Development of new environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania

Volume 1

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Resource Planning and Development Commission

The Resource Planning and Development Commission is established by the *Resource Planning and Development Commission Act 1997*.

The Commission has five principal functions:

- to assess and approve local government planning schemes and planning scheme amendments;
- to assess projects of State significance;
- to assess draft State Policies;
- to prepare the Tasmanian State of the Environment Report; and
- to conduct inquiries into the use of public land.

The Commission is part of the State's resource management and planning system, the objectives of which are set out in Schedule 1 of the *Resource Planning and Development Commission Act 1997*.

The Commission is made up of:

- an Executive Commissioner (Julian Green);
- a Commissioner with planning experience nominated by the Local Government Association of Tasmania (Geoff Davis);
- a Commissioner with expertise and management experience in resource conservation (Helen Locher);
- a Commissioner with planning experience and experience in industry and commerce (Andrew Edwards);
- a Commissioner with resource conservation or planning experience representing community interests (Lia Morris); and
- a Commissioner with public administration experience in regard to project implementation (Helen Hudson).

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Acknowledgments

The Commission would like to acknowledge the contributions from individuals and organisations that provided submissions during the review. Information provided through submissions has assisted the Commission prepare this report and finalise the recommended environmental emission limit guidelines.

Conduct of the review has been most ably performed by the Panel – the Commission expresses its appreciation to members of the Panel.

Beca AMEC Ltd (formerly Beca Simons Ltd) provided professional advice to the Commission on technical matters throughout the review. The Commission expresses its particular appreciation to Mr Roberto Miotti, Process Engineering Manager, who coordinated the provision of consultancy services by the company.

1 Introduction

1.1 Ministerial direction to the Commission

By letter dated 19 November 2003, the then Minister for Primary Industries, Water and Environment, the Hon. Bryan Green, directed the Resource Planning and Development Commission (the Commission) to undertake a review of the Commonwealth *Environmental Guidelines For New Bleached Eucalypt Kraft Pulp Mills 1995* (the 1995 Commonwealth Guidelines) and prepare new environmental guidelines for a new bleached kraft pulp mill in Tasmania (the Tasmanian Guidelines). On 3 May 2004 the Premier, the Hon. Paul Lennon, advised of the terms of reference having been amended to take into account the Stockholm Convention on Persistent Organic Pollutants 2001 (the Convention). The Convention became operative on 17 May 2004 and the Australian Government ratified the Convention on 20 May 2004. The amended terms of reference are contained in Appendix A.

The terms of reference require the Commission to prepare Tasmanian Guidelines, which set emission limits for key pollutants that are specific to any new bleached eucalypt kraft (BEK) pulp mill in Tasmania. Through the planning approval and environmental impact assessment process the proponent will be required to address a number of environmental and social matters of wider relevance, such as noise, transport, resource supply. These matters are not addressed in the Tasmanian Guidelines. A development proposal to build a BEK pulp mill in Tasmania would need to comply with all statutory and regulatory requirements, including the *State Policies and Projects Act 1993* (if the development is declared a project of State significance), the *Environmental Management and Pollution Control Act 1994* (EMPCA), environment protection policies made under EMPCA, the *Tasmanian State Coastal Policy 1996*, the *State Policy on Water Quality Management 1997*, the *Living Marine Resources Management Act 1995* and managements plans made under that Act.

In reviewing the 1995 Commonwealth Guidelines the Commission is required to take into account changes in technological capability; international guidelines or standards applying to new bleached kraft pulp mills; Tasmanian, national and international ambient guidelines for air quality and water quality; and environmental emission limits currently achievable utilising accepted modern technology and operated in accordance with best practice environmental management. Emission limits for both totally chlorine free (TCF) and elemental chlorine free (ECF) bleaching processes must be considered and documented.

The Commission's task is to review the 1995 Commonwealth Guidelines within the context of the terms of reference, and provide the Minister with a report with new recommended Tasmanian Guidelines no later than 6 months from the date of receiving the commission.

The review is non-statutory.

1.2 Review process

1.2.1 Framework for review

The direction from the Minister to undertake this review is an administrative request. It is not subject to a legislative process. However, in the conduct of the review, the Commission will follow the general principles regarding the conduct of hearings as set down in the *Resource Planning and Development Commission Act 1999*. An open, transparent and consultative process has been developed for the review. Figure 1 contains a flow chart showing the stages of the review process.

1.2.2 Preliminary input from expert stakeholders

To assist the Commission obtain sufficient information to prepare a draft report for public consultation, the views and input of a number of government and non-government agencies and expert groups have been sought. Organisations and agencies having knowledge and expertise in the pulp mill industry and State, national and international guidelines or standards that apply to new bleached eucalypt kraft pulp mills were invited to make a submission in line with the terms of reference. Appendix B contains a list of the organisations invited to make a submission. 14 submissions were received. Refer to Appendix C for a list of submitters. Issues raised in these submissions have been taken into account in the preparation of the Tasmanian Guidelines.

1.2.3 Appointment of a Panel and consultant

The Commission has appointed a Panel to undertake the review on its behalf. Membership of the Panel is:

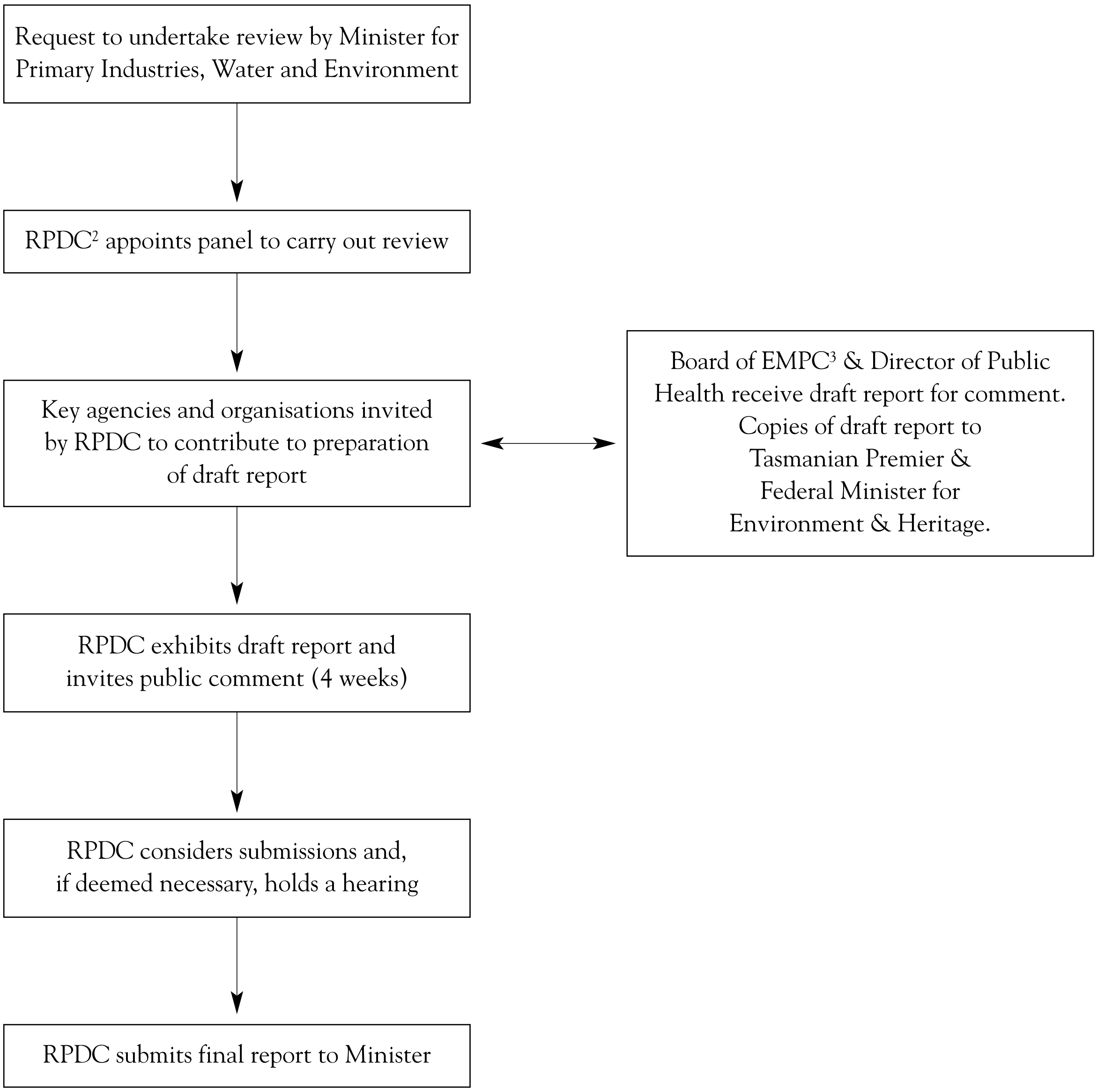
- Mr Julian Green (Executive Commissioner, Resource Planning & Development Commission);
- Dr Helen Locher (Commissioner, Resource Planning & Development Commission);
- Dr Warwick Raverty (Leader of the Paper Making Systems Team, CSIRO Forest Products Laboratory, Clayton, Victoria); and
- Professor Ian Rae (Australian Academy of Technological Sciences and Engineering, Melbourne).

Beca AMEC, formerly Beca Simons, and its parent and associated organisations, AMEC (Canada) and ÅF-Celpap (Sweden), has been appointed by the Commission to provide independent environmental and engineering expert advice to the Panel. The Commission required Beca AMEC to prepare a Study Report reviewing:

- state-of-the-art kraft mill technologies and management practices aimed at minimising the environmental impact of pollutants released from the production process of any new bleached eucalypt market[1] kraft pulp mill whose treated liquid effluent is discharged into the marine environment. Particular emphasis is given in the report to technology changes and developments that have occurred since the 1995 Commonwealth Guidelines were developed;

1 i.e. not integrated with another type of pulp mill or a paper mill.

Figure 1 Diagrammatic representation of review process



2 Resource Planning and Development Commission

3 Environmental Management and Pollution Control

- current guidelines or standards applying to new bleached kraft pulp mills overseas, with particular emphasis on European and North American requirements; and
- Section D.1 – Emission limits and Section D.2 – Solid waste disposal guidelines of the 1995 Commonwealth Guidelines in terms of the environmental emission limits currently achievable by any new BEK pulp mill employing accepted modern technology[4] (AMT) and operated in accordance with best practice environmental management[5] (BPEM) for either the elemental chlorine free (ECF) or the totally chlorine free (TCF) bleaching process and providing independent advice on the development of environmental guidelines for any new bleached eucalypt kraft (BEK) pulp mill in Tasmania.

The Study Report is a source document for this report [Beca AMEC, 2004].

1.2.4 Draft Report

On 7 June 2004 the Commission released for public comment a Draft Report, which was presented in three volumes:

- The Draft Main Report: Review of the Commonwealth *Environmental Guidelines For New Bleached Eucalypt Kraft Pulp Mills 1995* and development of new environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania. Volume 1;
- Draft Report: Review of the Commonwealth *Environmental Guidelines For New Bleached Eucalypt Kraft Pulp Mills 1995* and development of new environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania. Volume 2: Tracked changes to the 1995 Commonwealth Guidelines; and
- Draft Report: Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania. Volume 3.

Community, industry, and other interest groups and individuals were invited to comment in writing on the Draft Report, particularly Volume 3, Recommended environmental emission limit guidelines. The closing date for submissions was 5 July 2004.

The primary purpose of the Draft Report was to enable public comment on the document.

4 Accepted Modern Technology is defined in the *State Policy on Water Quality Management 1997* and *Draft Environment Protection Policy (Air Quality)* and Regulatory Impact Statement 2001 as a 'technology which has a demonstrated capacity to achieve the desired emission concentration in a cost-effective manner, takes account of cost-effective engineering and scientific developments and pursues opportunities for waste minimisation.'

5 Defined in the *Environmental Management and Pollution Control Act 1994* as 'the management of an activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity.'

1.2.5 Report to the Minister

At the close of the public exhibition period the Commission received 14 submissions in response to the Commission's invitation to interested parties to lodge a written submission. See Appendix D for a list of submitters. The Commission considered all submissions and determined that a hearing was not required to assist in the examination of the issues raised in submissions.

This report is presented in 2 volumes. Volume 1 describes how the review was conducted (see Chapter 1); provides an overview of accepted modern technologies (AMT) and best practice environmental management (BPEM) for new BEK pulp mills; describes the emerging technologies/future options (see Chapter 2). Under the terms of reference the Commission is also required to consider current international guidelines or standards applying to new bleached kraft pulp mills, with an emphasis on European and North American requirements. Existing supra-national, national and sub-national guidelines and standards are summarised in Chapter 2 of Volume 1. Chapter 3 of this report contains a table that lists the issues raised in submissions and the Commission's response in tabular form. Changes to the Tasmanian Guidelines arising from the submissions are indicated in the table and are also listed in Chapter 4.

With the assistance of its consultant, Beca AMEC, a recommended set of emission limit guidelines for any new BEK pulp mill in Tasmania has been prepared and is presented in Volume 2 of this report. The Tasmanian Guidelines have been developed using the 1995 Commonwealth Guidelines as the core framework. Recommended changes to the 1995 Commonwealth Guidelines have been proposed to reflect current technology, guidelines and standards, and legislation.

1.3 Application of the terms of reference

1.3.1 Introduction

The purpose of this review is to develop recommended environmental guidelines for any new bleached eucalypt kraft pulp mills in Tasmania (Tasmanian Guidelines) for endorsement by the Tasmanian government.

Under the terms of reference, the Commission is required to use the 1995 Commonwealth Guidelines as a broad framework for the Tasmanian Guidelines. Given that the 1995 Commonwealth Guidelines were last reviewed in 1995 it is essential that this document be reviewed and updated to reflect changes in technology, and current guidelines and standards. Tasmanian legislation and statutory policies will also need to be incorporated, where relevant, in the Tasmanian Guidelines.

It is noted that the Australian Government is supportive of the development of Tasmanian Guidelines and has given permission for the 1995 Commonwealth Guidelines to be reproduced or adapted for the purpose of developing the Tasmanian Guidelines.

1.3.2 Legislation, statutory policies, treaties and conventions

The Tasmanian Guidelines must be consistent with Commonwealth and State legislation. The terms of reference specifically require the Tasmanian Guidelines to be based on the *Environmental Management and Pollution Control Act 1994*, the *State Policy on Water Quality Management 1997*, and the *Draft Environment Protection Policy (Air Quality) 2001*.

Australia is a party to the Stockholm Convention on Persistent Organic Pollutants 2001 (the Convention). Australia ratified the Convention on Persistent Organic Pollutants on 20 May 2004.

Work is currently being carried out at an international level under the Convention to develop guidance on best available techniques and environmental practices for the control of pollutant by-products resulting from industrial process, including pollutants generated by some forms of pulp and paper manufacturing. The Australian Government has recommended that the development of the Tasmanian Guidelines have regard to the Convention work to ensure that the Tasmanian Guidelines take into account international developments. Chapter 2 of Volume 1 addresses the obligations arising from the Convention in detail.

1.3.3 Selected pulping process

The terms of reference for this report are confined to the bleached eucalypt kraft (BEK) pulp non-integrated production process whose treated liquid effluent is discharged into the marine (ocean) environment.

It is noted that:

- the kraft[6] process is the dominant chemical pulping process worldwide (90% of the world chemical pulp production and 70% of the world pulp production) due to its superior pulp strength properties, suitability for all wood species and efficient chemical recovery system;
- bleached kraft pulp presently accounts for over 50% of the wood pulp produced for papermaking and is globally traded;
- bleached kraft pulp demand is predicted to grow by over 50% over the next 15 years and the highest growth rate is expected for bleached hardwood kraft pulp, mainly from eucalypt;
- continuous process development has resulted in very low discharges to the atmosphere and the aquatic environment from pulping and bleaching in bleached kraft pulp (BKP) mills when state-of-the- art technologies and environmental management practices are employed; and
- discharge into the marine (ocean) environment ensures the maximum possible dilution of the liquid effluent resulting in the minimum possible environmental impact at the edge of the mixing zone.

6 After the German and Swedish word for strength.

1.4 *Key terminology*

The terms of reference require the Commission to use the terms accepted modern technology (AMT) and best practice environmental management (BPEM) in this report to describe minimum environmental impact technologies and management practices. The Commission is also required to use the terms best available techniques (BAT) and best environmental practices, to the extent required by the Stockholm Convention on Persistent Organic Pollutants 2001 (the Convention).

1.4.1 Accepted modern technology

AMT is defined in the *State Policy on Water Quality Management 1997* and *Draft Environment Protection Policy (Air Quality)* and Regulatory Impact Statement 2001 as a 'technology which has a demonstrated capacity to achieve the desired emission concentration in a cost-effective manner, takes account of cost-effective engineering and scientific developments and pursues opportunities for waste minimisation.'

The AMT included in this report are technologies that have a demonstrated track record of being technically effective and economically viable on an industrial scale for minimising the discharge of pollutants from bleached eucalypt kraft (BEK) pulp mills to the environment. These technologies have been accepted as an integral part of worldwide supra-national, national and sub-national environmental guidance.

1.4.2 Best practice environmental management

BPEM is defined in the *Environmental Management and Pollution Control Act 1994* (EMPCA) as 'the management of an activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity.'

Section 4(2) of the EMPCA provides that 'In determining the best practice environmental management of an activity, regard must be had to the following measures:

(a) strategic planning by the person carrying out, or proposing to carry out, the activity;

(b) administrative systems implemented by the person, including staff training;

(c) public consultation carried out by the person;

(d) product and process design; and

(e) waste prevention, treatment and disposal.'

BPEM includes practices like:

- high standards of maintenance;
- environmental management systems carried out to an international standard and independently audited;

- process control monitoring and optimisation; and
- training, education and motivation of personnel.[7]

The combination of these technologies and practices (also called ‘techniques’ or ‘measures’), or subsequently developed alternate techniques which produce similar or superior results, should be included in any new bleached eucalypt kraft pulp mill proposed to be built in Tasmania.

AMT and BPEM are conceptually similar to the Generally Accepted Accounting Principles (GAAP) of financial accounting which provide assurance to outsiders, who usually have no choice but to accept financial information as a company provides it, that the financial statements are prepared in accordance with a mutually understood set of ground rules. GAAP provide these common ground rules in financial accounting. Likewise, the AMT and BPEM practices listed in this report provide these common ground rules in BEK pulp production. These AMT and BPEM practices, if fully employed, allow cost-effective production of market BEK pulp with emissions to air and water that have minimum environmental impact.

1.4.3 Best available techniques and best environmental practices

BAT is defined in Article 5 of the Stockholm Convention on Persistent Organic Pollutants 2001 (the Convention) as meaning ‘the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for release limitations designed to prevent and, where that is not practicable, generally to reduce releases of chemicals listed in Part I of Annex C and their impact on the environment as a whole. In this regard:

‘Techniques’ includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

‘Available’ techniques means those techniques that are accessible to the operator and that are developed on a scale that allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages; and

‘Best’ means most effective in achieving a high general level of protection of the environment as a whole.

‘Best environmental practices’ is defined in Article 5 of the Convention as meaning ‘the application of the most appropriate combination of environmental control measures and strategies.’ ’

7 These practices are consistent with the measures listed in section 4(2) of the EMPCA.

1.5 *Key terminology used by supra-national and national environmental guidance*

1.5.1 European Union

The European Union (EU) has a set of common rules on setting of environmental permits for industrial installations. These rules were set out in the Integrated Pollution Prevention and Control (IPPC) directive 96/61/EC issued in 1996. The directive requires all installations covered by Annex I of the directive in each of the Member States, to have a permit from the State authorities. The permit shall include emission limits for pollutants likely to be emitted from a certain installation. Such limits are to be based on best available techniques (BAT) [IPPC directive, 1996]. Refer to section 1.4.3 above for the definition of BAT.

1.5.2 United Nations Environment Programme

Persistent organic pollutants (POP) are chemical substances that persist in the environment, bioaccumulate through the food chain, and pose a risk of causing adverse effects to human health and the environment. With the evidence of long-range transport of these substances to regions where they have never been used or produced and the consequent threats they pose to the environment of the whole globe, the international community has, on several occasions, called for urgent global action to reduce and eliminate releases of these chemicals.

The Stockholm Convention on POP was adopted in 2001 in response to this need for global action. The Convention is an international treaty adopted in Sweden by 151 countries aimed at restricting and ultimately eliminating the production, use, release and storage of all intentionally produced POP (i.e. industrial chemicals and pesticides). It also seeks the continuing minimisation and, where feasible, ultimate elimination of the release of unintentionally produced POP (UPOP) such as dioxins and furans.

The 90-day countdown to the treaty's entry into force was triggered on 17 February 2004 when France became the 50th state to ratify the treaty. Australia ratified the treaty on 20 May 2004.

The Convention came into force on 17 May 2004 and the first meeting of the Conference of the Parties will be held in May 2005 [UNEP/POPS/EGB.2/3, 2003], [www.pops.int].

In June 2002, an expert group on best available techniques (BAT) and best environmental practices (BEP) was established to develop guidelines on BAT and provisional guidance on BEP directed towards the reduction or elimination of releases of unintentionally produced persistent organic pollutants (UPOP) like polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCB).

The most recent relevant publication of this programme is the 'Draft guidelines on best available techniques (BAT) for pulping processes,' which was tabled at the 2nd Session of the expert group on BAT and best environmental practices (BEP), Villarrica, Chile, December 2003 [www.chem.unep.ch/pops], [www.pops.int], [UNEP, 2003]. In addition to the BAT identified by the

European Union, UNEP considered additional techniques to be BAT for the reduction or elimination of UPOP by a bleached kraft pulp mill.

These BAT and BEP include all the EU BAT and general measures of best environmental practice.

1.5.3 USEPA Final Water Cluster Rule

The US Environmental Protection Agency (USEPA) in April 1998 promulgated the Final pulp and paper cluster rule to protect human health and the environment by reducing toxic releases to the atmosphere and aquatic environment from U.S. pulp and paper mills [USEPA, 1998].

These guidelines are widely known as the 'Cluster Rule,' because they were designed to coordinate air and water discharge rules.

The final water rule includes best available technology (BAT) limits from mills in Subpart B, bleached papergrade kraft and soda and best management practice (BMP) requirements.

BAT is defined as the best control and treatment measures that have been or are capable of being economically achieved.

BMP include requirements such as recovery furnace capacity and the implementation and cost of pulping liquor spill prevention and control programs.

2 Summary of the review

2.1 Accepted modern technology for bleached eucalypt kraft pulp mills

The main environmental issues in kraft pulping are wastewater effluents, emissions to the atmosphere (including odorous gases), energy consumption and solid waste.

The main raw materials are renewable resources (wood and water) and chemicals for cooking and bleaching.

Emissions to the aquatic environment are dominated by organic compounds. Effluent from an ECF bleach plant contains chlorinated organic compounds, measured by the bulk analytical parameter AOX. Effluent from a TCF bleach plant still contains chlorinated organic compounds, although their quantity is much lower. Some compounds discharged from kraft mills are toxic to aquatic organisms. Emissions of coloured compounds may adversely affect biota in the environment. Emissions of nutrients (nitrogen and phosphorus) can contribute to eutrophication in the environment. Metals extracted from the wood are discharged in low concentrations but due to high flows the load can be of significance. A significant reduction of both chlorinated and non-chlorinated organic compounds in the effluent of kraft mills has been achieved to a large extent by the adoption of in-plant measures and techniques.

The measures and techniques listed below are a consolidation and expansion of those included in the international initiatives mentioned previously. They have been demonstrated to be technically effective and economically viable on an industrial scale for minimising the discharge of pollutants from bleached eucalypt kraft (BEK) pulp mills to the environment.

2.2 General measures for best practice environmental management

Table 1 includes general measures for BPEM aimed at achieving ongoing minimisation of emissions.

Table 1 General measures for best practice environmental management

High standards of maintenance	• To maintain the efficiency of the unit operations of pulp mills and the associated pollution abatement technologies at a high level
Emissions monitoring	• Development and implementation of protocols for monitoring the performance of pollution abatement facilities and compliance with environmental permits
Environmental Management System (EMS)	• A system which clearly defines the responsibilities for environmentally relevant aspects of a mill. It raises awareness of issues and includes goals and measures, process and job instructions, check lists and other relevant documentation • The EMS needs to be independently audited to an international standard and include environmental monitoring and a response mechanism • The reporting framework of the EMS needs to be open and transparent • Community consultation is recommended to ensure interested communities are informed and involved in any new kraft mill development and its impact on them
Planning	• Investment planning/cycles, co-ordination of process improvements to reduce technical bottlenecks and to introduce AMT
Process control monitoring and optimisation	• To be able to reduce different pollutants simultaneously and to maintain low emissions • Raw materials specification and monitoring of raw materials for precursor materials
Substitution	• Identification and substitution of potentially harmful compounds with less harmful alternatives • Use of a detailed inventory of raw materials used, chemical composition, quantities, fate and environmental impact
Training, education and motivation of personnel	• Pulp and paper mills are operated by people. Training of staff can be a very cost-effective way to reduce environmental impact and use of resources

2.3 Accepted modern technology for the reduction of emissions to the aquatic environment

Table 2 includes technologies that are considered AMT for the reduction of emissions to the aquatic environment.

Table 2 AMT for the reduction of emissions to the aquatic environment

Topic or mill area	Description of AMT
Avoidance of synthetic dioxin precursors	• Exclusion of wood chips produced from wood treated with polychlorinated phenols • Exclusion of defoamers containing more than 10 ppb dibenzo-p-dioxin and 40 ppb dibenzofuran by weight • Exclusion of polychlorinated phenols in paint, cutting oils and other inadvertent inputs to the process
Optimised wood handling	• Optimisation of raw material storage, seasoning period, chipping process, chip storage and chip dimensions • Dry debarking
Pulping and brown stock processing	• Modified batch cooking or modified continuous cooking • Closed brown stock screening and washing (i.e. return of all filtrates to chemical recovery) • Oxygen delignification followed by efficient washing (99% overall recovery of dissolved wood solids and pulping chemicals from the pulp)
Chemical recovery and handling of accidental discharges	• Effective control, containment, recovery and storage of all spills, leakages and releases of process liquids and solids and avoidance of any loss of these materials prior to their re-introduction to the process or their disposal in an approved manner • Adequate size of black liquor evaporation plant and recovery boiler to handle additional liquor and dry solids loads due to collection of spills and possible recycle of selected bleach plant effluents • Stripping and appropriate reuse of foul condensates • Collection and reuse of clean cooling and sealing waters, including those from cooling towers • Efficient washing of lime mud
Bleaching chemical preparation	• On-site generation of chlorine dioxide with low contamination of elemental chlorine (methanol or hydrogen peroxide processes)

Table 2 AMT for the reduction of emissions to the aquatic environment (continued)

Topic or mill area	Description of AMT
Effluent treatment	• Primary and secondary (biological) treatment of all process effluent, excluding uncontaminated cooling water[a] • Anoxic selector for chlorate reduction • Provision of containment basin(s) to temporarily store, for subsequent treatment, untreated process effluent that has sufficiently high levels of contamination to adversely affect the operation of the effluent treatment plant
Cooling water	• Recirculation to a cooling tower and reuse of indirect cooling water

Note:

a *Low-loaded activated sludge plants with an F/M ratio below 0.15 kg BOD/d/kg MLSS and typical hydraulic retention time in the aeration basin of about one day (up to 2 days) are regarded as AMT. Any other treatment system with comparable emission levels and cost is also regarded as AMT.*

2.3.1 Emission levels to the aquatic environment for BKP mills employing AMT/BPEM

Depending on the type of the specific process-integrated measures implemented, the following emissions to the aquatic environment associated with the use of AMT/BPEM can be generally achieved [IPPC BREF, 2001].

Table 3 Long term average emission levels to the aquatic environment generally achieved by new BKP mills employing AMT/BPEM

Parameter	Units	Min emission value	Max emission value
Wastewater flow[a]	m^3/ADt	30	50
COD	kg/ADt mg/L	8 270	23 460
BOD_5	kg/ADt mg/L	0.3 10	1.5 30
TSS	kg/ADt mg/L	0.6 20	1.5 30
AOX	kg/ADt mg/L	Non detectable Non detectable	0.25 5.0
Total nitrogen (N)[b]	kg/ADt mg/L	0.1 3.3	0.25 5.0
Total phosphorus (P)[c]	kg/ADt mg/L	0.01 0.3	0.03 0.6

Notes:

a *Cooling water and other clean water discharges are not included in the wastewater flow value.*

b *Any nitrogen discharge associated with the use of chelating agents should be added to the figure of total N.*

c *Due to the higher content of phosphorus in eucalypt, some BEK mills will not be able to achieve the emission value of P if P exceeds the need of the biological treatment plant.*

The emission values quoted in Table 3 are long term averages. Maximum emission values calculated on shorter averaging times (e.g. daily and monthly) can be obtained from these values by multiplying them by appropriate variability factors.

2.4 Accepted modern technology for the reduction of emissions to the atmosphere

Table 4 includes technologies that are considered AMT for the reduction of emissions to the atmosphere.

Table 4 AMT for the reduction of emissions to the atmosphere

Pollutant(s)	Description of AMT
Chlorine dioxide and related compounds[a]	• Collection and scrubbing in the bleach plant scrubber, which uses alkaline scrubbing media • Collection and scrubbing in the chlorine dioxide plant environmental scrubber, which uses alkaline scrubbing media
Inorganic chlorinated compounds[a]	• Collection and scrubbing in the bleach plant scrubber, which uses alkaline scrubbing media • Collection and scrubbing in the chlorine dioxide plant environmental scrubber, which uses alkaline scrubbing media

Total reduced sulfur (TRS)	• Collection and incineration of concentrated non condensable gases (CNCG) in either the recovery boiler or a standalone low-NO_x incinerator[b]
	• Backup system for the CNCG – which is activated during upsets, maintenance or other downtimes of the main system – consisting of:
	  • A flare/incinerator and secondary incineration unit (e.g. the lime kiln), or
	  • A pre-purged alternative disposal point immediately available with interlocks permitted to allow switching without venting (bump less transfer) to a power boiler
	• Collection and incineration of dilute NCG (DNCG) in the recovery boiler after their addition to its secondary or tertiary combustion air[c]
	• Methanol recovery from the foul condensate stripper off-gases
	• For the recovery boiler: computerised combustion control and carbon monoxide (CO) measurement
	• For the lime kiln: control of the excess oxygen, use of low-sulfur fuel, and control of the residual soluble sodium in the lime mud fed to the kiln
	• Spot monitoring program carried out by measuring odour with a mobile gas chromatograph/mass spectrometer (GC-MS). Testing will be more frequent initially and less frequent later in the program

Table 4 AMT for the reduction of emissions to the atmosphere (continued)

Pollutant(s)	Description of AMT
Dioxins and furans	• Inhibiting the formation of dioxins and furans within power and recovery boilers by appropriate design to achieve the most suitable time/temperature profile, and by appropriate operation including control of oxygen content, instituting systematic sootblowing, and the firing of fuels having minimum contamination with dioxins, furans and their precursors to minimise dioxins and furans in the flue gases[d]
Sulfur dioxide (SO_2)	• For the recovery boiler: firing of black liquor with high dissolved solid concentration to mitigate SO_2 formation or flue gas scrubbing, or both • For a standalone CNCG incinerator: flue gas cooling with either steam boiler or quench coolers and flue gas scrubbing • For the power boiler: use of bark, gas, low-sulfur oil, low-sulfur coal or flue gas scrubbing
Nitrogen oxides (NO_x)	• For the recovery boiler: control of combustion temperature profile; air distribution and excess air; and black liquor nitrogen content; and also appropriate design (low NO_x) • For the lime kiln: control of firing conditions and also appropriate design (low NO_x) • For the power boiler: control of firing conditions and also appropriate design (low NO_x)
Particulate matter (PM) or dust	• Cleaning of the flue gases from the recovery boiler, the power boiler (in which other biofuels or fossil fuels, or both are burned) and the lime kiln with efficient electrostatic precipitators

Notes:

a Small amounts of elemental chlorine are produced when chlorine dioxide reacts with the pulp in ECF bleaching.

b Sources for CNCG are the digester plant, the vacuum system of the evaporation plant and the foul condensate stripper.

c Sources of DNCG are the fibreline process vents, tank vents, chip bin vents and include the smelt dissolving tank (SDT) vent. The SDT vent is cooled and scrubbed before being piped to the recovery boiler.

d This is also considered a best available technique (BAT) for the purposes of the Stockholm Convention on Persistent Organic Pollutants.

2.4.1 Emission levels to the atmosphere for BKP mills employing AMT/BPEM

Depending on the type of the specific process-integrated measures implemented, the following atmospheric process emissions associated with the use of AMT/BPEM can be generally achieved (Beca AMEC), [IPPC BREF, 2001].

It should be noted that a direct comparison of the emission limits between countries requires concentrations from combustion sources to be corrected for reference oxygen level, which differs among jurisdictions. This correction can be only approximate in Sweden and other Nordic countries where the concentrations are specified at actual oxygen content of the flue gas.

Table 5 Daily average emission levels to the atmosphere from the pulping process associated with the use of a suitable combination of AMT/BPEM

Gas	Units[a]	Recovery boiler[f]	Lime kiln[f]	Bleach plant scrubber[f]	ClO_2 plant scrubber[f]
Inorganic chlorinated compounds	mg/NDm³ kg/ADt	N/A	N/A	30-50 0.03-0.05	10 0.01
PM	mg/NDm³ kg/ADt	30-50[b] 0.2-0.45	30-50 0.03-0.05	N/A	N/A
TRS as S	mg/NDm³ kg/ADt	15-20 0.1-0.2	20-25 0.02-0.025	N/A	N/A
SO_2 as S	mg/NDm³ kg/ADt	10-50[c] 0.1-0.4	5-30[d] 0.005-0.03	N/A	N/A
NO_x as NO_2	mg/NDm³ kg/ADt	80-120 0.7-1.1	100-200[e] 0.1-0.2	N/A	N/A
Flow	m³/ADt	7000-9000	1000	1000	25

Notes:

a *Concentrations of emissions are given with respect to a normal cubic metre of dry gas at standard conditions of 0°C and 101.325 kPa.*

b *For ESP only. With an SO_2 scrubber after the ESP, emissions of about 15 mg/NDm³ are achievable.*

c *Recovery boilers operating with high dry solid content of black liquor release very low SO_2 emissions normally below 0.1 kg S/ADt or down to 5-10 mg S/NDm³.*

d *Oil fired kiln without NCG incineration. Oil fired kiln with NCG incineration achieve 150-300 mg S/NDm³ or 0.15-0.3 kg S/ADt.*

e *Oil fired lime kiln. Gas fired kilns achieve 380-600 mg/NDm³ or 0.4-0.6 kg NO_x/ADt. Combustion of odorous gases in the lime kiln can also increase NO_x emissions. A separate furnace for TRS burning adds about 0.1-0.2 kg NO_x/ADt.*

f *The emission values refer to daily averages. The reference oxygen content is 5% for both recovery boilers and lime kilns.*

Depending on the actual energy balance of the mill, the type of external fuels used and the fate of possible biofuels like bark and wood waste, there are additional atmospheric emissions from power boilers to consider. Emission levels associated with AMT from power boilers incinerating biofuels and different fossil fuels are given in Table 6. The total releases to the atmosphere are very site specific (e.g. type of fuel, integrated or market pulp mill, production of electricity). It should be noted that many mills use fuel mixes [IPPC BREF, 2001].

