displaces the need to generate additional electricity from fossil fuel power stations while at the same time providing a concentrated low bulk density fertilizer product.

78. Several submitters note that it is well known that ash from thermal treatment usually contains significant amounts of dioxins and furans. This can be highlighted by the fact that the stack emissions data from the Eye Power Station show more than twice the allowed limit for dioxins and furans, which suggests that the proposal has the capacity to generate dioxins and furans, some of which will be included in the ash. It would appear that the proponent has not considered this concept. Has the proponent had the ash analysed for dioxins and furans ? Has the proponent determined other components of the ash, such as its TOC ? Does the proponent have any commercial arrangements for the ash to be used as a fertiliser ? Is the prospective client aware that the ash may potentially contain large amounts of dioxins and furans ? Will the relevant Government Department allow the ash to be sold as a fertiliser ?

Answer

The stack dioxin emission concentrations from the Eye power station were two to three times world's best practice levels. There were no actual UK regulatory limits on the emission. See question 76 above. The ash fertilizer product will be required to first meet all necessary guidelines and gain regulatory approval before it is provided to the market.

79. A submitter suggests that the processing of poultry litter should be placed in the hands of the Waste Management Board so that any interested parties can make submissions and the best outcome for the community and the environment can be determined. Could the proponent comment on this matter?

Answer

The Waste Management Board does not fulfil the suggested function.

80. A submitter states that the poultry litter cannot be stored in a concrete bunker as proposed, as there are examples where poultry litter has caught a light and been impossible to extinguish. Could the proponent comment on this possibility?

Answer

It is not intended to store poultry litter in concrete bunkers. It is intended that poultry litter will be stored on a flat concrete floor inside an enclosed shed. Fires in the poultry litter are not expected to be a major problem.

81. Several submitters were concerned about the increasing difficulty in obtaining poultry litter for use as a fertiliser and the increasing cost of fertiliser to market gardeners and other users. Could the proponent comment on this matter?

Answer

This concern is of little relevance because it is currently illegal to use raw poultry litter for 8 months of the year (in the traditional Shires where it has been used as a fertiliser). This market restraint was introduced by the Department of Health

and is independent of the power station project. However, composted/conditioned poultry litter is allowed to be used during the 8 month ban but the lower nutrient value of composted/conditioned poultry litter (see 39 above) and the increased handling costs have meant that this product has not been widely used by the traditional users of raw poultry litter.

82. A submitter asked if the broiler operators sold the litter to the horticulturists and at what price?

Answer

The terms of sale are commercial and in confidence and we are not aware of individual arrangements. However, given the current market restraints (see 81 above) a buoyant market does not exist.

83. A submitter asked who currently pays to transport the litter?

Answer

These are individual arrangements that are determined on a daily basis depending on the market – there is no clear uniform rule.

84. A submitter asked if the proponent intends to charge for removal or transport of litter, and if so how much? Will this lead to increases in poultry prices?

Answer

Removal and transport arrangements are commercial and in confidence. However, it can be said that the poultry litter power station will not increase the price of poultry it will decrease costs and help maintain the WA poultry industry's competitive position. The project has been implemented in part because of its cost effective nature. By generating electricity, that will be purchased by the industry, and a saleable fertilizer the industry is increasing efficiency and reducing its exposure to imports which would harm the WA agricultural sector and would increase the risk of disease coming into our State.

85. A submitter was concerned that the proponent intended to burn other wastes such as toxics and medical wastes. Could the proponent comment on this matter?

Answer

The power station will be a licensed and regulated poultry litter power station it is not an incinerator and will not be used for eliminating toxic wastes.

86. A submitter asked for more information on the "20 drums of cleaning chemicals" ie their composition, capacity and disposal?

Answer

The 20 drums of cleaning chemicals consist of detergents to be used for washdown of trucks and plant. These will be low phosphate/biodegradable.

Site

87. The CCWA believes the site has several major problems. Firstly the plant is close to several residences already affected by Tiwest, secondly the plant is close to Ellen Brook which is already polluted and thirdly the area is primarily rural and could lead to further industrialisation and eventual displacement of the farming community. The CCWA believes other sites should be investigated. Could the proponent comment on site selection?

Answer

Site selection is addressed in the Section 3.2 of the PER. The site is not located in close proximity to any residents with the nearest domestic resident at around 1.4km from the site the 2nd at 1.5km and the 3rd at 1.7km. See question 56 above for comment on site integrity. We cannot comment on the sites that CCWA are proposing as that information has not been provided.

88. PAN notes that other factors such as the proximity to Ellen Brook and the problem of noise, would also suggest that the site is not suitable. The plant will add to an existing noise problem in Muchea and we would like to see a cumulative noise assessment. We would prefer to see the plant located in an official industry zone with an adequate buffer.

Answer

See question 63, 64 and 87 above. Noise is also dealt with in Section 7.5 in the PER.

Other

89. The Shire of Gingin advocates the use of identified native species, namely Eucalyptus rudis and Melaleuca preissian, to enhance visual amenity and noise attenuation at the power station. Will the proponent adhere to this advice?

Answer

The PER contains commitments to significant re-planting of native and site-appropriate vegetation for specialised screening, water table control and aesthetic purposes.

90. The EBICG notes that the PER indicates that a management plan will be developed following implementation of the poultry litter fired power station. The EBICG would like the poultry litter fired power station management plan to be subject to the same right of review as the PER and would like all monitoring results submitted to the DEP to be open to public review. Would the proponent commit to this?

Answer

We are unsure of the nature of this statement as Section 9 Table 23 of the PER contains the following commitment: “Prior to commissioning, the Proponent will prepare an Environmental Management Plan (EMP) for the site, which will be submitted to the Department of Environment, Water and Catchment Protection (DEWCP) for approval.” We are keen for input into the Management Plan and are happy to receive submissions from EBICG. We have no issue in the DEP making available the monitoring data submitted to the EBICG and will place this information on a web site.

91. The EBICG are strongly concerned by the lack of detail in the PER relating to the projected impacts of this proposal. No contingency provisions have been detailed. All commitments have been postponed until after implementation of the proposal. Could the proponent comment on this matter?

Answer

We are unsure of the nature of this statement as there are numerous commitments contained in Section 9 Table 23 of the PER that are to be implemented prior to the construction of the project. However, some commitments cannot be met until the power station exists - such as monitoring, for example. No detail has been provided by EBICG specifying contingency events, therefore we cannot provide comment.

92. Several submitters were concerned that "extensive" community consultation had not been carried out, with no public meetings held in 2002. Could the proponent comment on this matter?

Answer

Community consultation has been ongoing with meetings and presentations with stakeholders over the project life. We have also offered presentations to numerous groups in area who have declined a meeting – for example follow-up meetings with the Muchea Progress Association were declined. Public consultation in 2002 have centred on presentations to the Chittering Shire Council in February and a meeting on site with the Shire President in March. Other relevant consultations (detailed in the PER) are as follows: 21 February 2000, Initial Public Consultation evening at Muchea Town Hall, hosted by Muchea Progress Association and attended by around 60 residents at the invitation of the Shire of Chittering via letter to all ratepayers. 27 March 2000, Initial meeting with Ellenbrook

Catchment Group at their invitation to discuss design parameters for plant to ensure protection of the Ellenbrook. 27 June 2001, Environmental Review Documents lodged at Council Library and Muchea Shop. 28 June 2001, Public Information Evening and location of Environmental Review Document advertised in local newspaper. 5 July 2001, Consultation session with Shire of Chittering full Council and principal officers. 20 July 2001, Reminder letter re Public Information Evening and information flyer mailed to each ratepayer. 27 July 2001, Public Information Evening at Muchea Community Hall. 13 August 2001, Meeting with Muchea Progress Association. 27 August 2001, Presentation to Ellenbrook Integrated Catchment Management Group. See Section 2.0 of the PER for more detailed information on stakeholder consultations.

93. A submitter asked if Blairfox would support local business as much as possible during the construction and maintenance of the project?

Answer

The proponent is committed to sourcing where feasible, service from within the local business community. For example, our exploration drilling program tender documents were issued to all local drillers and the contract was awarded to a local business.

94. Several submitters were concerned about the potential for devaluation of surrounding properties. Could the proponent comment on this matter?

Answer

This question was raised previously at a public meeting at Muchea town Hall on July 27 2001 and was answered by the

Shire President who, using Tiwest as an example, said that in fact the contrary was the case.

Health Risk Assessment - Specific comments

95. The DEP notes the HRA (p30) quotes deposition flux estimates as "maximum flux" or "annual rate of deposition"; these are distinct quantities which cannot be sensibly interchanged.

Answer

The HRA was based on the maximum annual deposition predicted at any of the receptors used in the dispersion modelling.

96. The DEP notes that maximum concentrations at relevant averaging times should be clearly tabulated. It is unclear where the estimates used in the HRA have come from in the air dispersion study. Could the proponent provide this information?

Answer

The revised modelling report includes a Table of the modelling outputs used for the HRA. This is also shown in the response to question 3.

97. The DEP notes apparent typographical errors in the HRA make the discussion of dioxin emission estimates difficult to follow. Emission "rate" and "concentration" are very different quantities that cannot be interchanged.

Answer

One typographical error is noted in paragraph 3 of page 8, in

the context of the discussion the error does not create ambiguity.

98. The DEP notes that "worst case" emissions have been estimated assuming 90% bag-house availability and calculating an annualised average emission rate. This does not represent the actual worst case short-term emission which will occur when the bag-house is completely off-line. Is the annualised emission rate appropriate for use in the HRA, or should the higher, short-term, rate be used?

Answer

The modelling was based on 90% (worst case) baghouse availability and a scrubbing efficiency of 90% when the baghouse is operating. When the baghouse is not available (ie 10% of the time), the uncontrolled dioxins emission rate was used. Therefore, short term emissions while the baghouse is off-line were taken into account in the modelling. However, it must be pointed out that this is a very conservative estimate as the plant would not be shut down if the baghouse was offline.

99. The DEP notes with regard to the air dispersion modelling for the Health Risk Assessment (HRA) that dioxins have been observed at the similar Eye power plant, and the proponent is investing in a catalytic bag-house facility to control dioxin and furan emissions, the citation of the HRL report contending that dioxins will not be produced is not useful.

Answer

The HRL report was included as dioxins were likely to be minimal.

100. The DOH notes that the Health Risk Assessment (HRA) on dioxins has relied heavily on draft information published by the US EPA. It is evident that large amounts of information have been used without appropriate acknowledgement, this being evident by the large number of references from US EPA documentation that have been quoted but not acknowledged in the reference section. Health authorities in Australia have not endorsed the approach of the US EPA that has been adopted in the PER to assess dioxin exposures. Many default values used by the US EPA have been reproduced and are not consistent with values that have been adopted for use in Australia. The enHealth Council recently released the document *Environmental Health Risk Assessment Guidelines for assessing human health risks from environmental hazards* and these should be referred to for the Australian context. The guidelines can now be accessed on the Internet at http://enhealth.nphp.gov.au/council/pubs/ecpub.htm. Could the proponent comment on this matter?

Answer

The enHealth document was only finalised in June 2002, which was well after the HRA work for the proposal had been completed. The HRA has been thoroughly referenced and reliance on the draft document has been openly acknowledged throughout the HRA. At the time of research no values from the Commonwealth were available. Every attempt has been made to put US data into an Australian context e.g. discussion on drinking water.

The authors are of the view that the HRA is consistent with the enHealth document. The introduction of the enHealth document states that a precise 'cookbook' is not always practicable. The HRA adequately covers: issue identification, hazard assessment and exposure assessment. The general methodology of section 8 of the enHealth document as conveyed in section 8.1 has been followed. Furthermore, all issues as detailed in section 8.2 of the enHealth document including the 'components of exposure assessment' model have been addressed by the HRA. Presentation of data and formula was clear, consistent and transparent.

It has been acknowledged in the HRA that the 'worst case scenario' is likely to overstate exposure, implicit in this acknowledgement is the effect of using multiple point estimates.

Variation is noted between some point values used in the HRA and the enHealth document; use of the enHealth values

would see a 'worst-case' LADD increase of less than 9% (equivalent to ~0.005pg). The most significant difference was in assignment of body weight: 70kg vs. 64kg; the use of 64kg would result in an increase in estimated LADD of approximate 8.5%. HRA air inhalation rates were assumed to be approximately 40-50% lower than the enHealth data: enHealth uses an elevated activity respiration rate for 16hr/day. Using a higher respiration rate would increase LADD by less than 0.01%. The soil ingestion rate for children was 600mg/day as opposed to the enHealth value of 100mg/day; a reduction in soil ingestion would result in a small reduction in LADD. The enHealth document does not list soil dermal contact values for adults, soil dermal contact for adults is a component in the HRA LADD assessment. 'High-end' scenario exposure modelling from bathing has not been assessed.

Given the HRA assessment criteria was WHO TDI; short-term exposure has not been assessed.

101. The DOH notes that while much effort has been given to present the theory of the HRA, this has not been followed through with presenting the different components of the HRA in a clear and open manner. Calculations provided to DOH were left out of the PER with the final figures only provided in the HRA discussion. It is difficult to check the accuracy of the calculations on the information presented to DOH. Nonetheless, the outcomes presented suggest that the increase in risk to individuals exposed to dioxin/furan air emissions is low.

Answer

Noted

102. A submitter asks why is there two versions of the HRA? Is there any information in the Full Version of the HRA that is considered too sensitive to be released to the public ?

Answer

At the request of the consultants who wish to protect IP two reports were prepared. Both versions of the HRA contain the same results however, the more detailed version of the HRA contains the full mathematical workings and requires expert knowledge to interpret – this version has been supplied to the DOH and the DEP. The version circulated with the general PER contains the results without the detailed mathematical workings.

103. A submitter notes that Section 1.3 of the HRA contained one of the most important pieces of information. It contained the only operating parameter that the facility is proposed to operate under. It is rather unusual that the only information on the operating parameters of the proposal are contained in the HRA. Is there any mechanism that is employed such that the gas burners are reactivated if the temperature in the combustion chamber drop below 850°C ? Will the gas burners be used during shutdown such that it can be ensured that there is total burnout of any components present during the shutdown phase ?

Answer

See question 4 above.

104. A submitter notes that Figure 1.2 is apparently an overview of the proposed facility, which looks remarkably similar to a picture that was published in Caddett Technical Brochure No. 17 on the Eye Poultry Litter Fired Power Station. It then goes on to describe in detail, the Gore-Tex Remedia D/F catalytic filters that are proposed to be used in the facility. Are these filters listed in the USEPA MACT's ? Several submitters asked are they the most effective technique available to minimise the amount of dioxins that are generated in the facility ? Does the supplier guarantee the performance of the filters ?

Answer

Remedia fitted baghouse is world's best practice for removing particulate and dioxin from exhaust gasses originating from combustion processes. The lowest achievable emission limits combined with high reliability are provided by the Remedia system. Activated carbon is not required as the Remedia destroys dioxin rather than adsorb it. Remedia is suitable for use in systems utilising lime injection. Baghouse technology is regarded worldwide as the best practice for minimising particulate emissions from industrial point sources. The lowest achievable emission rates are achieved by using baghouses. The baghouse technology has the advantage that it is a passive system and eliminates the possible mechanical failure that can occur with carbon injection systems (carbon injectors can become blocked). GORE-TEX® filtration products are regarded as the best performing industrial filtration products available and provide the highest filtration efficiency available through the use of the GORE-TEX microporous membrane. The Remedia catalytic filter system utilises the GORE-TEX membrane filtration surface for particulate removal and destroys dioxin using a catalytic process. The destruction of dioxin compared to adsorption (activated carbon) is also considered worlds best practice.

The supplier guarantees the Remedia product. Remedia was selected as a best available technique for waste gas treatment, "Integrated Pollution Prevention Control Draft Response reference Document on Best Available Techniques in Common Waste Water and Waste Gas Treatment/Management Systems in he Chemical Sector 2001", EC Technologies for Sustainable Development European IPPC Bureau 2001

105. A submitter notes Section 1.4.1.1 mentions that the aim of the HRA is to determine if the TDI of the residents living near the facility will be increased. Does the author actually mean the Daily Intake rather than the TDI ?

Answer

Yes.

106. Several submitters noted Section 2.1 contains a number of important statements. One is that a HRA provides an estimate of human health risks. It then goes on to say that the principal numerical criteria for the HRA was the WHO98 TDI, which is 1 – 4pg TEQ/kgBW-d. Is there a measure of risk in the WHO TDI? It would appear to only state a limit to what is 'tolerable'. A measure of risk would look something similar to 0.006pg TEQ/kgBW-d for a 1 in a million chance of an adverse effect, which is what the USEPA states as its measure of risk when associated with the 'intake' of dioxins. The USEPA definition of TDI is as follows:

Tolerable Daily Intake (TDI): "The term is used frequently in World Health Organisation (WHO) health assessments. The term "tolerable" is used as contaminants do not serve an intended function and as intake is unavoidably associated with the basic consumption of food and water. Tolerable does not generally connote "acceptable" or "risk free."

Then there is one of the most remarkable statements, that the advise from the DEP is that the evaluation of the risk of cancer is not required to be determined. How useful is a Health Risk Assessment, when it is not required to determine the risk of cancer?