Table 6 Emission levels from power boilers associated with the use of AMT for different fuels

Released substance	Unit	Coal	Heavy fuel oil	Distillate	Gas	Biofuel (e.g. bark)
Sulphur	mg S/MJ fuel input	100-200[a] (50-100)[b]	100-200[a] (50-100)[b]	25-50	<5	<15
NO_x	mg NO_2/MJ fuel input	80-110[c]	80-110[c]	45-60[b]	30-60[b]	60-100[c]
PM	mg/NDm³	10-30[d] 6% O_2	10-40[d] 3% O_2	10-30 3% O_2	<5 3% O_2	10-30[d] 6% O_2

Notes:

a *S emissions for oil or coal fired boilers depend on the availability of low-sulfur oil and coal. Certain reduction of S could be achieved with injection of $CaCO_3$.*

b *When a scrubber is used; only applied to larger installations.*

c *Only combustion technology is applied.*

d *Achieved values when electrostatic precipitators (ESP) are used. These data appear to be based on actual performance and in some cases may be well below the regulatory requirement, for a variety of reasons:*

- *The first reason for the low PM outlet concentrations is to provide a margin over regulatory limit values.*
- *The second reason is that the ESP may have more than one chamber, so compliance with regulations can continue to be achieved with one chamber down and possibly with the unit only partly loaded. Such sizing criteria are common in the case of recovery boilers. Thus low reported outlet concentrations result from deliberate over-design to thwart the risk of downtime.*
- *The third reason for low concentrations in the table may result from deliberate over-design of emission control equipment to allow operation at increased throughput at some later date. In the case of an ESP, all other things being equal, lower outlet concentrations are achieved by adding collection plate area. This investment and related operating cost increase exponentially as the outlet concentration is decreased. It should be recognised that the least expensive way to increase collection area is at the time of the initial design, because retrofitting collection area requires changes to ductwork and adequate space is frequently not available.*

It has to be noted that power boilers within the pulp and paper industry are of a very variable size (from 40GJ/h or less to above 800GJ/h). For the smaller ones only low-sulfur fuel and combustion technologies can be employed cost effectively while for the larger ones additional control measures like scrubbers are also cost effective.

The higher emission levels in Table 6 are considered AMT for smaller installations and are achieved when only quality fuel and good combustion technologies are applied. The lower emission levels (in parenthesis) are associated with additional control measures like scrubbers and are regarded as AMT for larger installations.

In a modern non-integrated mill the heat generated from black liquor and incineration of bark exceeds the energy required for the entire production process. However, fuel oil will be needed occasionally during start-up and also, in many mills, in the lime kiln.

2.5 Accepted modern technology for the reduction and handling of solid waste

Table 7 includes technologies that are considered AMT for the reduction and handling of solid waste.

Table 7 AMT for the reduction and handling of solid waste

• Minimised generation of solid waste and recovery, recycle and reuse of these materials as far as possible
• Separate collection of waste fractions at the source and, if necessary, intermediate storage of residuals/ waste to make possible an appropriate handling of the remaining waste products
• Incineration of all non-hazardous organic material (e.g. bark, wood waste, effluent sludge) in a power boiler, specially designed for burning of moist, low calorific value fuels (e.g. a fluidised bed boiler). Biosludge may be burned in the recovery boiler. All material to be burned after pressing to the maximum possible consistency
• Disposal of hazardous waste should be carried out by authorised firms only
• Material that cannot be reused, recovered or has to be handled differently should be taken to a secure landfill facility. Only inert, primarily inorganic waste should be landfilled. All material to be landfilled after pressing to the maximum possible consistency. Organic waste should not be landfilled
• Generation of dioxins and furans can occur in the convection back passes (the cooler sections) of power and recovery boilers. Depending on concentrations, dusts from these sections should be managed in the same way as other special wastes and not spread on land
• Efficient washing of green liquor dregs prior to disposal to landfill, to minimise leaching of caustic
• Efficient washing of lime mud prior to reuse in the lime kiln to minimise the formation of hydrogen sulfide (H_2S) during the mud drying process
• External utilisation of residuals/waste as substitutes in forestry, agriculture or other industries, if possible and subject to approval under the *Waste Management Regulations 2000*

2.5.1 Solid waste discharges for BKP mills employing BAT

It should be noted that there is little detailed and reliable information available on achievable amounts of solid wastes. There is a lack of statistical data and various terms for different waste fractions may be used. Some countries report only those solid wastes, primarily inorganic solid wastes, which can no longer be recycled or reused and have to be disposed of at a landfill.

This implies that some of the organic wastes which have a reasonable heating value and/or which can be burned without the risk of hazardous emissions in the power boiler of a mill are already excluded from the given solid waste amounts (bark and wood waste, primary and biosludge from effluent treatment). Hence, the solid waste disposed of at a landfill comprises mainly boiler ashes, green liquor dregs, lime mud, some wood and bark waste rejects and miscellaneous cleaning and mixed household-type wastes.

Therefore, it is difficult to present achievable values on the amount of non-hazardous solid waste. Table 8 shows the levels of solid waste to landfill that may be expected in kraft pulp mills that employ BAT. It is assumed that bark and other wood residues as well as the mixed sludge from effluent treatment are utilised for energy production in the power boiler. The waste amounts are all given as oven dry solids (100% DS).

Table 8 Typical solid waste to landfill from bleached kraft market pulp mills

Type of waste	Amount kg DS/ADt
Lime mud	9.7
Green liquor dregs	8.1
Bio- & primary sludge	8.7
Reject (wood handling)	2.1
Wood ashes	3.9
Other	10.5
TOTAL	43.0

A small amount of hazardous waste is generated in all mills. Such waste includes oil and grease residues, used hydraulic and transformer oils, waste batteries and other scrap electrical equipment, solvents, paints, biocide and chemical residues. This type of waste normally amounts to about 0.05-0.1 kg/ADt of product [IPPC BREF, 2001].

Solids waste can vary considerably over the year depending on maintenance shuts, general cleanup activities, and other mill activities.

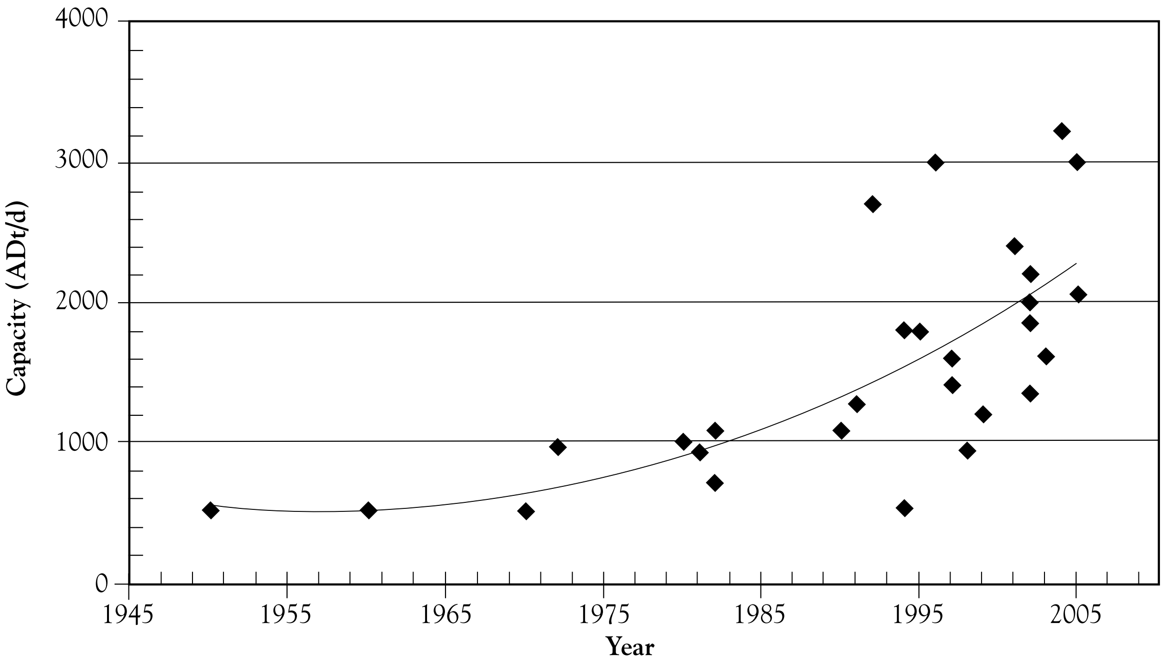
2.6 *Significant milestones and trends in kraft pulping technology*

2.6.1 Economies of scale

In general, economies of scale can be accomplished because as production increases, the cost of producing each additional unit falls through operational efficiencies.

Kraft fibrelines are no exception to this rule and their size has shown an increasingly faster rate of increase in the past 40 years. The trend is shown in Figure 2.

Figure 2 Chronological development of economy-of-scale size for kraft fibrelines (AMEC)



Fibreline sizes of 2,500-3,000 ADt/d have been made possible by the development of a recovery boiler capable of burning in excess of 4,500 t/d dry solids.

Line C at the Aracruz Celulose bleached eucalypt kraft pulp mill in Barra do Riacho, Brazil, which started up in 2002, has a production capacity of up to 2,500 ADt/d. The total production capacity for the 3 lines at this site is approximately 6,300 ADt/d.

2.6.2 Significant milestones in pulping and bleaching technology

Table 9 includes some significant milestones in the development of kraft pulping and bleaching technology.

Table 9 Significant milestones in the development of kraft pulping and bleaching technology

	Bleached Kraft Pulp Developments	
	Fibreline Technology	**Recovery Technology**
1950	**1950s:** Continuous Cooking Pulping	**1950s:** Black Liquor Oxidation
	1950s: Chlorine Dioxide Bleaching	
1960	**1960s:** Pressure Screening	**1960s:** Low Odour Boiler
	1960s: ClO_2 Substitution C-D Bleaching	
	1960s: Diffusion Washing	
1970	**1970s:** Pressure Washing	**1970s:** Falling Film Evaporators
	1970s: Increased ClO_2 Substitution, D-C	
	1970: First Oxygen Delignification, O	
	1978: First Closed-cycle Mill (shut down in 1988)	
	1978: First Integrated Chlorine Dioxide Plant	
1980	**1980s:** Medium Consistency Technology	
	1981: First Modified Batch Cooking	
1985	**1985:** Reinforced Extraction (EO), (EOP) Bleaching	
	1985: First Modified Continuous Cooking	
	1989: Wesley Vale Mill Proposed	
1990	**1990:** First ECF Bleaching and first TCF Mill	**1990s:** High Solids Firing
	1990s: Ozone Bleaching	
	1990s: Closed-cycle Development	
	1991: First Extended MCC Installation	
	1992: First Iso Thermal Cooking	
	1992: Regular mill use of xylanase enzymes	
	1993: First Lo Solids Cooking	
	1993: First ECF mill started – Alberta Pacific, Canada	
1995	**1996:** Integrated Pollution Prevention and Control (IPPC) Directive issued by European Union (EU)	
	1997: First Compact Cooking (CC)	
	1998: IDP in Burnie, Tasmania shut down	
	1998: Final Pulp & Paper Cluster Rule by US Environmental Protection Agency (USEPA)	
	1999: Ecocyclic Pulp Mill Study, Sweden	
2000	**2001:** Stockholm Convention on POPs (Persistant Organic Pollutants) adopted	

Significant developments worth mentioning are:

- low chlorine dioxide substitution for chlorine was practised in the 1960s in (CD) bleaching stages;
- low-odour recovery boiler technology was available in the 1960s;
- higher chlorine dioxide substitution for chlorine was practised in the 1970s in (DC) bleaching stages;
- falling film evaporation technology was available the 1970s;
- the first oxygen delignification plant was started up in 1970;
- Great Lakes Paper Company in Thunder Bay, ON, Canada decided in 1978 to adopt a concept for bleached kraft mill process closure called the Rapson-Reeve Process, from the names of its developers. A major factor in taking that decision was the lack of sufficient space to install wastewater treatment facilities at the site. The mill operated in a partially closed manner for several years before the concept was abandoned in 1988 and a secondary treatment plant was installed. This pioneering effort clearly established the technical challenges that must be overcome to eliminate bleached kraft mill discharges [Stratton, 2003];
- the first modified batch cooking installation started up in 1981;
- the first modified continuous cooking installation started up in 1985;
- the first reinforced extraction bleaching stage, (EO) and (EOP), started up in 1985;
- ECF bleach plants began operating in 1990 in existing mills;
- the first mill employing TCF bleaching was Aspa Bruk in Sweden in 1990;
- high solids firing technology in the recovery boiler began being practised in the 1990s; and
- the first purposely built bleached kraft pulp mill employing the ECF bleaching method and other AMT started up in 1993 at Alberta-Pacific, Boyle, AB, Canada.

These developments have had considerable impact on the reduction of emissions to the atmosphere and to the aquatic environment.

The chronology of these developments vis-à-vis the proposed pulp mill development at Wesley Vale in Tasmania in 1989 shows that the technology for minimised environmental impact from bleached kraft pulp mills had already made significant strides until then, however, ECF and TCF bleaching were, notably, not yet considered AMT.

2.7 Technology changes that have occurred since the 1995 Commonwealth Guidelines

A number of technology changes that have occurred since the publication of the 1995 Commonwealth Guidelines. Because of the time lag that typically characterises the acceptance of any new or modified technology, most of the technology changes and developments that have occurred since 1995 are considered emerging technologies/future options. Among these, developments in closed-cycle technologies have been particularly active.

The following sections outline technology changes and developments that have occurred since the publication of the 1995 Commonwealth Guidelines.

2.7.1 Technology changes in accepted modern technology

Compact cooking (CC™)

Kværner Pulping has developed a new chip feed system and a new cooking system called compact cooking. Details of the process have not been made public to maintain Kværner's competitive position. Secrecy agreements with Kværner are required to fully understand their system. Therefore, any comments made in the report are not from full knowledge of the system details. Conversations with mill personnel have been helpful in gaining some understanding. The first installation was a retrofit at the Södra Cell Mönsterås bleached softwood/hardwood TCF market kraft pulp mill in Sweden in 1997, and the first purposely built plant was at the Stora Enso Celbi bleached eucalypt ECF market kraft pulp mill in Portugal in 1999.

At the beginning of 2004 there are 5 new and 6 rebuilt compact cooking installations worldwide.

Aerated lagoon treatment

Biological treatment in an aerated lagoon has in the past been a rather common alternative to the activated sludge process.

However, since the discharges of organic matter (measured as COD and BOD), suspended solids and nutrients are higher than those from modern activated sludge plants, this technology can no longer be regarded as AMT for a new mill.

2.7.2 Technology changes and developments in emerging technologies/ future options

Hexenuronic acids

Approximately 75% of the hemicelluloses in hardwoods consists of *xylan* (4-O-*methyl-glucuronoarabinoxylan*). Under the kraft pulping conditions, xylan generates hexenuronic (*4-deoxy*-β-L-*threo*-4-*enopyranosyluronic*) acid groups (HexA) which form a considerable part of the residual oxidisable material after pulping (measured by the kappa number).

This had been recognised in the 1960s, e.g. [Clayton, 1962] and [Samuelson, 1967] but the full identification and verification of the occurrence of hexenuronoxylan during alkaline pulping was achieved only in the mid 1990s through nuclear magnetic resonance (NMR) spectroscopy [Buchert, 1995], [Teleman, 1996], [Dahlman, 1996].

Hardwood kraft pulps and especially eucalypt kraft pulps may contain high amounts of HexA, contrary to softwood kraft pulps.

HexA have adverse effects in bleaching. These include increased consumption of bleaching agents such as chlorine dioxide (ClO_2) and ozone (O_3) to reach target brightness, increased brightness reversion and contribution to formation and scaling of oxalates in bleaching equipment.

The HexA content in eucalypt kraft pulps can be lowered by extended cooking to a kappa number below 12 [Pedroso, 2003], but this can normally not be achieved in industrial practice. Such a low cooking kappa number in pulping of eucalypt would result in an excessive yield loss (excessive wood consumption) and low pulp bleachability.

Consequently, three other avenues have been explored for selective removal of HexA:

- hot acid stage (A_{hot}) [Henricson, 1997], [Jiang, 2000];
- combined hot acid and hot D stage $(AD)_{hot}$ [Ragnar, 2002b]; and
- high temperature D stage also called hot D stage (designated D_{HT} or D_{hot}) [Lachenal, 2000], [Eiras, 2003], [Lindström, 2003].

A hot acid stage and a D stage at high temperature hydrolyse and remove HexA and therefore reduce the consumption of mainly chlorine dioxide (ClO_2) but also ozone (O_3), reduce the formation of AOX, decrease brightness reversion and may reduce problems with scaling of oxalate on bleaching equipment.

Despite the positive effects of A_{hot}, $(AD)_{hot}$ and D_{HT}, possible drawbacks are increased yield loss, decreased pulp viscosity/strength and refinability and increased COD content in bleach plant effluents.

The positive and negative effects of the three modes of 'hot acid' or hot D stages vary considerably depending on the eucalypt species, the number of bleaching stages, the bleachability of the pulp and the conditions in pulping and bleaching.

Usually both the advantages and drawbacks are more accentuated for A_{hot} and $(AD)_{hot}$ than for D_{HT}.

There are a number of either stage in operation or coming into operation in BEK pulp mills. The rationale for, and effects from, the implementation of any of the stages must be evaluated from case to case.

Low-chlorine integrated chlorine dioxide plant

Small amounts of chlorinated organic compounds – such as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) – are formed in non-detectable or very low measurable levels in effluents from kraft pulp mills with ECF bleaching because:

Chlorine dioxide produces small amounts of elemental chlorine when reacting with the pulp.

Chlorine may be present in the chlorine dioxide solution, up to 0.22 kg Cl_2/kg ClO_2, depending on the generation method used.

As seen in Table 2 – AMT for the reduction of emissions to the aquatic environment, there are two AMT for the on-site generation of chlorine dioxide for ECF bleaching with low contamination of elemental chlorine:

- the methanol process (ERCO R8/R10 and Cellchem SVP-Lite/SVP-SCW); and
- the hydrogen peroxide process (ERCO R11 and Cellchem SVP-HP).

Conventional integrated chlorine dioxide plants (IDP) – i.e. those where chlorine, electrical power and water are the only inputs to the IDP whereas sodium chlorate, acids, and reducing agents are not required as raw materials – typically generate chlorine dioxide solutions with 0.22 kg Cl_2/kg ClO_2.

The low-chlorine IDP is a recent development proposed by Chemetics, a division of Aker Kværner Canada Inc. of Vancouver, BC, Canada to address this deficiency [Ma, 2000]. Chemetics claims this type of plant generates chlorine dioxide solutions with 0.02 kg Cl_2/kg ClO_2.

Integrated chlorine dioxide plants (IDP) have higher capital cost than the non-integrated counterparts but have much lower operating costs.

Chemetics claims that the simple payback period for an IDP compared to a non-integrated alternative is 2.1 years [Ma, 2000].

While the benefits of IDP are proven, the low-chlorine capability is not and there are no installed IDP generating low-chlorine chlorine dioxide solution.

Chloride and potassium removal from the recovery cycle

The element chlorine enters a kraft mill as the chloride ion (Cl) with the wood and makeup chemicals such as sodium hydroxide (caustic). Chloride is extremely soluble in the alkaline liquors of the kraft cycle, and will accumulate there. Potassium (K) also enters with the wood. The typical Cl and K purge points in a mill include recovery boiler stack emissions, washing losses from brown stock or post-oxygen washing into the (open) bleach plant, and losses of green, white, and black liquors. Because process closure minimises such losses, Cl and K concentrations will increase unless alternative purge means are provided.

Increased concentrations of Cl and K in black liquor have a detrimental effect on recovery boiler capacity and efficiency, and can result in increased corrosion in the recovery boiler, if not controlled.

Several techniques have been developed to purge Cl and K by separating them from saltcake (Na_2SO_4) in the electrostatic precipitator (ESP) catch. Among these, the most recent are:

Kværner has developed a leaching system in which a centrifuge is used to separate Na_2SO_4 from Cl and K and has an installation at the Aracruz, Brazil BEK pulp mill. There are also two Kværner systems being installed in Chile and one in China.

The precipitator dust purification (PDP) process was jointly developed by the Pulp and Paper Research Institute of Canada (Paprican) and ProSep Technologies, Inc. of Canada. This process utilises ion exchange technology to generate a purged stream rich in NaCl and a recovered stream rich in Na_2CO_3 and Na_2SO_4. Precipitator dust is dissolved in water and filtered prior to the ion exchange step. Water is used to regenerate the ion exchange resin. Laboratory development studies using precipitator dust from two mills showed efficiencies of more than 95% for Cl removal and of at least 85% for Na recovery. K was not significantly removed. The recovered stream would be directed to the black liquor evaporators [Jemaa, 1999].

Research programs

A number of research programs with a focus on minimum impact and sustainable, energy efficient pulp and paper manufacturing were undertaken in the 1990s, some of which continue today. Many of these are funded at national levels, and typically involve national pulp and paper research institutes. Notable programs include Sweden's ecocyclic mill research program (KAM), U.S. Department of Energy's agenda 2020, Finland's TEKES, and Progressive systems closure at Paprican.

The ecocyclic pulp mill – KAM program

The ecocyclic pulp mill or Krestsloppsanpassad massafabrik (KAM) program is an interdisciplinary research program funded by the Foundation for Strategic Environmental Research (MISTRA) and the Swedish Energy Agency (STEM). The program is also supported by the Swedish Pulp and Paper Research Foundation; Ångpanneföreningens Foundation for Research and Development; and the pulp and paper industry [KAM report A100, 2003].

The program was divided into two stages, KAM1 (1996-1999) and KAM2 (2000-2002). Its vision was a fully developed ecocyclic system for high quality paper products, with an efficient use of the potential biomass energy.

One aim of the program was the development of realistic and environmentally optimal solutions for the production of high-quality pulp and paper products which minimise the use of non-renewable resources and efficiently utilise the potential biomass energy. Another aim was the education of research scientists.

The focus was on the bleached softwood kraft pulp (BSKP) and bleached hardwood kraft pulp (BHKP) production processes.

Key issues were:

- mineral balances;
- minimisation of solid waste;
- reduction of energy consumption;
- utilisation of surplus energy;
- high degrees of system closure; and
- alternatives to the kraft process.

In each of the two stages, the base case, or starting point, for the analysis of these issues was a 'reference mill,' a hypothetical mill that employs the most recent and commercially available technologies (i.e. BAT), best management practices (BMP) and optimised process conditions.

> These BAT, BMP and process conditions are employed on an individual basis in operating Swedish and Finnish bleached kraft pulp mills, however, they are not employed all at the same time in any single mill location.[8] Consequently, the reference mill is a fictitious mill.

The Q(OP)(DQ)(PO) bleaching sequence was chosen for the reference mill. This sequence is powerful enough to reach high brightness targets and has a considerable flexibility in its use of hydrogen peroxide and chlorine dioxide. Similar TCF sequences with ozone or peracetic acid instead of chlorine dioxide, i.e. Q(OP)(ZQ)(PO) or Q(OP)(PaaQ)(PO), were studied. An important issue was a high degree of bleach plant closure.

The reference mill concept was similar in KAM1 and KAM2, with the exception of an increased spill recovery capability, a lower effluent load and a somewhat higher evaporation demand in KAM2.

As further improvements in the energy efficiency of the reference mill can be achieved through process integration, important focal points were changes in the secondary heat system and in the evaporation plant.

> The KAM program compared 17 different future cases or 'model mills' with a Reference Mill. The model mills built on the reference mill by including a number of emerging technologies/future options having variable time frames for achieving BAT status. Consequently, it is apparent that the model mills are also fictitious mills.

The implementation of model mill technologies requires further development work. The KAM report concluded that the most important future issues may include:

- higher pulp quality (alkaline sulfite) or good balance between pulp quality and yield (alkaline sulfite or polysulfide);
- further decrease in the impacts on the aquatic environment (alternatives with a high degree of closure);
- odour abatement (sulfur-free cooking);
- more efficient energy utilisation in the mill (pressurised black liquor gasification, with or without titanate auto-causticising, and increased heat integration);
- efficient use of excess energy externally (surplus biomass energy from precipitated lignin, integration with an ethanol plant, black liquor gasification and methanol production and pressurised black liquor gasification for power generation); and
- lower generation of solid waste.

Table 10 presents the estimated time frames for the implementation of the emerging technologies/future options studied in KAM1 and KAM2. These time frames are based on the reference mill as a starting point and the assumption that the emerging technologies/future options have become technically effective and economically viable on an industrial scale for the production of bleached

8 Many of the techniques and measures included in the KAM program are considered AMT/BPEM, however, quite a few are not since it is believed that they cannot be considered AMT/BPEM at present.

chemical pulp, i.e. BAT. The most important developments can be expected in the chemical recovery area.

Table 10 Time frames for the implementation of the emerging technologies/ future options studied in KAM1 and KAM2

	Short term **1-5 years**	**Medium term** **5-10 years**	**Long term** **more than 10 years**
Fibreline	Further development of black liquor pretreatment	Chip leaching	Alkaline sulphite cooking
	Polysulphide-AQ yield/ strength optimisation (tear and tensile strength)	Very high closure of the water system	Simplified bleaching
	Cooking chemical profiling (for optimal yield, refinability, and strength)		
Chemical and energy recovery	Condensing turbine power generation from excess energy	Sale of precipitated lignin	Complete borate auto-causticising
	Heat integration, primarily in black liquor evaporation	Possibly black liquor gasification with power or methanol production	Black liquor gasification with power or methanol production
	Partial borate auto-causticising in regular operation	No electrostatic precipitator ash discharge	Chemical recovery through gasification for alkaline sulphite cooking

Paprican

Paprican is leading the Canadian effort in system closure research. Paprican has expanded pilot plant facilities to develop system closure technologies. The recently constructed pilot plant facilities include an expanded bleaching pilot plant, a new pilot paper machine, a new mechanical pulping pilot plant, and several separation pilot units for evaluating system closure concepts.

Paprican's program in progressive system closure incorporates research, development, and mill implementation activities in the areas of water use reduction, improved prediction and design tools, dynamics and control, corrosion control, chemical separation and regeneration, removal and/or control of wood extractives, chemical additives, energy cost reduction, and management of solid and gaseous emissions [Voss, 2000], [Paleologou, 2001]. Paprican has current activities in system closure for mechanical pulp mills, chemical pulp mills, and paper machines.

Two benchmark criteria are applied to options investigated [Ramamurthy, 1998]:

- they should result in lower costs compared with current systems; and
- they should help maintain or improve final product quality.

Kraft pulping process developments include improving oxygen delignification with peroxymonosulfate, use of laccase and other enzyme systems, development of efficient chelation and metal management strategies, integration of ozone stages in a low effluent fibreline, improvements in bleached pulp yield, ECF bleaching with reduced reliance on chlorine dioxide, and methods for hexenuronic acid removal.

The recently rebuilt bleaching pilot plant includes washing with filtrate recovery and can run chlorine dioxide, peroxide, ozone, and single and double oxygen bleaching stages, complete with filtrate recycle. Paprican has developed steady-state and dynamic simulation capability including pulp washer control, modelling of bleaching chemical consumptions, and dynamic modelling of bleaching upset conditions.

2.8 *Progress of some accepted modern technologies since the 1995 Commonwealth Guidelines*

The detailed discussion of AMT has highlighted the following progress for some of the AMT that have occurred since the publication of the 1995 Commonwealth Guidelines.

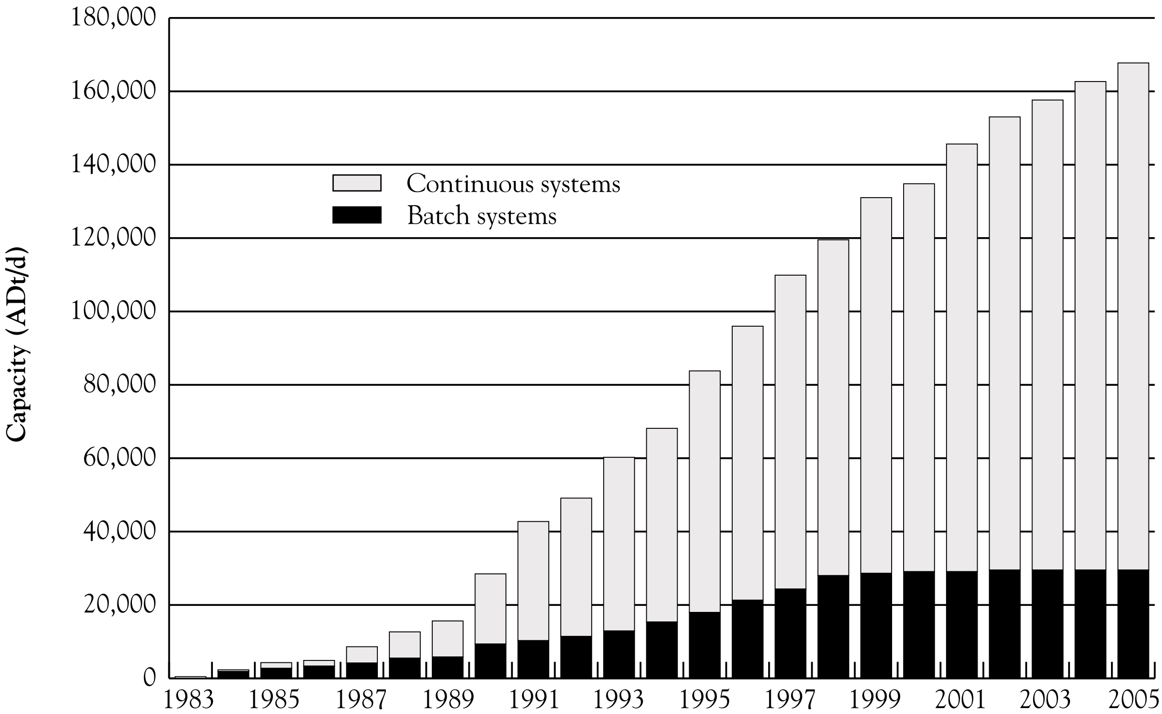
2.8.1 Modified cooking

At the end of 1994, approximately when the 1995 Commonwealth Guidelines were issued, 59 continuous digesters were in operation, new or retrofitted, with some form of modified continuous cooking. At the beginning of 2004 there are more than 130 operating modified continuous digesters. The two main types of modified cooking systems for continuous digesters operating today are Lo Solids from Andritz and Compact Cooking from Kværner.

In total there are today 40 operating modified batch cooking systems, 14 of which have been installed since 1995, when the 1995 Commonwealth Guidelines were issued. None of these 14 installations employed new technology, although some minor process improvements have been made.

Figure 3 illustrates the acceptance of modified cooking in pulping for both batch and continuous digester systems.

Figure 3 World daily production capacity of pulp from modified cooking processes

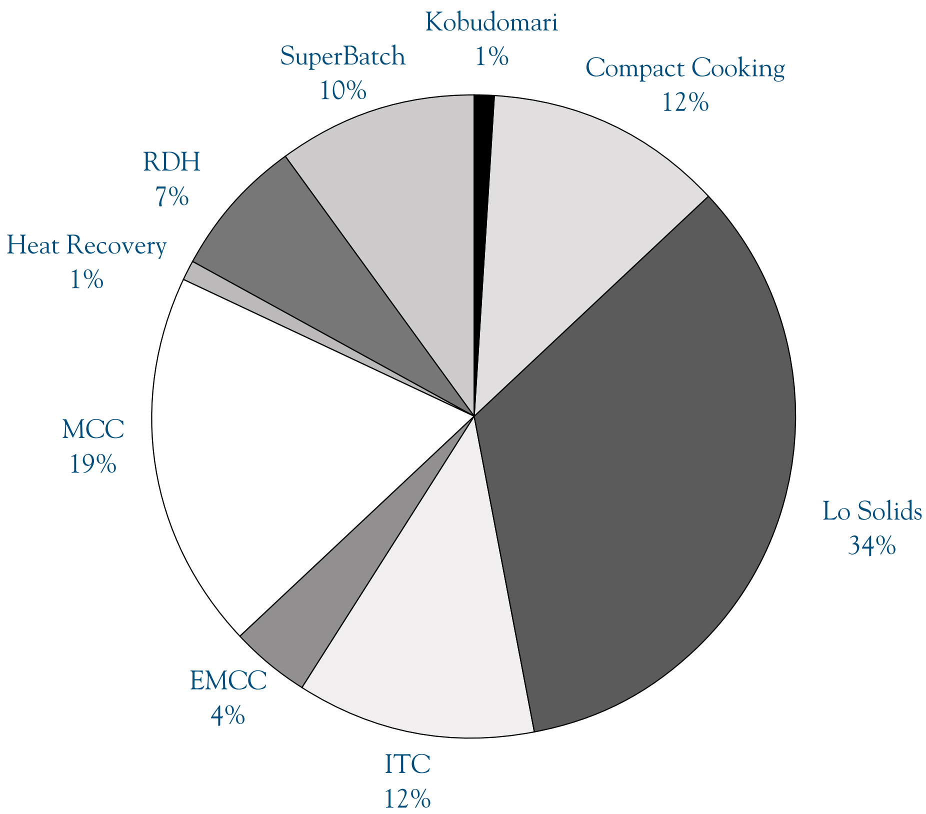


Source: Beca AMEC, Vendors (February 2004)

Modified cooking is considered AMT in new continuous and batch digester installations. Currently there are about 131 continuous and 40 batch digester systems with modified cooking worldwide, capable of producing about 125,000 and 30,000 ADt/d of pulp. Modified cooking capacity increased more than five-fold during the 1990s, but has tapered off in recent years.

Figure 4 shows the market share of the various systems offered, based on system capacity.

Figure 4 World market share of modified cooking processes

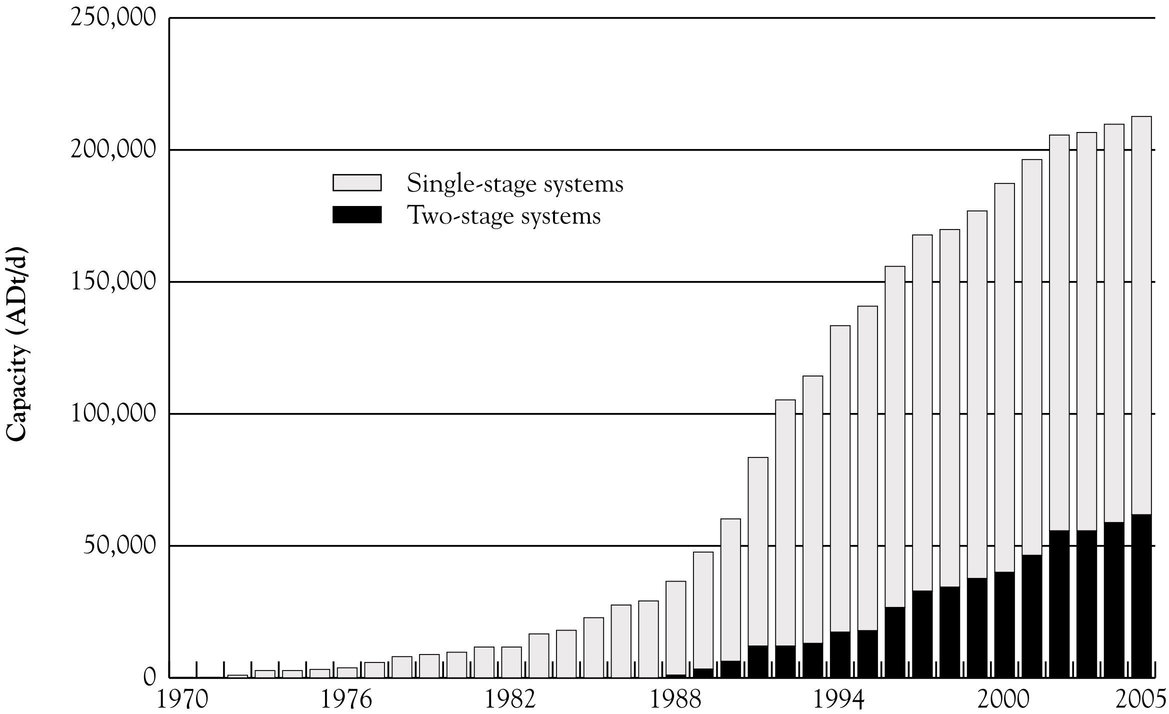


2.8.2 Oxygen delignification

Since 1995, the changes to oxygen delignification have not been major. There have been process condition changes which distinguish the systems provided by the different vendors, and pressure washers of new design which operate at medium consistency are the norm. The trend to medium consistency, two-stage installations has strengthened.

The industrial application of oxygen delignification has expanded very rapidly in recent years. In total today (2004), there are approximately 255 systems, 90% of which are processing kraft pulp. Figure 5 shows the trend.

Figure 5 World daily production capacity of oxygen delignified pulp



Source: Beca AMEC, Vendors (February 2004)

New developments will continue to occur, which may include the use of pre-treatment, inter-stage washing, inter-stage treatments, catalysts, chelants and other enhancements, to further develop oxygen delignification performance.

In 2004, oxygen delignification is an essential part of any modern, low environmental impact fibreline. Virtually all new fibrelines incorporate oxygen delignification.

2.8.3 Bleaching strategies

A step change in the environmental impact of bleach plant effluents was made when elemental chlorine bleaching was completely eliminated and substituted by either ECF or TCF bleaching.

The progress made in ECF bleaching since 1995 includes process improvements in bleaching sequences which allow further reductions of the charge of chlorine dioxide while maintaining optical and strength properties. Examples of these process improvements include the ACF bleaching method at Aracruz Celulose Barra do Riacho, Brazil and VCF bleaching method on Line C at Votorantim Celulose e Papel Jacareí, Brazil.

ECF bleaching is today (2004) the dominant bleaching method worldwide (75% of total bleached kraft pulp production) and has been adopted in most new installations.

The market demand and production capacity for TCF pulp have remained constant in the last 5 to 10 years. At present (2004) about 5% of all bleached kraft pulp is TCF bleached and most of it is produced in Europe (mainly in the Nordic Countries with smaller amounts in Germany and Spain). Some TCF pulp is also produced in Brazil. The worldwide annual production of TCF pulp is estimated to be approximately 4 million tonnes (ÅF-Celpap).

The approximate total annual production of bleached kraft pulp in Sweden, Norway, Finland and Germany is 9.5 million tonnes of which about 2.5 million tonnes is TCF pulp, or about 25%.

A large proportion of the TCF pulp produced is sold in Germany, where the demand for paper that has been produced without the use of chlorine-containing chemicals is strong.

None of the known new or planned bleached kraft pulp mill installations is dedicated to the exclusive use of TCF bleaching technology, however, the bleach plant may, in some cases, have the built-in capability of carrying out both ECF and TCF bleaching sequences. Examples of this trend have been Aracruz Celulose Barra do Riacho, Brazil and Line B at Votorantim Celulose e Papel Jacareí, Brazil (ÅF-Celpap, Beca AMEC).

2.9 *Highlights of main conclusions of environmental significance*

2.9.1 Closed-cycle technologies

As of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis, more specifically there are no bleach plants in papergrade bleached kraft mills that operate fully closed on a continuous basis.

The application of closed-cycle technologies to eucalypt processing was studied under the National Pulp Mills Research Program and reported in September 1994 [Galloway, 1994]. This included a review of current research work and computer based model development. Two conclusions of this study were that 'implementing closed-cycle in a bleached eucalypt kraft mill would appear no less feasible for a mill using eucalypt than any other wood species' and also that as of 1994 'Closed-cycle technologies are not yet technically or commercially proven.'

Today, almost 10 years later, although significant progress has been made, it appears that those conclusions are still valid.

The principal enabling elements for a closed-cycle bleached kraft pulp mill operation have been demonstrated or are in operation, for example brown stock system closure (both for continuous and upset conditions), recycle of debarking and wood preparation effluents, the recycle of bleaching effluents and foul condensate treatment. New technology has been introduced which facilitates kraft mill closure, but there are still areas where more development is needed.

Total system closure during pulp production, which theoretically makes an effluent-free pulp mill become a reality, is not yet possible because the non-process elements (NPE) which enter the process mostly with the wood, and to a lesser extent with the chemicals and the process water, accumulate in the process and must be purged out of the system.

New enabling technologies include low temperature evaporation for weak liquor, bleach plant effluent recovery, K and Cl removal and enhanced NPE removal.

These technologies have not yet been combined in a single mill. The incorporation of these emerging technologies in a single facility to achieve potential economic and environmental benefits should be carefully considered by carrying out a risk/benefit analysis.

The approach taken by many mills is compatible with a future that may include closed-cycle operation. This includes:

- attention to spill control and best environmental management practices;
- water use identification and reduction;
- reuse of water and effluent within the process (including separation and recycle of cooling waters from the process);
- use of an ECF or TCF bleach plant; and
- consideration of recovery, evaporation and delignification constraints.

If a wider vision of ecological balance (which addresses yield, energy and other resource use) is sought, then higher degrees of closure may have a role to play, but approaches in which effluent discharge and treatment are retained may prove to better meet this goal.

2.9.2 Elemental chlorine and ECF bleaching technologies

The formation of AOX as well as of specific chlorinated organic compounds, such as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF)[9], in elemental chlorine bleaching is very dependent on the amount of chlorine used and, therefore, varies within wide ranges among mills still using chlorine in their bleaching sequences.

At present, AOX can typically range from about 1 to 8 kg/ADt in bleach plant effluents from mills adopting 'chlorination,' including old and 'new' mills, with or without oxygen delignification, charging low or high amounts of chlorine and bleaching softwood or hardwood. The amount of PCDD and PCDF can also vary within a wide range because of the same contributing factors.

The United Nations Environment Programme (UNEP) has prepared a 'Standardized toolkit for identification and quantification of dioxin and furan releases,' which aims to assist countries in establishing release inventories [UNEP/PCDD and PCDF, 2003]. The Toolkit includes 'default' emission factors for different sources and activities, which could be used by countries with no or limited PCDD/PCDF emission data. This Toolkit should be used in the first screening and order-of-magnitude estimates of the scale of potential PCDD/PCDF sources and releases.

The 'default' emission factor 'set' by UNEP in untreated bleach plant effluent (i.e. prior to secondary treatment) for elemental chlorine bleaching of kraft pulp is 9 µg TEQ[10]/ADt bleached pulp [UNEP/

9 PCDD/PCDF refer to all 2,3,7,8-substituted congeners of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans.

10 Toxicity equivalent.

PCDD and PCDF, 2003]. This figure is somewhat conservative and is relevant for mills with relatively high charges of chlorine. If low charges of chlorine are applied, the levels of PCDD/PCDF are much lower in the untreated bleach plant effluent, e.g. 0.02-1 µg TEQ/ADt bleached pulp [SSVL, 1991].

The 'default' emission factor 'set' by UNEP in untreated bleach plant effluent for ECF and TCF bleaching of kraft pulp is 0.26 µg TEQ/ADt bleached pulp [UNEP/PCDD and PCDF, 2003].

The potential for formation of PCDD/PCDF in elemental chlorine bleaching of kraft pulp with relatively high charges of chlorine is approximately 35 times higher than that in ECF or TCF bleaching but can be of the same order of magnitude if low charges of chlorine are applied.

> UNEP does not differentiate between ECF and TCF bleaching with respect to the possible formation of PCDD/PCDF, however, PCDD and PCDF may be present in non-detectable or lower measurable levels than those indicated by the UNEP emission factor in effluents from kraft pulp mills with either ECF or TCF bleaching [SSVL, 1991], [UNEP/PCDD and PCDF, 2003].

The content of AOX in bleach plant effluents from ECF bleaching is usually in the range 0.2-1.0 kg/ADt. Secondary effluent treatment can reduce the amount of AOX generated in bleaching by 40-65%.

Specific chlorinated compounds, such as PCDD and PCDF are formed in non-detectable or very low measurable levels in ECF bleaching. Thus the releases of PCDD and PCDF are non-detectable or very low with ECF bleach plant effluents [SSVL, 1991], [UNEP/PCDD & PCDF, 2003].

Chlorine dioxide primarily reacts with the pulp (lignin) through oxidation. Consequently, much less substituted chlorinated organic compounds are generated in ECF bleaching compared to bleaching with elemental chlorine.

Small amounts of chlorinated organic matter or specific compounds (such as AOX, PCDD and PCDF) are formed in ECF bleaching mainly because:

- chlorine dioxide produces small amounts of elemental chlorine when reacting with the pulp; and
- chlorine may be present in the chlorine dioxide solution, up to 0.22 kg Cl_2/kg ClO_2, depending on the generation method used.

These small amounts of elemental chlorine, mostly in the form of hypochlorous acid (HOCl) at the prevailing bleaching conditions, are then capable of generating correspondingly small amounts of substituted chlorinated organic compounds.

2.9.3 Naturally occurring organochlorine levels

Several chlorophenolic isomers with biogenic origin have also been isolated. Studies in Sweden [Grimvall, 1994] have demonstrated that 2,4,6-trichlorophenol and its methylated analogue 2,4,6-trichloroanisole are ubiquitous in humus-rich waters and formed by the action of microorganisms. While chlorophenols are produced in ECF bleaching, they are usually less chlorinated than these naturally occurring compounds. Therefore, it is not surprising that organisms possess mechanisms for their effective breakdown, and some degradation products from naturally occurring chlorinated lignin are similar to those found in bleached kraft mill effluents [Dahlman, 1993].

Consequently, chlorinated compounds formed during ECF bleaching are biologically degradable in the environment. Pulp mill AOX will ultimately be mineralised through photochemical and biological processes and during mineralisation the chlorinated organic material will be released as chloride and carbon dioxide (CO_2) [Archibald, 1997].

Many studies have been carried out to assess the geographical distribution of natural surface waters and related AOX levels. In studies summarised by Tana *et al.*, levels of AOX from 1 to 80 µg/L were found in aquifers unaffected by human activities [Tana, 1996]. The sometimes very high background concentrations of AOX in water bodies are illustrated by a frequency distribution diagram based on 134 Swedish lakes that have no known point source of AOX. Concentrations of AOX ranging from 11 to 185 µg/L were found [Asplund, 1992].

The highest AOX concentrations were found in humus-rich, oligotrophic (pristine) lakes in remote areas. These concentrations were comparable to those in industrially polluted waters such as the Rhine River, where AOX concentrations ranging from 5 to 200 µg/L have been measured.

An investigation was carried out in 1991 on the concentrations of AOX in Lake Vättern, Sweden and a pristine tributary of this lake. A bleached pulp mill using conventional chlorine gas bleaching was discharging its effluent into this lake. Despite this, the mean AOX concentration in the pristine tributary was higher than that in the lake (32 µg/L in the tributary, 15 µg/L in the lake) [Grimvall, 1991].

The background concentrations of extractable organic chlorides (EOCl) in surface sediments from the Baltic Sea are reported in [SEPA, 1989]. This publication states:

'It appears to be reasonable to consider concentrations of 10-30 µg EOCl/g IG (ignition loss or organic matter) as normal background levels for surface sediment of widely different origin and composition. It is not possible to identify any geographical variation depending on where in Sweden the samples have been taken. The sediment from marine fiords has the same levels of EOCl as sediment from small and large lakes.'

Wulff *et al.* analysed EOCl levels in water along the Swedish Coast and in deep Baltic Sea waters. From a correlation between EOCl and AOX in water presented in their publication, the calculated concentrations of AOX varied from 4 to 31 µg/L [Wulff, 1993].

These background concentrations are of the same order of magnitude of those measurable at the edge of the mixing zone for BEK pulp using ECF bleaching and employing AMT/BPEM.

2.9.4 TCF bleaching technology

In TCF bleaching the formation of AOX is usually non-detectable.

Specific chlorinated compounds, such as PCDD and PCDF may be present in non-detectable or at very low measurable levels in effluents from kraft pulp mills with TCF bleaching [UNEP/PCDD & PCDF, 2003].

> The United Nations Environment Programme (UNEP) considers the ECF and TCF bleaching methods to be equivalent with respect to their potential formation of PCDD and PCDF [UNEP/PCDD & PCDF, 2003].

PCDD and PCDF may be detected in effluents from kraft pulp mills with TCF bleaching at the same levels as in effluents from kraft pulp mills with ECF bleaching because additives, such as defoamers and surfactants, contaminated with dibenzo-p-dioxins and dibenzofurans may be used.

TCF bleaching can be regarded as an established technology and as AMT. However, TCF pulp production usually results in higher production costs and the same or inferior pulp quality compared to ECF pulp production.

2.9.5 Bleach plant effluent recycle to chemical recovery

Currently, ECF effluents cannot be easily recycled to chemical recovery due to the build-up of chloride ions (Cl-) and in some cases potassium (K), and scaling/deposition of organic and inorganic compounds.

> Since TCF bleach effluents contain virtually no chloride, the problems associated with chloride in TCF bleaching are less than those in ECF bleaching when bleach plant effluent is recycled. However, the difficulty in managing the problems with NPE (need for their control and removal) and with increased concentrations of organic and inorganic compounds is the same or greater in TCF bleaching when compared with ECF bleaching since NPE have a greater impact on pulp quality and brightness in TCF bleaching. ECF and TCF bleaching are, to a great extent, alike from this point of view.

2.9.6 Odorous non condensable gases

Emissions to the atmosphere from kraft mills smell because odorous gases containing reduced sulfur compounds (TRS) such as hydrogen sulfide (H_2S), methyl mercaptan (CH_3SH), dimethylsulfide (CH_3SCH_3) and dimethyldisulfide (CH_3SSCH_3) are produced at various points in the kraft pulping process. The sulfur originates mainly from the sodium sulfide (Na_2S), which is one of the active cooking chemicals.

Modern kraft mills mitigate odorous emissions by employing AMT such as:

- collection and incineration of concentrated non condensable gases (CNCG) in either the recovery boiler or a standalone low-NO_x incinerator;
- backup system for the CNCG – which is activated during upsets, maintenance or other downtimes of the main system – consisting of:
  - a flare/incinerator and secondary incineration unit (e.g. the lime kiln); or
  - a pre-purged alternative disposal point immediately available with interlocks permitted to allow switching without venting (bump less transfer) to a power boiler.
- collection and incineration of dilute NCG (DNCG) in the recovery boiler after their addition to its secondary or tertiary combustion air;
- methanol recovery from the foul condensate stripper off-gases;
- for the recovery boiler: computerised combustion control and carbon monoxide (CO) measurement;
- for the lime kiln: control of the excess oxygen, use of low-sulfur fuel, and control of the residual soluble sodium in the lime mud fed to the kiln; and
- spot monitoring program carried out by measuring odour with a mobile gas chromatograph – mass spectrometer (GC-MS). Testing will be more frequent initially and less frequent later in the program.

2.10 Existing supra-national, national and sub-national guidance

Section 4 of the Commission's Draft Main Report, Volume 1, May 2004, presented a summary of current guidelines and standards applied to new bleached kraft pulp mills in Europe and North America.

Current guidelines and standards for emissions to the atmosphere and the aquatic environment were reviewed for:

- the European Union;
- the United Nations Environment Programme;
- European countries (Austria, Finland, France, Germany and Sweden);
- United States of America;
- Canada; and
- World Bank Group.

Section 4 of the Draft Main Report also presented effluent variability factors and monitoring frequencies used in several jurisdictions, as well as a brief discussion on greenhouse gases.

Except for Portugal and Spain, pulp mills in Europe and North America do not generally utilise eucalypt as a source of fibre. However, guidelines and standards applied to new bleached kraft pulp mills using hardwood as a fibre source should provide a suitable benchmark for similar mills using eucalypt as a fibre source.

The Alberta-Pacific bleached aspen and pine kraft pulp mill in Boyle, AB, Canada is considered a suitable benchmark because 85% of its production is from hardwood and it has employed BPEM and AMT for the reduction of emissions to the aquatic environment. Al-Pac was the first purposely built ECF mill in the world.

A comparative table of some of the national and sub-national emission limits is presented in Appendix E entitled 'Emission limit comparison for selected jurisdictions.'

2.11 Recommended environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania

Volume 2 of this report presents recommended guidelines for emissions to the atmosphere and the aquatic environment for any new bleached eucalypt kraft pulp mill proposed to be built in Tasmania (Tasmanian Guidelines).

The recommended Tasmanian Guidelines are technology-based guidelines and minimum standards that any new BEK pulp mill employing ATM/BPEM should meet, however, they do not take into account the environmental or social conditions at the site or sites proposed for the pulp mill development. The socio-environmental impact of the proposed mill will need to be assessed to determine whether these guidelines are sufficient to protect the environment or more stringent discharge limits are necessary.

Approval for construction will depend on the successful completion of an environmental impact statement (EIS) which examines a wider range of impacts than those included in these guidelines.

The emission guidelines defined below are based on the use of AMT and BPEM for the production of market grade bleached eucalypt kraft pulp that have been demonstrated to be technically effective and economically viable on an industrial scale for minimising the discharge of pollutants from the pulp mill to the environment. The treated liquid effluent from such a mill is intended to have a marine discharge.

The combination of these technologies and practices (also called 'techniques' or 'measures'), or subsequently developed alternate techniques which produce similar or superior results, should be included in any new bleached eucalypt kraft pulp mill proposed to be built in Tasmania.

Once a mill is built, the only justification for requiring modifications for environmental reasons to the limits included in the mill permit, should be that a significant impact has been identified.

2.11.1 Emissions to the marine environment

Table 11 lists the recommended monthly average and daily limits for biologically treated effluent at the point of discharge.

Table 11 Monthly average and daily discharge limits

Parameter	Units	Monthly average maximum	Daily maximum
TSS	kg/ADt	2.6	4.5
BOD_5	kg/ADt	2.1	3.6
COD	kg/ADt	20	34
AOX[a]	kg/ADt	0.2	0.4
Colour	kg/ADt	42	72

Note:

a These limits are not applicable to BEK pulp mills employing a TCF bleaching sequence.

Notwithstanding the recommended colour limits, any proponent of a BEK pulp mill to be built in Tasmania should ensure that the colour emissions will not affect the visual amenity of the local beaches and environs.

Table 12 lists additional parameters, and their discharge limits, which should be included in the effluent permit. These discharge limits apply to each individual effluent sample analysed and are not averaged. The effluent sample should be taken at the point of discharge and should exclude any uncontaminated water (such as indirect cooling water).

Table 12 Discharge limits for each effluent sample analysed

Parameter	Units	Value
Acute toxicity	LC_{50}/EC_{50}	[a]
Chronic toxicity	EC_{50}	[b]
2,3,7,8-TCDD	pg/L	10
2,3,7,8-TCDF	pg/L	30
Chlorate[c,d]	mg/L	10
Trihalomethanes including chloroform[d]		
Oil and grease	–	No visible contamination

Notes:

a *Acute toxicity should be measured in 100% effluent. The effect from the effluent should be less than 50%.*

b *Chronic toxicity should be measured in effluent at various dilutions above and below the dilution expected at the edge of the mixing zone. The concentration at which a 50% effect is obtained should be determined. The lowest observed effect concentration (LOEC) and the no observed effect concentration (NOEC) should also be determined. The discharge limit will be set such that the NOEC is not exceeded at the edge of the mixing zone.*

c *If the proponent proposes to use the ECF bleaching method in the mill process, the environmental impact assessment must include a study of the effects of chlorate ion on any sensitive marine flora and fauna species living within a 1 kilometre radius of the proposed discharge point for treated mill effluent. The discharge limit for chlorate will be set based on the results of this study so that no detectable environmental damage occurs beyond the dilution zone. Laboratory tests suggest that concentrations required to protect brown algae are less than 10 µg/L [Rosemarin et al. 1986]. It is strongly recommended that the EIS include specific study of the effects of appropriate levels of chlorate on algal communities in the particular discharge zones.*

d *These limits are not applicable to BEK pulp mills employing a TCF bleaching sequence.*

The table entitled 'Recommended limits for the Tasmanian Guidelines' included in Appendix F is a synoptic table of the recommended discharge limits for pollutants emitted to the marine environment and atmosphere from BEK pulp mills. This table also includes the rationale for the limits, the rationale for the testing frequencies and the recommended test methods for the pollutants.

2.11.2 Emissions to the atmosphere

Concentration limits for specified emission points are only given for:

- particulate matter (PM) for recovery boiler, lime kiln and power boiler;
- total reduced sulfur (TRS) expressed as hydrogen sulfide (H_2S) for recovery boiler, lime kiln and CNCG incinerator that must not be exceeded for a given percentage of the operating time;
- nitrogen oxides (NO_x) expressed as nitrogen dioxide (NO_2) for the power boiler;
- polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) for recovery boiler, lime kiln and power boiler; and
- inorganic chlorinated compounds expressed as chlorine (Cl_2) for all sources.

The oxygen reference levels[11] for combustion sources differ from those included in the 1995 Commonwealth Guidelines. According to Swedish practice, it is recommended that these reference levels be as close as possible to the actual operating conditions. Oxygen reference levels of 3% O_2 for all sources except the power boiler and 8% O_2 for the power boiler are recommended.

Millwide limits for sulfur and NO_x emissions from all sources excluding power boiler are given in kilograms per air dry metric tonne (kg/ADt). The advantage of this approach for the Regulator is that

11 The concentration of contaminants in a gaseous stream is generally referenced to a particular oxygen content of the stream in order to fix the amount of air that might be added to the emission as a diluent.

all emission points in a mill are covered, including lower-strength point sources. There are advantages also for the mill, as there is room for optimisation of the techniques aimed at reducing the emissions, i.e. the mill can concentrate its efforts where they give the best results.

Total reduced sulfur, sulfur dioxide (SO_2), sulfur trioxide (SO_3), sulfuric acid mist and odour are included in millwide sulfur from all sources excluding power boiler. Nitrogen oxides are included in millwide NOx from all sources excluding power boiler. Hydrogen chloride (HCl) from all sources is included in inorganic chlorinated compounds expressed as chlorine (Cl_2) for all sources.

The emission of SO_2 from the power boiler depends on fuel sulfur content and is not included in millwide sulfur from all sources. The emission of NO_x from the power boiler is not included in millwide NO_x from all sources.

In-plant air emission levels should also meet relevant Occupational Health and Safety criteria.

The recommended emission limits to the atmosphere are presented in Table 13 on the following pages.

Table 13 Emission limits to the atmosphere

Emission point	Pollutant	Units[a]	Annual average	Monthly average	Testing frequency
Recovery boiler	PM[b]	mg/NDm^3		50 @ 3% O_2	See note s
	TRS	mg H_2S/NDm^3		7 @ 3% O_2 for >99% of the time See notes c and d	Continuous
	NO_x	mg NO_2/NDm^3		See note e	Continuous
	SO_2	mg S/NDm^3		See note d	Continuous
	PCDD/PCDF	pg I-TEQ/NDm^3		100 @ 3% O_2	See note p
Lime kiln	PM	mg/NDm^3		40 @ 3% O_2	See note s
	TRS	mg H_2S/NDm^3		16 @ 3% O_2 for >95% of the time See notes c and d	Continuous
	NO_x	mg NO_2/NDm^3		See note e	Continuous
	SO_2	mg S/NDm^3		See note d	Continuous
	PCDD/PCDF	pg I-TEQ/NDm^3		100 @ 3% O_2	See note p
CNCG incinerator[f]	TRS	mg H_2S/NDm^3		7 @ 3% O_2 for >99% of the time See notes c, d and r	Continuous
	NO_x	mg NO_2/NDm^3		See note e	Continuous
	SO_2	mg S/NDm^3		See note d	Continuous
	SO_2+SO_3	mg S/NDm^3		See note d	Twice yearly
	H_2SO_4 Mist	mg SO_3/NDm^3		See note d	Twice yearly
CNCG emergency incinerator[g]	TRS	mg H_2S/NDm^3		See notes d and r	To be calculated[o]
	NO_x	mg NO_2/NDm^3		See note e	To be calculated[o]
	SO_2	mg S/NDm^3		See note d	To be calculated[o]
	SO_2+SO_3	mg S/NDm^3		See note d	To be calculated[o]

Table 13 Emission limits to the atmosphere *(continued)*

Emission point	Pollutant	Units[a]	Annual average	Monthly average	Testing frequency
Power boiler	PM	mg/NDm³		30 @ 8% O_2	See note s
	NO_x	mg NO_2/MJ fuel input		80 See note h	Continuous
		mg NO_2/NDm³		~200 @ 8% O_2[i]	
	SO_2	mg S/NDm³		See note j	Continuous
	PCDD/PCDF	pg I-TEQ/NDm³		100 @ 8% O_2	See note p
All sources	Sulphur	kg S/ADt	0.4	See note k	Continuous & manual
All sources	NO_x	kg NO_2/ADt	1.3	See note l	Continuous & manual
All sources	H_2SO_4 Mist	mg SO_3/NDm³		See note d	Twice yearly
All sources	Hydrogen chloride (HCl)	mg HCl/NDm³		See note m	Continuous
All sources	Odour	mg H_2S/NDm³		See note d	See note n
All sources	Inorganic chlorinated compounds	mg Cl_2/NDm³		50	Continuous

Notes:

a *NDm³ = Normal cubic metre of dry gas, measured at atmospheric pressure (101.325 kPa) and 273.15 K (0°C).*

b *PM = Total particulate matter.*

c *For >95% (99%) of the time = the limit can be exceeded for a total of ~36 (7) hours in a month. The emission limit concentrations for TRS are higher than those proposed for hydrogen sulfide in the Draft Environment Protection Policy (Air Quality) 2001, a fact that reflects what AMT can achieve in this industry. It should be noted that the objective for ground level concentration of TRS is ten times more stringent than that proposed in the Draft Environment Protection Policy (Air Quality) 2001 for two of the major components of TRS, namely hydrogen sulfide and methyl mercaptan.*

d *Included in millwide sulfur from all sources excluding power boiler.*

e *Included in millwide NO_x from all sources excluding power boiler.*

f *The CNCG incinerator does not emit significant amounts of PM.*

g *ÅF-Celpap believes the CNCG emergency incinerator need not be regulated.*

h *Not included in millwide NO_x from all sources.*

i *Recalculated for a 8% O_2 reference level.*

j *Dependent on fuel sulfur content. Not included in millwide sulfur from all sources.*

k *Includes lower-strength sulfur point sources.*

l *Includes lower-strength NO_x point sources.*

m *Included in inorganic chlorinated compounds from all sources.*

n *Depending on results of spot monitoring program carried out by measuring odour with a mobile gas chromatograph/mass spectrometer (GC-MS) or instrumentation of equivalent sensitivity. Results to be added to the results from continuous emission monitoring (CEM). The proponent will be required to conduct an odour monitoring program 12 months into full operation of the mill. The frequency of this testing will depend on the number of reported odour events. Testing will be more frequent initially and less frequent later in the program.*

o *From the CNCG emergency incinerator sulfur and nitrogen loads and the operating time.*

p *Quarterly in the first year of operation, twice yearly thereafter. Average value over sampling period of 4-8 hours.*

q *With the exception of odour and PCDD/PCDF, test methods for all emissions to the atmosphere will be in accordance with USA Code of Federal Regulations: Title 40 part 60, Appendix A or equivalent.*

The test method for odour will rely on the establishment of a panel of at least 10 local residents, to be agreed by the Tasmanian regulatory authority, and supported by the spot monitoring program carried out by measuring odour with a GC-MS or instrumentation of equivalent sensitivity.

The test method for PCDD/PCDF will be European Standard (CEN or Comité Européen de Normalisation) method EN 1948:1997 with sampling period of 4 hours minimum and 8 hours maximum.

r *As the CNCG incinerator and CNCG emergency incinerator can be sources of odour at times of process instability, it is strongly recommended that the stacks for these incinerators be taken to the same height as the recovery boiler stack to facilitate optimum dispersion of any adventitious TRS release. Furthermore, it is good practice for the lime kiln and the power boiler stacks to be taken to the same height as the recovery boiler stack. If practical, these stacks should be supported by a common structure.*

s *Manual testing carried out initially once a month and less frequently later depending on results.*

2.11.3 Emission limit comparison

The table entitled 'Emission limit comparison between recommended Tasmanian Guidelines and 1995 Commonwealth Guidelines' included in Appendix G is a synoptic table that allows a direct comparison between the emission limits of the recommended Tasmanian Guidelines and those of the 1995 Commonwealth Guidelines.

3 Analysis of issues

3.1 Introduction

For each submission received the Commission has considered the issues raised in relation to the Draft Report. Table 14 below presents issues extracted from submissions followed by the Commission's response to those issues. Where the Commission has accepted suggestions to change the draft Tasmanian Guidelines (as set out in Volume 3 of the Commission's Draft Report) these changes are identified. Chapter 4 contains a list of the changes to the Tasmanian Guidelines (as set out in Volume 3 of the Commission's Draft Report) arising from the public consultation period.

Table 14 Analysis of issues raised in submissions

Extracted issues	Commission's response
AOK Innovations Pty Ltd (1)	
1. Scope of Regulation: Examples are given in 'the document' of limits imposed by various jurisdictions around the world. When we compared the scope of regulation proposed for Tasmania with that illustrated in these examples, we found what to us appears to be an excessive number of limits proposed for Tasmania. We accept that the history and events of the past 30 years in Tasmania can explain a desire to err towards regulatory "overkill" rather than towards anything that could be construed as being "soft" yet we are concerned that imposition of limits simply for the sake of having limits is hardly going to impress a potential proponent. We firmly believe that the proposed profusion of limits will cause additional capital and operating costs for a proponent and therefore will lessen the economic viability of any Tasmanian mill – while not in any way resulting in a better environment.	Sections D.1.4 and D.1.9 of the Tasmanian Guidelines state that any new mill will be required to incorporate the listed AMT, or equivalent. The assumption is that these equivalent technologies would result in emissions to the atmosphere and marine environment that are equivalent to, or better than, the emissions from the technologies considered AMT. It is necessary, therefore, to define a sufficient number of emission limits based on AMT that will allow equivalency to be established. Having limits for only the parameters in AOK Innovations' "Short List" (see next issue below) would not be sufficient to establish equivalency. AOK Innovations point out that the Tasmanian guidelines have 32 gaseous and effluent limits compared to an average of 12 in other jurisdictions. The submission states that the 'proposed infusion of limits will cause additional capital and operating costs for the proponent and therefore will lessen the economic viability of any Tasmanian mill.' While the capital cost of equipment to measure the guideline's parameters will be minimal compared to the overall capital cost of the mill, it is certainly true that the operating cost for monitoring can be substantial. However, it should be noted that generally, the number of environmental parameters that mills in other jurisdictions have to monitor are significantly greater than just those having limits. To give two Canadian examples:

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1. cont.	Celgar Pulp Company, Castlegar, British Columbia (BC) has discharge limits on 8 effluent parameters (three separate limits on AOX giving a total of 10 limits) and discharge limits on 5 air emission parameters (a total of 13 limits when all discharge stacks are taken into account). The mill is required to routinely monitor 14 effluent parameters (this includes those with limits) and 6 air emission parameters (this also includes those with limits). In addition, an environmental effects monitoring program must be carried out in the river receiving the mill's effluent every 2-3 years; groundwater must be routinely monitored; ambient air must be routinely monitored at four locations; and a terrestrial monitoring program must be carried out annually. Alberta-Pacific Forest Industries Ltd., Boyle, Alberta (AB), has discharge limits on 11 effluent parameters (some parameters have more than one limit – the total number of limits is 15) and discharge limits on 5 air emission parameters (a total of 10 limits when all discharge stacks are taken into account). The mill is required to routinely monitor 28 effluent parameters and up to 13 parameters on each air emission stack (a total of 52 parameters when all stacks are taken into account). In addition, the receiving river is monitored annually; and surface runoff and groundwater must be routinely monitored. It is anticipated that any new Tasmanian mill will have additional monitoring requirements beyond those indicated in the proposed Tasmanian Guidelines. Any additional requirements will be set by the Tasmanian regulatory authority and will be dictated by the results of the environmental impact assessment (EIA) carried out prior to a mill being approved for construction. A Preamble to the Tasmanian Guidelines has been included to explain that, dependent on technologies proposed for a pulp mill, emission limits and monitoring requirements may vary. The Preamble is as follows: 'PREAMBLE These guidelines are non-statutory… They do not attempt to specify the technologies for installation and operation of a specific mill. The environmental

	Extracted issues	Commission's response
1. cont.		emission limits provided in the guidelines have been set to cover all accepted modern technologies described in the guidelines, or their equivalent. Monitoring requirements of various parameters will vary dependent on the proposed technology. For example, monitoring of AOX would not be required for a particular mill employing total chlorine free technology. During the environmental impact assessment specific monitoring requirements based on the proposed technology will be identified and included in the mill's permit conditions. In addition, these guidelines do not pre-empt any conditions arising out of an assessment of any mill proposal.'
2.	... we would propose a 'short list' of limits... To make a point, the list is deliberately short: We regard these as the only limits that must be regulated. Even then, AOX is included only because the public expect it to be there. As stated on page 51 of Volume 1 of 'the document,' the toxicity of the effluent *"from modern mills is generally very low and shows no correlation to the levels of AOX from ECF bleaching"* and *"there is no evidence available to indicate that further reductions of effluent AOX from the average level of 0.5 kg/ADt (in 2002) would result in any demonstrable environmental benefit."* 'Short list' To Water: AOX – monthly average Chronic Toxicity To Air: Recov. boiler – TRS – monthly average Lime kiln – TRS – monthly average All sources – sulphur – annual average All sources – NO_x – annual average We argue that addition of any limit to this short list must be justified in some way other than that it might satisfy a desire to have a longer list: Any extra limit must help ensure a higher probability that a negative environmental impact will not happen. We have included Chronic Toxicity in our 'short list' because this is the one issue that truly needs to be demonstrated by a mill.	While the guidelines will require any new mill to incorporate technologies that are considered AMT, the installation of these technologies alone does not necessarily guarantee that these technologies will be utilised to their maximum benefit at all times. Limits are necessary to "police" the mill's operation. Meeting these limits assures both the regulatory agencies and the public that the mill is being operated in an environmentally sound manner. The following are some examples of how limits can ensure that these technologies are used to their maximum benefit. Modified continuous or batch cooking and oxygen delignification are AMT because they remove as much lignin as possible from the pulp before bleaching thereby minimising the use of chlorine dioxide in ECF bleaching. This, in turn, ensures that the discharge of chlorinated organic compounds is also minimised. Placing limits on AOX discharge ensures that the discharge of any chlorinated organics and chlorate will be minimised. A low-loaded activated sludge effluent treatment plant is AMT but the guidelines do not state to what degree of efficiency this plant must be designed and operated. The BOD_5, TSS and acute toxicity limits provide this. Furthermore, these limits will ensure that effluent quality will not be degraded when, from time to time, a component of the plant, or perhaps the entire plant, is shut down for preventive maintenance or repairs. AMT requires mills to provide containment basins to store, for subsequent treatment, untreated

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2. cont.	That said, however, we do not know of any proven test method that will allow unquestioned proof to be obtained *one way or the other* and we believe that it is in the Regulator's interest to find a suitable method – not only in the interest of a mill proponent.	effluent that has sufficiently high levels of contaminants to adversely affect the operation of the effluent treatment plant. However, this does not guarantee that these containment basins will be empty and available to accept heavily contaminated untreated effluent when they are needed. Placing limits on BOD_5, COD, TSS and acute toxicity will help to ensure that these basins are available and used in such emergency situations. AMT requires the mill to have effective control, containment, recovery, and storage of all spills, leakages and releases of process liquids. However, the success of spill control facilities is very much dependent on the dedication of the mill's management and operational personnel to ensure that these systems work effectively. Setting limits on parameters such as COD, BOD_5, TSS and acute toxicity will give added incentive to make these systems work. AMT requires mills to avoid the use of synthetic dioxin precursors but this, in itself, does not guarantee that they will not be used. Specifying limits on 2,3,7,8-TCDD and 2,3,7,8-TCDF will provide some assurance that this AMT is followed. AMT requires the recovery boiler, power boiler and lime kiln to be equipped with electrostatic precipitators to control emission of particulate matter. However, the guidelines do not specify to what degree of particulate removal efficiency these precipitators should be designed or operated. The limits on particulate matter provide that. Furthermore, these units require maintenance from time to time to keep their removal efficiency at a high level. The PM limits will ensure that this maintenance is carried out. No change to the Tasmanian Guidelines is required.
3.	• TSS and BOD were left off the short list because no modern mill will emit the materials measured by these test procedures to the extent that there could be any negative impact in a marine environment – *regardless of the fact that 'the document' also contains site suitability criteria to ensure that this is the case*.	A low-loaded activated sludge effluent treatment plant is AMT but the guidelines do not state to what degree of efficiency this plant must be designed and operated. The BOD_5, TSS and acute toxicity limits provide this. Furthermore, these limits will ensure that effluent quality will not be degraded when, from time to time, a component of the plant, or perhaps the entire plant, is shut down for preventive maintenance or repairs. No change to the Tasmanian Guidelines is required.