Answer

While HRA's may quantify risk or the risk of cancer for some compounds, this HRA deals explicitly with dioxin where the criteria accepted by the Health Department is specified in terms of WHO criteria which is specified in terms of TDI not cancer risk. The WHO_{98} scheme has been widely adopted as the most appropriate standard in evaluating risk from exposure to dioxin.

Risk is to not specifically stated in the WHO_{98} TDI scheme, largely due to sciences' inability to currently quantify the level of risk. The International Agency for Research on Cancer (IARC) reported in 1997 to WHO that there is, to date, limited evidence in humans for the carcinogenicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin. Other polychlorinated dibenzo-p-dioxins are not classifiable as to their carcinogenicity to

humans. Dibenzo-p-dioxin is not classifiable as to its carcinogenicity to humans. The WHO_{98} limits of 1 to 4pg TEQ/kgBW-d incorporate a high degree of caution, reflecting advances in the understanding of dioxins' toxicology. The previous WHO limit (1991) was 10pg. Its reduction reflects assessment of risk in light of current knowledge.

The US EPA (1985) reported the risk of cancer from dioxin exposure at 1.6E-4. This figure is currently in review by the US Science Advisory Board and is seen as unrealistically high.

Based on estimated Australian daily intake, 'worst case' incremental increase and a linear slope factor (1.6E-4; US EPA) the equated risk of cancer would rise from 4.8E-5 to 5.7E-5 (from 5 to 6 in 100,000).

The 'worst case' scenario vastly overstates incremental increase; under normal operating conditions incremental increase is likely to be 5.0E-11 resulting in an increase in the risk of cancer of 8.0E-15 (~1 in 100,000 billion).

107. Several submitter noted Section 2.1 contains a number of important statements. One is that a HRA provides a estimate of human health **risks**. It then goes on to say that the principal numerical criteria for the HRA was the WHO_{98} TDI, which is 1 – 4 pg TEQ/kgBW-d. Is there a measure of risk in the WHO TDI ? It would appear to only state a limit to what is 'tolerable'. A measure of risk would look something similar to 0.006 pgTEQ/kgBW-d for a 1 in a million chance of an adverse effect, which is what the USEPA states as its measure of risk when associated with the 'intake' of dioxins. The USEPA definition of TDI is as follows:

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Answer

Risk is not specifically stated in the WHO_{98} TDI scheme, largely due to science's inability to currently quantify the level of risk. The International Agency for Research on Cancer (IARC)

reported in 1997 to WHO that there is, to date, limited evidence in humans for the carcinogenicity of 2,3,7,8-Tetrachlorodibenzo-p-dioxin. Other polychlorinated dibenzo-p-dioxins are not classifiable as to their carcinogenicity to humans. Dibenzo-p-dioxin is not classifiable as to its carcinogenicity to humans. The WHO_{98} limits of 1 to 4pg TEQ/kgBW-d incorporates a high degree of caution, reflecting advances in the understanding of dioxins' toxicology. The previous WHO limit (1991) was 10pg. Its reduction reflects assessment of risk in light of current knowledge.

108. Several submitters noted Section 2.4 goes on to state that the 'greatest resource existing today' for information on dioxins is the USEPA Draft Reassessment. Several other references are made, in the course of the HRA, to this document. Did the author not notice the very obvious statements in the USEPA Reassessment that state 'Draft – Do Not Quote or Cite' ? Is it possible that there could have been information that was used in the HRA that has not been validated and could be possibly incorrect ?

Answer

The authors stand by their claim that the US EPA Draft Reassessment (2000) is currently the best source of information on dioxin and evaluation of media exposure. The US draft has been in review for a number of years, undergone several drafts and is near the end of the peer review process. Model validation has been undertaken, with an entire section of the document devoted to validation. As with any model, it is possible that further refinements to model parameters will result in less uncertainty.

109. A submitter refers to Section 2.4.1 Identifying Sources. How many different sources of dioxin were identified ? Was the ash from the proposal identified as a source ? It would seem that the ash would contain reasonably significant levels of dioxins, and it is the proponents view that it would be suitable for use as a fertiliser. Does this then allow the dioxins from the ash to enter the food chain through soil adsorption into plants and then via grazing animals and humans?

Answer

Ash was not identified as a source of Dioxin, however it is acknowledged that it is potentially a source and will be assessed via direct sampling. The proponent will seek the necessary approvals regarding the marketing of the ash and representative samples of ash will be tested for dioxins/furans and metals to confirm suitability of the by-product for commercial sale as fertiliser.

110. A submitter refers to Section 3.2 Why was the proponent advised by the DEP that PCB's were not required to be considered in the HRA?

Answer

The HRA was required to assess exposure for dioxins. The Eye data was only available (and most other available data) in terms of International Toxic Equivalents I-TEQ_{89}. No data was available on any PCB's emissions from the Eye facility or any other similar facility. PCB's are not considered in the I-TEQ_{89} scheme. The above information was discussed with the DEP who subsequently advised inclusion of PCB was not necessary.

111. A submitter refers to Section 3.4.3 compare the proposal with that of the GOWA proposal. Is it likely that the cited reference (Ernie 1995) would have know the emission rate of the GOWA Proposal which was published in April 2000?

Answer

The emission rates for the GOWA proposal are summarised in Table 3-2 of the GOWA PER. Ernie 1995 is probably referring to the original source of data used in the GOWA report.

112. Several submitters referred to Section 4.2 which would seem to encapsulate a very important concept. There are no Commonwealth Estimates for dietary intakes of dioxins and furans. In the absence of such data, is it even reasonable to create another source of dioxins and furans?

Answer

The point seems quite baseless. There are no Australian estimates of dietary intake or exposure for many potentially harmful substances. For example, there are no daily intake estimates for benzene, however there are workplace exposure and ambient air standards, which endeavour to limit personal exposure. Vehicle emissions and petrol stations are significant sources of benzene; the risk of cancer from benzene exposure is estimated by many agencies, including NICNAS, as 10^{-5} (1 in 10,000). Lack of dietary intake or personal exposure estimates does not prevent the continued registration of new vehicles or establishment of new fuel outlets (sources of benzene).

113. A submitter refers to Section 4.4.1 Is there a particular reason why lamb was not considered as a potential pathway? Did dermal soil contact include contact with soil that was treated with poultry litter ash fertiliser?

Answer

Lamb was not considered separately. The 1995 National Nutrition Survey did not discern between meat types and consequently ingestion of meat was considered as beef and chicken with a proportion of total ingestion assigned to chicken. The need to assess chicken separately was due to significant

differences in soil ingestion and fat content.

Dermal contact with ash was not considered see answer to questions 109 and 75.

114. A submitter believes there are some very serious omissions from the Dioxin Health Risk Assessment. One cannot conduct a risk assessment without any consideration to published risk factors for exposure. The use of any form of model to determine, with any certainty, the likely effect of a particular exposure is extremely dependent on the information that is factored into the model. An interesting comment made in the 'EU Compilation of EU Dioxin Exposure & Health Data' is the following:

Human exposure from specific sources (eg waste incineration) has also been modelled, and has involved using multi media models of varying complexity. However, some of the dioxin transport & fate models use parameters which are often scarce, or show a wide range of possible values. Predictions that are based on such imprecise data will also be inherently imprecise'

This would seem to indicate that despite any attempt to model the fate of dioxins and furans with a view of determining the impact that it will have on members of the community, it will most likely generate a measure of risk that is meaningless, particularly when measured against a 'tolerable' daily intake rather than a risk factor.

Answer

The author believes the point the EU report were trying to make is it is extremely difficult to be 100% precise, especially given the low amount of dioxin testing that has been conducted worldwide. For this reason extremely conservative measures have been adopted by WHO in assessing an acceptable TDI. The same approach has been used in the proposed facility's HRA, the end result of which is to produce a vastly overstated TDI which sets the upper limit of exposure.

Dioxin Modelling – Specific comments

115. Section 2. (first dot points) Terminology for “transfers” and “deposition” seems to be non-standard and could give rise to errors. It is normal practice to use the word “deposition” to refer to all processes of gas and particle transfers. See CALPUFF manual pages 2-108 to 2-133. With respect to dry deposition, the table on p 2-109 list many processes and factors affecting dry deposition of gases and particles, the latter including gravitational settling.

Answer

Noted and corrected in revised report.

116. Section 2. What is the meaning of “and the particle phase for depositions”g?

Answer

In other words, gas deposition was not considered (see response to Question 117).

117. Section 2. (second dot points and point1.) Provide a reference to support neglect of gas deposition (to soil etc).

Answer

The USEPA (2000) states “Although the dry gaseous deposition of vapor-phase contaminants is currently considered in the ISCST3 model, this feature has not been calibrated for the estimation of the deposition flux of dioxin-like compounds into vegetation. Until the algorithm has been verified to make reasonably accurate estimates of gaseous deposition of dioxin-like compounds, this guidance will not incorporate examples of its site-specific application” (pg 3-38).

118. Section 2. (definition of Fi) “fraction” is incorrect – it should be the actual emission rate – please advise what was done.

Answer

The actual emission rate of the congener for the applicable phase (vapour or particles) was used – this being a fraction of the total emissions rate (vapour plus particles) for the congener. The terminology has been improved in the revised modelling report.

119. Section 2. (TEQ Concentrations) provide a reference (document, page) for this procedure please.

Answer

This procedure is described in U.S. EPA (2000), “Estimating Exposure to Dioxin-Like Compounds - DRAFT”, p3-46 – 3-47 and U.S. EPA Office of Solid Waste (1998) “Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities - Peer Review Draft”, EPA530-D-98-001A”, p3-62 - 3-63.

120. Section 2. (last line) provide a reference for Appendix 1.

Answer

The data in Appendix 1 “Partitioning – Vapour fraction at 20C “ is from U.S. EPA (2000), “Estimating Exposure to Dioxin-Like Compounds - DRAFT”, Table 3-14. The congener TEFs are referenced in the HRA.

121. Section 3.1 (table 1) Little detail on modelling parameters has been included in the Environmental Alliances report, and it is not clear whether CALPUFF deals adequately with building wake effects. The stack height is only 40m while building height is 30m, meaning that wake effects will occur and should have been incorporated into modelling. Please explain if this was considered. Stack height is low compared to building – downwash problems. Was this modelled and if so please provide the details.

Answer

Building wake effects from the proposal’s stack emissions were included using conservative estimates of dimensions. The precise dimensions are still subject to detailed design of the Project but it is likely that the effects of building wakes on dispersion were overestimated.

122. Section 4. All details as per DEP Modelling Guidelines are required.

Answer

A revised draft modelling report incorporating these requirements has been forwarded.

123. Section 4. The USEPA model, CALPUFF was used to model ground level concentrations and wet and dry deposition of particulates from the proposed plant. The reason for using CALPUFF was because Ausplume contained a bug which did not allow modelling of wet deposition. It is not clear why a simpler model, such as ISCPrime was not used. CALPUFF is a model which the DEP has not had the opportunity to evaluate. It is an approved USEPA model for long range transport. (40 CFR Part 51, p21539). Other uses require case by case proving p21540. For dry deposition or aerodynamic downwash the recommended model is ISC-Prime (p21517). (ISC-Prime is ISC3 with an improved building downwash calculation). ISC3 and ISC-Prime are known to the DEP and would have been appropriate for this project. ISC3 is the model recommended in the USEPA document cited in this report "Estimating Exposure to Dioxin-like Compounds". Because of this, the DEP has no practical option other than to recommend that the proponent be required to have the modelling redone using ISC-Prime to provide results that can be readily assessed. Note: It would be acceptable for the consultant to run this model and demonstrate that there are no significant differences in model predictions by way of separate correspondence (without rewriting the report).

Answer

The references to the U.S. CFR are to the proposed rule change – not the actual CFR.

The opening summary recommendation in the 1998 review of CALPUFF for the USEPA includes the following statements- "The CALMET/CALPUFF modeling system represents the state-of-the-practice insofar as dispersion models are concerned… The model should serve as a flexible and robust system for a wide range of applications both in the near field and the far field" (see "Peer Review Of The Calmet/Calpuff Modeling System", Allwine et al 1998). The USEPA (2000) report uses ISCST3 (not ISC-Prime) as an example only – it specifically states - "the use of ISCST3 in this assessment is not intended to imply that ISCST3 is the only acceptable model to use in the analysis of ambient air concentrations, and wet and dry deposition of dioxin-like compounds (p3-36).

It is acknowledged that repeating the modelling using a different model would add confidence to the results.

124. Section 4.2 This part of the report needs to be more informative. Where are deposition velocities determined based on a resistance model? – they seem to have been plucked directly from the USEPA report. On page 1 it states vapour phase air to plant transfers are calculated – where?, how? (provide details/evidence that this has been done).

Answer

The revised report contains more background regarding deposition theory. The deposition velocities are based on a resistance model as described in the ISC3 Users Guide (Section 1.3.2). The HRA describes the use of outputs from the dispersion modelling for the risk assessment.

125. Section 4.2 Where do wet coefficients come from (possibly in USEPA 2000)?

Answer

The wet coefficients are from USEPA (2000) Table 3-13. These are ultimately based on the ISC3 Users Guide Figure 1-11.

126. Section 4.2 Why are the dry deposition velocities in Table 6 chosen for use? In the excerpt of the USEPA (2000) report provided by Mr David Pitt, these values appear in an apparently inconsequential table for an example calculation. On page 3-42 of the USEPA report there are the words:

For the example application of the ISCST3 model in Chapter 5, particles less than 2 μm were represented by a 1 μm size and were calculated by ISCST3 to deposit at a velocity of <10 –2 cm/sec. Particles between 2 and 10 μm were represented by a 6.78 μm size and were calculated to deposit at a velocity of < 0.5 cm/sec. Finally, particles greater than 10 μm were represented by a 20 μm size and were calculated to deposit at a velocity of >2.0 < 5.0 cm/sec, although the variable ambient conditions resulted in more variable calculations. The derivation of these particle size representations is given in the next section.

Answer

The deposition velocities were based on a resistance model as described in the ISC3 Users Guide (Section 1.3.2). The congener particle distribution and characteristics were based values recommended by the USEPA (1998) where site specific data are not available (see revised modelling report).

127. Section 5. In terms of the results presented in the modelling report, it is generally expected that results will be presented which show 1) existing emissions; 2) the proposed plant in isolation; and 3) current and proposed emissions. This allows assessment of the significance of the proposal on current concentrations in the area but would not be expected if the impact of the facility was trivial. This should be expanded on in the report.

Answer

The revised modelling report contains predicted air impacts for the existing source and the proposal - see response to Question 3.

128. Section 5. The report does not include a table of results showing maximum ground level concentrations and deposition levels in the modelled area. A table should be provided. It is not clear if actual values for GLCs and deposition were used by Dingle and Bird in their HRA.

Answer

See response to Question 3.

129. Section 7. The USEPA (2000) document is marked "DRAFT – DO NOT QUOTE OR CITE" (as was the 1994 forerunner of this report). The report does not discuss or justify the use of this document. The DEP cannot accept use of this report without evidence that it is widely used and considered acceptable in the scientific community (Australia and overseas) and that there is not a more up to date reliable source.

Answer

Practically all of the methodology presented in the U.S. EPA (2000) document is identical to that described in U.S. EPA Office of Solid Waste (1998) "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities - Peer Review Draft", EPA530-D-98-001A which was used for the Global Olivine proposal at Kwinana - see "Multi-Pathway Health Risks Assessment for Emissions to Air for the GOWA Waste to Energy and Water Project" (Stevenson, 2000). This Global Olivine proposal was previously assessed by the EPA and the findings reported in EPA Bulletin 1004. The Bulletin stated that the health risk assessment methodology was endorsed by the Health Department of WA and a peer reviewer. The U.S. EPA (2000) report uniquely includes a basis for partitioning dioxin congeners between the vapour and particle-adsorbed phases.

See answer to question 108.

130. Section 7. What is the reference for Appendix 1? Note: This report does not follow proper conventions for referencing information.

Answer

The data in Appendix 1 “Partitioning – Vapour fraction at 20C “ is from U.S. EPA (2000), “Estimating Exposure to Dioxin-Like Compounds - DRAFT”, Table 3-14. The congener TEFs are referenced in the HRA.

APPENDIX 1 - REVISED AIR QUALITY ASSESSMENT FROM PROPOSED POULTRY LITTER-FIRED POWER STATION, MUCHEA

APPENDIX 2 - Attachment 1 to Revised Air Quality Assessment From Proposed Poultry Litter Fired Power Station, Muchea – DISPERSION MODELLING OF DIOXIN EMISSIONS FROM PROPOSED POULTRY LITTER FIRED POWER STATION AT MUCHEA

REVISED AIR QUALITY ASSESSMENT FROM PROPOSED POULTRY LITTER-FIRED POWER STATION, MUCHEA

DRAFT

Prepared for

Blair Fox Generation WA

by

Environmental Alliances

September 2002

Disclaimer and Limitation

Environmental Alliances will act in all professional matters as a faithful adviser to the Client and exercise all reasonable skill and care in the provision of its professional services.

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This report is based on the scope of services defined by the Client, budgetary and time constraints requested by the Client, the information supplied by the Client (and its agents), and methods consistent with the preceding.

Environmental Alliances has not attempted to verify the accuracy or completeness of the information supplied.

Client: Blair Fox Generation WA

Job No: J2113	Version	Prepared by	Reviewed by	Submitted to Client	
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1. INTRODUCTION

Blair Fox Generation WA Pty Ltd proposes to construct and operate a renewable energy, poultry litter power station in the Shire of Chittering in Western Australia. The Project will be located at a site approximately 70 km north of Perth on the Brand Highway, 5km north of Muchea.

The poultry litter-fired power station (PLFPS) proposal was referred to the Western Australian Environmental Protection Authority (EPA) in July 2002.

Prior to the EPA setting the level of assessment, Welker Environmental Consultancy and Environmental Alliances were engaged by Blair Fox Generation to predict the ambient air quality impacts from the proposed PLFPS. These studies are described in WEC (2001) and EA (2001).

The EPA determined that the proposal would be assessed as a Public Environmental Review (PER) with a four week public review period. The PER provides the relevant details of the Project and the proposed management techniques to enable the environmental acceptability of the Project to be assessed (BFG 2002).

This report consolidates and revises the air emissions dispersion modelling for the proposal in response to submissions made during the PER review period.

The main document describes the modelling of sulphur dioxide, nitrogen dioxide, PM10 and hydrochloric acid. The modelling of dioxins is described in Attachment 1.

2. METHODOLOGY

The methodology used in this report to predict ambient levels of air contaminants was to use the "Ausplume" computer model. Ausplume is a gaussian dispersion model developed and maintained by the Environment Protection Authority of Victorian (EPAV 1985), and is widely used throughout Australia. Ambient levels predicted by modelling can then be compared against criteria for acceptable levels.

Key site specific assumptions incorporated into the modelling are:

- a site roughness of 0.2 metres; and
- the effects of topography on dispersion have not been included as the region around the proposed site is reasonably flat.

3. METEOROLOGICAL DATA

The proposed power station is located about 25-30 km from the coast. A meteorological data set suitable for dispersion modelling and representative of this location has been derived from the DEP monitoring site at Caversham (20 kilometres from the coast).

The Caversham meteorological data is for the 1994 year, and consists of 1-hourly averaged wind speed, wind direction, sigma theta, temperature, stability class, mixing height, friction velocity and Monin-Obukov length in Ausplume-compatible form.

It is probable that Muchea, being further inland than Caversham, experiences slightly lower average wind speeds. This is unlikely to have any significant effect on the maximum predicted short-term ground level concentrations but may cause 24-hour and average concentrations to be slightly under-estimated.

4. NEAREST RESIDENCES

The locations of the residences up to 3 km north and south, and 1.5 km east and west, of the site for the proposed power station are shown in Table 1.

Table 1 Locations of nearest residences

Ownership	AMG Easting (m)	AMG Northing (m)
Private	399583	6512926
Private	399555	6512804
Private	400031	6511945
Private	400056	6511769
Private	400098	6511673
Private	400122	6511531
Tiwest	400476	6511461
Private	401551	6507932
Private	401912	6508091

Data provided by the Client.

5. AIR EMISSIONS

The main air emissions from the proposed power station are from two sources:

- sulphur dioxide, nitrogen oxides and particulates from a chimney stack serving the boiler; and
- odours from the shed containing the poultry litter.

It is assumed in the remainder of this report that:

- all particulate matter is PM10; and
- 50% of all NOx from the proposed PLFPS and the Tiwest main stack is or becomes NO_2.

These assumptions are conservative (ie will over-estimate ambient levels of air contaminants in relation to criteria).

6. APPLICABLE AIR CONTAMINANT CRITERIA

6.1 SULPHUR DIOXIDE, NITROGEN DIOXIDE, PARTICULATES AND HYDROCHLORIC ACID

In June 1998, the National Environment Protection Council (NEPC) endorsed the National Environment Protection Measure for Ambient Air Quality. The Measure includes standards for air quality. The goals of the Measure are for the standards to be within the maximum allowable exceedences by 2008 (NEPC 1998) at performance monitoring stations. The standards and goals for sulphur dioxide, nitrogen dioxide and particles (as PM10) are shown in Table 2 (NEPC 1998).

The criterion used for hydrochloric acid is that advised by the DEP of 0.7 mg/m^3 (peak) and 0.23 mg/m^3 (3 minutes) (DEP 2002[1]).

[1] Response to PER Submissions, September 2002.

Table 2 Ambient air quality criteria

Contaminant	Concentration	Averaging time	Maximum allowable exceedences
Sulphur dioxide	0.20 ppm (≈572 μg/m^3)	1 hour	1 day a year
	0.08 ppm (≈229 μg/m^3)	1 day	1 day a year
	0.02 ppm (≈57 μg/m^3)	1 year	none
Nitrogen dioxide	0.12 ppm (≈246 μg/m^3)	1 hour	1 day a year
	0.03 ppm (≈62 μg/m^3)	1 year	none
Particles as PM10	50 μg/m^3	1 day	5 days a year
Hydrochloric acid	230 μg/m^3	3 minutes	none

6.2 ODOURS

Since 1994, the Environmental Protection Authority (EPA) and Department of Environmental Protection (DEP) have preferred the use of quantitative odour assessment for predicting odour impacts from new developments.

Quantitative odour assessment makes use of a numerical criterion which defines unacceptable odour impacts, in the same way that conventional air quality "standards" are used to define an unacceptable risk of a health impact.

The measurement of odours however, cannot, as yet, be directly performed using instrumentation, because no instrument has been developed which responds to odour in the same way as the human olfactometry system. Assessment of odour impacts is therefore based on odour measurements using "dynamic olfactometry".

Dynamic olfactometry is the term used to describe the measurement of odour by presenting a sample of odorous air to a panel in a range of dilutions and seeking a response from the panellists on whether they can detect the odour. The correlations between the known dilution ratios and the panellists' responses are used to calculate the number of dilutions of the original sample required to achieve the odour threshold. The odour concentration of the sample is expressed in "odour units per cubic metre of air" (OU/m^3). References to odour units in this report based on the NVN2820 olfactometry method using forced choice certainty thresholds.

The EPA has recently released a final Guidance Statement for the assessment of odours (EPA 2002). The ambient odour criterion in the Guidance Statement is an odour concentration equivalent to an intensity level of "distinct" averaged over 3 minutes, expressed as the 99.5 percentile of one year's data. In the case of poultry odours, an odour concentration of 7 OU corresponds to a "distinct" odour intensity rating. The criterion applies at "odour-sensitive" land uses which includes residential premises.

7. STACK EMISSIONS

The emissions parameters, based on information provided by the proponent, for the boiler stack of the proposed power station are shown in Table 3.

Table 3 Poultry litter power generation plant main stack emission parameters

Parameter	Value
Stack height above ground (m)	42.3
Exit volume at exit temperature (m^3/hour) (m^3/s)	112,000 31
Exit velocity (m/s)	15
Exit temperature (C)	200
Stack diameter (m)	1.6

The outside maximum building dimensions of all buildings greater than 15 meters above ground were specified in the model to ensure that any wake effects on dispersion were taken into account. In practice, this meant the litter storage shed and boilerhouse, both having a maximum height (to the roof ridge) of 15.3 metres (see Figure 1).

The emissions from the boiler stack of the proposed power station are shown in Table 4.

Table 4 Expected emissions from proposed Western Australian plant

Substance	Typical maximum emissions		Worst case emission estimates		
	Concentration[g]	Rate (g/s)[f]	Concentration[g]	Rate (g/s)[f]	Frequency (hours/year)
Oxides of nitrogen (as NO_2)	258	4.6	387[c]	6.9	24[i]
Carbon monoxide	47	0.8	70[c]	1.3	24[i]
Sulphur dioxide[a]	861[b]	15.4	1230[h]	22.0	<1[j]
Hydrogen chloride	270	4.8	410[c]	7.3	24[i]
Particulates[d]	60[c]	1.1	80	1.4	<1[k]
Dioxins and furans	0.1	1.79E-09	0.1	1.79E-09	continuous
Arsenic[e]	0.0027	4.83E-05	0.0036	6.44E-05	<1[k]
Cadmium[e]	0.00003	5.37E-07	0.00004	7.16E-07	<1[k]
Chromium[e]	0.00042	7.52E-06	0.00056	1.00E-05	<1[k]
Copper[e]	0.024	4.30E-04	0.032	5.73E-04	<1[k]
Mercury[e]	<0.000003	5.37E-08	<0.000004	7.16E-08	<1[k]
Lead[e]	0.00066	1.18E-05	0.00088	1.58E-05	<1[k]
Nickel[e]	0.00072	1.29E-05	0.00096	1.72E-05	<1[k]
Zinc[e]	0.084	1.50E-03	0.112	2.00E-03	<1[k]

[a] The maximum potential SO2 emission rate is based on expected S in Western Australian poultry litter of 0.3%, a litter throughput of 108,000 tonnes/year at a 95% operability level. This gives the "worst case" emission rate of 22 g/s.

[b] Based on advice from HRL that at least 30% of the S in the litter would be retained in the ash/flyash (see Appendix 4). Monitoring for a similar UK poultry litter plant indicated 85% retention of S in flyash– see facsimile from Blair Fox to DEP dated 19/12/2000.

[c] Based on HMIP licence for UK plant in which the maximum daily level (ie. bag filter design maximum concentration = worst case emission) is 1.3 times the 7-day (ie. long-term) level.

[d] Based on bag filter design maximum concentration of 80 mg/Nm^3.

[e] Based on metal composition in poultry ash (see Appendix 3) x Total Suspended Particulates (TSP) emission concentration.

[f] Based on volume flow of 17.9 Nm^3/s for proposed plant.

[g] All concentrations in mg/Nm^3 except for dioxins in ng I-TEQ/Nm^3

[h] Based on 0% removal of S into flyash.

[i] Based on the assumption that the UK plant complies with its licence conditions and reaches the limit one day per year.

[j] Based on assumption that 0% removal of S into flyash is unlikely to ever be achieved.

[k] Based on the assumption that the UK plant complies with its particulate emissions licence limit and an exceedence is unlikely.

The "worst case emission" estimates have been made to satisfy DEP requests for modelling the worst case environmental impacts. The frequency of emissions at these levels will need to be confirmed by operating experience and monitoring.

Emissions from the Tiwest main stack supplied by the client (see Table 5) have also been included in the modelling because the Tiwest synthetic rutile plant is in close proximity to the proposed PLFPS.

Table 5 Tiwest main stack emissions

Parameter	Value
Stack height above ground (m)	58
Sulphur dioxide emission rate (licence limit) (g/s)	85
Particulates concentration (licence limit) (mg/m^3)	250
Particulates emission rate (g/s)	5.5
NOx concentration (mg/Nm^3)	90
NOx emission rate (g/s)	2.0
Exit volume at exit temperature (m^3/s)	22
Exit velocity (m/s)	11
Exit temperature (C)	80
Kiln Inlet Station Height (m)	39
Kiln Inlet Station Width (m)	15

Note: Data provided by the Client.. Tiwest do not emit any hydrochloric acid.

8. SHED EMISSIONS

The details of the shed for housing the poultry litter provided by the proponent are shown in Table 6.

The initial horizontal and vertical widths of the plume selected for modelling was one-quarter of the building width[2] and building height respectively in accordance with Ausplume guidelines. The initial plume release height was at the mid-point of the height of the louvres.

Table 6 Poultry litter power generation plant litter storage building emission parameters

Parameter	Value
Volume of litter (m^3)	5000 (approx)
Surface area of litter stockpile (m^2)	1559 (max)
Building dimensions (length x width x height) (m)	87.6 x 40.9 x 15.3
Height of side louvres above ground (m)	2
Side louvre dimensions (length x height) (m)	22 x 1

The calculation of odour emissions from the litter stockpile was based on emission rate measurements given in CH2M Hill (1997) for compost sources in operating facilities in Perth. The data relevant to this study are shown in Table 7.

[2] Defined as the minimum of the building length and width.

Table 7 Specific odour emissions rates for chicken litter

Source	Specific odour emissions rate (OU/m^2/s)[(a)]
Chicken litter (20 minutes after turning)	72
Chicken litter (50 minutes after turning)	58
Chicken litter (stable)	43

[(a)] Based 0.3 m/s half wind tunnel height wind speed which is considered to be appropriate for uneven surfaces such as stockpiles (CH2M Hill 1997).

This study has used the stable specific odour emission rate of 43 OU/s. On one hand, this is conservative because it is based on a sweep velocity of 0.3 m/s at 0.1 m (wind tunnel sampling velocity) whereas the actual air velocities inside the shed will be lower than this most of the time. On the other hand, agitation of the litter when it is conveyed into the boiler will increase the odour emissions from that part of the stockpile. Therefore, on balance, the assumed odour emissions rate should be a reasonable estimate.

The total odour emission rate (OER) from the stockpile is estimated to be 67,037 OU/s.

The precise distribution of odours within the shed will depend on many factors including the nature, amount, moisture content and age of litter, and the level of agitation from handling at any point in time. For this study, it has been simply assumed that the odour is uniformly distributed within the air inside the shed.

The amount of odour actually emitted from the shed will depend on the air ventilation rate into the shed. Since the air intake into the boiler will be located above the litter stockpile, a portion of the air inside the shed will be drawn into the boiler and combusted this eliminating the odour.

The air intake into the boiler is about 45,000 m^3/hr (12 m^3/s).

Ventilation through the shed will range from 45,000 m^3/h (12 m^3/s) to 225,000 m^3/h (62 m^3/s) (Process Developments Ltd 2000) and will primarily occur through louvres running down the sides. The area of the opening along each side is 22 m^2. The ventilation rate will be at a maximum when the wind is blowing directly into the side of the shed and the louvres are fully open.

The fraction of the total odour generated within the shed that is actually emitted from the shed can be determined from the maximum ventilation rate based on wind speed, and the proportion of the air emitted from the shed after allowing for the boiler intake. The resulting OERs based on wind speed are shown in Table 8.

Table 8 Variation in OER for wind speed and ventilation rate

Wind speed range (m/s)	Maximum potential ventilation air into shed (m^3/s)[(b)]	Maximum actual ventilation air into shed[(a)] (m^3/s)	Fraction of odour from stockpile actually emitted from shed	OER (OU/s)
0 – 0.75	16	16	0.24	16,100
0.75 – 1.5	33	33	0.62	41,200
1.5 – 3.0	66	62	0.80	53,800
3.0 – 6.0	68	62	0.80	53,800
6.0 – 9.0	113	62	0.80	53,800
>9.0	238	62	0.80	53,800

[(a)] The louvres will be closed during high wind speeds to prevent air velocities that could cause internal airborne dust to reach excessive levels.

[(b)] These are likely to be overestimated because:

- they are based on the upper bound of the wind speed range,
- they assume the wind is always perpendicular to the building face with the greatest louvre opening, and
- they assume the outside wind velocity across the full extent of the building openings. In reality, the actual ventilation rate is reduced by at least one-quarter.

Once the facility is operational procedures can be modified to ensure that the side louvres can be fully or partially closed if odour emissions arising from high ventilation rates cause adverse impacts. This would direct a greater portion of the ventilation air in the shed into the boiler, and reduce odour emissions from the shed.

9. PREDICTED AMBIENT LEVELS OF AIR CONTAMINANTS

9.1 SULPHUR DIOXIDE, NITROGEN DIOXIDE, PARTICULATES AND HYDROCHLORIC ACID

The maximum predicted ground level concentrations across the receptor grid from modelling sulphur dioxide, nitrogen dioxides, PM10 using the maximum emissions rates under normal operating conditions in Table 3 are summarised in Table 9.

Details of the modelling parameters and assumptions for the PLFPS and Tiwest sulphur dioxide emissions (as an example) are shown in Appendix 1.

Table 9 Maximum predicted ground level concentrations for typical emission rates

Source	Sulphur dioxide ($\mu g/m^3$)	Nitrogen dioxide[(a)] ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	HCl ($\mu g/m^3$)
Averaging time = 3 minutes				
PLFPS	-	-	-	22
Tiwest	-	-	-	0
Criterion	-	-	-	**230**
Averaging time = 1 hour				
PLFPS	12	12	-	-
Tiwest	500[(b)]	1	-	-
Cumulative	500[(c)(e)]		-	-
Criterion	**572[(d)]**	**246[(d)]**	-	-
Averaging time = 24 hours				
PLFPS	5	-	1	-
Tiwest	85	-	7	-
Cumulative	106			
Criterion	**229[(d)]**	-	**50[(d)]**	-
Averaging time = 1 year				
PLFPS	1	1	-	-
Tiwest	24	0	-	-
Criterion	**57**	**62**	-	-

[(a)] Conservatively assumes that 50% of NOx from both Tiwest and the proposal is or becomes NO2.

[(b)] Occurs within Tiwest boundary. Maximum outside Tiwest boundary is 467 $\mu g/m^3$.

[(c)] Occurs within Tiwest boundary. Maximum outside Tiwest boundary is 467 $\mu g/m^3$.

[(d)] Exceedences allowed by NEPM Standard not taken into account.

[(e)] Details of the modelling parameters and assumptions are shown in Appendix 1.

The contour of the maximum 1-hour average cumulative sulphur dioxide levels is shown in Figure 2.

It should be noted that the sulphur dioxide concentrations from Tiwest are based on an assumed continuous emission rate at the licence limit. The predicted concentrations may therefore be over-estimated since the actual emissions are likely to be considerably below the regulatory limit.

The cumulative maximum concentrations from contaminants and averaging times not shown in the Table can not be greater than the respective criterion.

All of the maximum predicted concentrations are below the relevant criteria. The maximum predicted concentrations from the PLFPS in isolation are less than 10% of the relevant criteria for all contaminants.