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4.	• The undiluted effluent will meet the Acute Toxicity limit, so why require a mill operator to spend money to prove it?	A low-loaded activated sludge effluent treatment plant is AMT but the guidelines do not state to what degree of efficiency this plant must be designed and operated. The BOD_5, TSS and acute toxicity limits provide this. Furthermore, these limits will ensure that effluent quality will not be degraded when, from time to time, a component of the plant, or perhaps the entire plant, is shut down for preventive maintenance or repairs. No change to the Tasmanian Guidelines is required.
5.	• COD is most useful as an indirect indicator of whether a mill is operating properly or not and it will pay the mill operator to routinely measure this parameter in any event but it serves no useful purpose to impose an emission limit for COD.	AMT requires mills to provide containment basins to store, for subsequent treatment, untreated effluent that has sufficiently high levels of contaminants to adversely affect the operation of the effluent treatment plant. However, this does not guarantee that these containment basins will be empty and available to accept heavily contaminated untreated effluent when they are needed. Placing limits on BOD_5, COD, TSS and acute toxicity will help to ensure that these basins are available and used in such emergency situations. AMT requires the mill to have effective control, containment, recovery, and storage of all spills, leakages and releases of process liquids. However, the success of spill control facilities is very much dependent on the dedication of the mill's management and operational personnel to ensure that these systems work effectively. Setting limits on parameters such as COD, BOD_5, TSS and acute toxicity will give added incentive to make these systems work. No change to the Tasmanian Guidelines is required.
6.	• Colour and Chlorate emissions are addressed by the Site Suitability Criteria and limits on the undiluted effluent are superfluous.	Colour in effluent comes primarily from two sources – the bleach plant and black liquor. Bleach plant filtrate colour is essentially related to the kappa number of the pulp entering the bleach plant. By specifying AOX limits we are ensuring that kappa number is minimal and therefore colour is also minimal. A limit on effluent COD (and the requirement to control, contain and recover process effluent) ensures that black liquor losses will be minimal. So, in effect, colour is controlled and monitored by these effluent parameters. Site Suitability Criteria (Section D.3.17 (a)) sets out ambient water quality criteria for colour. Meeting these criteria will depend on three factors –

Extracted issues		Commission's response
6. cont.		effluent colour, the definition of mixing zone, and the degree of dilution obtained at the edge of the mixing zone. It is expected that colour would be monitored in the liquid emission stream as well as in the ambient water. With modern technology, the colour of the effluents discharged is not expected to cause unacceptable environmental impacts. However, it is included in the initial monitoring program to address community concerns because experience in operating activated sludge wastewater treatment plants with anoxic selectors fed from mills using the species of eucalypt prevalent in Tasmania is extremely limited. Furthermore levels of anthropogenic colour discharged into the marine environment have proven to be a concern in other industrial development projects that have discharged into the Tasmanian marine environment. Final determination of an appropriate limit will be dependent upon the baseline studies, outcomes of the EIA process and monitoring results following commissioning and start up of the mill. Note h to Table 9 of the Tasmanian Guidelines has been amended to include at the end of the note the following: '...because experience in activated sludge wastewater treatment plants with anoxic selectors fed from mills using the species of eucalypt prevalent in Tasmania is extremely limited. Furthermore levels of anthropogenic colour discharged into the marine environment have proven to be a concern in other industrial development projects that have discharged into the Tasmanian marine environment.'
7.	Some specific limits: There is always a fine balance to achieve in setting limits but we notice that, almost invariably, the proposed Tasmanian emission limits are the most severe (or close to being the most severe) of those reported in Volume 1 of 'the document' for other jurisdictions. This severity could be justified if extremely low limits were needed to protect the environment but such is not the case for any mill for which "AMT ... will be mandatory" (refer Clauses B.6 and D.1.1 in Volume 3).	See response to issue 1.

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8.	AOX limits of the severity proposed are not needed to protect the environment but an operating ECF mill might occasionally exceed one or other of these proposed limits and, regardless of any regulatory penalty that may or may not be imposed, the certainty of being pilloried unmercifully and unnecessarily in the media for a breach that is of no consequence in the environment whatsoever will not entice a proponent to step forward.	Modified continuous or batch cooking and oxygen delignification are AMT because they remove as much lignin as possible from the pulp before bleaching thereby minimising the use of chlorine dioxide in ECF bleaching. This, in turn, ensures that the discharge of chlorinated organic compounds is also minimised. Placing limits on AOX discharge ensures that the discharge of chlorinated organics and chlorate will be minimised. No change to the Tasmanian Guidelines is required.
9.	Dioxin & Furan: The limits proposed here are effectively environmental "background levels" that are as likely to be exceeded in the raw water that comes into the mill as in the effluent from that mill. What is a mill to do then? The race to set the lowest dioxin/furan limit in the world is nonsensical and these proposed Tasmanian limits reveal that a scientific approach was not taken to limit setting. Rather, it shows that the focus was to appease a gullible electorate. The "*mandatory*" use of AMT is fully sufficient to protect the environment from dioxins and furans.	AOK Innovations suggests that the proposed guidelines are participating in 'the race to set the lowest dioxin/furan limits in the world' and that a scientific approach was not taken in limit setting. This is not correct. Firstly, these are not the lowest limits in the world. The US Cluster Rule has limits of 10 ppq for 2,3,7,8-TCDD and 31.9 ppq for 2,3,7,8-TCDF. The proposed Tasmanian limits are essentially the same (10 ppq and 30 ppq, respectively); however, the US limits are measured in bleach plant filtrate whereas the Tasmanian limits are measured in whole mill effluent. The US limits, therefore, do not have the benefit of dilution by effluent from other mill sources nor do they benefit from the probable reduction in dioxin and furan in the effluent through partitioning to the wasted activated sludge. Consequently, the US limits are much more restrictive (at least ½ the Tasmanian limits). These limits are based on the UNEP studies and on what has been demonstrated to be achievable in an ECF bleached kraft pulp mill providing other precautions, such as avoiding the use of defoamers and wood chips containing dioxin precursors, are taken. AOK Innovations states that the dioxin and furan levels are effectively "background levels" that are likely to be exceeded in raw water that comes into the mill. These matters should be addressed by a proponent when collecting baseline data, carrying out feasibility studies, and carrying out background studies for an EIA. If the dioxin and furan background levels are high the proponent should notify the relevant authorities. It should be noted also that the US limits have been set after extensive consultation and debate and given that the 100+ bleached kraft pulp mills in the

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9. cont.		US draw water from a variety of sources, it is unlikely the US would have established the limits noted above if there was a possibility that the incoming water would exceed these limits. Incidentally, the US drinking water quality criteria places a limit of 1.3 x 10^{-8} µg/L (0.013 ppq) on 2,3,7,8-TCDD. No change to the Tasmanian Guidelines is required.
10.	Site Suitability Criteria: We are pleased that the Commission has allowed this inclusion of site criteria to continue but we are concerned about two issues: Chlorate control: The original study relating to the impact of the herbicide chlorate on seaweed, reported in 1986, was based on observation of a Swedish species of bladder wrack. Sixteen years later, we still do not know if similarly sensitive species of seaweed are present in Tasmanian waters and – if so – how widespread they are and what their sensitivity might be to low concentrations of chlorate. We are concerned that no Tasmanian government has seen it as important to research these questions but (be that as it may) the consequence of this inaction may be serious. Table 2.24 in Volume 1 of 'the document' states that chlorate may be present up to 4 kg/ADt in untreated mill effluent. While we believe that a more likely upper limit is closer to 6 kg/ADt, we will accept the stated amount as this still illustrates the problem that we foresee ***if*** chlorate control has to be practiced to the extent implied by that Swedish study. Without a chlorate reactor, the "mixing zone" dilution may need to be as great as 13,000:1, achievable only if the regulatory body approves a very large area for the "zone." On the other hand, ***if*** a very effective chlorate reactor is available and is used, a dilution of 260:1 would suffice and the "zone" might not need to be more than a kilometre across. The problem is that, while laboratory research has shown that an anoxic treatment of effluent can reduce the	Current knowledge can be briefly summarised as follows. Chlorate is most likely toxic to all aquatic plants. Brown algae e.g. bladderwrack, seem to be the most sensitive to chlorate. The concentration at which the toxic effect sets in depends on species and also the concentration of other inorganic ions in the water, notably nitrate. The effect of chlorate is due to the fact that the plant normally takes up nitrate as a nutrient and if chlorate is present it will take up this as well. The lower the nitrate level the higher the risk for a chlorate uptake. At present a level of 20 – 30 µg/L is considered as the toxic level of chlorate to bladderwrack in the Baltic Sea and may result in the loss of large brown algae, such as kelps, which are common in many parts of the Australian marine environment. Although we do not have sufficient information on the sensitivity to chlorate of common algae in the seas surrounding Tasmania and the influence of the nitrate levels in the seas, a limit of 10 µg/L has been recommended for chlorate in the treated effluent for each effluent sample analysed. To achieve this level of chlorate when the starting range is 50-100 µg/L, will require an anoxic selector for chlorate reduction in the activated sludge treatment plant. This technique is available and practised in full scale. There are several mills in Sweden that run their treatment facilities this way. Anoxic chlorate reduction is AMT, whereas secondary treatment in an aerated lagoon can no longer be regarded as AMT for a new mill (refer to p. 60, Volume 1 of the Commission's Draft Main Report). The Tasmanian Guidelines have been amended to include an anoxic selector for chlorate reduction as AMT. Refer to Table 4 in the Tasmanian Guidelines. In addition note c in Table 6 in the Tasmanian Guidelines has been amended to include the following: "It is strongly recommended that the

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10. cont.	concentration of chlorate, we understand that no chlorate reactor of high efficiency has been demonstrated yet on a mill scale. We note that the extensive list of AMT in 'the document' omits mention of a chlorate reactor. Effectively, we argue that – as things stand – the site suitability criteria eliminate the choice of establishing an ECF mill in Tasmania.	EIS include a specific study of the effects of appropriate levels of chlorate on algal communities in the particular discharge zones." Chlorate limits are not applicable to a BEK pulp mill employing a TCF bleaching sequence (refer to note c in Table 6 of the Tasmanian Guidelines).
11.	Odour control: We are surprised that the TRS emission limits proposed are far less severe than they could be, while the site suitability criteria require a ground level concentration of TRS that is extremely low. The combination of these two features of the guidelines will require that a very high dilution is achievable in the atmosphere at a "suitable site." What if no such site can be found to exist in Tasmania? While we believe that an emission limit of 1 mg/Nm^3 is feasible for TRS in the recovery boiler and lime kiln flue gases, a mill that achieved this concentration might still not find a 'suitable site' in Tasmania. The obvious way to address this potentially serious barrier to establishment of any mill in Tasmania is to change the site suitability requirement to a more reasonable level, e.g. 1.5 µg/m^3 and to lower the allowable TRS emission limit at the same time.	A clear distinction should be made between odour and the concentration of odour causing compounds since the two are only very loosely related. The Tasmanian Guidelines provide emission limits to the atmosphere and air quality design criteria. The latter is a component of site suitability criteria. Despite the heading, 'Odour control,' this comment relates to the concentration of odour-causing compound limits for emission sources and ambient (design criteria) concentrations. In Vol.3 of the Commission's Draft Report the design concentration criteria (DCC) for Total Reduced Sulfur (TRS) expressed as hydrogen sulfide (H_2S) was changed from the 1995 Commonwealth Guideline level of 1.5 µg/NDm^3 to 0.14 µg/NDm3, thus tightening the concentration tenfold. This change was made on the basis that the amended terms of reference required the Commission to base the Tasmanian Guidelines on: "The policies, guidelines and values specified in current Tasmanian legislation and statutory policies where these are relevant and applicable (including the *Environmental Management and Pollution Control Act 1994*, *State Policy on Water Quality Management 1997*, ***Draft Environment Protection Policy (Air Quality)***; and" The Commission has sought advice from the Department of Primary Industries, Water and Environment (DPIWE) on the *Draft Environment Protection Policy (Air Quality)* to ascertain whether the DCC for TRS of 0.14 µg/NDm^3 is 'relevant and applicable.' DPIWE has advised that the DCC level for TRS was copied from the Victorian State Environment Protection Policy (SEPP). From a literature review and research carried out in the 1980s for their first SEPP the Victorian

Extracted issues	Commission's response
11. cont.	Environment Protection Authority (EPA) derived that 0.14 µg/NDm³ figure is the level at which **sensitive people** will detect H_2S. The figure of 7 µg/NDm³ is the **median** level at which H_2S will be detected. At this level, about half of the population will detect it, and, potentially, find it offensive. Following limited dispersion modelling DPIWE advises that the level of 0.14 µg/NDm³ would be difficult to achieve at the boundary of the land with normal stack heights. DPIWE advises that, based on limited modelling, it appears possible to achieve a design level of 1.5 µg/NDm³ for TRS (measured as H_2S) within a reasonably sized buffer zone. DPIWE has indicated that "the 1995 Commonwealth Guidelines value of 1.5 µg/NDm³ (3 min moving average) as a design criterion is an acceptable value to use. If a figure of 7 µg/NDm³ were to be used, and subsequently realised, it seems possible that persons living beyond the buffer zone will be able to detect H_2S and, potentially, be adversely affected by it." The lowest level DCC for TRS, measured as hydrogen sulfide, in Sweden has been reported as 5 µg/NDm³. DCC levels for TRS in Canadian provinces vary from 6 to 42 µg/NDm³ (1 hour moving average). A DCC for TRS of 3 µg/NDm³ (3 min moving average) was presented in the EIS document for the Visy pulp and paper mill at Tumut, NSW. The NSW EPA guidelines for assessment of air emissions provides the lowest DCC for urban conditions of >2000 people – 1.38 µg/NDm³, and 4.83 µg/NDm³ where there is 1 residence near the mill boundary. TRS emissions from modern recovery boilers are characteristically of very low concentrations during periods of normal operation of the boiler where the furnace inputs, particularly the black liquor fuel fired and environment are relatively uniform. Though generally true of TRS emissions, this is not the case for other emissions such as NO_x and SO_2 emissions, which display random variation of concentration. For TRS, steady operating regimes can result in extended periods of operation with concentrations below 1ppm dry volume basis (1.5 mg H_2S/NDm³). However, pulp mill operations are rarely uniform for very long and any changes in recovery boiler furnace that affect the furnace temperature profile, flue gas and combustion air

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11. cont.	mixing, such as black liquor heat input, changes in the smelt bed, will cause TRS excursions from these low levels. Emission levels due to these excursions will be much smaller than those that would cause adverse health effects. The Commission acknowledges the significance of this issue, (which is also raised in the submission from Dr Maddern (8)), and has determined that the DCC level of 0.14 µg/NDm^3, as set out in the *Draft Environment Protection Policy (Air Quality)*, is not relevant or applicable to a BEK pulp mill. This is not a practical concentration and, based on current advice, the Commission accepts that it is extremely unlikely that a site exists in Tasmania that could facilitate a BEK pulp mill to achieve a DCC of 0.14 µg/NDm^3 for TRS. This figure is economically unfeasible and is unreasonable. Based on the fact that DPIWE considers that a DCC level of 1.5 µg/NDm^3, with a reasonable buffer and stack height, is achievable, and that the two submissions supported maintaining the figure in the 1995 Commonwealth Guidelines, the Commission has changed the DCC for TRS back to 1.5 µg/NDm^3. The technical literature includes a number of odour studies including those in New Zealand [Vaczi, 1998] that compare odour perception with discharges of TRS, from which it is clear that odour awareness thresholds are very subjective matters and depend on the individual. It is unclear, therefore, whether the limit proposed will achieve an odour annoyance-free mill. The objective of the guidelines is to create environments adjacent to the mill that are as close to odour-free as possible. Air modelling leading to an appropriate stack height should lead to achievement of these objectives. It is anticipated that these provisions will result in escape of odour at low levels from the mill at a frequency of no more than 3 – 4 times per year. This is an important criterion among the site selection criteria. In-stack concentrations are related to AMT. The recommended emission limits are based on best Swedish and Finnish practice. In addition, the Commission has amended footnotes o, p and q of the Tasmanian Guidelines as follows:

Extracted issues	Commission's response
11. cont.	Footnote o: Specified in Schedule 2 of the *Draft Environment Protection Policy (Air Quality) 2001*, with the exception of TRS expressed as hydrogen sulfide. Footnote p: The proponent must consult the regulatory authority on the selection of the predicted maximum concentration. Footnote q: The specified design criteria are for the purposes of predicting or modelling the likely ground level concentrations from a proposed mill. They may be used later for operational purposes where appropriate. Proponents must use the currently approved version of the regulatory model Ausplume to predict the impact of emissions except where the proponent can demonstrate to the satisfaction of the regulatory authority that an alternative model is appropriate. Footnote r: The provisions of D.4.12 are intended to ensure that emission of odorous sulfur containing gases are kept to the absolute minimum achievable by AMT. While complete odour elimination from kraft mills is not achievable at the time of writing, selection of a site that minimises the nuisance caused by these odorous compounds should be a prime consideration in site selection. A new Section D.3.11 has been included to provide guidance on stack heights as follows: 'It is sound engineering practice [USEPA, 1985] for the exhaust stack to be at least 2.5 times higher than the recovery boiler building height and for the stacks from lime kiln, CNCG incinerator, CNCG emergency incinerator and power boiler to be taken to the same height as the recovery boiler stack. Site selection factors such as geographic location and air dispersion modelling will also influence the common stack height.' In endeavouring to strike a balance between nuisance from odour and appropriate industrial development for the State, the Commission believes that the measures incorporated in the Tasmanian Guidelines are appropriate and will achieve best outcomes. The proposed in-stack limits have been set based on AMT with additional monitoring requirements with continuous improvement measures based on in-mill experience in Australia and overseas.

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Jim and Linda Collier (2)		
12.	IN PRINCIPLE we wholeheartedly support downstream processing and value adding to Tasmanian Forestry and consequently would welcome a pulp mill, preferably in association with a paper mill, in other words full downstream processing and true value adding.	Noted.
13.	EMISSIONS: We are amazed that after the Wesley Vale debacle of 1989 (last century) when public opinion was so firmly expressed against a bleached kraft pulp mill that not that many years later (however another century) such a mill is even being considered. PUBLIC OPINION HAS NOT CHANGED SINCE 1989!	The bleaching process proposed for the Wesley Vale mill used elemental chlorine, which is no longer considered AMT, and would not be permitted in Tasmania.
14.	We understand other viable technologies are available for the processing of pulp such as the soda anthrax-quinone [*sic*] system developed by APPM Burnie producing an end product with all the strength and qualities as that from kraft pulp and eminently suitable for paper production. Even the prospect of a hemp mill should not be discounted; such a mill appears to offer many advantages over a bleached kraft pulp mill. After all if we can commercially produce and market poppies we can easily do the same with hemp (see attached copy of a 'letter to the editor' on the subject of hemp mills). SUCH ALTERNATIVES SHOULD BE CONSIDERED.	Noted. The terms of reference require the Commission to develop environmental emission limit guidelines for any bleached eucalypt kraft pulp mill in Tasmania, not soda-anthraquinone or hemp. Soda-anthraquinone (AQ) was the pulping process used at AP Burnie until 1998, when the pulp mill was shut down. AQ is a catalyst for the pulping reactions. Any reference to 'anthrax' appears to be a typographical error and is irrelevant for the purposes of this study. Soda-anthraquinone has not gained wide acceptance internationally because of inferior pulp product.
15.	We are of the opinion that any mill should not, under any circumstances, pollute the environment in any way whatsoever, in other words, a 'CLOSED LOOP' system. Though possibly a more expensive process this is the only system which would be totally acceptable to the vast majority of Tasmanians.	The Tasmanian Guidelines are based on a requirement that any new BEK pulp mill employ AMT and BPEM. Total closed loop and zero emissions technology are not currently available. Section 3.6.1 of the Draft Report (Vol. 1) explains that 'as of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis.' The Commission notes that the Canadian zero-effluent bleached chemi-mechanical pulp mills, (Louisiana-Pacific Canada Ltd, Chetwynd, BC and Millar Western Pulp Ltd, Meadow Lake, SK) are only "zero-effluent" with respect to the liquid

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15. cont.		effluent but emit pollutants to the air from the pulp mill, the recovery boiler and the power boiler. The emissions to air from the boilers are identical to those from a kraft mill (or any other chemical pulp mill) on a concentration basis. They also emit solid waste in the form of green liquor dregs and recovery boiler smelt as ingots. The total solid waste from zero-effluent bleached chemi-mechanical pulp mills is approximately 55% higher than that from a kraft mill. See also response to issue 83 below. No change to the Tasmanian Guidelines is required.
16.	TIMBER SUPPLY: It is our opinion that such a mill should only process plantation timber and certainly not any from Tasmanian native forests. We understand that given the lead in time to construct and render operational a new pulp mill such a source of timber should be readily available consequently this is a reasonable stipulation.	The issue of timber supply is beyond the terms of reference. This issue would be addressed as part of an environmental impact assessment (EIA). No change to the Tasmanian Guidelines is required.
17.	WATER: We understand pulp mills use copious amounts of fresh water in the processing of their product. Water is on the public agenda Australia wide and has been the subject of discussion at the highest governmental and political level in recent times, the Murray-Darling basin for example. Tasmania is not exempt from water scarcity and over demand on the state's limited supplies from industries... It is hoped water for any proposed pulp mill would be available from existing supplies and NOT impose any additional pressure on an already diminished supply!	For a kraft mill the degree of closure based on water use is generally much higher than 90%. The issue of water supply to a mill would be addressed as part of an EIA. No change to the Tasmanian Guidelines is required.
18.	LOCATION OF PROPOSED MILL: It is our opinion in regard to the location of any pulp mill that Long Reach on the River Tamar would be an excellent location already having most of the infrastructure in situ but especially an easily accessible and secure deep water port. In regard to this we feel it is necessary to point out that it is essential that such a mill be none polluting, any air or water emission would, with prevailing weather systems, inevitably affect the tidal Tamar River, Valley and Launceston; ...all located down wind of that location.	Noted. The Tasmanian Guidelines provide site suitability criteria. Final selection of a site for a pulp mill would be addressed as part of an EIA. No change to the Tasmanian Guidelines is required.

	Extracted issues	Commission's response
	Ms Victoria Jansen-Riley (3)	
19.	I wish to make a submission that does not support the development of a pulp mill in Tasmania, under the present guidelines. My reasons relate to the way that the Draft Report does not consider the use of 'closed cycle technology,' thus only presents guidelines for minimising environmental damage, not eliminating it.	Noted. The Tasmanian Guidelines are based on a requirement that any new BEK pulp mill employ AMT and BPEM. Total closed loop and zero emissions technology are not currently available. Section 3.6.1 of the Draft Main Report (Vol. 1) explains that 'as of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis.'
20.	Adverse Environmental Effects: Studies that were completed in the relatively recent Environmental Impact Statement on Basslink clearly revealed that chlorine toxins released into the aquatic environment have a detrimental effect. Numerous scientific submissions on this particular project led to the decision towards alternative technology in order to avoid this type of environmental damage. Therefore, one may ask why should the emission of chlorine be acceptable for any industrial project – pulp mill or otherwise?	Any new BEK pulp mill (whether ECF or TCF) employing AMT and BPEM would release specific chlorinated compounds, such as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) in non-detectable or very low measurable levels in the effluent discharged to the marine environment. The Tasmanian Guidelines do not provide an emission limit for chlorine in the liquid effluent because this would be immaterial. No change to the Tasmanian Guidelines is required.
21.	Other Pulp mill Technologies: The Draft Report does not seem to deliver enough information on 'closed – cycle' technologies, including why 'they are not technically or commercially proven' (Vol. 3. P.1 0.) There does not appear to be any clear evidence of this. (It could be that other countries have chosen the easiest and cheapest option.)	Section 3.6.1 of the Draft Report (Vol. 1) provides extensive information on process system technologies. No change to the Tasmanian Guidelines is required.
22.	Emission of gas: This report does not seem to offer guidelines on how to avoid the effects on humans of breathing in sulphur fumes, other than having a panel of 10 people periodically checking how 'smelly' the fumes are. Once again, it seems to be taken for granted that it is acceptable to have these fumes being emitted into the environment, with no discussion on the effects on plants and people in the long term.	The Tasmanian Guidelines provide limits for the following emissions to the atmosphere: particulate matter, total reduced sulfur, nitrogen oxide and nitrogen dioxide, sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen chloride, dioxins and furans, chlorine dioxide and related compounds. These emission limits have been set taking into account adverse environmental impact. There is no scientific evidence to suggest that a BEK pulp mill operating within the emission levels set in the Tasmanian Guidelines would have unacceptable environmental impacts, including adverse impacts on human health.

Extracted issues	Commission's response
	In addition to being required to comply with environmental discharge limits to the atmosphere, a mill proponent would also be required to establish a program of nuisance TRS odour monitoring (D.4.12). In endeavouring to strike a balance between nuisance from odour and appropriate industrial development for the State the Commission believes that the measures incorporated in the Tasmanian Guidelines are appropriate and will achieve best outcomes. No change to the Tasmanian Guidelines is required.
23. Site suitability: The report does not include 'visual amenity' within this criteria…	Visual amenity would be considered as part of an EIA. No change to the Tasmanian Guidelines is required.
24. Proposed Amendments to the guidelines: I wish to make the following recommendations, in relation to the above points-	
1) Other more environmentally 'friendly' technology should be investigated, and more details made public – including comparisons between that technology and the 'chlorine bleaching' technology; the effects on the environment, health and commercial viability.	The terms of reference require the Commission to develop environmental emission limit guidelines for any new BEK pulp mill in Tasmania.
2) 'Visual amenity' should be included under 'site suitability' – that any type of pulp mill development should only exist in a) an area that already houses industrial development and b) within this area, it is still sited in such a way that it is not visually predominating, i.e. a 'blot' on the landscape.	Visual amenity would be considered as part of an EIA.
3) Any guidelines made for a pulp mill proposal should be in keeping with Tasmania's clean and green image.	Noted. No change to the Tasmanian Guidelines is required.

Gunns Limited (4)

25. Gunns supports the draft reports findings on what is considered Advanced Modern Technology, AMT and Best Practice Environmental Management, BPEM. The company believes the technologies and	Noted.

	Extracted issues	Commission's response
	practices defined are consistent with the latest Scandinavian and North American practices in mill technology and operation.	
26.	The Guidelines specify requirements for baseline and post-start-up monitoring of the state of the environment. These are comprehensive and detailed. While Gunns believes they are generally reasonable, it is concerned that they are stricter than the requirements on main competitors to a potential Tasmanian BEK pulp mill in Indonesia, Brazil, China, South Africa, etc. The extensive environmental monitoring does involve additional cost for a new mill and thus impacts on its competitiveness. Hence, before adding any additional environmental monitoring requirements, Gunns recommends that the RPDC considers any marginal benefits to the environment with cost and competitiveness impacts on a new mill.	Noted. Any additional monitoring requirements would arise out of the EIA process and should be discussed with the regulatory authority. No change to the Tasmanian Guidelines is required.
27.	*Table 9, Volume 3 – Indicative core chemical, biological and other parameters to be monitored.* The notes to this table exempt mills using non-chlorine based bleaching processes from monitoring AOX and chlorinated phenols. Gunns recommends that the need to monitor chlorinated dioxins and furans and also trihalomethanes should also be exempted for TCF mills since these chemicals are not found in effluent of TCF mills. Testing for some of these chemicals requires very precise analysis and testing is very expensive, hence unnecessary testing should be avoided. If dioxins and furans need to be monitored due to other possible sources apart from bleaching; there should be a mechanism to allow the monitoring frequency to be reduced over time if initial measurements show no cause for concern. This is particularly the case if the mill has demonstrated that it has taken all steps to eliminate all possible sources and precursors of dioxins and furans.	The US Cluster Rule exempts TCF mills from monitoring dioxins and furans (although they must monitor AOX). The Commission considers that both ECF and TCF mills should monitor 2,3,7,8-TCDD and 2,3,7,8-TCDF with a sliding scale frequency, for example, 2,3,7,8-TCDD and 2,3,7,8-TCDF should be tested monthly. If the concentration of TCDD/F is below permitted levels for 3 consecutive months, frequency of testing can be reduced to quarterly. If the concentration of TCDD/F is below permitted levels for 3 consecutive quarters, frequency of testing can be reduced to annually. Table 9 of the Tasmanian Guidelines has been amended to include a variable frequency scale for monitoring 2,3,7,8-TCDD and 2,3,7,8-TCDF in the discharge. The frequency will be stipulated by the regulatory authority based on the outcome of the EIA and subsequent monitoring following commissioning and start up. The Tasmanian Guidelines have also been amended to note that where a TCF bleaching process is employed monitoring is not required for chlorate, AOX, chlorinated phenols and trihalomethanes including chloroform (refer to Tables 6 and 9).

Extracted issues		Commission's response
		An additional note n to Table 9, relating to chlorinated dioxins and furans, has been included: 'Three monthly for the first 12 months then twice yearly.' Concern about trihalomethanes has increased over recent years as more is understood about their release and formation. Testing for trihalomethanes should be undertaken for ECF mills.
28.	As a general comment, Gunns believes the Guidelines should contain provision for reviewing the frequency of some of the monitoring requirements if, after an agreed time, no significant concerns are identified. It is noted that the monitoring requirement for histopathology in Table 9 includes this provision.	The concerns are noted, but it is standard practice in most developed jurisdictions to require monitoring as indicated in Table 9 of the Tasmanian Guidelines. Monitoring requirements for a specific mill proposal would be tailored to the technology employed and would be an outcome of the EIA process. Table 9 of the Tasmanian Guidelines has been amended to include a variable frequency scale for monitoring 2,3,7,8 TCDD and 2,3,7,8 TCDF in the discharge. The frequency will be stipulated by the regulatory authority based on the outcome of the EIA and subsequent monitoring following commissioning and start up. Chlorate and trihalomethanes are also subject to a variable frequency scale for monitoring discharge. Chlorinated phenols should be subject to variable frequency scale for monitoring the receiving environment.
29.	The Guidelines specify that 30 months of data from monitoring of the receiving environment prior to start-up is required. Since a mill can typically be implemented in 20 months, collection of the pre-operational data will need to start early in the EIS process. The monitoring program must be agreed with authorities, so they must recognise the need for prompt agreement here to avoid delaying the mill start-up due to this requirement.	A proponent should enter into discussions with the regulatory authority regarding a monitoring program for pre-operational data at the earliest possible opportunity. This issue is beyond the scope of these guidelines.
	It is also noted that the monitoring requirements specified in Table 9, Volume 3 are only referred to as "indicative" leading to some uncertainty and further potential delays in agreeing to a monitoring program with authorities. Some clarification of these issues is recommended.	Precise monitoring requirements will be determined for a proposal during the EIA and will be specific to the technology proposed, site selection and other relevant environmental factors. No change to the Tasmanian Guidelines is required.