9.2 ODOURS

The contour for the 7 OU 3-minute average 99.5 percentile criterion odour level is shown in Figure 3. All of the nearby residences lie outside the contour, which demonstrates that this criterion is also met.

Details of the modelling parameters and assumptions for the shed odours are shown in Appendix 2.

10. REFERENCES

Blair Fox Generation WA, "Public Environmental Review, Poultry Litter Power Station", July 2002.

CH2M Hill, 1997, "Odour Impact Modelling – Composting Facility, Perth, WA".

Environmental Alliances, "Dispersion Modelling of Dioxin Emissions from Proposed Poultry Litter Fired Power Station at Muchea", December 2001.

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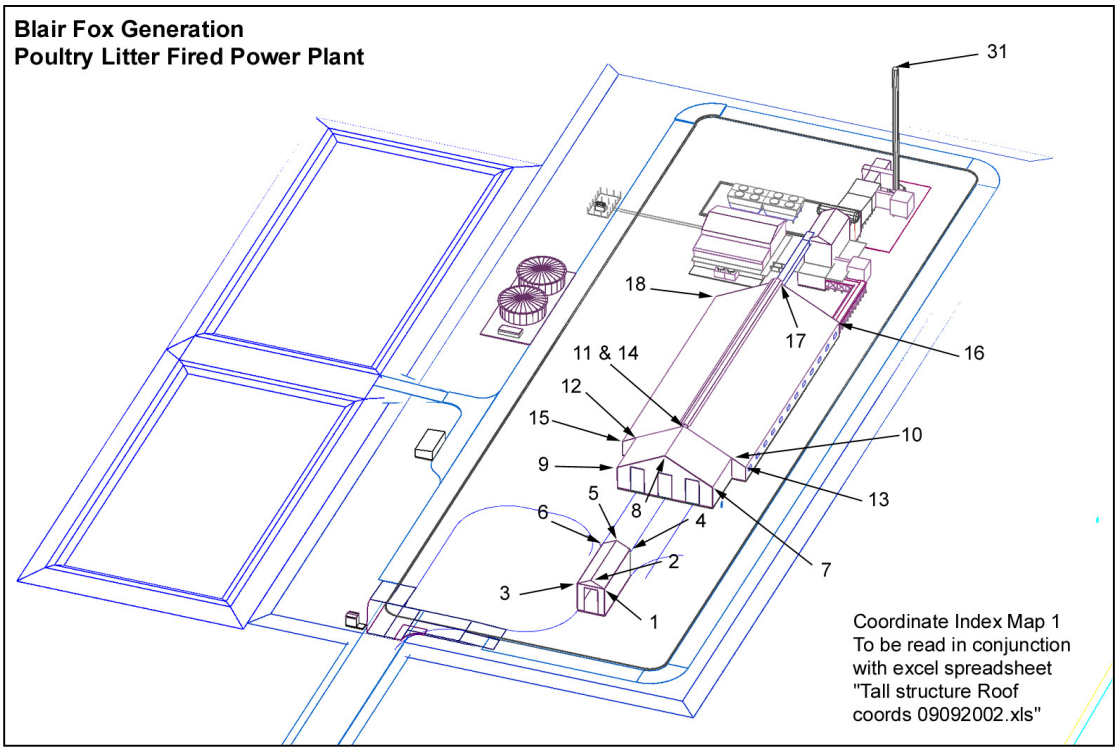

Figure 1 Layout of PLFPS buildings

Note that height of the litter storage shed roof ridge line (labelled 11 and 17) is 15.3 metres. The stack height is 42.3 metres.

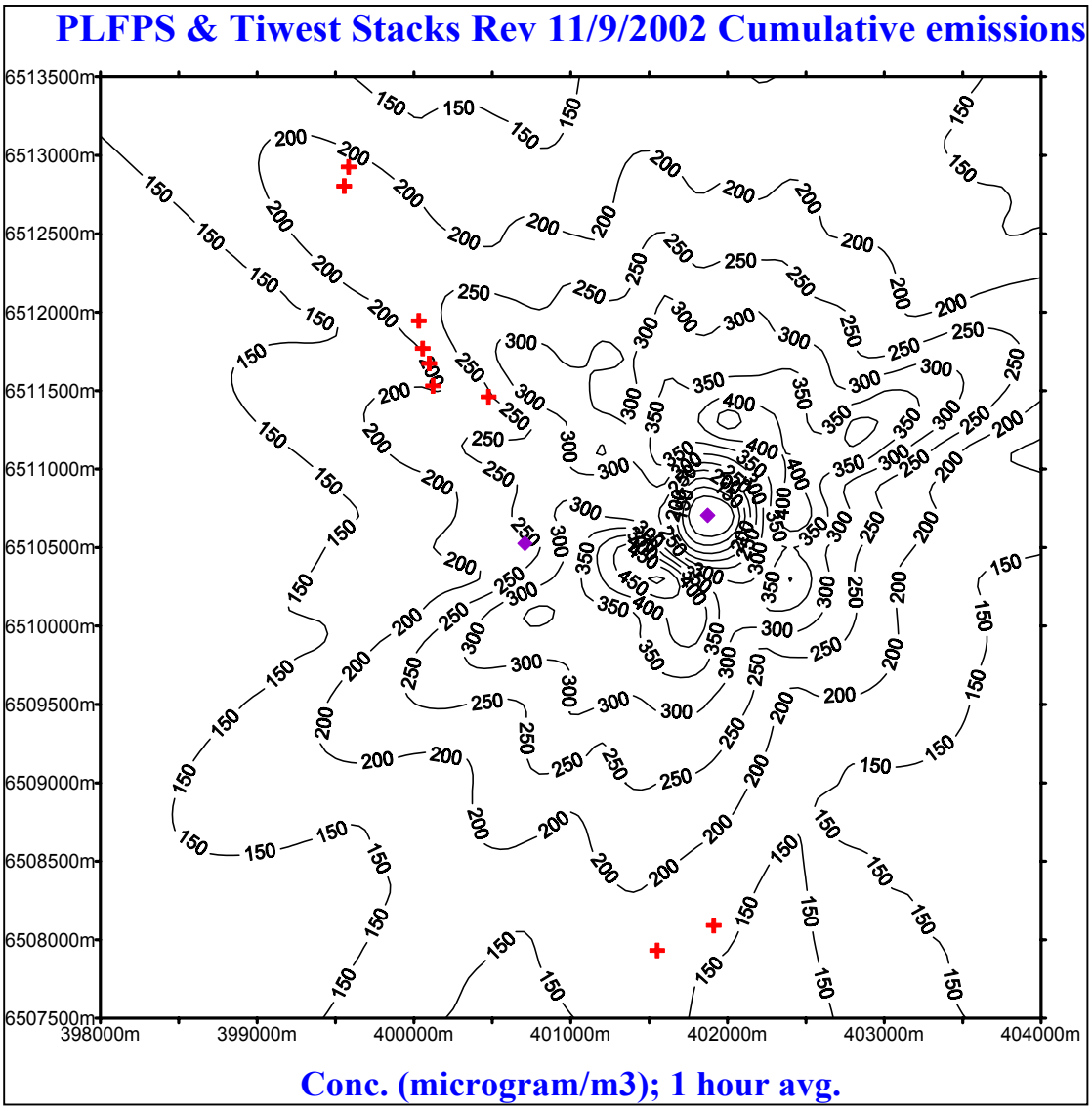

Figure 2 Predicted cumulative maximum 1-hour average sulphur dioxide concentrations

Notes:

- Criterion is 572 µg/m^3 (second highest day)
- Crosses show residence locations
- Diamonds show source locations

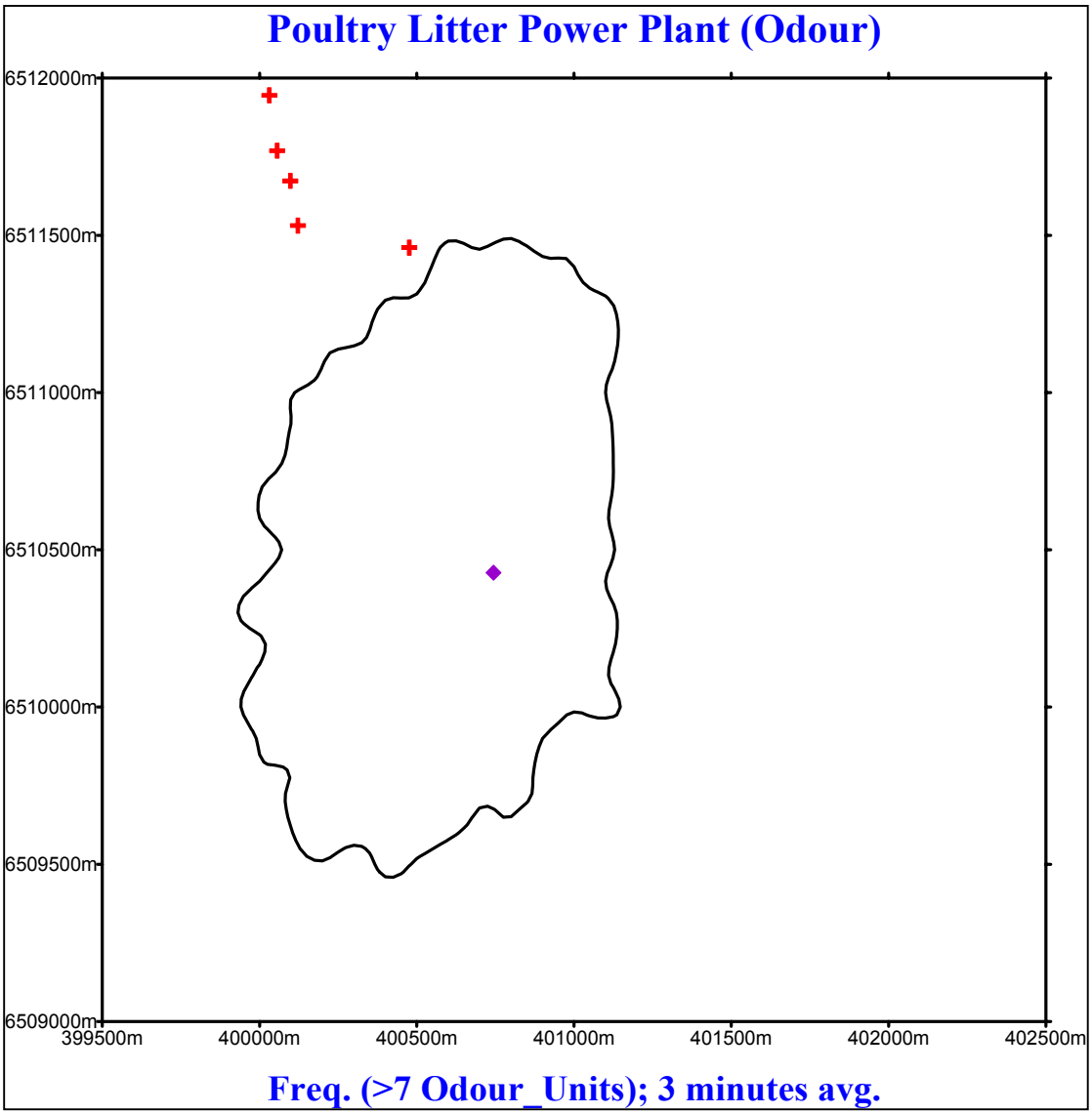

Figure 3 Predicted 7 OU 3-minute average 99.5 percentile odour concentrations

Notes:

- Crosses show residence locations
- Diamonds show source locations

Appendix 1 Ausplume parameters for stack emissions

```
1          ____________________________________________________________

             PLFPS & Tiwest Stacks Rev 11/9/2002 Cumulative emissions

           ____________________________________________________________

 Concentration or deposition                              Concentration
 Emission rate units                                      grams/second
 Concentration units                                      microgram/m3
 Units conversion factor                                  1.00E+06
 Constant background concentration                                0.00E+00
 Terrain effects                                          None
 Smooth stability class changes?                          No
 Other stability class adjustments ("urban modes")        None
 Ignore building wake effects?                            No
 Decay coefficient (unless overridden by met. file)       0.000
 Anemometer height                                        10 m
 Roughness height at the wind vane site                   0.200 m

                     DISPERSION CURVES
 Horizontal dispersion curves for sources <100m high  Pasquill-Gifford
 Vertical  dispersion  curves for sources <100m high  Pasquill-Gifford
 Horizontal dispersion curves for sources >100m high  Briggs Rural
 Vertical  dispersion  curves for sources >100m high  Briggs Rural
 Enhance horizontal plume spreads for buoyancy?       Yes
 Enhance  vertical  plume spreads for buoyancy?       Yes
 Adjust horizontal P-G formulae for roughness height? Yes
 Adjust  vertical  P-G formulae for roughness height? Yes
 Roughness height                                     0.200m
 Adjustment for wind directional shear                None

                      PLUME RISE OPTIONS
 Gradual plume rise?                                  Yes
 Stack-tip downwash included?                         Yes
 Building downwash algorithm:                        PRIME method.
 Entrainment coeff. for neutral & stable lapse rates 0.60,0.60
 Partial penetration of elevated inversions?          No
 Disregard temp. gradients in the hourly met. file?   Yes

 and in the absence of boundary-layer potential temperature gradients
 given by the hourly met. file, a value from the following table
 (in K/m) is used:

    Wind Speed                Stability Class
     Category       A      B      C      D      E      F
   ____________________________________________________________
        1         0.000  0.000  0.000  0.000  0.020  0.035
        2         0.000  0.000  0.000  0.000  0.020  0.035
        3         0.000  0.000  0.000  0.000  0.020  0.035
        4         0.000  0.000  0.000  0.000  0.020  0.035
        5         0.000  0.000  0.000  0.000  0.020  0.035
        6         0.000  0.000  0.000  0.000  0.020  0.035

 WIND SPEED CATEGORIES
 Boundaries between categories (in m/s) are:  1.54,  3.09,  5.14,  8.23, 10.80

 WIND PROFILE EXPONENTS: "Irwin Rural" values (hourly met. file values IGNORED)

 AVERAGING TIMES
  1 hour
 24 hours
  average over all hours

 ____________________________________________________________________________

1          ____________________________________________________________

             PLFPS & Tiwest Stacks Rev 11/9/2002 Cumulative emissions

                              SOURCE CHARACTERISTICS
```

STACK SOURCE: P-SO2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
400708	6510526	0m	42m	1.60m	200C	15.0m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	0	0	0	0	0	0	0	0	0	0	0	0
Effective building height	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow building length	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0
Across-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	0	0	0	0	0	0	0	0	0	0	0	0
Effective building height	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow building length	0	0	0	0	0	0	0	0	0	0	0	0
Along-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0
Across-flow distance from stack	0	0	0	0	0	0	0	0	0	0	0	0

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	0	0	0	0	0	0	0	0	42	42	54	37
Effective building height	0	0	0	0	0	0	0	0	14	14	14	14
Along-flow building length	0	0	0	0	0	0	0	0	89	90	93	17
Along-flow distance from stack	0	0	0	0	0	0	0	0	-156	-158	-157	17
Across-flow distance from stack	0	0	0	0	0	0	0	0	17	-1	-19	17

(Constant) emission rate = 4.60E+00 grams/second
No gravitational settling or scavenging.

STACK SOURCE: T-SO2

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
401873	6510705	0m	58m	1.60m	80C	11.3m/s

Effective building dimensions (in metres)

Flow direction	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	120°
Effective building width	23	23	23	21	20	17	16	17	17	17	18	19
Effective building height	39	39	39	39	39	39	39	39	39	39	39	39
Along-flow building length	17	18	19	19	18	17	18	21	22	23	23	23
Along-flow distance from stack	-19	-20	-21	-22	-22	-21	-22	-22	-22	-21	-20	-18
Across-flow distance from stack	10	8	7	5	3	1	-2	-5	-8	-10	-11	-12

Flow direction	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°	230°	240°
Effective building width	19	19	17	18	21	22	23	23	23	22	20	17
Effective building height	39	39	39	39	39	39	39	39	39	39	39	39
Along-flow building length	21	20	17	16	17	17	17	18	19	19	18	17
Along-flow distance from stack	-16	-13	-10	-6	-4	-1	2	2	3	3	4	4
Across-flow distance from stack	-13	-13	-13	-12	-12	-11	-10	-9	-7	-5	-3	-1

Flow direction	250°	260°	270°	280°	290°	300°	310°	320°	330°	340°	350°	360°
Effective building width	16	17	17	17	18	19	19	18	17	18	20	22
Effective building height	39	39	39	39	39	39	39	39	39	39	39	39
Along-flow building length	18	21	22	23	23	23	21	20	17	16	17	17
Along-flow distance from stack	3	2	0	-2	-3	-5	-6	-7	-8	-10	-14	-16
Across-flow distance from stack	2	5	8	10	12	12	13	13	12	12	12	11

(Constant) emission rate = 8.50E+01 grams/second
No gravitational settling or scavenging.