Extracted issues	Commission's response
30. *Tables 2 and 3, Volume 3 – Emission limits to atmosphere. Total Reduced Sulphur and Nitrogen Oxides:* While the specified TRS control technology represents AMT, care should be taken to allocate an appropriate contribution from the incineration of the High Concentration Low Volume (HCLV) gases to the NOx emission of the recovery boiler, since HCLV gases contain ammonia in addition to TRS and methanol. It has been observed that some modern recovery boiler burning the HCLV gases have higher emissions of NO_x than the older recovery boilers which do not burn these gases and hence require higher emission limits. Methanol recovery from the stripper off-gas may partly offset the potential NO_x emission, but this should be verified. The potential contribution of HCLV gases to NOx emission has been taken into account in the EU IPPC BREF document, in which the process borne NO_x was set at 1-2 kg NO_2/ADt. However, the NO_x limit in the draft Guidelines is set at 1.3 kg NO_2/ADt which is very tight. Gunns believes this limit may have been based on older technology and should be reviewed.	The limits for TRS and Nitrogen Oxides specified in Tables 2 and 3 of the Tasmanian Guidelines are based on advice that the limits are achievable using AMT and BPEM. The EU IPPC BREF (Dec 2001) includes Table 2.43: "Emission levels from the pulping process associated with the use of a suitable combination of best available techniques." This table lists millwide values for NO_x of 1.0-1.5 kg NO_2/ADt. These are process related emissions which include recovery boiler(s), lime kiln(s), fugitive emissions and separate furnaces (e.g. for TRS incineration) linked to the process, if any. Emissions from any auxiliary boiler are not included. The emissions values refer to daily averages and standard conditions of 273 K, 101.3 kPa and dry gas. The reference oxygen content is 5% for lime kilns and 5% for recovery boilers. Comparable values at 3% reference oxygen content are 1.13-1.69 kg NO_2/ADt. Annual average values (used in Vol. 1 of the Commission's Draft Main Report) would be lower than daily averages. Consequently, the annual average limit of 1.3 kg NO_2/ADt recommended by the Commission is appropriate, is based on AMT and does not require modification. No change to the Tasmanian Guidelines is required.
31. *Tables 3, Volume 3 – Emission limits to atmosphere:* The PCDD/PCDF limit in all regulated flue gases is 0.1 ng/Nm^3, which is the same as in the EU. However, the reference excess oxygen level for the recovery boiler and the lime kiln is 3% and for the power boiler 8%, whereas the level in the EU is 11% O_2. This implies that at the same excess oxygen concentration, the concentration limit of 0.1 ng/Nm^3 in Tasmania is about 50% (recovery boiler and lime kiln) and about 30% (power boiler) stricter than the corresponding limit in the EU. This could make these limits difficult to achieve and Gunns recommends that this limit is reviewed and brought into line with EU specified levels. (It is suspected that the tight limit is due to a mistake in allowing for the excess oxygen levels).	The limits for PCDD/PCDF are based on advice that the limits are achievable using AMT and BPEM. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
32.	The strategy to meet the objectives (see Draft report, Volume 3, "Reviewing these Guidelines" item A.6) defines that… "At two yearly interval… the Tasmanian Government will commission a report on developments in pulping technology and techniques, and on the basis of that report consider whether a full review of these guidelines is warranted and make a report and recommendation publicly available…" While the Guidelines are only intended to apply to new pulp mills, it should be noted that the implementation time of a new pulp mill from the investment decision is about 20 months. This implies that there could be a new AMT report available from the Government during the construction or start-up phase of a new pu1p mill. To avoid possible delays and additional investments the Guidelines should provide an assurance that a pulp mill project which has already received environmental and planning approval, could proceed as per the Consent Conditions given at the time of the approval and would not be required to meet any new provisions in newly revised Guidelines.	It is beyond the scope of the Tasmanian Guidelines to address this issue. Any assurance of the type sought by Gunns is a matter for the Government of the day. Section A.6 of the Tasmanian Guidelines provides for a report to be prepared on developments in pulping technology and techniques, which will form the basis of whether or not a full review of the guidelines is warranted at that time. A.6 does not, of itself, require a review of these guidelines. To take into account situations where a proponent has entered into major contracts, section C.7 has been amended to read: 'These guidelines do not apply to any mills in existence at the time of their release <u>or where major contracts have been let</u>…'

Department of Primary Industries, Water and Environment (5)

33.	It is not made sufficiently clear in the draft report and guidelines that the guidelines are limited in scope and do not encompass all of the environmental issues that would need to be considered in the assessment of a proposed BEK pulp mill.	The Tasmanian Guidelines (C.4, C.5, C.9, C.10, C.11, C.12, C.16) explain that they cover environmental emission limits and that any proposal would be subject to an EIA and planning approval process, which would address a wide range of environmental, social and economic issues. No change to the Tasmanian Guidelines is required.
34.	Certain sections of the draft guidelines are potentially misleading in regard to the scope of an assessment and the criteria for approval, as follows: Paragraph (b) of section C.16 may imply that a proponent only needs to satisfy the Tasmanian Government that a pulp mill will operate within the atmospheric, water and biological limits and criteria specified in the guidelines. In practice the proponent may	The Tasmanian Guidelines (C.4, C.5, C.9, C.10, C.11, C.12, C.16) explain that they cover environmental emission limits and that any proposal would be subject to an EIA and planning approval process, which would address a wide range of environmental, social and economic issues. C.16(b) indicates that this paragraph is dealing with emission limits and criteria defined in the Tasmanian Guidelines. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
34. cont.	need to satisfy the assessing authority that the mill will also operate within limits and criteria relating to other environmental issues such as those listed above. One way of clarifying this would be to add the words "in respect of the emissions covered by these guidelines..." at the start of paragraph (b).	
35.	There is a similar implication in Section D.3.2 that could be corrected in a similar manner.	Noted. No change to the Tasmanian Guidelines is required.
36.	Section D.3.3 makes a rather sweeping claim. This statement could be read as implying that there are no foreseeable conditions under which a BEK pulp mill that complies with the guidelines would have a harmful effect on the environment. It would be useful to ensure that this statement is read in the proper context. One way of achieving this would be to begin the statement with "In respect of the emissions covered by these guidelines....".	The Commission agrees that D.3.3 of the Tasmanian Guidelines should be amended as proposed.
37.	Total Reduced Sulphur Compounds: In both Volume 1 (Table 5.11, and Appendix H) and Volume 3 of the draft report, attention is drawn to the fact that the proposed limits on Total Reduced Sulphur Compounds (TRS) in stack emissions from the Recovery Boiler, Lime Kiln and CNCG Incinerator are higher than the guideline stack limit for hydrogen sulphide in the draft Environment Protection Policy (Air Quality) 2001. However, the report makes the case that the levels proposed represent Accepted Modern Technology for kraft pulp mills. On this basis the levels proposed for the guidelines would be consistent with the provisions of the draft Policy. The same Table and Appendix also point out that the design ground level concentration for TRS in the proposed Tasmanian guidelines is ten time more stringent than the equivalent values in the draft EPP for two of the major components of TRS. While my officers agree that the Tasmanian guidelines approach is more stringent, they do not agree that it is necessarily ten times more stringent. This aside, we agree that the	Noted. Refer to response to issue 11.

	Extracted issues	Commission's response
37. cont.	proposed guidelines approach of considering the four odorous sulphidic compounds that comprise TRS collectively as one pollutant is appropriate in the case of a kraft pulp mill. Therefore, we support the proposed design ground level concentration specified in the Tasmanian guidelines and will consider amending the draft EPP if this is necessary to give effect to the guidelines.	
38.	Sludges and lime mud: Section D.2 discusses sludges and lime mud but does not make clear that it is desirable to dewater them to the extent that they are 'spadeable' and can be treated as solid wastes. It is desirable that such wastes are fully converted to solid wastes, because liquid wastes can be more difficult to deal with.	The Commission agrees that the Tasmanian Guidelines should clarify that waste must be dewatered. Section D.2.6 has been amended to include an additional sentence: 'Prior to disposal the waste must be dewatered to the maximum extent possible using a high intensity press.'

Forests and Forest Industry Council of Tasmania (6)

39.	We note the stringent limits set and observe that we remain in accord with the intention for Tasmania to set guidelines that reflect the best achievable modern practice. However, we also observe that investment in a new mill will be massive if it is to be a competitive producer of pulp. Modern world scale kraft mills now have a capacity in the region of 4 million tonnes of green wood input. It pays, therefore, to be extremely cautious in proposing guidelines that might threaten an investment needed to build a mill of this size.	Refer to responses to issue 1.
	I make this comment because it appears that these Draft Guidelines contain prescriptions for many more compounds and lower tolerances than specified in comparable regulations elsewhere. It does not appear that these are warranted when, by meeting the specification, there is no appreciable improvement for the environment over that achieved without the limiting condition. It adds cost and makes daily functioning more uncertain. The inclusion of superfluous specifications may be inimical to the attraction of investment.	No conclusive evidence is available to the Commission to demonstrate that 2,3,7,8 TCDD and 2,3,7,8 TCDF is not formed in TCF mills. Therefore the Commission is of the view that it is appropriate to monitor for these emissions for a period of time, to be determined by the regulatory authority and the mill owner. Any decision to discontinue the requirement to test would be based on no detection of 2,3,7,8-TCDD and 2,3,7,8-TCDF above background levels in mill samples over a period of time. The Commission has amended Table 9 of the Tasmanian Guidelines to provide for monitoring of 2,3,7,8-TCDD and 2,3,7,8-TCDF to be conducted

Extracted issues		Commission's response
39. cont.	In other jurisdictions an average of around 14 emission limits are specified. These guidelines contain specific limits for 29 types of emission. The test for dioxins is a case in point. The limit specified is 15ppq. There should not be any dioxin produced in a mill these days. We noted in our original submission "Dioxin, with the abolition of free chlorine as a bleaching agent, is a thing of the past."	using a variable frequency scale to be stipulated by the regulatory authority based on the outcome of the EIA and subsequent monitoring following commissioning and start up. See responses to submissions from AOK Innovations (1) and Dr Maddern (8).
40.	Definition B.8 [Vol 3] makes it apparent that the choice of technology is to be left to the proponent; it is highly unlikely that any candidate would advance a process relying on elemental chlorine bleaching. In any case, B.14 [Vol 3] indicates that ECF and TCF are considered Accepted Modern Technology so a free chlorine bleaching process would not be acceptable on any score. B.14 also notes "releases of dioxins and furans are non-detectable or very low in TCF bleach plant effluents and are of the same order of magnitude as in ECF bleach plant effluents." To then require a test for compounds not associated with the process, at a concentration at the edge of measurable limits, places an onerous burden on a proponent. It is more likely that dioxin will be introduced into the mill in input water. B.12 [Vol 3] concedes that chlorinated organic material resulting from microbial activity may be present at background levels in surface water i.e. occurring naturally. Yet a test is required for which the analytical protocols are arduous and that can deliver no discernable benefit.	See responses to submissions from AOK Innovations (1) and Dr Maddern (8). Given that dioxins and furans bioaccumulate, while they may not be detectable in any one test, if they accumulate in the environment they will become increasingly apparent over time. If this does not eventuate then the variable frequency scale (refer to amendment to Table 9) will eliminate the need for the test.
41.	The test for BOD is similar. The guidelines are for effluent emission to the marine environment, an environment oxygenated by continuous wave action and in no way stagnant. The limits set place Tasmanian 2004 requirements at the upper end for land-bound installations discharging organic matter in effluent to freshwater lakes. Testing for this and adhering to a tight tolerance has no real environmental consequence.	A low-loaded activated sludge effluent treatment plant is AMT but the guidelines do not state to what degree of efficiency this plant must be designed and operated. The BOD_5, TSS and acute toxicity limits provide this. Furthermore, these limits will ensure that effluent quality will not be degraded when, from time to time, a component of the plant, or perhaps the entire plant, is shut down for preventive maintenance or repairs. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
42.	It is heartening to note, however, that the reviewing Commissioners (B.16 [Vol 3]) agree that closed cycle technologies remain beyond technical reach. The adoption of the millwide limit concept for testing for NOx and S02 emissions rather than multiple sources is also welcomed.	Noted.

Dept of Environment and Heritage (Commonwealth) (7)

43.	General comments: The Department (DEH) is of the view now, as it was at that time of the 1995 Commonwealth guidelines, that such guidelines are not intended to (and would not) replace or pre-empt conditions that may be set as a result of any environment assessment process under Commonwealth legislation, now the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (the EPBC Act). DEH notes the statement to this effect in Volume 3 of the Draft Report, Section C.4 which states: These guidelines will not replace or define the existing Australian Government and Tasmanian Government EIA and planning approval processes. Rather, it is intended that they provide information in advance on some key issues that will guide assessment of proposals being evaluated under these processes. DEH stresses that this must not be held to mean that, for example, levels of emissions such as dioxins and furans would necessarily be assessed according to the levels given in the guidelines.	Noted.
44.	The Report also states (at Volume 3, Section A6): At two[-]yearly intervals the Tasmanian Government will commission a report on developments in pulping technology and techniques, and on the basis of that report consider whether a full review of these guidelines is warranted, and make a report and recommendation publicly available.	The Commission considers that C.4, C.5 and C.12 adequately notify any proponent that the Tasmanian Guidelines do not pre-empt conditions that may be imposed as a result of any EIA process. A preamble to the Tasmanian Guidelines will emphasise and alert potential proponents that these are non-statutory guidelines that cannot override the requirements of the Tasmanian or Australian Governments. The Preamble is as follows:

Extracted issues		Commission's response
44. cont.	Whilst this is commendable, there could well be information (e.g. on technological advances or toxicity levels of pollutants) that arises in shorter timeframes than this and which would supersede any limits stated in the guidelines. Further, the environmental impact assessment (EIA) of any specific proposal for a pulp mill which might be put forward in the future would be highly specific to its site and, whilst emission standards could be expected to lie within the limits set by the Stockholm Convention and contained within the guidelines, DEH's assessment process under the EPBC Act may set more stringent ones if it was appropriate. DEH is, of course, in favour of signalling to any prospective proponent the sorts of standards that are likely to be expected in any EIA process. As indicated in our covering letter and reiterated above, such levels do not and will not pre-empt conditions that might be imposed under such a process. It is essential that any proponents be made aware of this in the finalised guidelines, perhaps in the preamble to them and in a strengthening of the text of Vol. 3, Section C.4.	'PREAMBLE These guidelines are non-statutory… They do not attempt to specify the technologies for installation and operation of a specific mill. The environmental emission limits provided in the guidelines have been set to cover all accepted modern technologies described in the guidelines, or their equivalent. Monitoring requirements of various parameters will vary dependent on the proposed technology. For example, monitoring of AOX would not be required for a particular mill employing total chlorine free technology. During the environmental impact assessment specific monitoring requirements based on the proposed technology will be identified and included in the mill's permit conditions. In addition, these guidelines do not pre-empt any conditions arising out of an assessment of any mill proposal.'
45.	Section 4.2.1 of Volume 1 makes reference to the "Draft Guidelines on Best Available Techniques for Pulping Processes" developed by the UNEP Expert Group on Best Available Techniques (BAT) and Best Environmental Practices (BEP). This document, along with guidelines for other sectors, is a draft document. Future reviews of the Tasmanian pulp mill guidelines or proposals to build a pulp mill would need to consider the guidelines in the form as eventually adopted by the 1st Conference of Parties to be held in Uruguay from 2-5 May 2005.	Noted.
46.	Section 4.10.5 of Volume 1 includes a summary of the 1998 "Sources of Dioxins and Furans in Australia: Air Emissions." This inventory has been updated in the National Dioxins Program, Technical Report No. 3, "Inventory of Dioxin Emissions in Australia,	Noted. The emission estimates presented in Tables 4.27 and 4.28 of Vol. 1 of the Commission's Draft Main Report are **indicative** only of the likely dioxin releases by various sources in Australia. This is due to the limitations of the study carried out by the

Extracted issues	Commission's response
46. cont. 2004," which can be found at http://www.deh.gov.au/industry/chemicals/dioxins/reports.html, along with reports of other information gathering studies and risk assessments undertaken through the Dioxins Program. These reports contain data about the background levels of dioxins in the Australian environment and would provide valuable reference for comparison with monitoring activities undertaken by a pulp mill.	National Dioxins Program (2004), the most significant of which was the lack of source test data for Australian sources, resulting in a heavy reliance on the "default" emission factors that are "set" in [UNEP/PCDD & PCDF, 2003], which based on the international dioxin measurement data. Major PCDD/PCDF emitters to air are biomass burning, waste burning and accidental fires, zinc production, fossil fuel power plants, metal ore sintering, household heating and cooking with biomass and iron and steel production plants. The PCDD/PCDF emissions to air from bleached kraft pulp mills is approximately 0.09% of the total PCDD/PCDF emissions to air. Major PCDD/PCDF emitters to water are disposal/landfilling, medical waste incineration and pulp and paper production. The PCDD/PCDF emissions to water from pulp and paper production is approximately 13% of the total PCDD/PCDF emissions to water and 0.09% of the total PCDD/PCDF emissions to air. Major PCDD/PCDF emitters to land are biomass burning, pulp and paper production, fossil fuel power plants, aluminium production, sewage and sewage treatment and medical waste incineration. The PCDD/PCDF emissions to products from pulp and paper production is approximately 8% of the total PCDD/PCDF emissions to land and 22% of the total PCDD/PCDF emissions to air. The dioxin emissions estimates reported in [National Dioxin Program, 2004] appear to be high compared to those reported in Sweden and Canada where kraft pulp production is much higher than that in Australia.[12] This is especially true for the dioxin emissions estimates to land since the National Dioxins Program study assumed that all sludge generated from the pulp and paper industry is disposed on land or taken to landfill. Dioxin emissions to products from the pulp and paper industry were also considered an emission to land in the National Dioxins Program inventory.

12 Australia produces approximately 0.6 Mt/a of kraft pulp, of which approximately 0.4 Mt/a is unbleached. Canada and Sweden produce approximately 11 Mt/a of bleached kraft pulp each.

Extracted issues		Commission's response
46. cont.		As mentioned in Section 2.15 – Solid Waste Handling and listed in Table 5.7 – AMT for the Reduction and Handling of Solid Waste (Vol.1 of the Commission's Draft Main Report), BEK pulp mills employing AMT would incinerate all non-hazardous organic material (e.g. bark, wood waste, effluent sludge and biosludge) in suitably designed boilers and would take to landfill only inert, primarily inorganic waste. Also, depending on concentrations, dusts from the convection back passes (the cooler sections) of power and recovery boilers, where generation of dioxins can occur, should be managed in the same way as other special wastes and not spread on land. No change to the Tasmanian Guidelines is required.
47.	Paragraph A.3 of Volume 3 (page 5) includes the following footnote: "References to the Stockholm Convention on Persistent Organic Pollutants will only take effect after the Convention is incorporated into Australian law." Australia ratified the Stockholm Convention on 20 May 2004 and it enters into force ninety days after ratification i.e. 17 August 2004. Obligations under the Convention do not necessarily have to be incorporated into law as stated in this footnote. The footnote should therefore be reworded to read as follows: "Australia ratified the Stockholm Convention on Persistent Organic Pollutants on 20 May 2004."	The Commission supports the proposed rewording of the footnote.
48.	The last sentence in Paragraph B3 of Volume 3 (page 7) refers to the "twelve" pollutants listed on the Convention. As this can be confusing, depending on context, DEH suggests the number "twelve" be deleted: The Stockholm Convention on Persistent Organic Pollutants (the Stockholm Convention) is particularly relevant as at least two of the persistent organic pollutants listed in the Convention can be formed and released during pulp bleaching processes.	The Commission supports the proposed amendment to Section B.3 of the Tasmanian Guidelines.

Extracted issues		Commission's response
49.	Paragraphs B6-B10 of Volume 3 (pages 8, 9) discusses the application of AMT, BEP and BPEM yet the title only refers to AMT and BPEM. It is suggested that the title also include BEP.	The Commission supports the proposed amendment to the heading of Sections B.6-B.10 and will amend to include 'Best available technique' in the title.
50.	Paragraph C7 of Volume 3 (page 12) states that: "These guidelines do not apply to any mills in existence at the time of their release. Nor have they been developed for direct application for major upgrades of existing mills." Noting that the guidelines take into consideration the obligations of the Stockholm Convention, DEH advises that guidance under Article 5, in relation to application of Best Available Techniques and Best Environmental Practices, applies to all new sources including sources resulting from substantial modification as described in Article 5, paragraph (f)(vi): "New source" means any source of which the construction or substantial modification is commenced at least one year after the date of: a. Entry into force of this Convention for the Party concerned; or b. Entry into force for the Party concerned of an amendment to Annex C where the source becomes subject to the provisions of this Convention only by virtue of that amendment." DEH would support the new pulp mill guidelines also applying to substantial modifications of existing pulp mills.	Noted. No change to the Tasmanian Guidelines is required.
51.	DEH notes that dioxin and furan emissions to the atmosphere have now been included in the guidelines (Table 3, Volume 3), with a limit placed at 100pg I-TEQ/Nm^3 @ 3% O_2 for emission points at the recovery boiler and lime kilns, and 100pg I-TEQ/Nm^3 @ 8% O_2 for emission points at the power boiler. DEH notes that this level (usually expressed as 0.1ng I-TEQ/Nm^3) is generally recognised internationally as the current standard for	Noted.

Extracted issues		Commission's response
51. cont.	emissions from combustion sources based on world's best practice. It is a legally binding limit for hazardous incinerators in Europe but is used only as a guideline in other countries. Although Australia has yet to adopt a national standard for dioxin and furan emissions from combustion facilities, the level of 0.1ng I-TEQ/Nm^3 is used by several States as a licensing condition for a range of combustion facilities. The National Dioxins Program is yet to address possible responses to managing dioxins in Australia following the recent release of the reports from the information gathering studies and risk assessments.	
52.	DEH notes that Table 3 of Volume 3 lists the frequency of monitoring for dioxins and furans emissions to the atmosphere as quarterly in the first year and twice yearly thereafter. DEH suggests that monitoring should be conducted monthly in the first year, to ensure that any high levels are detected early to enable modifications to be made to bring about reduced levels and to determine an appropriate longer term monitoring regime.	The indicated testing frequency is based on EU IPPC BREF, 2001 and Canada Wide Standard 2001. It is also noted that analytical turnaround exceeds 1 month. No change to the Tasmanian Guidelines is required.
53.	DEH notes that in Table 6 of Volume 3 the discharge limits for 2,3,7,8-TCDD to effluent have been amended from 15ppq to 10pg/L. Limits for 2,3,7,8-TCDF have also been included at a level of 30pg/L. However, DEH notes that the UNEP "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases," measures dioxins and furans as units expressed as Toxic Equivalents (TEQ). Measuring in TEQ would enable more realistic comparisions to be made with data contained in the UNEP toolkit and in the National Dioxins Program information gathering reports. Furthermore, TEQs are recognised as world's best practice and provide the best assurance of protection of human health and the environment.	Toxicity Equivalency Factors (TEF) particularly aid in expressing cumulative toxicity of complex PCDD/PCDF mixtures as one single TEQ value. It should be noted that TEF are interim values and administrative tools for order of magnitude estimates. TEF for 2,3,7,8 TCDD = 1 and TEF for 2,3,7,8 TCDF = 0.1. Concentrations of specific compounds like 2,3,7,8 TCDD and 2,3,7,8 TCDF are usually expressed as pg/L. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
54.	DEH notes that Table 8 in Volume 3 sets out a number of technologies for the reduction and handling of solid waste. The table proposes that residues and wastes could be used as "substitutes" in forestry, agricultural and other industries. This use of sludge is also discussed under section 2.15 of Volume 1. DEH advises that under the Environment Protection and Heritage Council, the Commonwealth, in consultation with the States and Territories, is developing a national framework for the reuse and recycling of industrial waste, such as pulp mill wastes, for land management applications. Subject to the agreement of Council this framework would be released for comment. Future reviews of the Tasmanian pulp mill guidelines or proposals to build a pulp mill may need to consider this framework.	Noted.
55.	The release of CO_2 and N_2O from the manufacture of kraft pulp is almost entirely related to the use of fossil fuel and purchased electricity if the latter is derived in part or whole from fossil fuel. The contribution of CH_4 and small amounts of chlorofluorocarbon-based chemical use is normally negligible. While older technology kraft pulp mills required the use of fossil fuel and purchased power, kraft mills designed in the last decade are much more likely to be energy self-sufficient and are often found to be net exporters of either power or thermal energy, or both. These energy resources can be used in paper manufacture. Generally fossil fuel is the only fuel used in lime kilns, though a number of wood fired kilns operate in Sweden. The degree of energy self-sufficiency of a kraft pulp mill is largely dictated by the wood properties, proximity to a major power grid, the price of fossil fuels and purchased power, corporate philosophy and economic criteria of the firm.	Noted.

Extracted issues		Commission's response
Ken Maddern (8)		
56.	I believe that the objectives of the guidelines should be to: 1. Ensure that any complying project will have no significant detrimental effect on the environment or community; and 2. facilitate the approval of a complying project. I believe the guidelines as currently presented fall short of the above objectives, particularly objective 2 as discussed below.	Noted.
57.	Scope of regulations: From Volume 1, Appendix H and J it is seen that 'the document' imposes far more limits than other jurisdictions around the world. 'The document' imposes 16 limits for water and 16 for air while the average for other jurisdictions is 6 and 6, respectively. I question what is so special about the Tasmanian environment that it requires so many more emission parameters and limits. There is little doubt that these are over specified in 'the document' and many of these parameters have no environmental significance for a complying AMT project. For example, there is no evidence of a relationship between COD and environmental impact, so why set COD limits?	Refer to response to issues 1 and 3.
58.	Chronic toxicity raises another issue. A reliable chronic toxicity test requires a suitable test organism and robust established protocols to e.g. keep the organism alive in the absence of mill effluent. Such protocols are not available so how is the mill supposed to handle this? It appears that no other jurisdiction has imposed such a requirement on a pulp mill, presumably because of this lack of defined suitable organisms and test protocols.	This statement is not correct. The province of Alberta requires its mills to carry out sublethal/chronic toxicity tests on treated effluent four times a year using three organisms – Fathead Minnow, *Selenastrum capricornutum*, and *Ceriodaphnia dubia*. The protocol for such tests can be found in the following references: Environment Canada, "Test of Reproduction and Survival Using the Cladoceran *Ceriodaphnia dubia*," Report EPS 1/RM/21, Ottawa, February 1992; Environment Canada, "Test of Larval Growth and Survival Using Fathead Minnows," Report EPS 1/RM/22, Ottawa, February 1992; Environment Canada,"Biological Test Method: Growth Inhibition Test Using the Freshwater Alga *Selenastrum capricornutum*," Report EPS 1/RM/25, Ottawa, November 1992.

Extracted issues		Commission's response
58. cont.		While Alberta does not place limits on chronic toxicity, the state of Washington in the US does. Chapter 173-205 of the Washington Administrative Code (WAC) sets out regulations and limits for acute and chronic toxicity. There are undoubtedly other jurisdictions that require monitoring for chronic toxicity and some of these jurisdictions may set limits. A search for such jurisdictions has not been made. The two jurisdictions identified above are given simply to illustrate that Tasmania would not be alone in requiring pulp mills to measure chronic toxicity and meet certain limits. Account has also been taken of the extensive work undertaken by the National Pulp Mills Research Program, during preparation of the 1995 Commonwealth Guidelines, in developing methods of assessing acute toxicity and chronic toxicity (refer to note g in Table 9 of the Tasmanian Guidelines). No change to the Tasmanian Guidelines is required.
59.	Over specification should be avoided because it not only increases compliance costs for the mill but also increases the chance that a mill will at some time or other be in breach, with all the negative publicity etc. this entails, while not causing any significant environmental impact.	Noted. No change to the Tasmanian Guidelines is required.
60.	Some specific limits: It is seen from Volume 1, Appendix H and J that in almost all cases the proposed Tasmanian emission limits are the most severe, or close to the most severe, of those reported for other jurisdictions.	Refer to response to issue 1.
61.	AOX: The limit imposed of 0.2 kg/ADt (monthly average) is very severe compared to other jurisdictions and does not appear to be justified by the evidence. In Volume 1, page 51 it is stated that “there is no evidence available to indicate that further reduction of effluent AOX from the average level of 0.5 kg/ADt (in 2002) would result in any demonstrable environmental benefit.” This means that a complying mill could occasionally exceed the 0.2 kg/ADt limit and be subject to regulatory penalties and negative public perception for a breach that has no environmental consequence. Not a	While it is recognised that there would appear to be no demonstrable environmental benefit in reducing the average AOX level below 0.5 kg/ADt, it must be emphasised that the limits are based primarily on the use of AMT and not on environmental impact. Consequently, the 0.2 kg/ADt monthly average represents what can be achieved with AMT in a bleached hardwood kraft pulp mill. (For example the Alberta-Pacific Forest Industries Ltd. bleached hardwood (aspen) kraft mill has a long term average AOX discharge of 0.05 kg/ADt.) It should be noted that mills processing softwood pulp have higher levels of AOX in the treated effluent than mills processing hardwood pulp.

	Extracted issues	Commission's response
61. cont.	situation likely to attract a proponent! There appears to be no basis for an AOX limit tighter than 0.5 kg/ADt, and in fact the benefit of an AOX limit less than 1.5 kg/ADt must be questioned based on information given in Volume 1.	The reason is the higher lignin content of the softwood pulp entering the bleach plant. Jurisdictions having mills processing both softwoods and hardwoods (such as, for example, the US and Québec) generally do not have AOX limits in their regulations for mills processing exclusively hardwoods. Consequently, the regulated AOX limits are those that can be achieved by a bleached softwood kraft mill employing AMT. Since only hardwoods will be processed in Tasmania, the AOX limit can be set correspondingly lower. No change to the Tasmanian Guidelines is required.
62.	Dioxin &- Furan: Volume 1 page 51 states, "treated wastewater from well-managed pulp and paper mills using ECF bleaching is virtually free of dioxin and persistent bioaccumulative toxic compounds." It is clearly established in Volume 1 that dioxins and furans exist in the natural environment and, in Australia, are mainly derived from wood burning, e.g. forest fires etc. It is highly likely that these background levels will from time to time (e.g. depending on forest fire and other wood burning activity close to the mill's water catchment area) exceed the limit set for the mill in Appendix H and will be present in the raw water supply to the mill. Thus the mill could be in violation even though it may not make any significant contribution to the dioxin and furan levels from its own operations. What is the mill supposed to do about this situation, which is entirely beyond its control? The mandatory use of AMT is sufficient to protect the environment from dioxin and furan and there is thus no justification for the limit set in 'the document,' or in fact for any limit to be set.	Refer to response to issue 9. There is no concrete evidence that Australia's water contains dioxins and furans of sufficiently high levels that would result in the proposed limits being exceeded. It is the Commission's understanding that forest fires tend to produce the higher substituted dioxin and furan congeners (hepta-chloro and octa-chloro) rather than the 2,3,7,8 congeners. The Commission notes that forest fires also occur in Canada but this does not seem to impact on the ability of the pulp mills there to meet the Canadian dioxin and furan regulations. No change to the Tasmanian Guidelines is required.
63.	The establishment of site suitability criteria is a good approach that I fully support. However, there are at least two issues with 'the document' that present problems and need addressing Chlorate control: Chlorate is generated as a result of the use of chlorine dioxide in ECF bleaching and so there will be some present	Refer to response to issue 10.

Extracted issues	Commission's response
63. cont. in the effluent from an ECF mill. Table 2.24, Volume 1, of 'the document' states that chlorate may be present up to 4 kg/ADt in untreated effluent. Chlorate is an herbicide and in ~1986 it was shown in Sweden that a Swedish species of seaweed (bladder wrack) was sensitive to levels as low as 10 µg/L. Unfortunately we do not know if any Tasmanian seaweed species are similarly sensitive to chlorate – it is unfortunate that the Tasmanian government has not resolved this issue in the intervening time. This means that any proponent wishing to use ECF bleaching would need to do a thorough study of each potential site to determine the seaweed species present and their sensitivity to chlorate. This presents quite an imposition and a long delay for any proponent before they could start seriously evaluation potential sites. The only ways around this are Opt for TCF bleaching where no chlorate would be formed. Any proposed Tasmanian pulp mill is likely to aim at the premium pulp market, which will require high pulp strength, high brightness and good brightness stability at the lowest possible cost. TCF is inferior to ECF in all these aspects putting the TCF mill at a disadvantage to an ECF mill. Install a chlorate reactor or anoxic zone in the secondary treatment system. Unfortunately the anoxic approach is not AMT as it has only been used with laboratory studies and there is no proven AMT chlorate reactor system. Rely on effluent dilution. This would (probably) require an unacceptably large dilution zone. A result of the chlorate limit is to essentially impose TCF bleaching on the proponent. TCF bleaching requires the removal of detrimental metal ions by chelants to be successful. The environmental fate of chelant effluents is unresolved as is the potential effect on mobilisation of metals in the environment such as from sediments. Opponents of any pulp mill project could	

Extracted issues		Commission's response
63. cont.	use this uncertainty during the expected highly emotional and supercharged political environment that would accompany any serious pulp mill project debate. This is not a situation that would be attractive to, or encourage, project proponents.	
64.	TRS emissions: The TRS limit for 3 minute moving average ground level TRS concentration has been set as 0.14 µg/m³, which is extremely tight, cf. the 1995 Commonwealth Guidelines limit of 1.5 µg/m³. I strongly support the principle that a mill must be built and operated such that there will be no detectable odour for most of the time (e.g. 98%), and this is achievable. Low ground level odour relies on good dispersion and atmospheric dilution of the recovery boiler stack gas. This means that a site must be chosen where the topography and meteorology are favourable to achieve this. Given the very tight ground level TRS limits in 'the document' there is no certainty that such a site exists in Tasmania, or that any suitable site is a viable option for the proponent (e.g. it may be too far away from the wood supply, the ocean, etc.). This means that a proponent could go through the long and expensive site monitoring process and fail. I believe the ground level TRS limit should be relaxed as discussed above.	Refer to response to issue 11.
65.	Recommended action: Based on the above discussion I believe the Commission should undertake the following action:	Noted.
	1. Each of the parameters listed in Volume 1, Appendix H should be reviewed against the following question: Is there any evidence that, for a complying AMT project, there is any relationship between the parameter and adverse environmental impact? If the answer is no, then the parameter should be dropped from the list.	The parameters listed in the Tasmanian Guidelines have been developed taking into account adverse environmental impact.
	2. Each of the limits listed in Volume 1, Appendix H should be reviewed against the following question: Is there any evidence that, for a complying AMT project, there is any relationship between	The limits listed in the Tasmanian Guidelines have been set taking into account adverse environmental impact.

Extracted issues		Commission's response
65. cont.	the limit and adverse environmental impact? If the answer is no, then the limit should be relaxed to a justifiable level. 3. The issues of chlorate and ground level TRS concentration, as discussed above, need to be resolved.	

Forest Industries Association of Tasmania (FIAT) (9)

66.	FIAT supports the establishment of a new economically viable pulp mill on the basis of the best technology available within the limits of that viability. Such a new mill should not be competitively disadvantaged by conditions more stringent than those of competitors operating in Scandinavian countries.	Noted.
67.	Review of guidelines: FIAT believes a review period for developments in technology of two years is to [*sic*] frequent given the mill is starting from the best technology available. Five years is more appropriate period and the counting should start from when the mill is commissioned. To require frequent review of the Guidelines will impact on the confidence of potential investors to invest significant sums in plant and equipment that may ultimately be the subject of biennial review.	Section C.14 of the Tasmanian Guidelines does not require the guidelines to be reviewed every two years. C.14 provides for the Tasmanian Government to commission a report on developments in pulping technology and techniques, and on the basis of that report consider whether a full review of the guidelines is warranted. No change to the Tasmanian Guidelines is required.
68.	Monitoring of effluent (Table 5.10 – Effluent Monitoring Guidelines): A TCF mill as a result of its environmentally friendly processes must deal with higher production costs and perhaps the production of inferior pulp than that of an ECF pulp mill. FIAT does not see any need for monitoring chemicals not found in TCF mills such as AOX, 2,3,7,8-TCDD, 2,3,7,8-TCDF, chlorate and trihalomethane. The equipment to monitor these chemicals and subsequent monitoring is an unnecessary expense to a TCF mill without any benefit accruing from that investment.	Refer to response to issue 27. The Tasmanian Guidelines have been amended so that a TCF mill will not be required to measure chlorate, chlorinated phenols and trihalomethanes. But 2,3,7,8-TCDD and 2,3,7,8-TCDF will continue to be required to be measured as these can be formed in non-detectable or at very low measurable levels in effluents from kraft pulp mills with TCF bleaching.

Extracted issues		Commission's response
69.	Emissions (Table 5.11 – Emission Limits to the Atmosphere): FIAT believes that the permitted emission levels should be no more stringent than Scandinavian countries. The guidelines for 1.3 kg NO_2/Adt is too low and should be raised to 2kg NO_2/Adt. Similarly the limit of excess oxygen for the recovery boiler (8%) and the lime kiln (3%) should be increased to 11%, which is equivalent to the European Union level.	Refer to response to issue 30. The millwide limit should remain as is. The EU O_2 reference level is 5% in this case, not 11%. No change to the Tasmanian Guidelines is required.
70.	Closed Loop Systems: The report concludes that a closed cycle mill (with no effluent discharge) is not yet feasible and therefore not AMT. FIAT agrees with this finding as it clearly would not satisfy the viability, economic nor competitive criteria.	Noted.

Construction, Forestry, Mining and Energy Union (CFMEU) (10)

71.	…the sole purpose of revising the guidelines is to attract investment into world class and environmentally sustainable new pulp mills in Tasmania. It is therefore important that the guidelines meet the community expectation for world's best practise emission and testing standards and also encourage capital investment.	Noted.
72.	As the CFMEU understands, the revised emission and testing guidelines are sufficiently rigorous to ensure that any new BEK pulp mill would have to fully embrace AMT and BAT. This is appropriate. The use of AMT and BAT, coupled with Best Practice Environmental Management (BPEM) will ensure the highest possible environmental standards are met.	Noted.
73.	Closed loop pulping is a concept used in part to ensure that emissions (and inputs for that matter) are at a minimum. It is simply not possible to close the pulp production loop to avoid all emissions. As the CFMEU understands, there is no pulp mill anywhere in the world – BEK or otherwise – that is genuinely 'closed loop' and we do not expect there ever will be.	Noted.

Extracted issues		Commission's response
74.	The market reality is that the significant markets available for world class eucalypt pulp are for bleached pulp, not unbleached. If the emission standards were amended so as to reduce the capacity to bleach pulp, the CFMEU would expect there would be no potential investors interested in Tasmania. The CFMEU's view is that the revised emission and testing standards are at world's best practice and when taken as a whole, may exceed current world's best practice for bleaching pulp. In the CFMEU's view, this is appropriate but must not be extended beyond world's best practice if the guidelines are to meet the investment and employment objectives.	Noted.
75.	It is generally considered that it is technically unwise and potentially impossible, to commence a pulp mill as Totally Chlorine Free (TCF). It is however considered possible to commence a mill as Elementally Chlorine Free (ECF) with a possible move to TCF when the mill is stabilised. In our view, it is worth noting that ECF pulp mills meet the rigorous environmental standards of Europe, the United States and Canada. In that regard, the CFMEU welcomes the emphasis on world's best practise emissions from pulp bleaching, recognising that they will aid in the development of a BEK pulp mill that is ECF and that may in the future have the capacity to become TCF.	Noted. The choice of technology is a matter for a proponent – the Tasmanian Guidelines do not specify technologies to be employed in a BEK pulp mill. No change to the Tasmanian Guidelines is required.

Christine Milne, Tasmanian Greens (11)

76.	Scope of the Guidelines: The Tasmanian Greens reject any guidelines that permit discharge into the marine environment. A closed loop mill is the only mill that is acceptable. A prudent and feasible alternative technology to the kraft process is chemi thermo mechanical pulping. This process would allow for complete closure of the liquid effluent loop and have zero liquid	Refer to response to issue 15. The term "closed cycle" describes a mill operation that is still a goal but not yet an industrial reality for either chemical or mechanical pulp mills. Conversely, the term "zero effluent" describes a mill operation that is an industrial reality for APP/BCTMP mills. No change to the Tasmanian Guidelines is required.

	Extracted issues	Commission's response
76. cont.	emissions to a waterway. Pulp mills of this kind are operating in Canada. The Tasmanian Greens believe that if a pulp mill is to be built in Tasmania, there should be a requirement for it to be integrated with a paper mill to maximise the value adding of the resource. Pulp production for the export commodity market restricts the technological options that would be available for an integrated mill and exposes Tasmania as a price taker in global markets.	
77.	C13. Need for Wide Consultation: The Guidelines require consultation to take into account community concern over the environmental impacts of large scale pulp mill developments but there is no requirement for the company to act on those concerns. All that is required is that the company is willing to effectively address sensitive issues that emerge. There is no way to effectively address the concerns of Tasmanians who believe that there are superior ways to create jobs than a pulp mill or who believe that a BEK pulp mill is not consistent with Tasmania's clean and green image or a community that does not want the pulp mill in its district or to address concerns relating to odour, marine discharge and solid waste disposal. Kraft pulp mills smell of rotten egg gas (H_2S) and that cannot be removed to the point where it cannot be detected by the human nose. (See comments re gaseous emissions.) The Tasmanian Greens believe that if the proponent cannot guarantee that the waste streams will be contained within the boundaries then the mill cannot proceed.	The Tasmanian Guidelines (C.13) note the need for a pulp mill proponent to consult widely with the community. Extensive community consultation is also undertaken during EIA and planning approval processes. No change to the Tasmanian Guidelines is required. This is not possible to fulfill for any type of mill based on current technology.
78.	Public consultation should be designed not to just inform a community but also to provide confidence that community concerns will be acted upon. Motherhood statements about community consultation will not satisfy Tasmanians who are tired of pledges to consult when what occurs is the company telling Tasmanian communities what they are prepared to build	The Tasmanian Guidelines (C.13) note the need for a pulp mill proponent to consult widely with the community. Extensive community consultation is also undertaken during EIA and planning approval processes. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
78. cont.	and where they are prepared to build it. This consultation in relation to pulp mill guidelines is a case in point. The company, Gunns has told the Tasmanian government what resource it wants to use, the technology it is prepared to consider, and the scale of the mill it is prepared to build and the RPDC has been told to facilitate that outcome. It is an insult that this process is now called consultation. Before the period for consultation on these guidelines is over the company, Gunns has commissioned an economic viability study to determine if the TCF technology is viable and what is the optimum site for the company and its effluent. What guarantee does the company have that the community will not reject these guidelines or refuse a marine outfall? If the community rejects these guidelines as being unacceptable for Tasmania, will the RPDC recommend against such a mill?	
79.	It is clear that the Gunns/Tasmanian government strategy is to develop guidelines for both an ECF mill and a TCF mill, the former being cheaper to build than the latter. When the feasibility study conducted by pulp mill consultants is concluded it will almost certainly demonstrate that the ECF mill is more economically viable than a TCF mill because it is cheaper. It may also be more technologically viable to maximise profits from pulp sales because the resource for the mill includes native forest woodchips that require stronger bleaching than plantation chips to produce the kraft pulp for the export commodity market. The result will be an ECF mill proposed for the optimum site for the company which will be on a hill to disperse the gaseous effluent and near Bass Strait for marine dumping. Viability will not be in environmental terms but rather in profit concerns. Where does this leave the community?	An ECF mill is not necessarily cheaper to build than a TCF mill. Depending on the detailed process design it can go both ways. Other factors such as market, pulp grade, fibre raw material available and production costs will determine the cost of a particular mill, whether it be ECF or TCF. The statement "…native forest woodchips… require stronger bleaching than plantation chips…" is incorrect. A detailed evaluation of the technical differences in pulping and bleaching of mature and plantation wood is outside the scope of this inquiry but in general: Mature wood requires more pulping chemicals than plantation wood to reach a certain kappa number after oxygen delignification. At the same kappa number entering the bleach plant, bleaching will be equally "strong" for mature and plantation wood derived pulp. No change to the Tasmanian Guidelines is required.

	Extracted issues	Commission's response
80.	C17. Monitoring.: The self regulation proposed is unacceptable. Allowing the company to 'monitor and report regularly on effluent composition and environmental impacts' gives no comfort to local communities who are currently having to put up with noise and other impacts from the current woodchip mills and existing plants at Wesley Vale and in the Tamar Valley. Compliance is a major issue that is not satisfactorily addressed. How adequate is the staffing in the Dept of Environment to achieve compliance and enforcement? Do the woodchip mill in the Tamar or the Wesley Vale pulp mill comply with their noise limits. If so, then the monitoring and compliance systems are poor given the complaints of local residents and the lack of publicly funded capacity to monitor independently. The Tasmanian Greens reject self regulation. Regulation must be independent and at the cost of the proponent.	Noted. These issues are beyond the scope of the terms of reference and the Tasmanian Guidelines. No change to the Tasmanian Guidelines is required.
81.	D. Emission Limits to Atmosphere: Local Nose Test a Nonsense, D4.10, 4.11, 4.12, D5.15. Odour will [be] a major issue for a kraft pulp mill which is why the Kraft process and hence these emission limits for gaseous emissions should be rejected. It is noted that the guidelines provide for the mill to exceed the emission limits to atmosphere for 7 hours in a month to a total of ten days in a year. This means that hydrogen sulphide and methyl mercaptan can be released at far higher levels for seven hours every month. What are the impacts and lost opportunity costs on the surrounding tourism, farming and residential amenity? This is a licence to pollute. The mill must comply beyond its boundaries at all times. The Greens do not believe that discretion for determining whether the mill operator has made satisfactory progress in limiting the stench should be left to the Tasmanian	The Tasmanian Guidelines provide limits for the following emissions to the atmosphere: particulate matter, total reduced sulfur, nitrogen oxide and nitrogen dioxide, sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen chloride, dioxins and furans, chlorine dioxide and related compounds. In addition to being required to comply with environmental discharge limits to the atmosphere, a mill proponent would also be required to establish a program of nuisance TRS odour monitoring (D.4.12). Technological and operational advances will no doubt drive the odour emissions down, but the Commission is advised that the odour-free kraft mill does not exist. Kraft pulp mills in Brazil, North America, Sweden and Finland – leading kraft pulp producers – tolerate some TRS and consider this emission as a minor nuisance. The appropriate application of the site selection criteria is necessary in order to limit nuisance TRS odour emissions. Section D.3.9 of the Tasmanian Guidelines has been amended to include a footnote to D.3.9(b): "The provisions of Section D.4.12 are intended to ensure that emission of odorous sulfur containing

	Extracted issues	Commission's response
81. cont.	authorities. The emission limits should stand and if compliance is not achieved the mill should be closed in accordance with the environmental protection legislation. The Greens completely reject the time frame and process established in 5.15. 'If the mill operator has not made satisfactory progress (as judged by the Tasmanian regulatory authorities) in limiting nuisance TRS odour emissions beyond the mill boundary in two and a half years after mill start up, the Tasmanian regulatory authorities MAY require the mill operator to commission one or more recognised experts on industrial odour control to review the operation of the mill and to make recommendations to the operator that will remedy the emissions to the standard of international best practice.' Two and a half year is too long for local residents to have their quality of life and air quality destroyed. The fact that this statement is in these guidelines demonstrates that the RPDC recognises that the odour cannot be satisfactorily contained. May should read MUST. The time frame should be reduced and there should be provision for closing a mill that cannot comply.	gases are kept to the absolute minimum achievable by AMT. While complete odour elimination from kraft mills is not achievable at the time of writing, selection of a site that minimises the nuisance caused by these odorous compounds should be a prime consideration in site selection." The Tasmanian Guidelines are based on AMT, BPEM and international practice. It will be a matter for the regulatory authority to enforce the limits. The Commission agrees that the word 'may' in Section D.5.15 is not strong enough. Section D.5.15 of the Tasmanian Guidelines has been amended by replacing 'may' with 'shall.' Commissioning of a mill would take typically 1 year. The Commission agrees that the period of two and a half years can be reduced. Section D.5.15 of the Tasmanian Guidelines has been amended to replace 'two and a half years' with 'two years.' 'May' has been replaced with 'shall.' The timeframe has been reduced. Section D.5.7 of the Tasmanian Guidelines provides the option of suspension of mill operations.
82.	D4.12: The Greens reject the local sniff test. Atmospheric environmental effects Monitoring. 'The establishment of a panel of at least 10 local residents who are willing to be trained to provide regular and systematic feedback on the type and level of any nuisance odours emanating from the mill that are detectable on their properties.' P 46 Vol 2. If the odour is detectable on their properties, then what? Asking local people to report regularly on the pollution that emanates from the mill is a clear statement of anticipated lack of compliance and an indication of loss of local amenity and property value. The community is not a	Odour panels are common in the pulp and paper industry, and several other industries, and provide a sensible way to monitor TRS emissions. The Tasmanian Guidelines provide limits for the following emissions to the atmosphere: particulate matter, total reduced sulfur, nitrogen oxide and nitrogen dioxide, sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen chloride, dioxins and furans, chlorine dioxide and related compounds. In addition to being required to comply with environmental discharge limits to the atmosphere, a mill proponent would also be required to establish a program of nuisance TRS odour monitoring (D.4.12). Section D.5.7 of the Tasmanian Guidelines provides the option of suspension of mill operations in the event of unacceptable breaches.

	Extracted issues	Commission's response
82. cont.	free resource to Gunns and neither is the Tasmanian air. The guidelines must be amended to provide that the mill operator and the Tasmanian authorities guarantee that the atmospheric pollution, odour, is not detected beyond the mill boundaries and if it is then the mill must be closed until compliance can be achieved.	No change to the Tasmanian Guidelines is required.
83.	D1.10: There should be no effluent discharged into the marine environment since a prudent alternative, closed loop chemi thermo mechanical pulping exists.	Refer to response to issue 15. Refer to Section 3.6. of Vol. 1 of the Commission's Draft Main Report for detailed information on advances that have been made toward partial system closure and the finding that: "However, as of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis, more specifically there are no bleach plants in papergrade bleached kraft mills that operate fully closed on a continuous basis." There are a few Chemi-Thermo-Mechanical Pulping (CTMP) and Alkaline Peroxide Mechanical Pulping (APMP) mills that were designed for and operate with no liquid effluent discharge. These mills utilise wastewater evaporation and combustion to dispose of the organic and inorganic matter dissolved in the process. Solid wastes are generated at many points in mechanical pulp mills. These solids may be removed from the process at the wood yard, as part of pulp screening and from the wastewater treatment plant (WTP). Waste solids from primary and secondary treatments are dewatered prior to incineration, disposal to landfill or land spreading. Zero-effluent APMP/CTMP mills also generate a solid waste stream of concentrated inorganic salts. In recent years a number of new mechanical pulp mills have been built in areas where water supplies are limited or where the receiving water is unsuitable for the introduction of treated effluents. In such situations, a mill designed to operate with no effluent discharge is the only alternative. To achieve zero discharge, contaminants must be removed from the effluent, producing clean water suitable for reuse in the process.

Extracted issues	Commission's response
83. cont.	The operation at the Millar Western Meadow Lake pulp mill would be "closed cycle" if the inorganic solids were fully recovered as chemicals and reused in the process. However, only approximately 30% of the inorganic solids are recovered and reused in the bleach plant. This is why the Millar Western Meadow Lake pulp mill (and similarly the Tembec Chetwynd pulp mill) is called a "zero effluent" mill. Implicit in this definition is the understanding that the "effluent" is the liquid effluent. Emissions to the atmosphere from the pulp mill (e.g. refiners), recovery boiler, power boiler and evaporation from ponds and flash drying of the pulp for market are not considered. Similarly, solid waste in the form of green liquor dregs and ingots is not considered either. The term "closed cycle" describes a mill operation that is still a goal but not yet an industrial reality for either chemical or mechanical pulp mills. Conversely, the term "zero effluent" describes a mill operation that is an industrial reality for APMP/CTMP mills. Due to design and the extensive use of buffer tank/pond capacities in zero-effluent market APMP/CTMP mills, there is no emission to the aquatic environment. Emission levels associated with BAT for zero-effluent market APMP/CTMP mills are identical to those listed for BKP mills employing BAT in Table 4.2 (for the recovery boiler only) and Table 4.3 (for the power boiler) of Vol. 1 of the Commission's Draft Main Report. Solid waste discharges associated with BAT for BKP mills are listed in Table 4.4 of the Draft Main Report. The total amount is 43 kg dry solids/ADt. This compares favourably with the solid waste discharges associated with BAT for zero-effluent market APMP/CTMP mills, which are approximately 67 kg dry solids/ADt. No change to the Tasmanian Guidelines is required.

Extracted issues		Commission's response
84.	A pulp mill should use no chlorine in the bleaching sequence and should not render a kilometre radius from its outfall a dead zone as a result of chlorate ion.	Noted. A TCF mill does not use chlorine in the bleaching sequence, resulting in non-detectable levels of chlorate. An ECF bleaching sequence uses chlorine dioxide. About 10% of the ClO_2 charged on an active chlorine basis oxidises to chlorate. Appropriate effluent treatment, such as anoxic treatment, can achieve a 90-100% reduction of chlorate. The Tasmanian Guidelines set chlorate levels to be met, and require chlorate to be monitored. No change to the Tasmanian Guidelines is required.
85.	D1.13: The proponent should not have the discretion to determine whether the colour emissions affect the visual amenity of the local beaches or environs. The local beaches are not a free resource to a company. This is a direct opportunity cost to tourism and local amenity. Background studies must be conducted before operation and independent monitoring conducted at the cost of the company. What action is proposed if local beaches are ruined?	The Tasmanian Guidelines set a discharge limit in relation to colour (D.1.12) as well as requiring any proponent to ensure that colour emissions do not affect the visual amenity of the local beaches and environs (D.1.13). The EIA will determine strategies aimed to avoid any adverse environmental impact. No change to the Tasmanian Guidelines is required.
86.	D.2 Solid Waste: Landfill is inappropriate for highly toxic solid waste. What method of disposal is proposed for such material at the designated landfill? Will a purpose built storage facility be required?	The Tasmanian Guidelines (D.2) provide guidance on the disposal of solid waste. The EIA and planning approval process would address solid waste disposal in detail. No 'highly toxic solid waste' is generated through BEK pulp mills employing AMT and BPEM. No change to the Tasmanian Guidelines is required.
87.	D3.2 Site Suitability Criteria: The site specifications are written to optimise the proponents requirements relating to air emission disposal and ocean outfall. The Tasmanian community is being told, 'Proponents of pulp mills will be required to undertake studies that will enable them to demonstrate the suitability or a proposed site in terms of the mills ability to meet specified ambient air and water quality.' There is nothing about the community's site specifications. The Community is left at the mercy of the decisions about technology that the proponent makes. This is exactly what occurred in 1988~89. Why should a proponent be permitted to impose itself on a community because that community	Extensive community consultation occurs during the EIA and planning approval processes. The community would have the opportunity to raise issues in relation to the site of a proposed mill at that time. The provisions of the *State Policies and Projects Act 1993* in relation to the assessment of a project of State significance guarantee that the community has the opportunity to have input and comment on site specifications. In addition, the *Land Use Planning and Approvals Act 1993* provides for public input if a planning scheme amendment is required. No change to the Tasmanian Guidelines is required.

	Extracted issues	Commission's response
87. cont.	happens to be able to absorb the proponent's chosen waste streams better than others. If the emissions were required to be contained within the site boundaries this would not occur.	
88.	The site criteria must include the site options that would be available if a non chlorine, closed loop mill was required.	Refer to response to issue 15. The terms of reference require the Commission to prepare recommended environmental emission limit guidelines for any new BEK pulp mill in Tasmania. Section D.3, Site suitability criteria, have been prepared in accordance with AMT and BPEM, and taking into account State and Commonwealth policies and statutory requirements. No change to the Tasmanian Guidelines is required.
89.	The siting criteria must include an additional paragraph relating to the Tasmanian community's assessment of site suitability of a mill relating to strategic development aspirations. Just as local government has to have industrial zones so the state of Tasmania should be able to decide where it would strategically place heavy industry to take into account opportunity costs to existing industries like agriculture, fishing and tourism. The opportunity costs to each of these industries must be assessed in siting criteria.	These matters are beyond the scope of the guidelines but they would be addressed through the EIA and planning approval processes. All interested persons would be invited to provide a written submission and make a presentation at a hearing on a mill proposal and any required planning scheme amendment. No change to the Tasmanian Guidelines is required.
90.	D3.4: The statement that "while they (atmospheric emissions) are extremely smelly and can be detected by the human senses at extremely low levels, they can be relatively easily controlled" is not consistent with the assumptions contained in D4 and D5.1f they can be so easily controlled, why are there provisions for the local sniff test beyond the boundaries and for non compliance for 10 days per year?	The Commission acknowledges that emission of odorous sulfur containing gases cannot, at the time of writing, be eliminated. Section D.3.4 of the Tasmanian Guidelines has been amended by deleting the words 'relatively easily' from the first sentence, and adding the following at the end of the first sentence: 'but cannot be eliminated entirely given the nature of the process.'

Extracted issues	Commission's response

Tasmanian Fishing Industry Council (12)

91. I note with interest that the Draft Report reiterates in all three volumes (e.g. Volume 2, B.16)

"…Closed-cycle technologies are not yet technically or commercially proven." While significant progress has been made in closed-cycle technology, it appears that those conclusions remain valid…

Not necessarily contrary to the thrust of your report, it is worthy of mention that there appears to be technology available (internationally) that is now operating, economically producing pulp with no effluent discharge.

The question that should be asked is why Tasmania insists on limiting pulp production to the Kraft process when other Totally Chlorine Free (TCF) mills are operating successfully overseas? I quote:

"In May 2003 a Technical Bulletin written by Stratton and Gleadow titled Pulp Mill Process Closure: A Review of Global Technology Developments and Mill Experiences in the 1990s was released by the National Council for Air and Stream Improvement. It can be found at the following weblink http://www.ncasi.org/publications/tb860.pdf

4.1.1 Millar Western Pulp (Meadow Lake) Ltd. – Meadow Lake, Saskatchewan, Canada

The Millar Western Pulp (Meadow Lake) Ltd. mill has been the most successful **zero effluent discharge market pulp mill operation to date**. It is a totally chlorine-free, alkaline peroxide pulp/bleached chemi-thermo-mechanical pulp (APP/BCTMP) mill, with a current production capacity of 300,000 metric tons per year of market pulp made from 100% aspen. Pulp produced per mass of wood consumed by this high-yield mill ranges from 85 to 95%.

A groundbreaking wastewater treatment and recycling system implemented by Millar Western at the mill allows the manufacture

Commission's response:

Refer to Section 3.6 of Vol. 1 of the Commission's Draft Main Report for detailed information on advances that have been made toward partial system closure and the finding that:

'However, as of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis, more specifically there are no bleach plants in papergrade bleached kraft mills that operate fully closed on a continuous basis.'

The mills referred to employ Chemi-Thermo-Mechanical Pulping (CTMP). There are a few Chemi-Thermo-Mechanical Pulping (CTMP) and Alkaline Peroxide Mechanical Pulping (APMP) mills that were designed for and operate with no liquid effluent discharge. These mills utilise wastewater evaporation and combustion to dispose of the organic and inorganic matter dissolved in the process.

Solid wastes are generated at many points in mechanical pulp mills. These solids may be removed from the process at the wood yard, as part of pulp screening and from the wastewater treatment plant (WTP). Waste solids from primary and secondary treatments are dewatered prior to incineration, disposal to landfill or land spreading. Zero-effluent APMP/CTMP mills also generate a solid waste stream of concentrated inorganic salts.

In recent years a number of new mechanical pulp mills have been built in areas where water supplies are limited or where the receiving water is unsuitable for the introduction of treated effluents. In such situations, a mill designed to operate with no effluent discharge is the only alternative.

To achieve zero discharge, contaminants must be removed from the effluent, producing clean water suitable for reuse in the process.

The operation at the Millar Western Meadow Lake pulp mill would be "closed cycle" if the inorganic solids were fully recovered as chemicals and reused in the process.

However, only approximately 30% of the inorganic solids are recovered and reused in the bleach plant. This is why the Millar Western Meadow Lake pulp

Extracted issues	Commission's response
91. cont. of pulp with **no discharge of liquid effluent, eliminating water pollution** concerns for the mill." And... "4.1.2 Tembec (formerly Louisiana-Pacific) – Chetwynd, BC, Canada Louisiana-Pacific constructed a new BCTMP mill in Chetwynd, British Columbia, in the early 1990s. The factors which weighed in the decision to go **zero discharge** at Chetwynd included: a corporate vision for efficient resource use and to meet and exceed current and future environmental regulations; concerns over regulatory delays for permitting an effluent discharge; progress in CTMP technology which made operation at low water and effluent flows possible; anticipated demographic changes; and market trends. The zero discharge technologies Louisiana-Pacific considered included freeze crystallization, evaporation, conventional water treatment, and membrane technologies (Rogers and Arac 1997; Arac 1998)."	mill (and similarly the Tembec Chetwynd pulp mill) is called a "zero effluent" mill. Implicit in this definition is the understanding that the "effluent" is the liquid effluent. Emissions to the atmosphere from the pulp mill (e.g. refiners), recovery boiler, power boiler and evaporation from ponds and flash drying of the pulp for market are not considered. Similarly, solid waste in the form of green liquor dregs and ingots is not considered either. The term "closed cycle" describes a mill operation that is still a goal but not yet an industrial reality for either chemical or mechanical pulp mills. Conversely, the term "zero effluent" describes a mill operation that is an industrial reality for APMP/CTMP mills. Due to design and the extensive use of buffer tank/pond capacities in zero-effluent market APMP/CTMP mills, there is no emission to the aquatic environment. Emission levels associated with BAT for zero-effluent market APMP/CTMP mills are identical to those listed for BKP mills employing BAT in Table 4.2 (for the recovery boiler only) and Table 4.3 (for the power boiler) of Volume 1 of the Commission's Draft Main Report. Solid waste discharges associated with BAT for BKP mills are listed in Table 4.4 of the Draft Main Report. The total amount is 43 kg dry solids/ADt. This compares favourably with the solid waste discharges associated with BAT for zero-effluent market APMP/CTMP mills, which are approximately 67 kg dry solids/ADt. No change to the Tasmanian Guidelines is required.

Greenpeace and National Toxics Network (13)

92. Dioxins and Furan emissions: The recently released *Inventory of Dioxin Emissions in Australia* by the Department of Environment and Heritage showed the high dioxin emissions caused by pulp and paper production in Australia. An estimated 0.4g of the 3.4g ITEQ of dioxin per annum emitted to water and an estimated 110g of the 1,300g ITEQ of dioxin per annum emitted to land is from pulp and paper production.	Noted. The emission estimates presented in Tables 4.27 and 4.28 of Vol. 1 of the Commission's Draft Main Report are **indicative** only of the likely dioxin releases by various sources in Australia. This is due to the limitations of the study carried out by the National Dioxins Program (2004), the most significant of which was the lack of source test data for Australian sources, resulting in a heavy reliance on the "default" emission factors that are "set" in

Extracted issues		Commission's response
92. cont.		[UNEP/PCDD & PCDF, 2003], which are based on the international dioxin measurement data. Major PCDD/PCDF emitters to air are biomass burning, waste burning and accidental fires, zinc production, fossil fuel power plants, metal ore sintering, household heating and cooking with biomass and iron and steel production plants. The PCDD/PCDF emissions to air from bleached kraft pulp mills is approximately 0.09% of the total PCDD/PCDF emissions to air. No change to the Tasmanian Guidelines is required.
93.	As stated in our primary submission, the Stockholm Convention on Persistent Organic Pollutants requires the minimisation and where feasible, the elimination of dioxin and furan emissions. The adoption of allowable emission limits that do not reflect performance ability or attempts to minimise dioxin emissions is unacceptable. This is particularly so when pulp and paper production already contribute such a large dioxin burden.	The recommended emission limits contained in the Tasmanian Guidelines are for any new BEK pulp mill adopting AMT, BPEM and BAT according to the Stockholm Convention, that is, the Tasmanian Guidelines do reflect performance ability and the minimisation of dioxin emissions. No change to the Tasmanian Guidelines is required.
94.	Stockholm Convention: The RPDC's interpretation of the Stockholm Convention requirement for minimisation of emission is incorrect. The Convention requirement for the minimisation of dioxin is an absolute requirement, with elimination of dioxin being subject to feasibility.	The Commission considers that its interpretation of the Stockholm Convention and that of Greenpeace and the National Toxics Network is the same, i.e. the Convention requires minimisation of dioxins, subject to feasibility. The difference lies in the estimation of (or judgement concerning) what is 'feasible.' No change to the Tasmanian Guidelines is required.
95.	The RPDC's flippant assessment of totally chlorine free processes as unviable without a feasibility study into totally chlorine free processes is unwarranted and without basis. Evidence of the rate of historical take-up of ECF versus TCF systems is now irrelevant as there is now a new international obligation under the Stockholm Convention. In addition, the whole approach of the RPDC in defining *accepted modern technology* ignores the fact that there is a new international obligation from 17 May 2004. What is accepted before this date is no indication of the new responsibilities under the Stockholm Convention.	The Commission considers that the Stockholm Convention would require an assessment of the feasibility of a TCF mill as opposed to alternate technologies. Evidence of the rate of historical take-up of ECF versus TCF mills remains very relevant as the low level of take-up of TCF processes must be due to factors apart from emissions of dioxins and furans. There is no discernible difference in emissions of dioxins and furans between the two processes. There are quality disadvantages of TCF product which, amongst other issues, contribute to its low-level take-up. The Commission does not accept the submission by Greenpeace and the National Toxics Network that the Tasmanian Guidelines have been prepared in ignorance of the Stockholm Convention. It is noted

	Extracted issues	Commission's response
95. cont.		that the terms of reference were amended by the Tasmanian Government on 3 May 2004 (refer to page 1 of Vol. 1 of the Commission's Draft Main Report). The Stockholm Convention definition of 'Best Available Technology' has been included in the Tasmanian Guidelines. In addition the Tasmanian Guidelines recognise the significance of the Stockholm Convention specifically in Sections A.3, B.3, B.5, B.6, B.7, B.9, B.10, B.1, C.2, C.3, C.12 and C.14 and in several footnotes.) No change to the Tasmanian Guidelines is required.
96.	Technology Requirements: The Stockholm Convention requires the use of the best available techniques and technology to minimise or eliminate dioxin emissions. The presence of a feasible technology that does eliminate dioxin emissions, totally chlorine free processes, the Convention requirements are that those technologies be preferred. There is no indication in the draft guidelines that this is to be done.	Section B.8 of the Tasmanian Guidelines states that the guidelines do not attempt to specify the technologies for installation in a mill as these decisions should remain the decision of the proponent. During the planning approval assessment process a proponent will be required to demonstrate that the technology choices will meet these guidelines. The Commission considers that the 'feasibility' of a BEK pulp mill employing a TCF bleaching process has not been conclusively established (refer to section 4.2.1, Vol. 1 of the Commission's Draft Main Report). No change to the Tasmanian Guidelines is required.
97.	Closed loop technologies must also be given preference to reduce any impacts of the process. The absence of chlorine from the process allows for closure of the system to maximise recycling and reduce emissions of other pollutants. To write off the feasibility of closed loop systems without analysis of feasibility in the Tasmanian situation, particularly with the current operation of the closed loop mills such as at Meadow Lake in Saskatchewan, is again premature.	Refer to Section 3.6 of Vol. 1 of the Commission's Draft Main Report for detailed information on advances that have been toward partial system closure and the finding that: 'However, as of the beginning of 2004, there are no papergrade bleached kraft mills (using eucalypt or other raw material) that operate fully closed on a continuous basis, more specifically there are no bleach plants in papergrade bleached kraft mills that operate fully closed on a continuous basis.' There are a few Chemi-Thermo-Mechanical Pulping (CTMP) and Alkaline Peroxide Mechanical Pulping (APMP) mills that were designed for and operate with no liquid effluent discharge. These mills utilise wastewater evaporation and combustion to dispose of the organic and inorganic matter dissolved in the process. Solid wastes are generated at many points in mechanical pulp mills. These solids may be removed

Extracted issues	Commission's response
97. cont.	from the process at the wood yard, as part of pulp screening and from the wastewater treatment plant (WTP). Waste solids from primary and secondary treatments are dewatered prior to incineration, disposal to landfill or land spreading. Zero-effluent APMP/CTMP mills also generate a solid waste stream of concentrated inorganic salts. In recent years a number of new mechanical pulp mills have been built in areas where water supplies are limited or where the receiving water is unsuitable for the introduction of treated effluents. In such situations, a mill designed to operate with no effluent discharge is the only alternative. To achieve zero discharge, contaminants must be removed from the effluent, producing clean water suitable for reuse in the process. The operation at the Millar Western Meadow Lake pulp mill would be "closed cycle" if the inorganic solids were fully recovered as chemicals and reused in the process. However, only approximately 30% of the inorganic solids are recovered and reused in the bleach plant. This is why the Millar Western Meadow Lake pulp mill (and similarly the Tembec Chetwynd pulp mill) is called a "zero effluent" mill. Implicit in this definition is the understanding that the "effluent" is the liquid effluent. Emissions to the atmosphere from the pulp mill (e.g. refiners), recovery boiler, power boiler and evaporation from ponds and flash drying of the pulp for market are not considered. Similarly, solid waste in the form of green liquor dregs and ingots is not considered either. The term "closed cycle" describes a mill operation that is still a goal but not yet an industrial reality for either chemical or mechanical pulp mills. Conversely, the term "zero effluent" describes a mill operation that is an industrial reality for APMP/CTMP mills. Due to design and the extensive use of buffer tank/pond capacities in zero-effluent market APMP/CTMP mills, there is no emission to the aquatic environment. Emission levels associated with BAT for zero-effluent market APMP/CTMP mills are identical to those listed for BKP mills employing BAT in Table 4.2 (for the recovery boiler only) and Table

Extracted issues		Commission's response
97. cont.		4.3 (for the power boiler) of Vol. 1 of the Commission's Draft Main Report. Solid waste discharges associated with BAT for BKP mills are listed in Table 4.4 of the Draft Main Report. The total amount is 43 kg dry solids/ADt. This compares favourably with the solid waste discharges associated with BAT for zero-effluent market APMP/CTMP mills, which are approximately 67 kg dry solids/ADt. The Tasmanian Guidelines do not 'write off' the feasibility of closed loop systems as the guidelines do not attempt to specify the technologies for installation in a mill as these decisions should remain the decision of the proponent (refer to Section B.8). As discussed in Section 3.6 of Volume 1 of the Commission's Draft Main Report, at the time of writing closed loop or closed cycle mill operations are not AMT. No change to the Tasmanian Guidelines is required.
98.	The guidelines must also allow for improvements in technology over time and the possible development of further improvements in closure of the mill.	Section C.14 of the Tasmanian Guidelines, which provides for the Tasmanian Government to commission a report on developments in pulping technology and techniques, and on the basis of that report consider whether a full review of the guidelines is warranted. These guidelines are for any new BEK pulp mill in Tasmania. If a significant impact was identified the regulatory authority would need to review the environmental emission limits in the mill's operating permit. These matters are well beyond the scope of the Tasmanian Guidelines. No change to the Tasmanian Guidelines is required.
99.	Testing: The testing regime proposed for releases of dioxin to air is inadequate. As found by De Fre and Wevers (De Fre, R., Wevers, M. 1998. *Underestimation in dioxin emission inventories*. Organohalogen Cpds. 36:17-20) the standard 6-8 hour sampling time *"underestimated the average [dioxin] emission by a factor 30 to 50* in comparison to the AMESA continuous sampling system. The AMESA sampling system has been validated by the German EPA and is now in widespread use in Europe. For example, all municipal waste incinerators in the Flanders	The AMESA test results were performed on the emissions from municipal solid waste incineration plants, and are unlikely to be true of combustion sources of a kraft pulp mill for two reasons. The composition of municipal solid waste is extremely heterogeneous in comparison with the black liquor fired in the recovery boiler, the biomass-based material fired in the power boiler and fossil fuel fired in the lime kiln in a typical kraft pulp mill. In addition, municipal solid waste contains chlorine and may contain PCDD/F precursor species from a variety of wastes collected by municipalities. Because of this and emissions

Extracted issues	Commission's response
99. cont. portion of Belgium are now required to use the AMESA method and through such use, have demonstrated substantial reductions in dioxin releases to air.	survey work comparing sources in national inventories, municipal solid waste incineration has been the focus of intensive emission evaluations particularly in the decade. Maintenance of elevated combustion temperature is important in limiting PCDD/F emissions from combustion. In general, the combustion temperature is lowered as the fuel moisture content increases. Particularly problematic are fuel beds on a grate that contains pockets of elevated moisture. In the case of the black liquor fired in recovery boilers, the moisture content is relatively uniform. This is also true of lime kilns, where moisture is introduced with the lime mud but again tends to be relatively uniform. The moisture content of the wood waste and bark typically fired in the power boiler is less likely than the recovery boiler or the kiln to be very uniform on grate equipped boilers, so that pockets of higher moisture are more likely to occur. This is particularly true if they are co-fired with dewatered effluent treatment sludge, because of the difficulty of achieving a homogeneous mixture on the grate. An advantage of fluidised bed boilers is the through mixing of the solid fuel that the bed achieves. For this reason, some jurisdictions require minimum furnace temperatures to be maintained with fossil fuel firing. It seems likely therefore that more uniform fuel compositions found in pulp mills as compared with municipal solid waste will show excursions in PCDD/F emissions are less pronounced. The apparent lack of published AMESA continuous sampling results from pulp mill combustion sources means that this is conjecture at present. It would therefore not be appropriate to include a testing program using the AMESA continuous sampling system in Guidelines as it adds a further burden of uncertainty on the project for a prospective proponent. No change to the Tasmanian Guidelines is required.