1

PLFPS & Tiwest Stacks Rev 11/9/2002 Cumulative emissions

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):

398000.m 398200.m 398400.m 398600.m 398800.m 399000.m 399200.m
399400.m 399600.m 399800.m 400000.m 400200.m 400400.m 400600.m
400800.m 401000.m 401200.m 401400.m 401600.m 401800.m 402000.m
402200.m 402400.m 402600.m 402800.m 403000.m 403200.m 403400.m
403600.m 403800.m 404000.m

and these y-values (or northings):
6507500.m 6507700.m 6507900.m 6508100.m 6508300.m 6508500.m 6508700.m
6508900.m 6509100.m 6509300.m 6509500.m 6509700.m 6509900.m 6510100.m
6510300.m 6510500.m 6510700.m 6510900.m 6511100.m 6511300.m 6511500.m
6511700.m 6511900.m 6512100.m 6512300.m 6512500.m 6512700.m 6512900.m
6513100.m 6513300.m 6513500.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	400098	6511673	0.0	0.0	6	400031	6511945	0.0	0.0
2	400122	6511531	0.0	0.0	7	400056	6511769	0.0	0.0
3	400476	6511461	0.0	0.0	8	401551	6507932	0.0	0.0
4	399583	6512926	0.0	0.0	9	401912	6508091	0.0	0.0
5	399555	6512804	0.0	0.0					

METEOROLOGICAL DATA : Caversham 1994 Blockley 271200. Read ca94aus.rea for

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Concentrations at the discrete receptors (No. : Value):

1:5.88E+00 2:6.78E+00 3:7.22E+00 4:2.96E+00 5:3.09E+00 6:4.67E+00
7:5.39E+00 8:4.31E+00
9:3.66E+00

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1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 1 hour

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)		
1	5.00E+02	10,12/05/94	(401600,	6510300,	0.0)
2	4.74E+02	09,04/10/94	(401400,	6510300,	0.0)
3	4.67E+02	11,17/07/94	(402000,	6511300,	0.0)
4	4.45E+02	09,27/03/94	(402400,	6510700,	0.0)
5	4.30E+02	11,04/05/94	(402400,	6510700,	0.0)
6	4.28E+02	10,12/07/94	(401800,	6510100,	0.0)
7	4.14E+02	07,24/11/94	(402200,	6511300,	0.0)
8	4.13E+02	10,23/08/94	(402000,	6511300,	0.0)
9	4.10E+02	11,15/08/94	(402000,	6511300,	0.0)
10	4.08E+02	11,11/05/94	(402400,	6510900,	0.0)
11	4.04E+02	08,20/03/94	(402800,	6511300,	0.0)
12	4.02E+02	11,06/07/94	(401800,	6509900,	0.0)
13	4.02E+02	09,28/09/94	(402400,	6510300,	0.0)
14	3.93E+02	11,26/07/94	(401800,	6511300,	0.0)
15	3.90E+02	08,07/02/94	(401600,	6509900,	0.0)
16	3.87E+02	10,21/05/94	(401400,	6510500,	0.0)
17	3.86E+02	10,14/05/94	(401800,	6511300,	0.0)
18	3.84E+02	09,11/09/94	(401800,	6511300,	0.0)
19	3.62E+02	10,13/05/94	(401600,	6510300,	0.0)
20	3.59E+02	10,07/06/94	(401600,	6510100,	0.0)
21	3.58E+02	09,20/04/94	(402400,	6510300,	0.0)
22	3.57E+02	07,22/01/94	(400800,	6510100,	0.0)
23	3.55E+02	10,20/03/94	(401600,	6511500,	0.0)
24	3.53E+02	10,24/08/94	(401200,	6511100,	0.0)
25	3.52E+02	11,11/06/94	(402400,	6511300,	0.0)
26	3.44E+02	10,06/08/94	(401400,	6510500,	0.0)
27	3.42E+02	11,27/08/94	(402000,	6511300,	0.0)
28	3.42E+02	10,22/04/94	(402400,	6510700,	0.0)

29	3.41E+02	09,13/09/94	(401400, 6510100, 0.0)
30	3.37E+02	11,09/08/94	(401000, 6511500, 0.0)
31	3.34E+02	10,05/08/94	(401800, 6510100, 0.0)
32	3.28E+02	07,07/02/94	(401200, 6509700, 0.0)
33	3.27E+02	10,09/09/94	(401800, 6510100, 0.0)
34	3.25E+02	10,19/05/94	(401600, 6510100, 0.0)
35	3.25E+02	10,25/08/94	(401800, 6509700, 0.0)
36	3.24E+02	09,02/08/94	(401200, 6509900, 0.0)
37	3.23E+02	11,05/07/94	(401600, 6510100, 0.0)
38	3.23E+02	08,31/12/94	(402200, 6511700, 0.0)
39	3.19E+02	07,11/10/94	(401400, 6509900, 0.0)
40	3.19E+02	09,24/04/94	(401600, 6509700, 0.0)
41	3.19E+02	10,09/10/94	(402200, 6511100, 0.0)
42	3.18E+02	09,14/03/94	(402200, 6511500, 0.0)
43	3.17E+02	11,15/05/94	(401600, 6510100, 0.0)
44	3.16E+02	08,13/03/94	(401600, 6511900, 0.0)
45	3.14E+02	08,24/03/94	(401000, 6510700, 0.0)
46	3.13E+02	12,16/06/94	(401600, 6510100, 0.0)
47	3.13E+02	10,01/08/94	(401400, 6510100, 0.0)
48	3.11E+02	11,20/07/94	(401800, 6511300, 0.0)
49	3.11E+02	09,02/06/94	(402000, 6511700, 0.0)
50	3.09E+02	09,29/03/94	(401200, 6511700, 0.0)
51	3.09E+02	08,22/01/94	(401200, 6510300, 0.0)
52	3.08E+02	17,18/02/94	(401600, 6511100, 0.0)
53	3.08E+02	10,15/08/94	(401400, 6511100, 0.0)
54	3.07E+02	09,09/04/94	(401800, 6511500, 0.0)
55	3.07E+02	14,31/01/94	(401800, 6511100, 0.0)
56	3.06E+02	08,02/10/94	(402000, 6509900, 0.0)
57	3.05E+02	08,12/10/94	(402000, 6510100, 0.0)
58	3.05E+02	15,06/11/94	(402000, 6511100, 0.0)
59	3.04E+02	09,24/03/94	(401400, 6510500, 0.0)
60	2.99E+02	14,30/12/94	(402200, 6510500, 0.0)
61	2.99E+02	14,07/03/94	(401800, 6510300, 0.0)
62	2.99E+02	10,14/06/94	(401400, 6510100, 0.0)
63	2.98E+02	16,29/11/94	(401600, 6510500, 0.0)
64	2.98E+02	13,13/03/94	(401600, 6510500, 0.0)
65	2.97E+02	11,23/01/94	(402200, 6510900, 0.0)
66	2.97E+02	14,06/11/94	(401600, 6510900, 0.0)
67	2.96E+02	15,13/03/94	(402000, 6510300, 0.0)
68	2.96E+02	14,13/03/94	(401800, 6510300, 0.0)
69	2.95E+02	10,22/01/94	(402000, 6511100, 0.0)
70	2.94E+02	11,22/01/94	(402000, 6511100, 0.0)
71	2.93E+02	07,06/12/94	(401600, 6511500, 0.0)
72	2.92E+02	19,07/11/94	(402400, 6510700, 0.0)
73	2.90E+02	11,17/06/94	(401400, 6509700, 0.0)
74	2.89E+02	07,26/05/94	(402000, 6509700, 0.0)
75	2.89E+02	10,14/07/94	(401600, 6509900, 0.0)
76	2.89E+02	11,03/06/94	(401800, 6510100, 0.0)
77	2.89E+02	16,24/08/94	(402000, 6511100, 0.0)
78	2.88E+02	13,16/03/94	(401600, 6510900, 0.0)
79	2.87E+02	15,15/11/94	(401600, 6510500, 0.0)
80	2.86E+02	13,21/03/94	(401600, 6510300, 0.0)
81	2.85E+02	08,19/03/94	(401000, 6510100, 0.0)
82	2.85E+02	11,14/04/94	(401400, 6510500, 0.0)
83	2.84E+02	15,24/08/94	(402000, 6511100, 0.0)
84	2.84E+02	09,21/04/94	(401600, 6511500, 0.0)
85	2.83E+02	16,06/11/94	(401800, 6511300, 0.0)
86	2.82E+02	10,18/06/94	(401600, 6509500, 0.0)
87	2.82E+02	16,07/10/94	(402000, 6511100, 0.0)
88	2.82E+02	15,13/04/94	(401800, 6511100, 0.0)
89	2.82E+02	09,04/04/94	(401400, 6511500, 0.0)
90	2.81E+02	14,01/11/94	(401800, 6511100, 0.0)
91	2.80E+02	16,13/04/94	(401600, 6511100, 0.0)
92	2.80E+02	12,29/10/94	(401600, 6510500, 0.0)
93	2.80E+02	10,07/07/94	(401600, 6509500, 0.0)
94	2.80E+02	15,07/10/94	(402200, 6510900, 0.0)
95	2.79E+02	16,17/05/94	(401800, 6510300, 0.0)
96	2.78E+02	09,22/01/94	(402000, 6511100, 0.0)
97	2.78E+02	14,20/08/94	(401600, 6510300, 0.0)
98	2.78E+02	13,29/10/94	(401600, 6510500, 0.0)
99	2.77E+02	10,25/07/94	(401200, 6511100, 0.0)
100	2.77E+02	14,13/04/94	(401400, 6510700, 0.0)

1 Peak values for the 100 worst cases (in microgram/m3)
Averaging time = 24 hours

Rank	Value	Time Recorded hour,date	Coordinates (* denotes polar)	
1	1.06E+02	24,12/12/94	(402400, 6511100,	0.0)
2	1.03E+02	24,25/01/94	(402400, 6511300,	0.0)
3	9.97E+01	24,20/12/94	(401000, 6510900,	0.0)
4	9.96E+01	24,27/02/94	(401000, 6510900,	0.0)
5	9.88E+01	24,14/10/94	(402000, 6511500,	0.0)
6	9.57E+01	24,13/02/94	(402400, 6511300,	0.0)
7	9.55E+01	24,22/01/94	(402200, 6511100,	0.0)
8	9.51E+01	24,15/01/94	(402400, 6511300,	0.0)
9	9.45E+01	24,07/12/94	(401000, 6510700,	0.0)
10	9.42E+01	24,18/11/94	(402200, 6511500,	0.0)
11	9.41E+01	24,29/01/94	(401000, 6510900,	0.0)
12	9.08E+01	24,25/11/94	(402600, 6510700,	0.0)
13	8.96E+01	24,24/01/94	(402800, 6510900,	0.0)
14	8.93E+01	24,19/12/94	(401200, 6511100,	0.0)
15	8.91E+01	24,30/01/94	(401200, 6510700,	0.0)
16	8.87E+01	24,02/02/94	(402600, 6511300,	0.0)
17	8.85E+01	24,24/11/94	(402600, 6510700,	0.0)
18	8.82E+01	24,23/03/94	(402400, 6511300,	0.0)
19	8.81E+01	24,19/09/94	(401000, 6510700,	0.0)
20	8.80E+01	24,17/12/94	(402400, 6511100,	0.0)
21	8.75E+01	24,17/04/94	(401000, 6510700,	0.0)
22	8.72E+01	24,19/10/94	(400800, 6510900,	0.0)
23	8.68E+01	24,05/11/94	(401200, 6510700,	0.0)
24	8.65E+01	24,06/02/94	(402200, 6511100,	0.0)
25	8.63E+01	24,14/11/94	(401200, 6510700,	0.0)
26	8.57E+01	24,23/11/94	(402400, 6511100,	0.0)
27	8.52E+01	24,27/03/94	(402400, 6511100,	0.0)
28	8.45E+01	24,18/09/94	(401000, 6511100,	0.0)
29	8.41E+01	24,10/04/94	(401000, 6510700,	0.0)
30	8.39E+01	24,15/02/94	(401000, 6510900,	0.0)
31	8.38E+01	24,17/02/94	(401000, 6510700,	0.0)
32	8.29E+01	24,23/10/94	(402800, 6510700,	0.0)
33	8.25E+01	24,08/03/94	(402400, 6511100,	0.0)
34	8.21E+01	24,10/03/94	(401000, 6510900,	0.0)
35	8.18E+01	24,06/01/94	(402200, 6511100,	0.0)
36	8.17E+01	24,16/02/94	(401000, 6510700,	0.0)
37	8.17E+01	24,31/12/94	(402400, 6511300,	0.0)
38	8.10E+01	24,23/01/94	(402200, 6511100,	0.0)
39	8.04E+01	24,28/02/94	(401000, 6510700,	0.0)
40	8.02E+01	24,12/11/94	(402200, 6511500,	0.0)
41	8.01E+01	24,20/02/94	(402000, 6511700,	0.0)
42	7.96E+01	24,08/12/94	(401000, 6510500,	0.0)
43	7.93E+01	24,29/08/94	(400800, 6510900,	0.0)
44	7.93E+01	24,28/03/94	(402400, 6511300,	0.0)
45	7.83E+01	24,24/10/94	(402400, 6511100,	0.0)
46	7.80E+01	24,11/04/94	(401000, 6510300,	0.0)
47	7.78E+01	24,10/01/94	(402200, 6511100,	0.0)
48	7.78E+01	24,09/10/94	(402200, 6511100,	0.0)
49	7.70E+01	24,25/12/94	(402400, 6511100,	0.0)
50	7.60E+01	24,27/08/94	(402000, 6511500,	0.0)
51	7.59E+01	24,06/04/94	(401000, 6510700,	0.0)
52	7.55E+01	24,27/01/94	(401000, 6510700,	0.0)
53	7.55E+01	24,26/02/94	(401000, 6511100,	0.0)
54	7.54E+01	24,03/12/94	(402400, 6511100,	0.0)
55	7.53E+01	24,05/10/94	(402200, 6511300,	0.0)
56	7.53E+01	24,09/11/94	(402400, 6510900,	0.0)
57	7.53E+01	24,30/09/94	(402800, 6511100,	0.0)
58	7.51E+01	24,14/03/94	(402400, 6511100,	0.0)
59	7.51E+01	24,28/01/94	(401000, 6510900,	0.0)
60	7.46E+01	24,21/12/94	(401000, 6510700,	0.0)
61	7.45E+01	24,10/12/94	(402400, 6510900,	0.0)
62	7.44E+01	24,01/02/94	(402800, 6510900,	0.0)
63	7.44E+01	24,24/05/94	(403000, 6510900,	0.0)
64	7.43E+01	24,21/09/94	(402200, 6511300,	0.0)
65	7.42E+01	24,20/10/94	(401000, 6510700,	0.0)
66	7.39E+01	24,01/08/94	(401600, 6510100,	0.0)
67	7.33E+01	24,05/12/94	(402400, 6511500,	0.0)
68	7.32E+01	24,05/04/94	(401200, 6511300,	0.0)

69	7.30E+01	24,04/12/94	(402400, 6511100,	0.0)
70	7.28E+01	24,11/12/94	(402400, 6511100,	0.0)
71	7.27E+01	24,02/11/94	(402200, 6511100,	0.0)
72	7.26E+01	24,21/02/94	(401200, 6511100,	0.0)
73	7.23E+01	24,09/01/94	(402200, 6511100,	0.0)
74	7.16E+01	24,11/02/94	(401200, 6510700,	0.0)
75	7.14E+01	24,18/10/94	(401000, 6511100,	0.0)
76	7.10E+01	24,02/12/94	(402400, 6511100,	0.0)
77	7.07E+01	24,28/11/94	(402400, 6511100,	0.0)
78	7.06E+01	24,14/02/94	(401200, 6511100,	0.0)
79	7.06E+01	24,26/04/94	(402400, 6511300,	0.0)
80	7.05E+01	24,26/12/94	(402400, 6511100,	0.0)
81	7.02E+01	24,07/01/94	(402200, 6511100,	0.0)
82	7.01E+01	24,15/03/94	(401000, 6510900,	0.0)
83	6.94E+01	24,05/01/94	(402200, 6511100,	0.0)
84	6.92E+01	24,17/03/94	(402400, 6511100,	0.0)
85	6.88E+01	24,12/04/94	(401200, 6509700,	0.0)
86	6.80E+01	24,22/04/94	(402400, 6511100,	0.0)
87	6.79E+01	24,16/04/94	(402000, 6511500,	0.0)
88	6.78E+01	24,16/01/94	(402200, 6511300,	0.0)
89	6.77E+01	24,20/01/94	(401000, 6510900,	0.0)
90	6.75E+01	24,12/08/94	(401000, 6510700,	0.0)
91	6.75E+01	24,03/02/94	(402200, 6511100,	0.0)
92	6.75E+01	24,11/05/94	(402400, 6511100,	0.0)
93	6.72E+01	24,24/12/94	(402400, 6511100,	0.0)
94	6.70E+01	24,07/05/94	(401000, 6511500,	0.0)
95	6.70E+01	24,02/04/94	(401200, 6510500,	0.0)
96	6.69E+01	24,27/11/94	(402400, 6511100,	0.0)
97	6.66E+01	24,04/01/94	(402400, 6511300,	0.0)
98	6.63E+01	24,07/08/94	(401200, 6510300,	0.0)
99	6.63E+01	24,08/09/94	(401200, 6510300,	0.0)
100	6.60E+01	24,17/09/94	(401000, 6511100,	0.0)

Appendix 2 Ausplume parameters for shed odour emissions

1

Poultry Litter Power Plant (Odour)

Concentration or deposition	Concentration
Emission rate units	OUV/second
Concentration units	Odour_Units
Units conversion factor	1.00E+00
Constant background concentration	0.00E+00
Terrain effects	None
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file)	0.000
Anemometer height	10 m
Roughness height at the wind vane site	0.250 m

DISPERSION CURVES

Horizontal dispersion curves for sources <100m high	Pasquill-Gifford
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	No
Enhance vertical plume spreads for buoyancy?	No
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.200m
Adjustment for wind directional shear	None

PLUME RISE OPTIONS

Gradual plume rise?	Yes
Stack-tip downwash included?	No
Building downwash algorithm:	Schulman-Scire method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	Yes

and in the absence of boundary-layer potential temperature gradients
given by the hourly met. file, a value from the following table
(in K/m) is used:

Wind Speed Category	Stability Class A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 0.75, 1.50, 3.00, 6.00, 9.00

WIND PROFILE EXPONENTS: "Irwin Rural" values (hourly met. file values IGNORED)

AVERAGING TIME: 3 minutes.

1

Poultry Litter Power Plant (Odour)

SOURCE CHARACTERISTICS

VOLUME SOURCE: SHED

X(m)	Y(m)	Ground Elevation	Height	Hor. spread	Vert. spread
400744	6510427	0m	8m	10m	4m

Emission rates by stability and wind speed, in OUV/second:

Wind speeds (m/s):	< 0.8	0.8_ 1.5	1.5_ 3.0	3.0_ 6.0	6.0_ 9.0	> 9.0
Stability A:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04
Stability B:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04
Stability C:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04
Stability D:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04
Stability E:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04
Stability F:	1.61E+04	4.12E+04	5.38E+04	5.38E+04	5.38E+04	5.38E+04

No gravitational settling or scavenging.

1

Poultry Litter Power Plant (Odour)

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
399500.m 399600.m 399700.m 399800.m 399900.m 400000.m 400100.m
400200.m 400300.m 400400.m 400500.m 400600.m 400700.m 400800.m
400900.m 401000.m 401100.m 401200.m 401300.m 401400.m 401500.m
401600.m 401700.m 401800.m 401900.m 402000.m 402100.m 402200.m
402300.m 402400.m 402500.m

and these y-values (or northings):
6509000.m 6509100.m 6509200.m 6509300.m 6509400.m 6509500.m 6509600.m
6509700.m 6509800.m 6509900.m 6510000.m 6510100.m 6510200.m 6510300.m
6510400.m 6510500.m 6510600.m 6510700.m 6510800.m 6510900.m 6511000.m
6511100.m 6511200.m 6511300.m 6511400.m 6511500.m 6511600.m 6511700.m
6511800.m 6511900.m 6512000.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT	No.	X	Y	ELEVN	HEIGHT
1	400098	6511673	0.0	0.0	6	400031	6511945	0.0	0.0
2	400122	6511531	0.0	0.0	7	400056	6511769	0.0	0.0
3	400476	6511461	0.0	0.0	8	401551	6507932	0.0	0.0
4	399583	6512926	0.0	0.0	9	401912	6508091	0.0	0.0
5	399555	6512804	0.0	0.0					

METEOROLOGICAL DATA : Caversham 1994 Blockley 271200. Read ca94aus.rea for

---

Appendix 3 Characteristics of poultry litter ash

January 05, 2001

Dear Mr Rosser

In reply to your facsimile dated 4th December 2000, I can provide the following information.

The ash material has a high nutrient content in terms of phosphorus (P) and potassium (K), with ash contents of these nutrients over 9% on a weight basis. There are smaller concentrations of Ca, Mg and S that are also essential nutrients for crops. In addition, the material contains useful concentrations of copper (Cu) and zinc (Zn) that are essential micronutrients for crops.

Assuming the material is to be used as a phosphatic fertiliser, typical application rates to soils would vary depending on the agricultural system into which the ash is marketed. The material has a similar P concentration to that found in single super-phosphate, and after supplementation with additional sulphur (S), would probably find a useful market in the pasture and grazing industries.

Typical application rates for P fertilisers on pastures vary from 5-30 kg P/ha/yr, so that likely application rates for the ash material are in the range 55-330 kg/ha/yr.

Concentrations of heavy metals as noted in your facsimile were as follows:

Arsenic (As) 45 mg/kg

Cadmium (Cd) 0.5 mg/kg

Chromium (Cr) 7 mg/kg

Copper (Cu) 400 mg/kg

Mercury (Hg) < 0.05 mg/kg

Lead (Pb) 11 mg/kg

Nickel (Ni) 12 mg/kg

Zinc (Zn) 1400 mg/kg

It has been suggested by the WA Department of Environmental Protection that a Toxicity Characteristic Leaching Procedure (TCLP) test be performed on the material. I believe this to be an inappropriate procedure to assess risks from heavy metals in the material when it is used as a fertiliser on agricultural soils. The TCLP test (US EPA Method 1311) is designed to simulate the leaching a waste will undergo if disposed to a landfill. As pointed out in the USA EPA notes to this procedure "the test is designed to simulate leaching that takes place in a sanitary landfill only". It involves the extraction of the waste with acetic acid for 18 hours. Such a procedure is inappropriate to assess the suitability of a material when the intended use is on agricultural soils for crop and animal production.

In terms of use on agricultural soils, the heavy metal of most concern is cadmium (Cd), due to the possibility of transfer of this element through the food chain. All States in Australia have regulations governing concentrations of impurities in fertilisers or soil amendments. For example in Western Australia, concentrations of cadmium (Cd) in fertilisers are covered under the Fertiliser Act (1977) amendments 1984, where a phosphatic fertiliser cannot contain in excess of 500 mg Cd per kg P (due to be reduced to 300 mg Cd/kg P in the near future). Under the Act, the ash material would be classed as a phosphatic fertiliser, with the Cd concentration on a per unit P basis around 5 mg Cd/kg P, almost 100 times lower than the present limit value as prescribed under the

Fertiliser Act. Indeed, this ash material has a lower Cd concentration that most other manufactured phosphatic fertilisers marketed in Australia and could be classed as an extremely "clean" product from a cadmium viewpoint.

In terms of other heavy metals, the following comments apply.

Arsenic - As concentrations in fertilisers are currently not regulated in WA or any other State. Typical concentrations of As in commercially used phosphate rocks for fertiliser manufacture vary from 5 to 200 mg/kg, but are usually less than 10 mg/kg. Typical concentrations of As found in unpolluted agricultural soils vary from 1-20 mg/kg. Amounts of As added to agricultural soils through use of bisolids (sewage sludge) are regulated in some States (no guidelines available yet in WA). Maximum permitted concentrations of As in biosolids used on soils for food production are generally set at a value of 20 mg/kg in most States, recognising that biosolids are added to soil in large amounts (usually several tonnes per hectare). South Australia has an annual loading limit of 70 g/ha.

Assuming the poultry litter ash is added at a maximum rate of 400 kg/ha, which would be considered a high rate of P application (37 kg P/ha) not required each and every year to most pasture soils, annual loadings of As to soils would be 18 g/ha.

This figure is well under the SA annual loading limit for biosolids. Assuming a typical WA soil has a background As concentration of 5 mg/kg, it would take over 360 years of repeated annual applications of poultry ash to double the background As concentration. It would take over 1000 years to raise the soil concentration to the current Environmental Investigation Level (20 mg/kg) as determined by the recent National Environmental Protection Measure (NEPM), or until the amounts of As added exceeded the Cumulative Contaminant Loading Limit for As as set out in the National Water Quality Management Strategy Guidelines for agricultural irrigation water quality. Thus, it appears that As in the material is not a major threat to soil or food quality.

Chromium, mercury, lead and nickel - concentrations are low enough in the material to ignore in terms of environmental or food chain risks. Concentrations of these elements are within the range of normal concentrations currently found in agricultural soils. Copper and zinc - these elements are essential micronutrients often added as a supplement to other

fertilisers at 0.1% to 1% levels. The concentrations in the poultry ash are therefore of no concern but add to the commercial value of the product. If you wish to discuss any of the above information, please do not hesitate to call me on 08 8303 8433 or 0409 693 906.

Sincerely

Dr M.J. McLaughlin

Dr M.J.McLaughlin

National Cadmium Coordinator/Research Group Leader

CSIRO Land and Water

PMB 2

Glen Osmond

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Mob: 0409 693 906

http://www.waite.adelaide.edu.au/Soil_Water/McLaughlin/MikeMc%20Laugh.html

Appendix 4 Sulphur retention in ash

| Matthew,
|
| We have a chicken litter sample and have commenced the a fluorine
analysis.
|
|
| The cost for the analysis plus some words from me will be $250.00 (HRL
| Technology Quotation Number T17261)
|
| I have looked at a couple of chicken litter ash analyses including the
| analysis we did for you in March 2000.
|
| Chicken litter ash has around 0.5% S (db) and a high ash content ~15% (db)
| The main ash components (as oxide) are CaO, K2O, P2O5.
| There is a large excess of Ca over S (6:1 on a mass basis) therefore we
| would expect that some of the sulphur will be captured by the Ca during
| combustion. In the laboratory ash sample, about 75% of the sulphur was
| retained in the ash. Laboratory ash samples tend to have higher levels of
| sulphur retention than found in actual combustion systems. The Ca in the
| ash will also have a tendency to form calcium phosphates which may limit
| sulphur retention. Overall I would expect of the order of 30% sulphur
| capture by the ash. I may have some reported data on sulphur retention in
| chicken litter ash.
|
| Regarding in combustor injection for S control. There is also risk that
| such a technology may reduce combustion efficiency (and increase other

| emissions). In combustor sulphur capture is typically only used for
| fluidised-bed systems. Wet or dry stack scrubbing is generally used for
| other combustion systems.
|
| I will also check on PAH and VOC's
|
| Note that the National Guideline for F emission is 0.05g/m3 as HF except
for
| manufacture of aluminium from alumina 0.02g/m3 as HF. This value is also
| used by all states and is very much higher than your target of 0.0006g/m3.
| I have also seen this number and need to track its source. I believe it
is
| based on an actual measurement of HF in a chicken litter facility.
|
|
| regards
|
| Tony
|
|
| ----------
| Anthony Campisi PhD
| Senior Research Scientist
| Combustion, Gasification, Ash Fouling, Process Chemistry
| HRL Technology Pty Ltd
| 677 Springvale Road, Mulgrave, Victoria, Australia 3170
| Telephone: +61 3 9565 9760
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| Mobile: 0409 550 982

| e-mail: campa@hrl.com.au

| WWW: http://www.hrl.com.au

| ----------

ATTACHMENT 1

TO

REVISED AIR QUALITY ASSESSMENT FROM PROPOSED POULTRY LITTER-FIRED POWER STATION, MUCHEA

DISPERSION MODELLING OF DIOXIN EMISSIONS FROM PROPOSED POULTRY LITTER FIRED POWER STATION AT MUCHEA

DRAFT

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1. INTRODUCTION

Blair Fox Generation WA Pty Ltd have engaged Environmental Alliances to model the dispersion of polychlorinated dibenzo-p-dioxins (CDDs) and polychlorinated dibenzofurans (CDFs) emissions from a proposed poultry litter fired power station (PLFPS) in Muchea together with those from the nearby Tiwest synthetic rutile production facility.

2. METHODOLOGY FOR PREDICTING DISPERSION OF CDD/FS

Since the late 1970's, it has become well established that the combustion of certain fuels containing both organic material and chlorides can form polychlorinated dibenzo-p-dioxins (CDDs) and polychlorinated dibenzofurans (CDFs). This discovery has prompted world-wide research to identify combustion sources, to characterise the conditions favouring the formation of CDD/Fs within the combustion process, and to characterise the emission of dioxin-like compounds to the air from the stack of the process.

In the report, CDD/Fs refers to the 17 substances (CDD/F congeners) listed in Appendix 1.

Each dioxin congener has a unique WHO assigned toxicity equivalency factor (TEF). The measurement of dioxins as a whole is expressed in mass units of toxicity equivalents (TEQ).

There are two significant references containing methodologies for the dispersion modelling and health risk assessment from dioxins:

- U.S. EPA, 1998, "Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities - Peer Review Draft", EPA530-D-98-001A, July 1998.
- U.S. EPA, 2000, "Estimating Exposure to Dioxin-Like Compounds - DRAFT".

The U.S. EPA (1998) document was developed by staff of the U.S. EPA Region 6 with contributions from staff throughout the USEPA. The main purpose of the document is to present a user-friendly set of procedures for performing risk assessments, including a complete explanation of the basis of those procedures and a comprehensive source of data needed to complete those procedures.

The U.S. EPA (2000) document has the words "Draft - Do Not Quote or Cite" on each page and the Web link has the following notice:

> *NOTICE: THESE DOCUMENTS ARE PRELIMINARY DRAFTS. They have not been formally released by the U.S. Environmental Protection Agency and should not at this stage be construed to represent Agency policy or factual conclusions. These documents are being provided now for review to EPA's Science Advisory Board. They should not be cited or referred to as EPA's final assessment of dioxin risks.*

The reason for emphasising these issues is to point out that these neither document represents formal U.S. EPA guidance for health risk assessment from dioxins although many aspects of the dispersion modelling follow regulatory approaches described in 40 CFR Part 51 Appendix W –"Guideline On Air Quality Models"[1] (U.S. Federal Register 1999).

[1] This is proposed to be replaced by 40 CFR Part 51 – "Requirements for Preparation, Adoption, and Submittal of State Implementation Plans (Guideline on Air Quality Models); Proposed Rule" (U.S. Federal Register 2000)).

This are considerable similarities in the air dispersion methodologies presented in both documents. The main difference is that the former document does not contain a procedure for partitioning congeners between the vapour fraction and those adsorbed onto airborne particles.

The methodologies in the above-mentioned documents have been used for predicting the dispersion of CDD/Fs from the PLFPS proposal because:

- They are extremely comprehensive and appear to represent the current state of knowledge in terms of dioxin health risk assessment; and
- The USEPA (1998) methodology was followed for the assessment of the Global Olivine Waste to Energy and Water Plant at Kwinana carried out in 2000 (Stevenson 2000). This proposal subsequently received environmental approval from the Environmental Protection Authority (EPA 2001).

In brief, the methodology for evaluating the emission of dioxin-like compounds from stationary combustion sources is:

- characterise stack emissions in terms of mass of each CDD/F congener released,
- partition that release into a vapour and a particle phase.
- use a dispersion model to estimate ambient air vapour and particle phase concentrations, and wet and dry particulate deposition amounts, in the vicinity of the release.
- estimate human health risk using a multi pathway exposure approach.

The latter step is described in a companion document to this one – "Health Risk Assessment – Dioxin" authored by Dingle & Bird Environmental Pty Ltd.

3. DISPERSION MODEL

The dispersion model used for this assessment is ISC3-Prime, developed by the U.S. EPA.

ISC3-Prime is the ISC3 model with an improved building downwash algorithm and proposed to be a U.S. EPA-approved regulatory model (U.S. Federal Register, 2000).

ISC3-Prime is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial source complex. This model can account for the following:

- settling and dry deposition of particles;
- building downwash;
- area, line and volume sources;
- plume rise as a function of downwind distance;
- building dimensions and stack placement with respect to a building;
- separation of point sources;
- and limited terrain adjustment.

ISC3-Prime is considered by the U.S. EPA to be appropriate for the following applications:

- Industrial source complexes where aerodynamic downwash or deposition is important; ·
- Rural or urban areas; ·

- Flat or rolling terrain; ·
- Transport distances less than 50 kilometres; ·
- 1-hour to annual averaging times; and ·
- Continuous toxic air emissions.

The above conditions are met for the PLFPS situation. The use of ISC3-Prime has also been endorsed by the Department of Environmental Protection.

4. VAPOUR/PARTICLE PHASE PARTITIONING

In the environment, each CDD/F congener may be present in vapour and particle phases.

This is important from the viewpoint of modelling dispersion because each phase will be subject to different deposition processes.

The U.S. EPA (2000) report extensively evaluated stack testing results, ambient monitoring and theoretical approaches for estimating vapour/particle partitioning. The following is a very abbreviated account of this discussion.

Stack testing results

The report concluded that stack testing results of vapour/particle partitioning were found to be contradictory and inconclusive. Hence these data were unable to be used to infer the V/P distributions of CDD/Fs at the point of release from the stack.

Ambient monitoring

The monitoring of CDD/Fs in ambient air is conventionally undertaken using a high volume air sampler. Ambient air is drawn at a high flow rate over a24 hour period, through a glass fibre filter for the collection of particles followed by a polyurethane foam absorbent traps for the collections of vapours. The U.S. EPA (2000) report concluded that while this method reliably ensured the collection and retention of CDD/Fs, estimated of V/P rations were subject to the following uncertainties:

- the glass fibre filter can potentially allow particles ≤ 0.1 micron in diameter to pass through, in which case the particle fraction will be underestimated; and
- the combination of high air velocities and temperature changes could cause a portion of the particle phase CDD/Fs initially trapped on the glass filter to volatilise and carry through to the polyurethane trap, in which case the particle fraction will again be underestimated.

Theoretical approaches

The most widely accepted theoretical estimation for estimating the adsorption of CDD/Fs to aerosols is the Junge-Pankow model:

$$\Phi = \frac{c\,\Theta}{p^{\circ}_{L} + c\,\Theta}$$

where:

Φ = fraction of the compound adsorbed due to aerosol particles.