Extracted issues		**Commission's response**
100.	Conclusion: The draft guidelines as they stand ignore the requirements of the Stockholm Convention on Persistent Organic Pollutants.	The Commission does not accept the submission by Greenpeace and the National Toxics Network that the Tasmanian Guidelines have been prepared in ignorance of the Stockholm Convention. The terms of reference were amended by the Tasmanian Government on 3 May 2004 (refer to page 1 of Volume 1 of the Commission's Draft Main Report). The Stockholm Convention definition of 'Best Available Technology' has been included in the Tasmanian Guidelines. In addition the Tasmanian Guidelines recognise the significance of the Stockholm Convention specifically in Sections A.3, B.3, B.5, B.6, B.7, B.9, B.10, B.1, C.2, C.3, C.12 and C.14 and in several footnotes.) No change to the Tasmanian Guidelines is required.
101.	The Convention is recognition that the setting of allowable emission limits for dioxin are inappropriate and that rather, where techniques that minimise dioxin emission are available, they must be given preference.	Noted. Refer to response to issue 96. No change to the Tasmanian Guidelines is required.
Peter Smith (14)		
102.	The Report which contains a valuable compilation of data is, however, unfortunately marrred [*sic*] by incorrect chemical terminology in a number of instances. The most glaring of these is in the Glossary definitions of strong acid and strong base, weak acid and weak base, which are completely incorrect. Together with other instances in the body of the text these give the impression that the Reort [*sic*] has been prepared without chemical expertise, which is an essential requirement for this topic	The definitions of strong acid and strong base, weak acid and weak base were accidentally reversed in the Glossary of Vol. 1 of the Commission's Draft Main Report. No change to the Tasmanian Guidelines is required.

4 Changes to the Tasmanian Guidelines

This chapter lists the changes that have been made to the Tasmanian Guidelines as a result of issues raised in submissions.

The inclusion of a Preamble as follows:

These guidelines are non-statutory. They have been formulated on the basis of a review of state-of-the-art kraft mill technologies and management practices aimed at minimising the environmental impact of pollutants released from the production process of any new bleached eucalypt market kraft pulp mill employing either the elemental chlorine free (ECF) or the totally chlorine free (TCF) bleaching process and whose treated liquid effluent is discharged into the marine environment.

These guidelines do not attempt to specify the technologies for installation and operation of a mill. The environmental emission limits provided in the guidelines have been set to cover all accepted modern technologies described in the guidelines, or their equivalent. Monitoring requirements of various parameters will vary dependent on the proposed technology. For example, monitoring of adsorbable organic halide (AOX) would not be required for a mill employing total chlorine free technology. During an environmental impact assessment specific monitoring requirements based on the proposed technology will be identified and included in the mill's permit conditions.

In addition, these guidelines do not pre-empt any conditions arising out of an assessment of any mill proposal. (responding to issue 1, 44)

Amendments to Section A, Executive overview

- Amending footnote c noting Australia ratified the Stockholm Convention on Persistent Organic Pollutants on 20 May 2004. (responding to issue 47)

Amendments to Section B, Background

- Deleting the word 'twelve' from the last sentence in Section B.3 where it refers to 'two of the twelve persistent organic pollutants listed in the Convention (responding to issue 48)
- Amending the heading above Sections B.6 to B.10 to include 'best available techniques (BAT) (responding to issue 49)

Amendments to Section C, Guidelines strategy

- Amending Section C.7 as follows: 'These guidelines do not apply to any mills in existence at the time of their release <u>or where major contracts have been let</u>.' (responding to issue 32)

Amendments to Section D, The Guidelines

- Amending Table 4, to include an additional description of AMT under the heading effluent treatment: 'Anoxic selector for chlorate reduction' (responding to issue 10)
- Amending Table 6, to include an additional sentence at the end of footnote c as follows: 'It is strongly recommended that the EIS include specific study of the effects of appropriate levels of chlorate on algal communities in the particular discharge zones.'

- Amending Table 6, to include an additional note d: 'These limits are not applicable to BEK pulp mills employing a TCF bleaching sequence.' (responding to issue 27)
- Amending Tables 6 and 9 to note that where a TCF bleaching process is employed monitoring is not required for chlorate, AOX, chlorinated phenols and trihalomethanes including chloroform. (responding to issue 27)
- Amending Section D.2.6 by adding a sentence: 'Prior to disposal the waste must be dewatered to the maximum extent possible using high intensity press.' (responding to issue 38)
- Amending Section D.3.3 by adding the words 'In respect of the emissions covered by these guidelines...' (responding to issue 36)
- Amending the second sentence in Section D.3.4 as follows: 'While they are extremely smelly and can be detected by the human senses at extremely low levels, they can be ~~relatively easily~~ controlled but cannot be eliminated entirely given the nature of the process.' (responding to issue 90)
- Amending Section D.3.9 (b) changing the TRS expressed as hydrogen sulfide from 0.00014 mg/m^3 to 1.5 $\mu g/NDm^3$. (responding to issue 11)
- Amending the following footnotes:

  Footnote o: Specified in Schedule 2 of the *Draft Environment Protection Policy (Air Quality) 2001*, with the exception of TRS expressed as hydrogen sulfide. (responding to issue 11, 64)

  Footnote p: The proponent must consult the regulatory authority on the selection of the predicted maximum concentration. (responding to issue 11)

  Footnote q: The specified design criteria are for the purposes of predicting or modelling the likely ground level concentrations from a proposed mill. They may be used later for operational purposes where appropriate. Proponents must use the currently approved version of the regulatory model Ausplume to predict the impact of emissions except where the proponent can demonstrate to the satisfaction of the regulatory authority that an alternative model is appropriate. (responding to issue 11)

  Footnote r: The provisions of D.4.12 are intended to ensure that emission of odorous sulfur containing gases are kept to the absolute minimum achievable by AMT. While complete odour elimination from kraft mills is not achievable at the time of writing, selection of a site that minimises the nuisance caused by these odorous compounds should be a prime consideration in site selection. (responding to issue 81)
- Inserting an additional Section after D.3.10 as follows: 'It is sound engineering practice [USEPA, 1985] for the exhaust stack to be at least 2.5 times higher than the recovery boiler building height and for the stacks from lime kiln, CNCG incinerator, CNCG emergency incinerator and power boiler to be taken to the same height as the recovery boiler stack. Site selection factors such as geographic location and air dispersion modelling will also influence the common stack height.' (responding to issue 11, 64)
- Amending Table 9 by including an additional sampling frequency: 'V, variable frequency scale to be stipulated by the regulatory authority based on the outcome of the EIS and subsequent monitoring following commissioning and start up;' (responding to issue 27)

- Amending Table 9 by changing the sampling frequencies for air and liquid chlorinated dioxins and furans emissions, chlorate, chlorinated phenols and trihalomethanes. (responding to issue 27)
- Amending note d to Table 9 by altering the first sentence: 'Chlorate, AOX, chlorinated phenols and trihalomethanes need only be measured in effluents from mills using chlorine-based bleaching processes.'
- Amending note d to Table 9 by adding the following at the end of the third sentence: '...because experience in activated sludge wastewater treatment plants with anoxic selectors fed from mills using the species of eucalypt prevalent in Tasmania is extremely limited. Furthermore levels of anthropogenic colour discharged into the marine environment have proven to be a concern in other industrial development projects that have discharged into the Tasmanian marine environment.' (responding to issue 6)
- Including an additional note n to Table 9 relating to chlorinated dioxins and furans: 'Three monthly for the first 12 months then twice yearly.' (responding to issue 27)
- Amending the first sentence in Section D.5.15 as follows: 'If the mill operator has not made satisfactory progress (as judged by the Tasmanian regulatory authorities) in limiting nuisance TRS odour emissions beyond the mill boundary 2 years after mill start-up, the Tasmanian regulatory authorities shall require the mill operator to commission one or more recognised experts on industrial odour control to review the operation of the mill and to make recommendations to the operator that will remedy the emissions to the standard of international best practice.' (responding to issue 81)

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Units and conversion factors

Units and Conversion Factors	
µ	Micro = 10^{-6}
°C	Degree Celsius
a	Annum, year, 365 days
d	Day, 24 hours
f	Femto = 10^{-15}
h	Hour(s)
m	Metre
kg steam	Assuming a pressure of 2.5 bar in the steam piping, the heat of steam which can be used corresponds to about 0.7 $kW_{th}h$/kg steam or about 2.5 MJ/kg steam
K	Kelvin or absolute temperature
J	Joule. The basic SI unit of energy. It is the quantity of work done when a force of 1 Newton acts through a distance of 1 metre
kWh	Kilowatt hour = 3.6 MJ
L	Litre
m	Milli = 10^{-3}
N	Newton. The basic SI unit of force
n	Nano = 10^{-9}
Pa	Pascal. The SI unit of pressure. It corresponds to a force of 1 Newton applied to an area of 1 square metre
NDm^3	Normal dry cubic metre: the volume a gas occupies at atmospheric pressure (101.325 kPa) and 273.15 K (0°C). In this report gas conditions are dry
p	Pico = 10^{-12}
SDm^3	Standard dry cubic metre: the volume a gas occupies at atmospheric pressure (101.325 kPa) and 293.15 K (20°C). In this report gas conditions are dry
ppb or µg/L	Parts per billion (10^{-9}) Time scale equivalent: 1 second vs 31.7 years
ppm or mg/L	Parts per million (10^{-6}) Time scale equivalent: 1 second vs 11.6 days
ppq or pg/L	Parts per quadrillion (10^{-15}) Time scale equivalent: 1 second vs 31,709,790 years
ppt or ng/L	Parts per trillion (10^{-12}) Time scale equivalent: 1 second vs 31,710 years
t	Metric tonne (10^6 grams)

Abbreviations and acronyms[15]

Abbreviations and acronyms	
%ISO	Brightness unit according to ISO, the International Organisation for Standardisation
≤	Less than or equal to
≥	Greater than or equal to
(EO)	Extraction bleaching stage using sodium hydroxide with subsequent addition of oxygen as a reinforcing agent
(EOP)	Extraction bleaching stage using sodium hydroxide with subsequent addition of oxygen and hydrogen peroxide as a reinforcing agents
(EP)	Extraction bleaching stage using sodium hydroxide with subsequent addition of hydrogen peroxide as a reinforcing agent
(OP)	Pressurised peroxide bleaching stage using hydrogen peroxide with oxygen at low peroxide charge
(PO)	Pressurised peroxide bleaching stage using hydrogen peroxide with oxygen at high peroxide charge
<	Less than
>	Greater than
1995 Commonwealth Guidelines	Commonwealth Environmental Guidelines for New Bleached Eucalypt Kraft Pulp Mills 1995
2,3,7,8-substitutedPCDD	Any polychlorinated dibenzo-p-dioxin that has the molecular formula $C_{12}H_{8-n}Cl_{n}0_{2}$, in which $4 \leq n \leq 8$ and chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8-substitutedPCDF	Any polychlorinated dibenzofuran that has the molecular formula $C_{12}H_{8-n}Cl_{n}0$, in which $4 \leq n \leq 8$ and chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8-TCDD	2,3,7,8-Tetra Chloro Dibenzo-p-Dioxin (a dioxin). Also named 'Seveso dioxin' after the name of the municipality that was most severely affected by a toxic cloud containing 2,3,7,8-TCDD that was accidentally released into the atmosphere following an explosion that occurred in a TCP (2,4,5-trichlorophenol) reactor of the ICMESA chemical plant on the outskirts of Meda, a small town about 20 kilometres north of Milan, Italy on 10 July 1976. The dioxin cloud contaminated a densely populated area about six kilometres long and one kilometre wide, lying downwind from the site. TCDD is considered to be the most toxic man-made compound
2,3,7,8-TCDF	2,3,7,8-Tetra Chloro Dibenzofuran (a furan)
AA	Active alkali or NaOH + Na_2S, as g/L Na_2O
AD	Air dry (dry solids content of 90% and 10% water)

15 All acronyms refer to either the singular or the plural form of their expanded version.

Abbreviations and acronyms	
ADt	Air dry metric tonne of pulp (dry solids content of 90% and 10% water)
AMESA	The adsorption method for sampling of dioxins and furans
AMT	Accepted modern technology is defined in the Tasmanian State Policy on Water Quality Management and Draft Environment Protection Policy (Air Quality) as a 'technology which has a demonstrated capacity to achieve the desired emission concentration in a cost-effective manner, takes account of cost-effective engineering and scientific developments and pursues opportunities for waste minimisation'
ANZECC	Australian and New Zealand Environment and Conservation Council
AOX	Adsorbable organic halides measured in wastewaters. In the ECF kraft process, halides are chlorides. AOX measures adsorbable chlorinated organic compounds in effluent from ECF kraft pulp mills. AOX is primarily non-toxic material (~99%) with a small amount of fat-soluble toxic chlorinated organic compounds (~1%). While AOX is not a measure of toxicity, the associated fat-soluble chlorinated group (dioxins, furans, & polychlorinated phenolic compounds) is considered to be toxic, persistent and bio-accumulative (POP). Since 2,3,7,8-TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) has been found to cause cancer in rats, it is considered the most toxic of the dioxin group and regulators have focused primarily on limiting the emissions of TCDD [Harrion, 1994], [Lindsay, 2001]
APMP	Alkaline peroxide mechanical pulping
AQ	Soda-anthraquinone
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
ASB	Aerated stabilisation basin (or aerated lagoon); a particular form of secondary effluent treatment
AST	Activated sludge treatment; a particular form of secondary effluent treatment
BAT	Best available techniques (IPPC BREF and UNEP) Best available technology economically achievable (USEPA Final Water Rule)
BEK	Bleached eucalypt kraft
BEP	Best environmental practices (IPPC Directive)
BFR	Bleach filtrate recycle
BKP	Bleached kraft pulp
BL	Black liquor, a solution of wood lignins, organic compounds, oxidised inorganic compounds (sodium sulfate (Na_2SO_4), sodium carbonate (Na_2CO_3)), and white liquor (Na_2S and NaOH)
BMP	Best management practice (USEPA Final Water Rule)
BOD_5/BOD_7	Biological oxygen demand indicating the amount of biodegradable organic matter in the wastewaters assessed using a standard 5 day or 7 day test
BP	Bleach plant, mill department where pulp is bleached

Abbreviations and acronyms	
BPEM	Best practice environmental management; defined in the *Environmental Management and Pollution Control Act 1994* as 'the management of an activity to achieve an ongoing minimisation of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity'
BREF	Best available techniques reference document (IPPC)
BS	Brown stock, the suspension of unbleached pulp
CH_3COOOH	Peracetic acid
CH_3OH	Methanol
Cl_2	Chlorine
ClO_2	Chlorine dioxide
COD	Chemical oxygen demand indicating the amount of chemically oxidisable organic matter in the wastewaters (normally referring to analysis with dichromate oxidation)
Commission	Resource Planning and Development Commission (RPDC)
Convention	Stockholm Convention on Persistent Organic Pollutants 2001
CRP	Chloride removal process
CSF	Canadian standard freeness – a measure of the rate at which water drains from a pulp, the smaller the number the slower draining is the pulp
CSIRO	Commonwealth Scientific & Industrial Research Organisation
CTMP	Chemi-thermo-mechanical pulping
D	Chlorine dioxide bleaching stage using a water solution of chlorine dioxide (ClO_2)
DAF	Dissolved air flotation
DCC	Design concentration criteria
DPIWE	(Tasmanian) Department of Primary Industries, Water and Environment
DS	Dry solids
DTA	Direct toxicity assessment. The use of toxicity tests to determine the acute and/or chronic toxicity of wastewater discharges or total pollutant loads in receiving waters. Assesses the toxicity of mixtures of chemicals rather than individual chemicals
DTPA	Diethylene triamine penta acetic acid, complexing (chelating) agent
E	Extraction bleaching stage using sodium hydroxide (NaOH)
E.	*Eucalyptus* genus
EC_{50}	The concentration of a toxic material that causes a specific effect in 50% of the test organisms in a specified time

Abbreviations and acronyms	
ECF	Elemental chlorine free. Bleaching process that uses no chlorine gas, no chlorine water and no sodium hypochlorite as bleaching agents. The only chlorine-containing bleaching agent is chlorine dioxide
EDTA	Ethylene diamine tetra acetic acid, complexing (chelating) agent
EIA	Environmental impact assessment
EIS	Environmental impact statement
EKP	Eucalypt kraft pulp
EMPCA	*Environmental Management and Pollution Control Act 1994*
EMS	Environmental management system
EOCl	Extractable organic chlorides
EOX	Extractable organic halides (chlorides) measured in wastewaters (following extraction with organic solvents). A common practice in environmental management is to use surrogate parameters when assessing or regulating water quality. Such parameters are used when the complexity of the effluent precludes the identification and quantification of individual chemical compounds. In the context of the chlorine issue, two surrogate parameters have been developed and have been used, or proposed for use, in regulations. The adsorbable organic halogen (AOX) method determines the quantity of chlorine in a sample which is retained on activated carbon. It is viewed as determining the total quantity of organically bound chlorine. The extractable organic halogen or chlorine (EOX or EOCl) method involves extraction of the aqueous sample with a non-polar solvent. The EOX test is regarded as giving a better indication of potential for bioaccumulation than AOX and typically gives a concentration of a few percent of the AOX value (Axegård, 1986a; 1986b, Earl and Reeve, 1989) implying that most of the components of AOX are hydrophilic, i.e. water soluble
EPA	Environmental Protection Agency/Authority
EQO	Environmental quality objective
ESP	Electrostatic precipitator
ETP	Effluent treatment plant
EU	European Union
F/M	Food to biomass ratio. The amount of substrate (i.e. BOD_5) in the influent to an AST plant in kg/day divided by the amount of mixed liquor volatile suspended solids (MLVSS) in the aeration basin in kg. The unit of F/M is day^{-1}
FBK	Fully bleached kraft (i.e. to high brightness, typically 90% ISO)
Fe	Iron
GAAP	Generally accepted accounting principles
GC	Gas chromatograph/chromatography

Abbreviations and acronyms	
GC/MS	Gas chromatography/mass spectroscopy. Spectroscopy is the study of the interaction of electromagnetic radiation with matter. Nuclear magnetic resonance spectroscopy is the use of the NMR phenomenon to study physical, chemical, and biological properties of matter. As a consequence, NMR spectroscopy finds applications in several areas of science. NMR spectroscopy is routinely used by chemists to study chemical structure using simple one-dimensional techniques. Two-dimensional techniques are used to determine the structure of more complicated molecules. These techniques are replacing x-ray crystallography for the determination of protein structure. Time domain NMR spectroscopic techniques are used to probe molecular dynamics in solutions. Solid state NMR spectroscopy is used to determine the molecular structure of solids. Other scientists have developed NMR methods of measuring diffusion coefficients http://www.cis.rit.edu/htbooks/nmr/inside.htm
GPC	Gel permeation chromatograph/chromatography
H_2O_2	Hydrogen peroxide
H_2SO_4	Sulfuric acid
HC	High consistency – pulp concentration in the interval 30-50% dry solid content
HCB	Hexachlorobenzene
HexA	Hexenuronic acid groups
IDP	Integrated chlorine dioxide plant
IGCC	Integrated gasification combined cycle
IPPC	Integrated Pollution Prevention and Control (European Commission). A regulatory system issued under the auspices of the European Commission that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a permit, operators will have to show that they have systematically developed proposals to apply the 'best available techniques' (BAT) and meet certain other requirements, taking account of relevant local factors
I-TEF	International toxicity equivalency factor for PCDD/PCDF (see also Glossary of terms)
K	Potassium
KP	Kraft pulp, chemical pulp which has been manufactured using alkaline (NaOH) sodium sulfide (Na_2S) as the main cooking chemical
LC	Low consistency – pulp concentration in the interval 3-5% dry solid content
LC_{50}	The concentration of a toxic material that kills 50% of the test organisms in a specified time

Abbreviations and acronyms	
LOEC	Lowest observed effect concentration. The lowest concentration of a material used in a toxicity test that has a statistically significant adverse effect on the exposed population of test organisms as compared with the controls. When derived from a life-cycle or partial life-cycle test, it is numerically the same as the upper limit of the MATC
MACT	Maximum achievable control technologies (USEPA Final Air Rule)
MATC	Maximum acceptable toxicant concentration. The maximum concentration of a toxic substance that a receiving water may contain without causing significant harm to its productivity or uses as determined by chronic toxicity tests
MBR	Membrane bioreactor
MC	Medium consistency – pulp concentration in the interval 8-15% dry solid content
Mg	Magnesium
MLSS	Mixed liquor suspended solids. The amount of suspended solids (both organic and inorganic) in the system, usually measured in mg/L but also in kg. MLSS is a measure of both volatile and non-volatile SS
MLVSS	Mixed liquor volatile suspended solids. The amount of volatile (organic) suspended solids in the AST system, usually measured in mg/L but also in kg. MLVSS is usually a measure of the amount of biomass but since wood fibre is also volatile, it can be a measure both
Mn	Manganese
MOE	Generic acronym for the ministry responsible for the environment in each of the Canadian provinces
MS	Mass spectrometer/spectrometry
MVR	Mechanical vapour recompression
Na	Sodium
Na_2CO_3	Sodium carbonate
Na_2S	Sodium sulfide
Na_2SO_4	Sodium sulfate
NaHS	Sodium bisulfide or hydrosulfide
NaOH	Sodium hydroxide
NCG	Non condensable gases referring to the odorous gases generated in chemical pulping
NMR	Nuclear magnetic resonance. A phenomenon which occurs when the nuclei of certain atoms are immersed in a static magnetic field and exposed to a second oscillating magnetic field. Some nuclei experience this phenomenon, and others do not, dependent upon whether they possess a property called spin. The spin can be thought of as a small magnetic field, and will cause the nucleus to produce an NMR signal http://www.cis.rit.edu/htbooks/nmr/inside.htm

Abbreviations and acronyms	
NOEC	No observed effect concentration. The highest concentration of a toxicant at which no statistically significant effect is observable, compared to the controls; the statistical significance is measured at the 95% confidence level
NO_x	The sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2) expressed as NO_2
NPE	Non-process elements that can accumulate when closing up the water circuits in pulp mills such as Al, Si, Ca, Mg, Mn
NSPS	New source performance standards for new installations as promulgated by the USEPA. NSPS regulate emissions of pollutants from affected facilities. An affected facility is defined as a facility for which a standard exists and for which construction, reconstruction, or modification is commenced after the standard was promulgated. Sources constructed prior to the promulgation date are not subject to the NSPS until such time as they undergo a modification or reconstruction. A modification is defined as a physical change or a change in the method of operation which results in an increase in emissions of any air pollutant for which the NSPS applies. If an existing facility undergoes reconstruction, it becomes an affected facility regardless of any change in emissions. The USEPA defines reconstruction as the replacement of components of an existing facility or source meeting one of the following characteristics: The replacement has a fixed capital cost greater than 50% of the fixed capital cost that would be required to construct a comparable new facility or source; or The replacement makes it technically or economically feasible to meet the NSPS
NWQMS	The Australian National Water Quality Management Strategy (NWQMS) aims to achieve the sustainable use of Australia's and New Zealand's water resources by protecting and enhancing their quality while maintaining economic and social development. The NWQMS is a joint strategy developed by two Ministerial Councils – the Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ) and the Australian and New Zealand Environment and Conservation Council (ANZECC). The Australian National Health and Medical Research Council (NHMRC) is involved in aspects of the strategy that affect public health. The NWQMS aims to meet future needs by providing policies, a process and national guidelines for water quality management
O	Oxygen delignification stage
O_2	Oxygen
O_3	Ozone
OD	Oven dry, the solids content of pulp containing 100% dry solids and 0% water; also called bone dry (BD)
ODt	Oven dry metric tonne of pulp (dry solids content of 100%)
OX	Organic halides measured in pulp. In the kraft process, halides are chlorides
P	Alkaline bleaching stage with hydrogen peroxide (H_2O_2)/Phosphorus

Abbreviations and acronyms	
Paa	Peracetic acid
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls. These are highly toxic and persistent compounds derived from the replacement by Cl radicals of numerous H radicals on biphenyl, which consists of two benzene rings joined by a covalent bond, with the elimination of two H radicals ($C_{12}H_{10}$)
PCDD	Polychlorinated dibenzo-p-dioxins
PCDF	Polychlorinated dibenzo furans
pH	Value that represents the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion concentration of the solution. Measures the acidity (low pH) or alkalinity (high pH) of a solution
PM	Total particulate matter (in flue gases), dust
POP	Persistent organic pollutants. Organic compounds that, to a varying degree, resist photolytic, biological and chemical degradation. The carbon-chlorine bond is very stable towards hydrolysis and the greater the number of chlorine substitutions and/or functional groups, the greater the resistance to biological and photolytic degradation. Chlorine attached to an aromatic (benzene) ring is more stable to hydrolysis than chlorine in aliphatic (straight or branched) structures. As a result, chlorinated POP are typically ring structures with a chain or branched chain framework. By virtue of their high degree of halogenation, POP have very low water solubility and high lipid (fat) solubility leading to their propensity to pass readily through the phospholipid structure of biological membranes and accumulate in fat deposits. They are also semi-volatile, enabling them to be transported over great distances in the atmosphere before deposition occurs. Although many different forms of POP may exist, both natural and anthropogenic, POP which are noted for their persistence and bioaccumulative characteristics include many of the first generation organochlorine insecticides such as dieldrin, DDT, toxaphene and chlordane and several industrial chemical products or by-products including polychlorinated biphenyls (PCB), dibenzo-p-dioxins (dioxins) and dibenzo-p-furans (furans). POP are also noted for their semi-volatility; that property of their physico-chemical characteristics that permit these compounds to occur either in the vapour phase or adsorbed on atmospheric particles, thereby facilitating their long range transport through the atmosphere. While the risk level varies from POP to POP, by definition all of these chemicals share four properties: They are highly toxic They are persistent, lasting for years or even decades before degrading into less dangerous forms They evaporate and travel long distances through the air and through water They accumulate in fatty tissue

Abbreviations and acronyms	
Q	Acid bleaching stage where a chelating agent, EDTA or DTPA, has been used for the removal of metal ions
RO	Reverse osmosis. The passage through a semipermeable membrane of solvent molecules *from a solution into a pure solvent*. RO can be achieved by applying to the solution a pressure in excess of its osmotic pressure
S	Sulfur
SBK	Semi bleached kraft (i.e. to intermediate brightness, typically 70-75% ISO)
SDT	Smelt dissolving tank
SEPA	Swedish Environmental Protection Agency
SNCR	Selective non-catalytic reduction
SO_2	Sulfur dioxide
SO_3	Sulfur trioxide
SS	Suspended Solids
SVI	Sludge volume index; Volume in ml occupied by 1 gram of activated sludge after settlement under specified conditions for a specified time, usually 30 minutes
TCF	Totally chlorine free (bleaching). Uses no chlorine-containing bleaching agents
TDS	Total dissolved solids. A measure of the inorganic salts (and organic compounds) dissolved in water
TEF and TEQ	Many regulatory agencies have developed so-called toxicity equivalency factors (TEF) for risk assessment of complex mixtures of PCDD/PCDF. The TEF are based on acute toxicity values from *in vivo* and *in vitro* studies. This approach is based on the evidence that there is a common, receptor-mediated mechanism of action for these compounds. However, the TEF approach has its limitations due to a number of simplifications. Although the scientific basis cannot be considered as solid, the TEF approach has been developed as an administrative tool and allows to convert quantitative analytical data for individual PCDD/PCDF congeners into a single toxicity equivalent (TEQ). TEF particularly aid in expressing cumulative toxicity of complex PCDD/PCDF mixtures as one single TEQ value. It should be noted that TEF are interim values and administrative tools for order of magnitude estimates. They are based on present state of knowledge and should be revised as new data gets available. Today there are two schemes applied: the older one are the TEF established by a NATO/CCMS Working Group on Dioxins and Related Compounds as International toxicity equivalency factors (I-TEF) and the most recent scheme established by a WHO/IPCS working group, who re-evaluated the I-TEF and established a new scheme. The TEF for 2,3,7,8-TCDD is 1.0 and that for 2,3,7,8-TCDF is 0.1. For these congeners, the TEF are the same under the two schemes

Abbreviations and acronyms	
TKN	Total Kjeldahl nitrogen. The sum of organic nitrogen and ammonia in a water body. High levels of organic nitrogen in water may indicate excessive production or organic pollution from the watershed. Animal and human waste, decaying organic matter, and live organic material like tiny algae cells can cause organic nitrogen enrichment of lake water. TKN is measured in milligrams per litre (mg/L)
Total PCDD	The sum of the concentrations of all polychlorinated dibenzo-p-dioxin congeners that have the molecular formula $C_{12}H_{8-n}Cl_n0_2$, in which 4≤n≤8
Total PCDF	The sum of the concentrations of all polychlorinated dibenzofuran congeners that have the molecular formula $C_{12}H_{8-n}Cl_n0$, in which 4≤n≤8
TRS	Total reduced sulfur meaning the sum of the following reduced foul sulfur compounds generated in the pulping process: hydrogen sulfide, methyl mercaptan, dimethylsulfide and dimethyldisulfide expressed as sulfur (measured as hydrogen sulfide)
TSS	Total suspended solids (in wastewater)
TTA	Total titratable alkali or NaOH + Na_2S + Na_2CO_3, as g/L Na_2O
UASB	Upflow anaerobic sludge blanket reactor/process
UNEP	United Nations Environment Programme
UPOP	Unintentionally produced persistent organic pollutants. Dioxins, furans and, to a limited extent, PCB and pesticides are the POP that may be released from BEKP mills. Dioxins and furans may be released from the recovery boiler and the bleaching process in ECF kraft mills. PCB and pesticide releases may occur via the contamination of raw materials. These POP are called 'unintentionally produced POP'
USEPA	United States Environment Protection Agency
VOC	Volatile organic compounds
WBL	Weak black liquor. A dilute solution of wood lignins, organic materials, oxidised inorganic compounds (sodium sulfate (Na_2SO_4), sodium carbonate (Na_2CO_3)), and white liquor (Na_2S and NaOH)
WHO	World Health Organisation
WHO-TEF	World Health Organisation toxicity equivalency factor for PCDD/PCDF (see also Glossary of Terms)
WQG	Water quality guideline
Z	Ozone bleaching stage using ozone (O_3)

Glossary of terms

Glossary of terms	
Abiotic	The non-living components of a system (see biota)
Absorber	Equipment used to carry out gas absorption
Achievable value	When using a particular technique or combination of technologies achievable level means that a certain emission level may be expected to be achieved over a substantial period of time (e.g. a year) in a well designed, well maintained and well operated installation or process using those technologies
Acidic	Having a high hydrogen ion concentration (low pH)
Acute toxicity	Toxicity which causes a rapid adverse effect (e.g. death) in a living organism following short-term exposure. Can be used to define either the exposure or the response to an exposure (effect)
Adsorption	The taking up of one substance at the surface of another
Aerobic	Of organisms requiring oxygen for respiration or conditions where oxygen is available
Aesthetic	Aspects of, say, a water body, that can be considered beautiful or pleasant to the senses
Algae	Comparatively simple chlorophyll-bearing plants, most of which are aquatic and microscopic in size
Alkali metals	Consist of the 6 metal elements in group 1 of the periodic table of the elements. The main alkali metals of interest in the kraft process are sodium (Na) and potassium (K)
Alkaline earth metals	Consist of the 6 elements in group 2 of the periodic table of the elements. The main alkaline earth metals of interest in the kraft process are magnesium (Mg), calcium (Ca) and barium (Ba)
Alkalinity	The quantitative capacity of aqueous media to react with hydroxyl ions. The equivalent sum of the bases that are titratable with strong acid. Alkalinity is a capacity factor that represents the acid-neutralising capacity of an aqueous system
Ambient levels	Those in the general environment outside the influence of specific discharges
Amphipods	Invertebrates belonging to the order Crustacea
Anaerobic	Conditions where oxygen is lacking; organisms not requiring oxygen for respiration
Anion	A negatively charge ion. An anion migrates toward the anode in an electrochemical cell
Anionic	Characteristic behaviour or property of an ion that has a negative charge. Anions move to the anode in electrolysis
Anode	The electrode where oxidation occurs