$p°_L$ = saturation liquid phase vapour pressure of the pure compound at ambient temperature (Pa).

θ = the particle surface area per unit volume of air (cm^2 aerosol/cm^2 air).

c = a constant which is related to the difference between the heat of desorption from the particle surface and the heat of vaporisation of the compound. The value of c is often estimated at 17.2 Pa-cm.

Recommended approach

Comparisons between ambient monitoring data from a number of sources with predictions from the Junge-Pankow model showed measured particle bound fractions consistently below those predicted by the model. For example, the particle-bound percentages of tetrachlorodioxins and furans, which were predicted to be 43-65% at 20° , averaged only 11-18% using the high volume filter-sorbant sampler. It was considered that the discrepancies may be related to both sampling artefacts (of the form described previously) and model uncertainties. The latter include:

- uncertainties in the assumed value for c – this is likely to be compound-specific, however, the report considered that insufficient experimental data existed to justify an alternative to assuming a constant value;
- uncertainties in θ - the best estimated values are still based on assumptions relating to particle size distributions and particles being spherical, and neither adsorption/desorption kinematics nor humidity effects are taken into account.

The U.S. EPA (2000) report ultimately concluded that neither ambient sampling nor the Junge-Pankow model necessarily give the "correct" V/P distributions. Nevertheless, the report recommended the use of the Junge-Pankow model because it reproduces the general trend in partitioning with vapour pressure and was used in an air-to-beef model validation[2].

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[2] As described in the text, the relative concentration of each congener in each phase is dependent on the specific properties of the congener (eg molecular weight), temperature and concentration of particles. The properties of the congener are constant.

For dispersion modelling in this study – following the USEPA (2000) methodology, the V/P ratios of each congener are based on those at ambient temperature.

When dioxins are actually emitted to the environment from a (hot) combustion source, the V/P ratios will vary as the emission cools. The initial parameter which most strongly affects V/P partitioning is temperature. It follows that partitioning has not stabilised until the plume has reached ambient temperature. This is about the time that final plume rise has been achieved. The USEPA (2000) methodology suggest that, from this time, partitioning depends on particle concentrations. The USEPA recommends these be based on ambient TSP.

It would appear more logical that once ambient temperature is reached, partitioning is based on the particle concentration at that time - assuming that further dilutions of the plume particle concentrations, culminating in the "ambient" concentrations, do not change the V/P ratio (ie in other words the liquid and vapour phases of the congener have truly reached equilibrium). Notwithstanding this assumption, this approach would then be consistent with the weighting of particle CDD/Fs adsorbed to plume particles based on the distribution of particle sizes within the plume (ie rather than ambient particle size distributions).

The apparent effect of the USEPA (2000) methodology for determining V/P ratios could be to potentially underestimate how much CDD/Fs is particulate bound in the "near-field" from a source. However, the methodology would tend towards bringing predicted V/P ratios closer to ambient monitoring data in the "far-field".

Some researchers suggest that partitioning is still very depended on ambient temperature eg Bidleman (1988) suggests that the percentage of particle-bound TCDD is 85% at 12C, falling to 51% at 25C. Monitoring results described in Koester and Hites (1992) support this.

A further theoretical complication is the assumption that all compounds emitted from combustion sources are freely exchangeable. A number of researchers actually consider that while a portion of the semivolatile compounds found in ambient air does appear to be freely exchangeable between the particulate and gaseous phases, a second portion (the "non-exchangeable" fraction) may be irreversibly sorbed or occluded by the aerosols and not in equilibrium with the corresponding gas phase (p3-26).

The determination of V/P ratios for this study requires θ and values of $p°_L$ for each congener.

The particle surface area per unit volume of air (θ) is based on background particle concentrations.

Tiwest have provided monthly data of Total Suspended Particulates (TSP) concentrations measured in Muchea between August 1989 and March 2002. The average TSP concentration from these measurements is 22 $\mu g/m^3$. This gives a value of 6.7 x 10^{-7} cm^2 aerosol/cm^3 air for θ.

Values of $p°_L$ for each congener are given in U.S. EPA (2000).

The V/P ratios determined for each congener are shown in Table 1.

Table 1 CDD/F congener properties and V/P ratios for Muchea environment

Congener	TEF	Liquid sub-cooled vapour press @20C ($p°_L$) (Pa)	Junge-Pankow model	
			Particle fraction	Vapour fraction
2,3,7,8-TCDD	1	6.34E-05	0.487	0.513
1,2,3,7,8-PeCDD	1	9.3E-06	0.866	0.134
1,2,3,4,7,8-HxCDD	0.1	2.03E-06	0.967	0.033
1,2,3,6,7,8-HxCDD	0.1	2.03E-06	0.967	0.033
1,2,3,7,8,9-HxCDD	0.1	2.03E-06	0.967	0.033
1,2,3,4,6,7,8-HpCDD	0.01	5.1E-07	0.992	0.008
OCDD	0.0001	1.34E-07	0.998	0.002
2,3,7,8-TCDF	0.1	6.81E-05	0.469	0.531
2,3,4,7,8-PeCDF	0.5	1.17E-05	0.837	0.163
1,2,3,7,8-PeCDF	0.05	1.98E-05	0.753	0.248
1,2,3,4,7,8-HxCDF	0.1	4.25E-06	0.934	0.066
1,2,3,6,7,8-HxCDF	0.1	4.25E-06	0.934	0.066
2,3,4,6,7,8-HxCDF	0.1	2.58E-06	0.959	0.041
1,2,3,7,8,9-HxCDF	0.1	2.58E-06	0.959	0.041
1,2,3,4,6,7,8-HpCDF	0.01	1.14E-06	0.981	0.019
1,2,3,4,7,8,9-HpCDF	0.01	6.58E-07	0.989	0.011
OCDF	0.0001	1.24E-07	0.998	0.002

Particle phase congeners will be subject to gravitation settling – unlike the gaseous phase constituents. Therefore, the dispersion patterns of particles will differ to those of the vapours.

The implication of unique TEFs and vapour/particle ratios for each congener is the dispersion of each congener from each source must be modelled separately if individual congener concentrations/depositions are required for risk assessment.

The estimation of environmental risks from dioxins exposure requires, the output from dispersion modelling to address, across the receptor grid:

In summary, it should be recognised that while the USEPA methodology is likely to be the best available for estimating partitioning of CDD/Fs for dispersion modelling, there are still considerable uncertainties in this area.

- vapour phase concentrations;
- particle phase concentrations; and
- particle phase depositions.

Modelling the dispersion of each congener individually would be an onerous task. A simpler approach is to make use of the proportionality between mass emission rates and predicted ambient concentrations, in accordance with the following steps:

1. Model annual average vapour phase concentrations from each source using a unitary emission rate and no wet or dry deposition.
2. Model annual average particle phase airborne concentrations and depositions from each source using a unitary emission rate and wet plus dry deposition.
3. Combine predicted average concentration and depositions at each receptor, adjusting for actual emission rates from each source.

As an illustration, the modelling methodology for vapour phase congeners is outlined in Figure 1. The derivation of the values in the Figure is described in the following Sections.

5. EMISSIONS PARAMETERS

5.1 POULTRY LITTER FIRED POWER STATION

The concentration of dioxin congeners in the emissions from the proposed PLFPS are based on sampling results from a similar facility in the UK (Kendall, 1995). These emissions are uncontrolled for dioxins. The derivation of the CDD/F emission data for the proposed PLFPS from the UK facility data is shown in Table 2.

Table 2 CDD/F emission data from proposed poultry litter fired power station

Congener	Uncontrolled concentration (ng/m^3)[(a)]	Uncontrolled concentration (ng/dry Nm^3) [(b)]	Uncontrolled emission rate for PLFPS (ng/s)
2,3,7,8-TCDD	0.01	0.018	0.33
1,2,3,7,8-PeCDD	0.015	0.027	0.49
1,2,3,4,7,8-HxCDD	0.03	0.055	0.98
1,2,3,6,7,8-HxCDD	0.03	0.055	0.98
1,2,3,7,8,9-HxCDD	0.03	0.055	0.98
1,2,3,4,6,7,8-HpCDD	0.1	0.183	3.28
OCDD	0.58	1.062	19.00
2,3,7,8-TCDF	0.07	0.128	2.29
2,3,4,7,8-PeCDF	0.1	0.183	3.28
1,2,3,7,8-PeCDF	0.12	0.220	3.93
1,2,3,4,7,8-HxCDF	0.3	0.549	9.83
1,2,3,6,7,8-HxCDF	0.14	0.256	4.59
2,3,4,6,7,8-HxCDF	0.09	0.165	2.95
1,2,3,7,8,9-HxCDF	0.03	0.055	0.98
1,2,3,4,6,7,8-HpCDF	0.47	0.860	15.40
1,2,3,4,7,8,9-HpCDF	0.05	0.092	1.64
OCDF	0.86	1.574	28.18

[(a)] As measured based on Eye power plant. Stack conditions were 194C, 6.9% O_2, 7% H_2O. The concentration of congeners reported at below the detection limit was assumed to 50% of the limit.
[(b)] At 6.9% O_2.

The emissions from the proposed PLFPS are, however, proposed to be scrubbed for dioxins. It has been assumed that the average scrubbing efficiency is a uniform 90% for each congener and phase. The emissions concentrations for various assumptions for baghouse availability are illustrated in Table 3.

Table 3 Proposed facility emission concentration

Operating conditions	Emission concentration (ng I-TEQ/dry Nm^3 at 11% O_2)
Raw gas – baghouse off-line	0.208
Assuming 100% baghouse availability[(a)]	0.021
Assuming 95% annual availability of baghouse[(a)]	0.030
Assuming 90% annual availability of baghouse[(a)] (Worst case)	0.040

[(a)] Baghouse scrubbing efficiency assumed to be 90%.

The emissions assumed for this study are based on the "worst case" annual baghouse availability of 90% and a scrubbing efficiency (ie while the scrubber is operational) of 90%. The mass emission rates of each congener for the PLFPS based on measurements from the UK facility and adjusted for this level of control are shown in Table 4.

Table 4 CDD/F emissions from proposed poultry litter fired power station

Congener	Emission rates for baghouse at 90% efficiency and 90% availability			
	Mass emission rate (ng/s)	Emission concentrations (ng I-TEQ/Nm3)	Vapour emission rates (ng I-TEQ/s)	Particle emission rates (ng I-TEQ/s)
2,3,7,8-TCDD	0.06	0.003	0.053	0.010
1,2,3,7,8-PeCDD	0.09	0.005	0.042	0.052
1,2,3,4,7,8-HxCDD	0.19	0.001	0.003	0.016
1,2,3,6,7,8-HxCDD	0.19	0.001	0.003	0.016
1,2,3,7,8,9-HxCDD	0.19	0.001	0.003	0.016
1,2,3,4,6,7,8-HpCDD	0.62	0.000	0.000	0.006
OCDD	3.61	0.000	0.000	0.000
2,3,7,8-TCDF	0.44	0.002	0.037	0.006
2,3,4,7,8-PeCDF	0.62	0.017	0.157	0.154
1,2,3,7,8-PeCDF	0.75	0.002	0.024	0.014
1,2,3,4,7,8-HxCDF	1.87	0.010	0.050	0.136
1,2,3,6,7,8-HxCDF	0.87	0.005	0.023	0.064
2,3,4,6,7,8-HxCDF	0.56	0.003	0.010	0.046
1,2,3,7,8,9-HxCDF	0.19	0.001	0.003	0.015
1,2,3,4,6,7,8-HpCDF	2.93	0.002	0.003	0.027
1,2,3,4,7,8,9-HpCDF	0.31	0.000	0.000	0.003
OCDF	5.35	0.000	0.000	0.001
Total	**18.8**	**0.055[(a)]**	**0.41**	**0.58**

[(a)] To be < 0.1 ng I-TEQ/dry Nm^3 at 11% O_2

5.2 TIWEST

There was no data available on the relative concentrations of the dioxin congeners in the Tiwest emissions since testing of the Kiln Stack did not detect any dioxins. As a conservative measure, it was assumed for this study that CDD/F emissions from the Tiwest stack were one-half of the detection limit of the stack testing - this gives 0.034 ng I-TEQ/Nm^3. Dioxin congener concentrations were therefore estimated from the relative concentrations of dioxin congeners in incinerator emissions published in U.S. EPA (2000), adjusted to give the one-half of the detection limit I-TEQ concentration. The estimated congener emission concentrations and rates from Tiwest are shown in Table 5.

Table 5 Estimated CDD/F congener emission concentrations from Tiwest

Congener	Emission concentration[(a)] (ng I-TEQ/Nm^3)	Emission rate[(a)] (ng I-TEQ/s)
2,3,7,8-TCDD	0.0019	0.0326
1,2,3,7,8-PeCDD	0.0040	0.0682
1,2,3,4,7,8-HxCDD	0.0005	0.0088
1,2,3,6,7,8-HxCDD	0.0007	0.0117
1,2,3,7,8,9-HxCDD	0.0008	0.0128
1,2,3,4,6,7,8-HpCDD	0.0007	0.0116
OCDD	0.0000	0.0002
2,3,7,8-TCDF	0.0125	0.2130
2,3,4,7,8-PeCDF	0.0066	0.1118
1,2,3,7,8-PeCDF	0.0004	0.0068
1,2,3,4,7,8-HxCDF	0.0019	0.0325
1,2,3,6,7,8-HxCDF	0.0018	0.0307
2,3,4,6,7,8-HxCDF	0.0007	0.0118
1,2,3,7,8,9-HxCDF	0.0012	0.0202
1,2,3,4,6,7,8-HpCDF	0.0002	0.0041
1,2,3,4,7,8,9-HpCDF	0.0001	0.0018
OCDF	0.0000	0.0001
Total	**0.034**	**0.5788**

[(a)] Based on a zero measured emissions therefore one-half of the sampling detection limit.

Note that the estimated congener distribution in the Tiwest emissions is different to that in the PLFPS emissions. The Tiwest I-TEQ emission rate is about one-half that of the PLFPS.

The V/P ratios were determining using the same partitioning approach as for the PLFPS emissions.

6. DISPERSION MODEL DATA AND MODELLING ASSUMPTIONS

6.1 METEOROLOGICAL DATA

The dispersion modelling approach using ISC3-Prime requires continuous site-representative data of wind speed, wind direction, temperature, mixing height, stability class, friction velocity, Monin-Obukhov length, roughness length and rainfall.

A suitable data set has been produced by the DEP using data form its Caversham air monitoring stations and was used for this study. The roughness length assumed for the derived turbulence parameters in the file was 0.2 metres hence this is implicitly assumed to be the roughness for the site. This may be a little conservative compared to generic roughness lengths recommended for various land use types.

6.2 DEPOSITION

Deposition refers to dry and wet removal processes that may deposit vapour and particulate-phase air contaminants emitted from a source back to the Earth's surface.

The ISC3-Prime model contains a sophisticated set of algorithms for dry and wet deposition. These are detailed in the model User's Guide (USEPA 1998).

6.3 DRY DEPOSITION OF GASES

Although the dry gaseous deposition of vapour-phase contaminants is also potentially considered in the ISC3-Prime model, the U.S. EPA (2000) report considers that this feature has not been calibrated for the estimation of the deposition flux of dioxin-like compounds into vegetation and that "until the algorithm has been verified to make reasonably accurate estimates of gaseous deposition of dioxin-like compounds, this guidance will not incorporate examples of it's site-specific application". Consequently, dry deposition of the vapours phase CDD/Fs have not been modelled in this study.

6.4 PARTICLE DEPOSITION

Particle size is the main determinant of the fate of particles in air flow, whether dry or wet. The key to dry particle deposition rate is the terminal, or falling, velocity of a particle. Particle terminal velocity is calculated mainly from the particle size and particle density. Large particles fall more rapidly than small particles and are deposited closer to the stack. Small particles have low terminal velocities, with very small particles remaining suspended in the air flow. Wet particle deposition also depends on particle size as larger particles are more easily removed, or scavenged, by falling liquid (rain) or frozen (snow or sleet) precipitation.

6.5 DRY DEPOSITION OF PARTICLES

Dry deposition in this study refers to the transfer of airborne particulate matter to the Earth's surface (including water, soil, and vegetation) whereby it is removed from the atmosphere.

The dry deposition flux, F_d, for particles is calculated as the product of the concentration, χ_d, and a deposition velocity, v_d, computed at a reference height z_d:

$$F_d = \chi_d \bullet v_d$$

A resistance method is used to calculate the deposition velocity, v_d. The general approach used in the resistance methods for estimating v_d is to include explicit parameterisations of the effects of Brownian motion, inertial impaction, and gravitational settling. The deposition velocity is written as the inverse of a sum of resistances to pollutant transfer through various layers, plus gravitational settling terms:

$$v_d = \frac{1}{r_a + r_d + r_a r_d v_g} + v_g$$

where,

v_d = the deposition velocity (cm/s),

v_g = the gravitational settling velocity (cm/s),

r_a = the aerodynamic resistance (s/cm), and,

r_d = the deposition layer resistance (s/cm).

The model requires the mass mean diameters (microns), particle densities (gm/cm^3), and the mass fractions for each particle size category being modelled, and the surface roughness length (cm), friction velocity (m/s), and Monin-Obukhov length (m).

6.6 WET DEPOSITION

A scavenging ratio approach is used to model the deposition of gases and particles through wet removal. In this approach, the flux of material to the surface through wet deposition (F_w) is the product of a scavenging ratio times the concentration, integrated in the vertical:

$$F_w(x, y) = \int_o^\infty \Lambda \, \chi(x, y, z)\, dz$$

where the scavenging ratio (Λ) has units of s^{-1}.

The scavenging ratio is computed from a scavenging coefficient and a precipitation rate:

$$\Lambda = \lambda \bullet R$$

where the coefficient λ has units $(s\text{-}mm/hr)^{-1}$, and the precipitation rate R has units (mm/hr).

The scavenging coefficient depends on the characteristics of the pollutant (eg. solubility and reactivity for gases, size distribution for particles) as well as the nature of the precipitation (eg., liquid or frozen).

For vapours, the U.S. EPA (1998) suggests that there are insufficient data available to adequately develop pollutant-specific wet scavenging coefficients. It may, however, be possible to estimate wet scavenging of vapours by assuming they are scavenged at the rate of the smallest particles with behaviour in the atmosphere that is assumed to be influenced more by the molecular processes that affect vapours than by the physical processes that may dominate the behaviour of larger particles. In this case, a scavenging coefficient for a 0.1 μm particle may be input to simulate wet scavenging of very small (molecular) particles. Alternatively, site-specific measured wash-out data or a calculation based on Henry's Law constant could possibly also be used.

The U.S. EPA (2000) report suggests that vapour scavenging is generally not well understood and did not consider wet scavenging of vapours in modelling the dispersion of CDD/Fs. At this stage, the wet scavenging of vapours has not been considered in this study.

6.7 MODELLING PARAMETERS

6.7.1 Particle sizes

As described above, the dispersion of the congeners in particle phase was modelled assuming wet and dry deposition. The dry deposition of particles is determined using deposition velocities based on a resistance model. The particle characteristics required are size and density. Wet removal of particles is determined using scavenging coefficients and precipitation rates.

The distribution of particles by particle diameter in emissions will differ from one combustion process to another, and is greatly dependent on:

- the type of furnace,
- the design of the combustion chamber,

- the composition of the feed fuel,
- the particulate removal efficiency,
- the design of the air pollution control system/s,
- the amount of air in excess of stoichiometric amounts that is used to sustain combustion, and
- the temperature of combustion.

Hence, particle size distributions cannot be calculated, but only directly measured or inferred from prior data. Commensurately, the Client has advised that the these data cannot be provided by the PLFPS design engineers.

Few studies have been performed to directly measure particle size distributions from a variety of stationary combustion sources. The particle size distribution used for this study is that recommended by the U.S. EPA (1998) where site specific data are not available. These data are considered suitable for combustion facilities equipped with either ESPs or fabric filters, and are shown in Table 6.

The U.S. EPA (1998) suggests that a minimum of three particle size categories (> 10 microns, 2-10 microns, and < 2 microns) are required for air modelling. In view of the reliance on theoretical data, it does not appear justified to use more categories than this for this study.

Table 6 Generalised particle size distributions where site-specific data are unavailable

U.S. EPA (1998) default values						Aggregated		
Mean Particle Diameter (μm)	Particle Radius (μm)	Surface Area/ Volume (μ/m)	Fraction of Total Mass	Proportion of Available Surface Area	Fraction of Total Surface Area	Particle Diameter range (μm)	Mean Particle Diameter (μm)	Fraction of Total Surface Area(%)
>15.0	7.50	0.400	0.128	0.0512	0.0149	> 10	20	87.5
12.5	6.25	0.480	0.105	0.0504	0.0146			
8.1	4.05	0.741	0.104	0.0771	0.0224	> 2 to ≤ 10	6.78	9.5
5.5	2.75	1.091	0.073	0.0796	0.0231			
3.6	1.80	1.667	0.103	0.1717	0.0499	≤ 2	1	3.0
2.0	1.00	3.000	0.105	0.3150	0.0915			
1.1	0.55	5.455	0.082	0.4473	0.1290			
0.7	0.40	7.500	0.076	0.5700	0.1656			
<0.7	0.40	7.500	0.224	1.6800	0.4880			

6.7.2 Particle density

The particle density used for modelling CDD/Fs particle deposition from the hypothetical incinerator case study in U.S. EPA (2000) was 1.4 g/cm^3 (See Table 3-15)[3]. This density value derives from the use of the Junge-Pankow equation for the initial V/P partitioning in which θ is derived from TSP referencing work by Bidleman (1988). It would appear from the Bidleman (1988) paper that a density of 1.4 g/cm^3 may have simply been an assumed, representative value. A different assumption of average ambient particle density would change the relationship between ambient TSP and θ for partitioning calculations.

[3] This value may also have been used in validation studies

In contrast, a particle density of 1 g/cm^3 is an accepted default value for modelling particle emissions from new sources (U.S. EPA. 1998) where specific data are not available.

There would seem to be a case for using an average particle density of 1 g/cm^3 to model particle dispersion and deposition for this proposal because:

- the calculation of the proportion of available particle surface areas for determining the size distribution of emitted particles in the U.S. EPA (2000) is based on an average emission particle density of 1 g/cm^3 anyway, and
- the U.S. EPA (1998) suggests particle densities from combustion sources are, if anything, less than 1 g/cm^3 rather than greater than 1 g/cm^3.

Since the context of this issue is deposition (rather than V/P partitioning), a particle density of 1 g/cm^3 has been used in this study.

6.7.3 Wet scavenging coefficients

The U.S. EPA (1998) states that there is not enough data available to develop congener-specific wet scavenging coefficients. The wet scavenging coefficients used for this study were based on the relationship in the ISC3 User's Guide for the mean particle size for the particle size distribution shown in Table 6. The resulting wet scavenging coefficients are shown in Table 7.

Table 7 Wet scavenging coefficients for particle size ranges

Particle size range (μm)	Average particle size (μm)	Wet scavenging coefficient (1/(sec-mm/hr)
≤ 2	1.0	0.43×10^{-4}
> 2 to ≤ 10	6.78	0.46×10^{-3}
> 10	20	0.66×10^{-3}

6.7.4 Receptors

Receptors were specified across a 20 km x 20 km grid at 1 km intervals.

6.7.5 Other modelling parameters

The U.S. EPA (1998) recommend that for regulatory applications the following default parameters be set for the dispersion modelling of CDD/Fs for risk assessment purposes:

- stack tip downwash,
- final plume rise,
- buoyancy induced dispersion (BID),
- the vertical potential temperature gradient,
- a treatment for calms,
- the appropriate wind profile exponents.

These are set through the DEFAULT keyword.

Details of other modelling parameters are shown in the ISC3-Prime input specifications given in Appendices 2 to 5.

7. RESULTS

A summary of changes between the original and revised assessments of CDD/F dispersion for this proposal is shown in Table 8.

Table 8 Summary of changes between original and revised assessments

Issue	Original assessment	Revised (this) assessment
V/P partitioning of emissions	Based on ambient TSP of 60 μg/m^3	Based on ambient TSP of 22 μg/m^3 (measured data for Muchea)
Dispersion model	CALPUFF	ISC3-Prime
Assumed density of congener particles (g/cm^3)	1.4	1.0
Plume downwash	Moderate effect for PLFPS; no downwash for Tiwest stack	Minimal effect for PLFPS; moderate effect for Tiwest stack
Site roughness length (m)	0.4	0.2

The predicted CDD/F air concentrations and particle depositions based on the modelling and assumptions described above are shown in Table 9.

Table 9 Summary of maximum predicted CDD/F air concentrations and particle depositions

Maximum predicted value at any receptor grid	Results from previous (Calpuff) modelling	ISC3-Prime modelling and revised assumptions		
		PLFPS	Tiwest	Total
Airborne vapour phase (fg I-TEQ/m^3)	0.051	0.0403	0.0488	**0.0699**
Airborne particle phase TEQ (fg I-TEQ/m^3)	0.22	0.0473	0.0437	**0.0728**
Total airborne (fg I-TEQ/m^3)	0.28	0.0876	0.0925	**0.139**
Total particle deposition TEQ (pg I-TEQ/m^2/yr)	86	79.6	99.2	**156**

Compared to the previous assessment in EA (2001), the revised ISC3-Prime modelling and assumptions predict:

- about the same vapour phase concentrations; and
- a greater level of deposition from the particle phase congeners and correspondingly lower airborne concentrations from the particle phase.

Tiwest's emissions are more affected by local building wakes than emissions from the PLFPS stack. Therefore, the maximum predicted unitary concentrations and depositions from Tiwest are higher that for the PLFPS stack. Tiwest's CDD/F emission rate is about one-half that of the PLFPS. The two differences lead to Tiwest having about the same level of maximum ground level impact as the PLFPS – noting that Tiwest's maximum impact location is within the facility boundary.

Table 10 below summarises the calculation of the PLFPS CDD/F concentrations and deposition from the modelling output. The emissions rates are multiplied by the ISC3-Prime output of maximum predicted values (shown in Appendices 2 and 3) to give the final calculated values of maximum concentration and deposition.

Table 10 Example summary calculation of max annual concentration and deposition from PLFPS only

Congener phase	Inputs	ISC3-Prime output from unitised emission rate		Calculated values	
	Emission rate (ng I-TEQ/s) (see Table 4)	Predicted maximum average conc ($\mu g/m^3$/year)	Max deposition (g/m^2/year)	Ambient conc (fg I-TEQ/m^3/year)	Ambient deposition (pg I-TEQ/m^2/yr)
Vapour	0.411	0.0981 (see Appendix 2)	-	0.0403	
Particles	0.581	0.0814 (see Appendix 3)	0.137 (see Appendix 3)	0.0473	79.6
Total (see Table 9)				**0.0876**	**79.6**

A summary of some other published values of dioxin concentrations and deposition is shown in Table 11.

Table 11 Published values of dioxin concentrations and deposition

Site	Ground level air concentration	Total deposition
Indianapolis[(a)]	-	540 ng/(m^2yr)
Bloomington[(a)]	-	370 ng/(m^2yr)
Siskiwit Lake[(a)]	-	230 ng/(m^2yr)
Great Lakes (av) [(a)]	-	1400 ng/(m^2yr)
Baltic Sea[(a)]	-	1700 ng/(m^2yr)
Modelled/predicted around MWI, Avonmouth (emission rate ≈582 ng TEQ/s)[(b)]	≈32.5 fg TEQ/m^3/year (maximum receptor impact)	-
Predicted contribution from Global Olivine facility, Kwinana at most affected site (emission rate 0.002-0.015 μg I-TEQ/s) [(c)]	0.2-0.6 fg I-TEQ/m^3/year	-
Ambient air in NZ[(c)] –		-
Remote sites	1.4-3.4 fg I-TEQ/m^3/yr	
Rural site	3.8 fg I-TEQ/m^3/yr	
Town and urban sites	28-100 fg I-TEQ/m^3/yr	

[(a)] Koester and Hites, (1992).Values are for total PCDD/F - sum of all tetra-through octachlorinated congeners.
[(b)] Basham and Whithead (1999).
[(c)] Barker & Associates Ltd (2000).

As a comparison, the maximum CDD/Fs air concentrations from the PLFPS and Tiwest are a little less than that predicted for the Global Olivine facility (in isolation) at Kwinana. The impact on human

health from the former should be considerably less however, since the location of the maximum predicted concentration is not at a residential area.

The results of this assessment appear to be broadly consistent with that of the original assessment and with other published results and data.

8. GLOSSARY

Congeners: Individual dioxin and furan compounds distinguished by the number and position of their chlorine atoms. There are potentially 75 PCDD and 135 PCDF congeners. Example - All hexachlorodibenzodioxin congeners have six chlorine atoms.

PCDD: Abbreviation for Polychlorinated Dibenzo Dioxins.

PCDF: Abbreviation for Polychlorinated Dibenzo Furans.

TEQ: Toxicity Equivalents - a rough measure of the toxicity of a mixed group of dioxins and furan congeners, expressed as an equivalent amount of 2,3,7,8-TCDD (The most toxic form of dioxins).

ng: nanogram = 10^{-9} grams

pg: picogram = 10^{-12} grams

fg: femtogram = 10^{-15} grams

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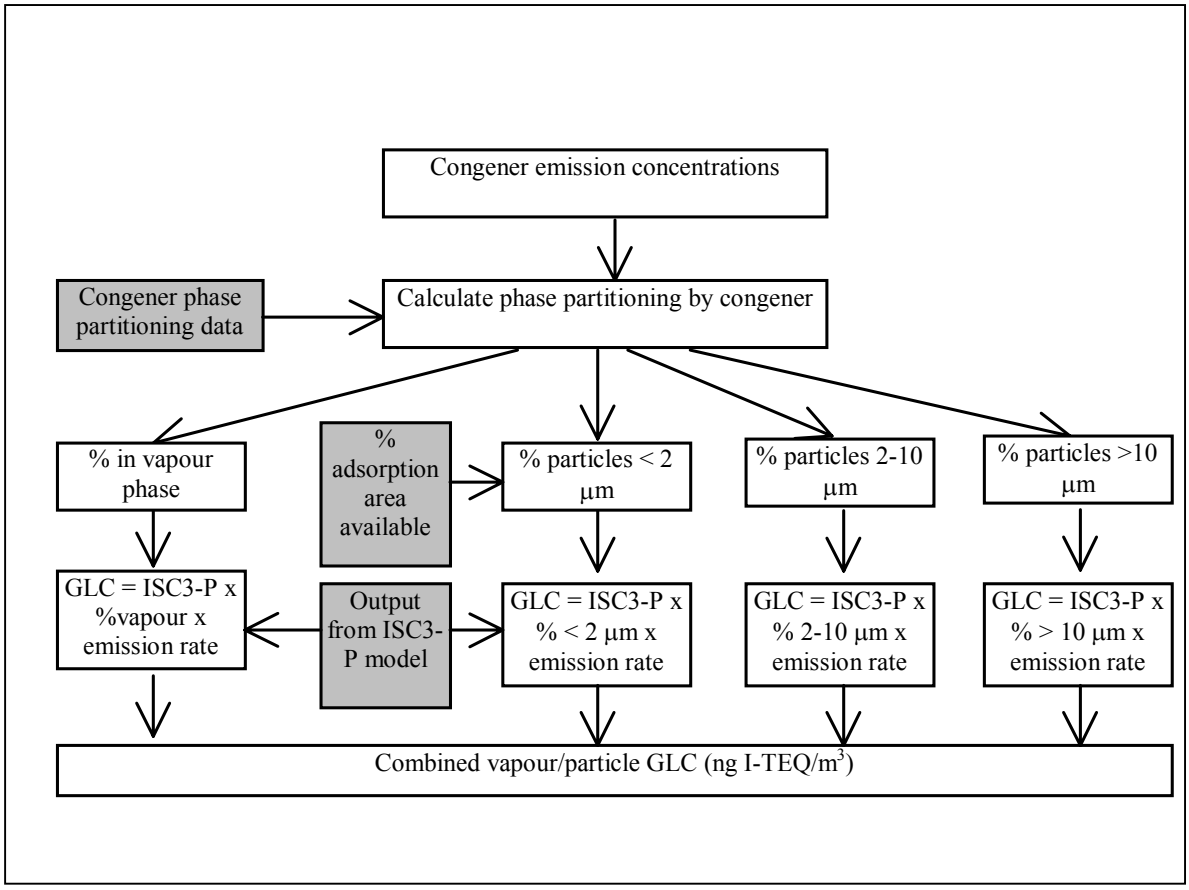

Figure 1 Outline of method for calculating CDD/Fs airborne concentrations

Appendix 1 Dioxin congeners properties

Table A1.1 Dioxin congeners and TEFs

Classification	Congener	#	TEF	Partitioning – Vapour fraction at 20C and ambient TSP=60 μg/m^3
Dioxin Congeners	2,3,7,8-TCDD	1	1	0.51
	1,2,3,7,8-PeCDD	3	1	0.13
	1,2,3,4,7,8-HxCDD	5	0.1	0.03
	1,2,3,6,7,8-HxCDD	6	0.1	0.03
	1,2,3,7,8,9-HxCDD	7	0.1	0.03
	1,2,3,4,6,7,8-HpCDD	9	0.01	0.01
	OCDD	11	0.0001	0.002
Furan Congeners	2,3,7,8-TCDF	12	0.1	0.53
	2,3,4,7,8-PeCDF	14	0.5	0.16
	1,2,3,7,8-PeCDF	15	0.05	0.25
	1,2,3,4,7,8-HxCDF	17	0.1	0.07
	1,2,3,6,7,8-HxCDF	18	0.1	0.07
	2,3,4,6,7,8-HxCDF	19	0.1	0.04
	1,2,3,7,8,9-HxCDF	20	0.1	0.04
	1,2,3,4,6,7,8-HpCDF	22	0.01	0.02
	1,2,3,4,7,8,9-HpCDF	23	0.01	0.01
	OCDF	25	0.0001	0.002

(from U.S. EPA (2000))

Table A1.2 Nomenclature for dioxin-like compounds

Symbol	Definition
Pe	Symbol for penta (i.e., five halogen substitution)
Hx	Symbol for hexa (i.e., six halogen substitution)
Hp	Symbol for hepta (i.e., seven halogen substitution)
O	Symbol for octa (i.e., eight halogen substitution)
CDD	Chlorinated dibenzo-p-dioxins, halogens substituted in any position
CDF	Chlorinated dibenzofurans, halogens substituted in any position
PCB	Polychlorinated biphenyls