Glossary of terms	
Anoxic selector	A selector *(also referred to as selective reactor)* is a 'mini' bio-reactor placed ahead of the main *activated sludge* treatment (AST) plant bio-reactor. Selectors in AST plants can have one or more of the following functions: a) prevention of *foaming*; b) minimisation of the growth of filamentous (bulking or *non-settling*) bacteria and promotion of the growth of floc-forming (settling) bacteria; c) *reduction of* chlorate ion (ClO_3^-); d) *nutrient removal. The chlorate reduction process is an anoxic process, i.e. it is operated without measurable amounts of dissolved oxygen. The anoxic stage is usually a separate tank before the aeration tank with a retention of the order 5-10 hours.*
Anthropogenic	Produced or caused by human activity
Aquatic ecosystem	Any watery environment from small to large, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment
Aquifer	An underground layer of permeable rock, sand or gravel that absorbs water and allows it free passage through pore spaces
Assimilative capacity	The maximum loading rate of a particular pollutant that can be tolerated or processed by the receiving environment without causing significant degradation to the quality of the ecosystem and hence the environmental values it supports
Benthic	Referring to organisms living in or on the sediments of aquatic habitats (lakes, rivers, ponds, etc.)
Bioaccumulation	General term describing a process by which chemical substances are accumulated by aquatic organisms from water, either directly or through consumption of food containing the chemicals
Bioassay	A test that exposes living organisms to several levels of a substance that is under investigation, and evaluates the organisms' responses
Bioavailable	The fraction of the total of a chemical in the surrounding environment that can be taken up by organisms. The environment may include water, sediment, soil, suspended particles, and food items
Biomass	All materials that are produced by photosynthesis and potentially useful for the production of organic chemicals or as energy sources
Biota	The sum total of the living organisms of any designated area
Bladderwrack	Bladderwrack is a type of brown algae (seaweed) that grows on the northern Atlantic and Pacific coasts of the United States and on the northern Atlantic coast and Baltic coast of Europe. The main stem of bladderwrack, known as the thallus, is used medicinally. The thallus has tough, air-filled pods or bladders to help the algae float-thus the name bladderwrack. Its Latin name is *Fucus vesiculosus* and it belongs to the family of kelps
Bleachability	The ease with which pulp is bleached
Bleaching	The process of brightening the fibre by removal or decolourising of the coloured substance

Glossary of terms	
Bleaching efficiency	Some of the oxidising power of a bleaching agent is always wasted in side reactions. Some bleaching agents are more prone than others to undergo wasteful reactions, conversely, some use their oxidising power more efficiently than others. Efficiency is a measure of the degree to which a bleaching agent's oxidising power is used in desirable, kappa reducing reactions
Brightness	Reflectance of blue light from a thick sheet. Sheets having a low brightness appear yellow or brown, those having a high brightness appear white. Brightness may be increased either by decreasing the absorption coefficient (colour intensity) or by increasing the scattering coefficient (e.g. snow vs water)
Brightness reversion	Decrease of brightness of a sheet of pulp or paper due to ageing
Buffer	A solution containing a weak acid and its conjugate weak base, the pH of which changes only slightly on the addition of acid or alkali
Buffer capacity	Amount of acid and/or base that a buffer solution can neutralise and still maintain an essentially constant pH. A measure of the relative sensitivity of a solution to pH changes on addition of acids or base
Calcination	Decomposition of a solid by heating at temperatures below its melting point, such as the decomposition of calcium carbonate to calcium oxide and CO_2(g)
Carbohydrates	Large group of polymer compounds synthesised by plants containing carbon, hydrogen and oxygen, in which the latter 2 elements are usually in the 2:1 proportion of water. Cellulose, sugars and starches are all carbohydrates. The chemistry of carbohydrates is essentially the chemistry of 2 functional groups, the hydroxyl (OH^-) and the carbonyl ($C{=}O^{2-}$), hence, also technically known as polyhydroxy aldehydes and ketones
Carcinogen	A substance that induces cancer in a living organism
Catalyst	An agent that speeds up a chemical reaction by changing the reaction mechanism to one of lower activation energy
Catchment	The total area draining into a river, reservoir, or other body of water
Cathode	The electrode where reduction occurs
Cation	A positively charge ion. A cation migrates toward the cathode in an electrochemical cell
Cationic	The characteristic behaviour or property of an ion with a positive charge. Cations move to the cathode in electrolysis
Cellulose	Material that forms the framework or cell walls of all plants; the most abundant organic compound in nature. Cellulose is a straight-chain (linear) polysaccharide composed of repeating glucose units, the number of which can vary over a wide range
Chelate	Results from the attachment of chelating agents (multidentate ligands) to a metal ion. Chelates are five- or six-membered rings that include the central metal ion and atoms of the ligands

Glossary of terms	
Chelating agent	A multidentate ligand. It simultaneously attaches to two or more positions in the coordination sphere of a central metal ion. Chelants or chelating agents such as ethylene-diamine-tetra-acetic acid (EDTA) and diethylene-triamine-penta-acetic acid (DTPA) are applied because of good sequestering properties, i.e. their ability to suppress the activity of dissolved transition metal ions without precipitation
Chemical pulp	Fibrous material obtained by removal from the raw material of a considerable part of those non-cellulosic compounds that can be removed by chemical treatment (cooking, delignification, bleaching)
Chronic	Lingering or continuing for a long time; often for periods from several weeks to years. Can be used to define either the exposure of an aquatic species or its response to an exposure (effect). Chronic exposure typically includes a biological response of relatively slow progress and long continuance, often affecting a life stage
Chronic toxicity	Toxicity which results in adverse physiological effects in exposed organisms which appear slowly and persist for long periods following frequent, prolonged, repeated or continuous exposure to a toxicant
Closed-cycle	A mill or industrial plant that has little or no process effluent
Complexation	The formation of a compound by the union of a metal ion with a non-metallic ion or molecule called a ligand or complexing agent
Consistency	The weight percent of air dry (or oven dry) fibrous material in a stock or stock suspension. Typical ranges are: low consistency (3-5%, LC), medium consistency (10-15%, MC) and high consistency (30-50%, HC)
Contaminant	Biological (e.g. bacterial and viral pathogens) and chemical (see Toxicants) introductions capable of producing an adverse response (effect) in a biological system, seriously injuring structure or function or producing death
Corrosion	Deterioration of surfaces through erosion processes such as the conversion of metals to oxides and carbonates
Cytotoxic	Having an adverse impact on cells
Daily production capacity	The weight of products (air dry mass) an installation can produce during one day
Defoamer	Any product that is added to the water-pulp mixture during the manufacture of pulp in a mill to prevent the production of foam or reduce the amount of foam that would otherwise be produced
Detection limit	The smallest concentration or amount of a substance that can be reported as present with a specified degree of certainty by definite complete analytical procedures
Dioxin	Type of organochlorine compound which occurs naturally and is produced in a number of industrial processes

Glossary of terms	
Donnan effect	British chemist whose work was instrumental in the development of colloid chemistry. In electrochemistry, he studied (1911) the electrical potential set up at a semipermeable membrane between two electrolytes, an effect of importance in living cells, known as the Donnan Equilibrium: If diffusible solutes are separated by a membrane that is freely permeable to water and electrolytes but totally impermeable to one species of ion, the diffusible solutes become unequally distributed between the two compartments
Ecologically sustainable development	Development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends
Effluent	A complex waste material (e.g. liquid industrial discharge or sewage) that may be discharged into the environment
Electrical conductivity	The ability of water or a solution to conduct an electric current
Environmental impact or effect	Change in one or several components of the natural environment, that may occur as a result of a particular human activity
Enzyme	A substance containing protein that catalyses biological reactions
***Eucalyptus* spp.**	The genus *Eucalyptus* belongs to the family Myrtaceae. Worldwide, Myrtaceae comprises some 140 genera and 3000 species (spp.). In Australia, Mrytaceae is represented by some 75 genera and 1400 species. Myrtaceae is found mainly in Australia, South America and Malesia
Euphotic	Of surface waters to a depth of approximately 80-100 m; the lit region that extends virtually from the water surface to the level at which photosynthesis fails to occur because of reduced light penetration
Euphotic zone	The uppermost layer of a body of water that receives sufficient light for photosynthesis and consequent growth of green plants
Eutrophic	Very biologically productive (in terms of its algal biomass) body of fresh water with relatively high nutrient concentration (>21 µg/L of phosphorus). Frequently resulting in oxygen depletion below the surface layer of a water body
Eutrophication	The over-fertilisation of lakes due to pollution by sewage, runoff from the land, and industrial wastes (inorganic phosphates and nitrates). These compounds act as nutrients, stimulating algal growth to produce huge blooms. Their subsequent decomposition reduces the oxygen content in the water and this leads to the death of the algae themselves and proliferation of bacteria which do not require oxygen and kills most aquatic life
Extractives	Compounds extractable from wood with organic solvents. From a physiological standpoint, they can be classified into the following groups: Food reserves (fats, fatty acids) Protectants (terpenes, resin acids, phenols) Plant hormones (phytosterols) Composition in E. globulus from Spain is 8.3% hydrocarbons, 13.4% fatty acids, 3% waxes, 32% sterols, 10.8% ketones, 26% sterol esters and 6.5% fats

Glossary of terms	
Fate	Disposition of a material in various environmental compartments (e.g. soil or sediment, water, air, biota) as a result of transport, transformation and degradation
Fats	Triglycerides in which saturated fatty acid components predominate
Fossil fuels	Petroleum, natural gas and coal. These fuels are derived from plant and animal life of millions of years ago
Furan	Type of organochlorine compound which occurs naturally and is produced in a wide variety of oxidation processes
Gas absorption	A unit operation in which a soluble component of a gas mixture is dissolved in a liquid
Green liquor and dregs	Molten inorganic salts, referred to as 'smelt,' collect in a char bed at the bottom of the recovery furnace. Smelt is drawn off and dissolved in weak wash water in the SDT to form a solution of carbonate salts called 'green liquor,' which is primarily Na_2S and Na_2CO_3. Green liquor also contains insoluble unburned carbon and inorganic impurities, called 'dregs,' which are removed in a series of clarification tanks
Guideline trigger values	These are the concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem specific investigations or implementation of management/remedial actions
Habitat	The place where a population (e.g. human, animal, plant, microorganism) lives and its surroundings, both living and non-living
Half-life	Time required to reduce by one-half the concentration of a material in a medium (e.g. soil or water) or organism (e.g. fish tissue) by transport, degradation, transformation or depuration
Hardness	The concentration of all metallic cations, except those of the alkali metals, present in water. In general, hardness is a measure of the concentration of calcium and magnesium ions in water and is frequently expressed as mg/L calcium carbonate equivalent
Hardwood	Group of wood species including the following pulpwoods: aspen, beech, birch and eucalypt
Hemicelluloses	Short-chain polysaccharides having a DP (degree of polymerisation) of 15 or less, mainly polymers of sugars other than glucose. Principal hemicelluloses are xylan in hardwoods and glucomannan in softwoods

Glossary of terms	
Hexenuronic acids	Approximately 75% of the hemicelluloses in hardwoods consists of *xylan* (4-O-*methyl-glucuronoarabinoxylan*). Under the kraft pulping conditions, xylan generates hexenuronic (4-*deoxy*-β-L-*threo*-4-*enopyranosyluronic*) acid groups (HexA) which form a considerable part of the residual oxidisable material after pulping (measured by the kappa number). Hardwood kraft pulps, and especially eucalypt kraft pulps, may contain high amounts of hexenuronic acids (HexA), contrary to softwood kraft pulps. HexA have adverse effects in bleaching. The most important ones are: increased consumption of bleaching agents such as chlorine dioxide (ClO_2) and ozone (O_3) to reach target brightness, increased brightness reversion and contribution to formation and scaling of oxalates in bleaching equipment
Humic substances	Organic substances only partially broken down that occur in water mainly in a colloidal state. Humic acids are large-molecule organic acids that dissolve in water
Hydrolysis	The formation of an acid and a base from a salt by the ionic dissociation of water The decomposition of organic compounds by interaction with water
Hydrophilic	Having an affinity for water, readily absorbs water
Hydrophobic	Having little or no affinity for water, repels or does not absorb water
Industrial smog	Air pollution in which the principal pollutants are SO_2(g), SO_3(g), H_2SO_4 mist and smoke
Ion	Electrically charged species consisting of a single atom or a group of atoms. It is formed when a neutral atom or group of atoms either gains or loses electrons
Ion exchange	A process in which ions in solution are exchanged for corresponding ions held on the surface of an ion exchange material. For example, Ca^{2+} and Mg^{2+} may be exchanged for Na^+; or SO_4^{2-} for OH^-
Kappa factor	Ratio between 1st-stage bleaching chemical charge and kappa number. If the 1st bleaching stage is D, the kappa factor is usually expressed as active chlorine
Kappa number	A measure of residual oxidisable material content in pulp. It is the volume (in mL) of 0.1N potassium permanganate ($KMnO_4$) solution consumed by one gram of moisture-free pulp under the conditions specified in TAPPI Test Method T 236 cm-85
Leachate	Water that has passed through a soil and that contains soluble material removed from that soil
Leaching	A hydrometallurgical process in which a metal is dissolved in aqueous solution and then deposited from it after purification
Levels associated with AMT/BPEM	Emission (and consumption) levels that represent the environmental performance that could be anticipated as a result of the application of AMT/BPEM, bearing in mind the balance of costs and advantages inherent within in the definition of AMT
Ligand	A molecule, ion or atom that is attached to the central atom of a co-ordination compound, a chelate or other complex. May also be called complexing agent.

Glossary of terms	
Lignin	Natural binding constituent of the cells of wood and plant stalks, a complex 3-dimensional polymer of phenylpropane or propylbenzene structure. The chemistry of lignin is characterised by having hydroxyl (OH-) or methoxyl (CH_3O^-) groups attached to the benzene carbon atoms
Lipids	Several naturally occurring substances (e.g. fats and oils) sharing the property of solubility in solvents of low polarity (such as $CHCl_3$, CCl_4, C_6H_6 and $(C_2H_5)_2O$)
Lipophilic	Hydrophobic
Littoral zone	Nearshore. Area out from the shore to the depth of the euphotic zone
Market pulp	Pulp produced for sale to the open market and not used for the manufacture of paper and/or board at the same site
Mass spectrometer	A device used to separate and measure the quantities and masses of different ions in a beam of positively charge gaseous ions
Mesotrophic	Moderately productive (in terms of its algal biomass) body of fresh water with moderate nutrient concentration (11 to 20 µg/L of phosphorus)
Microtox®	The Microtox® system is a bioassay to test the acute toxicity on environmental samples and pure compounds based on the natural bioluminescence of the marine bacteria *Vibrio fischeri*; in presence of pollutant agents, the natural bioluminescence of *V. fischeri* is reduced and the toxicity is expressed as the agent concentration which produces a 50% reduction of the initial luminescence (EC_{50}). Nowadays Microtox® is a widespread screening toxicity test for its characteristics of sensitivity, discriminant power, reproducibility and easy application for organic and inorganic pollutants
Mixing zone	A three-dimensional area of the receiving waters around a point of discharge of pollutants within which it is recognised that the water quality objectives for the receiving waters may not be achieved [SPWQM, 1997]
Monosaccharides	The simplest repeating units of carbohydrates. Also known as sugars or saccharides (glucose and fructose are monosaccharides)
Not detectable	Below the limit of detection of a specified method of analysis
Oils	Triglycerides in which unsaturated fatty acid components predominate
Oligosaccharides	Carbohydrates that hydrolyse to yield 2-10 molecules of a monosaccharide (maltose and sucrose are disaccharides)
Oligotrophic	Very unproductive (in terms of its algal biomass) body of fresh water with low nutrient concentration (<10 µg/L of phosphorus). Oligotrophic fresh water bodies are usually photosynthesis-limited, very transparent and oxygen rich
Organochlorines	Group name for organic compounds containing chlorine, both those occurring naturally and those formed during bleaching with chlorinated compounds
Osmosis	Diffusion of a solvent through a semi-permeable membrane into a more concentrated solution, tending to equalise the concentrations on both sides of the membrane

Glossary of terms	
Oxidation	The combination of oxygen with a substance, or the removal of hydrogen from it or, more generally, any reaction in which an atom loses electrons
Oxidation/reduction	The process in which electrons are 'lost' or 'gained' and the oxidation state (valence) of some atoms increases or decreases. The substance containing atoms whose oxidation states *increase* is oxidised. The substance containing atoms whose oxidation states *decrease* is reduced.
Oxidising agent	An agent that makes possible an oxidation process by itself becoming *reduced*
Paper	Sheet of fibres with a number of added chemicals. According to the basic weight it can be distinguished as follows: Paper <150 g/m^2 <paper-board (or board) <250 g/m^2 <cardboard
Para (p–)	An isomer with 2 substituents located opposite to each other on a benzene ring
Phenols	Phenol is a benzene ring with one –OH radical replacing hydrogen. Phenols are compounds which contain additional chemical groups bound to this basic structure (each replacing hydrogen)
Photodegradation	Breakdown of a substance by exposure to light; the process whereby ultra-violet radiation in sunlight attacks a chemical bond or link in a chemical structure
Photolysis	The decomposition of a compound into simpler units as a result of the absorption of one or more quanta of radiation
Photosynthesis	The process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugars and oxygen in the presence of chlorophyll using sunlight for energy. Photosynthesis is essential in producing a lake's food base and is an important source of oxygen
Phytoplankton	Microscopic free floating aquatic plants, mainly unicellular algae, that live suspended in bodies of water and drift about because they cannot move themselves or because they are too small to swim
Pitch	Resinous material in virgin pulps
Polysaccharides	Carbohydrates that hydrolyse to yield more than 10 molecules of a monosaccharide (cellulose and starch are glucose polymers)
Primary treatment	Physical treatment of wastewater to reduce settleable and floatable solids
Protocol	A formally agreed method and procedure for measuring an indicator; it defines the sampling, sample handling procedures and sample analysis
Pulping	The process of converting raw fibre (e.g. wood) or recycled fibre to a pulp useable in papermaking
Reactivity	Reactivity may be defined in terms of the fraction of the residual oxidisable material that a bleaching agent is capable of removing (i.e. delta kappa/delta bleaching agent)
Redox potential	An expression of the oxidising or reducing power of a solution relative to a reference potential. This potential is dependent on the nature of the substances dissolved in the water, as well as on the proportion of their oxidised and reduced components
Reducing agent	An agent that makes possible an reduction process by itself becoming *oxidised*

Glossary of terms	
Refinability	The ease with which paper or pulp can be treated in a refiner as measured in kWh/ODt or MJ/kg
Salinity	The presence of soluble salts in or on soils or in water
Saponification	The hydrolysis of a triglyceride by a strong base. The products are glycerol and a soap
Secondary treatment	Biological treatment of wastewater to reduce BOD and toxicity; it normally reduces TSS also
Sediment	Unconsolidated mineral and organic particulate material that settles to the bottom of aquatic environment
Selectivity	Selectivity is the degree to which a pulping or bleaching agent can lower the kappa number without dissolving or damaging the other components of the fibre, cellulose and hemicellulose (i.e. delta kappa/delta viscosity). Selectivity can be loosely defined as the ratio of attack on lignin to attack on carbohydrate
Soaps	The salts of fatty acids, e.g. $RCOO^{-}Na^{+}$, where the R group is a hydrocarbon chain containing from 3 to 21 C atoms
Softwood	Group of wood species including the following pulpwoods: pine and spruce
Sootblowing	Blowing of soot carried over from the furnace section of a boiler. This carry-over, along with the high temperatures in the heat transfer section of the boiler, causes continuous deposition and fouling on the outside of heat transfer tubes. Sootblowing is usually done with steam
Specific water consumption	The amount of fresh water consumed during production (surface water, ground water) which is taken out from external resources. This fresh water demand is related to air dry net production and is expressed as m^3/t. Fresh water that is only used for cooling purposes (i.e. water that had no contact with fibres and additives) and that is directly discharged into the environment is not included. Wastewater generated in steam and power plants on site is also not included
Stakeholder	A person or group (e.g. an industry, a government jurisdiction, a community group, the public, etc.) who have an interest or concern in something
Stock	The mixed suspension of fibre and other materials used to form paper
Stripper	Equipment used to carry out stripping (desorption)
Stripping (desorption)	A unit operation in which a volatile component of a liquid mixture is transferred into a gas
Strong acid	An acid that is completely ionised in aqueous solution
Strong base	A base that is completely ionised in aqueous solution
Sub-lethal	Involving a stimulus below the level that causes death
Sulfidity (on AA)	The ratio of sodium sulfide to AA or $Na_2S/(NaOH + Na_2S)$, as g/L Na_2O
Sulfidity (on TTA)	The ratio of sodium sulfide to TTA or $Na_2S/(NaOH + Na_2S + Na_2CO_3)$, as g/L Na_2O

Glossary of terms	
Total nitrate (NO_3)	Nitrates are a form of nitrogen found in aquatic ecosystems and an essential plant nutrient. In excess amounts nitrate can cause significant water quality problems. Together with phosphorus, nitrates in excess amounts can accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes in the types of plants and animals that live in the stream. This, in turn, affects dissolved oxygen, temperature, and other indicators. Excess nitrates can cause hypoxia (low levels of dissolved oxygen) and can become toxic to warm-blooded animals at higher concentrations (10 mg/L or higher) under certain conditions. The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L) but the level of ammonia or nitrate in the effluent of wastewater treatment plants can be up to 30 mg/L. Sources of nitrates include wastewater treatment plants, runoff from fertilised lawns and cropland, failing on-site septic systems, runoff from animal manure storage areas, and industrial discharges that contain corrosion inhibitors
Total phosphorus	Phosphorus is an essential plant nutrient and the one that most often controls aquatic plant (algae and rooted plant) growth. Total phosphorus includes both soluble and particulate forms of phosphorus and is measured in milligrams per litre (mg/L). Elevated levels of total phosphorus increase plant growth producing increased plant/algae decomposition, which depletes dissolved oxygen concentrations. The water quality problems that result from phosphorus overload are collectively known as eutrophication. Phosphorus enters aquatic systems: as organic material like dead organisms or yard waste, attached to soil particles, with fertilisers, with industrial by-products and via resuspension from lake bottom sediments
Toxicant	A chemical capable of producing an adverse response (effect) in a biological system at concentrations that might be encountered in the environment, seriously injuring structure or function or producing death
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism
Transition metals	Consist of the 38 elements in groups 3 through 12 of the periodic table of the elements. As with all metals, the transition elements are both ductile and malleable, and conduct electricity and heat. One interesting aspect of transition metals is that their valence electrons, or the electrons they use to combine with other elements, are present in more than one shell. Consequently, they often exhibit several common oxidation states. A partial list of transition metals includes: titanium (Ti), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), molybdenum (Mo), silver (Ag), cadmium (Cd), tantalum (Ta), tungsten (W), platinum (Pt), gold (Au) and mercury (Hg). Transition metals of interest in chemical pulp bleaching are Mn, Fe and Cu because they catalyse the decomposition of hydrogen peroxide. Transition metals of interest for their environmental impact are Cd and Hg because of their poisoning effect
Trigger values	These are the concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should ‘trigger’ some action, either further ecosystem specific investigations or implementation of management/remedial actions

Glossary of terms	
Triglycerides	Esters of glycerol (1,2,3 propanetriol) with long-chain monocarboxylic (fatty) acids
Trophic status	Trophic means nutrition or growth. Trophic status is a means of classifying lakes and describing lakes' processes in terms of productivity: *oligotrophic* lakes have low nutrients and plant growth, *eutrophic* lakes are well nourished with high nutrients and plant growth and *mesotrophic* lakes fall somewhere in between oligotrophic and eutrophic
Turpentine	A mixture of terpenes, principally pinene, obtained by the steam distillation of pine gum recovered from the condensation of digester relief gases from the cooking of softwoods by the kraft pulping process
Uptake	A process by which materials are absorbed and incorporated into a living organism
Viscosity	Measured by dissolving pulp fibres in CED and observing the time taken for the solution to pass through a standard capillary (TAPPI Test Method T230 om-94). Viscosity is expressed in centipoises (cP) or milliPascal-seconds (mPa·s), which are numerically the same. It is related to cellulose molar mass (degree of polimerisation) and indirectly to fibre strength
Volatile	Having a low boiling or subliming pressure (a high vapour pressure)
Water quality objective	A numerical concentration limit or narrative statement that has been established to support and protect the designated uses of water at a specified site. It is based on scientific criteria or water quality guidelines but may be modified by other inputs such as social or political constraints
Watershed	All land and water areas that drain towards a receiving body (river or lake). Also called drainage basin or water basin
Weak acid	An acid that is only partially ionised in aqueous solution
Weak base	A base that is only partially ionised in aqueous solution
Whole effluent toxicity testing	The use of toxicity tests to determine the acute and/or chronic toxicity of effluents
Whole mill effluent	All of the process effluent generated by the mill excluding uncontaminated cooling water and surface run-off as it enters the aquatic environment
Woodfree paper and/or board	Paper and board having in principle only chemical pulp in its fibre composition; in practice however it may contain a small amount of other fibres or pulps (less than 5% non-cellulosic compounds)
Yield	The amount of useful fibre after pulping and/or bleaching expressed as a percentage of the raw fibre on an oven dry basis
Zooplankton	The animal portion of the living particles in water that freely float in open water. They eat bacteria, algae, detritus and sometimes other zooplankton and are in turn eaten by other planktivorous fish

APPENDIX A

Amended reference to the Resource Planning and Development Commission

Amended reference to the Resource Planning and Development Commission

Development of Environmental Guidelines for New Bleached Eucalypt Kraft Pulp Mills in Tasmania

In 1989 the Commonwealth Government published *Environmental Guidelines for New Bleached Eucalypt Kraft Pulp Mills* (the 'Commonwealth Guidelines'). These guidelines were based on the concept of Best Available Technology, and were reviewed and updated in 1995 to take account of technological advances. The 1995 Commonwealth Guidelines introduced the concept of Best Practice Environmental Management.

The Tasmanian Government wishes to develop environmental guidelines for a new bleached eucalypt kraft pulp mill in Tasmania. The guidelines should build on the framework of the 1995 Commonwealth Guidelines, taking account of changes in technological capability since 1995 and the Tasmanian legislative and policy framework.

Terms of Reference

The project scope is to develop recommended 'Environmental Guidelines for New Bleached Eucalypt Kraft Pulp Mills in Tasmania' for endorsement by the Tasmanian Government. The guidelines must be informed by a review of the emission limits, solid waste disposal criteria and site suitability criteria (Section D1, D2 and D3) of the 1995 Commonwealth Guidelines.

The Tasmanian Guidelines are to use the broad framework of the Commonwealth *Environmental Guidelines for New Bleached Eucalypt Kraft Pulp Mills 1995*. The Commission, with the assistance of expert consultants as appropriate, is to address the following terms of reference.

1. Review of Sections D1, D2 and D3 of the 1995 Commonwealth Guidelines

The review of the 1995 Commonwealth Guidelines must specifically address the following:

- changes in
  - Commonwealth law,
  - kraft pulp mill pulping and bleaching technology, with a focus on technology to reduce the level of pollutants produced in the production process, and
  - associated pollutant treatment technology

  that have occurred since the 1995 Commonwealth Guidelines were developed.
- the Stockholm Convention on Persistent Organic Pollutants 2001 (the Convention).
- current guidelines or standards applying to new bleached kraft pulp mills overseas, with particular emphasis on European and North American requirements.

- the ambient guidelines for air quality and water quality in section D3 of the 1995 Commonwealth Guidelines (Site Suitability Criteria) in comparison to the values specified in current Tasmanian legislation and statutory policies or, where no such values are specified, the values in the most appropriate national or international guidelines.
- consideration of the environmental emission limits currently achievable by a new bleached eucalypt kraft pulp mill utilising:
  - Accepted Modern Technology[1] and operated in accordance with Best Practice Environmental Management[2]; and
  - Best Available Techniques operated in accordance with Best Environmental Practices, to the extent required by the Convention[3].

  Emission limits for both Totally Chlorine Free (TCF) low-flow or closed-cycle processes, and advanced Elemental Chlorine Free (ECF) bleaching processes should be documented.

1 Accepted Modern Technology is defined in the State Policy on Water Quality Management and draft Environment Protection Policy (Air Quality) as 'technology which has a demonstrated capacity to achieve the desired emission concentration in a cost-effective manner, takes account of cost-effective engineering and scientific developments and pursues opportunities for waste minimisation.'

2 Best Practice Environmental Management is defined in the *Environmental Management and Pollution Control Act 1994* as 'the management of the activity to achieve an ongoing minimization of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity.'

3 The terms 'Best Available Techniques' and 'Best Environmental Practices' are used in the meaning which they have in the Convention.

2. Preparation of recommended Guidelines for New Bleached Eucalypt Kraft Pulp Mills in Tasmania

The recommended Tasmanian guidelines must be consistent with the broad framework of the 1995 Commonwealth Guidelines, except where a variation has been justified on the basis of the review defined in Task 1. The sections of the 1995 Commonwealth Guidelines on Background (B) and Guidelines Strategy (C) will need to be modified to reflect the Tasmanian context.

The recommended Tasmanian guidelines must be based on:

- The policies, guidelines and values specified in current Tasmanian legislation and statutory policies where these are relevant and applicable (including the *Environmental Management and Pollution Control Act 1994*, *State Policy on Water Quality Management 1997*, *Draft Environment Protection Policy (Air Quality)*; and
- The values derived from the review undertaken under the first Term of Reference where relevant values are not specified in Tasmanian legislation or statutory policies, or Tasmanian standards are significantly less stringent than those arising under international best practice or the Convention.

3. Consultation

A draft of the review and recommended Tasmanian Guidelines must be made available to the Board of Environmental Management and Pollution Control and Director of Public Health for comment prior to a public release.

A draft of the review and recommended guidelines is to be made available for public comment for a period of [28] days.

The Commission may hold public hearings on the submissions made by the public on the guidelines.

4. Reporting

The Commission is to provide a report comprising the review and final recommended guidelines to the Minister for Primary Industries, Water and Environment no later than six 6 months from the date of receiving this commission.

Note: amendments to the terms of reference are underlined.

Appendix B

Key stakeholders invited to comment on Commonwealth Guidelines

Key stakeholders invited to comment on Commonwealth Guidelines

Organisation	City	State
Tasmanian Aquaculture & Fisheries Institute	Taroona	TAS
Australian Pulp & Paper Institute	Monash University	VIC
Environment Australia	Canberra	ACT
Department of Industry, Tourism & Resources	Canberra	ACT
Department of Agriculture, Fisheries & Forestry	Canberra	ACT
Department of Primary Industries, Water and Environment	Hobart	TAS
Department of Infrastructure, Energy and Resources	Hobart	TAS
Australian Paper Industry Council	Manuka	ACT
Tasmanian Fishing Industry Council	Sandy Bay	TAS
Greenpeace	Sydney	NSW
Department of Health and Human Services	Hobart	TAS
Tasmanian Conservation Trust	Hobart	TAS
CSIRO	Dickson	ACT
School of Chemistry	Monash University	VIC
National Toxics Network	Rivett	ACT
Australian Conservation Foundation	Carlton	VIC

Appendix C

Submissions received from key stakeholders and unsolicited submissions

Submissions received from key stakeholders

Organisation		State
1.	National Toxics Network	ACT
2.	Department of Agriculture, Fisheries and Forestry	ACT
3.	Tasmanian Conservation Trust	TAS
4.	Australian Paper Industry Council	ACT
5.	Department of Industry Tourism and Resources	ACT
6.	Tasmanian Fishing Industry Council	TAS
7.	Greenpeace	NSW
9.	Department of Primary Industries, Water and Environment	TAS
10.	Australian Conservation Foundation	VIC

Unsolicited submissions

Organisation		State
8.*	Christine Milne, spokesperson - Tasmanian Greens	TAS
11.*	Peg Putt MHA, Tasmanian Greens	TAS
12.*	Forests & Forest Industry Council of Tasmania	TAS
13.*	Forest Industries Association of Tasmania	TAS
14.*	Australian Paper	TAS

Appendix D

Submissions received on the Commission's Draft Report

Submissions received on the Commission's Draft Report

Organisation		State
1.	AOK Innovations	TAS
2.	Mr & Mrs Collier	TAS
3.	Ms Jansen-Riley	TAS
4.	Gunns Ltd	TAS
5.	Tasmanian Department of Primary Industries, Water and Environment	TAS
6.	Forests & Forest Industry Council of Tasmania	TAS
7.	Commonwealth Department of Environment and Heritage	ACT
8.	Dr K Maddern	VIC
9.	Forest Industries Association of Tasmania	TAS
10.	Construction, Forestry, Mining and Energy Union	VIC
11.	Christine Milne, spokesperson – Tasmanian Greens	TAS
12.	Tasmanian Fishing Industry Council	TAS
13.	Greenpeace/National Toxics Network	NSW
14.	Peter Smith	TAS

APPENDIX E

Emission limit comparison for selected jurisdictions

Emission limit comparison for selected jurisdictions

			European Union		Austria	France	Germany	Sweden[b)d)e)]		Finland[c)d)e)]			USA		Canada	QC, Canada		BC, Canada	
Emission point	Pollutant	Units	Annual average	Daily average	Monthly average	Monthly average	Monthly average	Annual average	Monthly average	Annual average	Monthly average	Daily max	Monthly average	Daily max	Monthly average	Monthly average	Daily max	Monthly average	Daily max
Final effluent	TSS	kg/ADt	0.6-1.5		2.5	5	No limit - part of COD						3.9	8.5		3	6	N/A	5
	BOD_5	kg/ADt	0.3-1.5		2	2	30 mg/L						2.4	4.5		2.5	4	N/A	6
	COD	kg/ADt	8-23		20	25	25						No regs	No regs		No regs	No regs	No regs	No regs
	AOX	kg/ADt	0.25		0.25	1	0.25						0.27	0.48		0.25	0.3	0.5	0.6
	Acute toxicity (LC_{50}/EC_{50})	%														100 (Rainbow trout)		100 (Rainbow trout)	
	2,3,7,8-TCDD	pg/L	10											10		15		15	
	2,3,7,8-TCDF	pg/L	31.9											31.9		15		50	
Recovery boiler	PM	mg/NDm^3		34-56					60-100			60	51			151		74	
	TRS	mg H_2S/NDm^3		17-26					10		12					11		7 (24 h)/ 16 (1 h)	
	NO_x	mg NO_2/NDm^3		90-135															
	SO_2	mg S/NDm^3		11-56															
	PCDD/ PCDF	pg I-TEQ/NDm^3	100		100	100	100				120		150		80				
Lime kiln	PM	mg/NDm^3		34-56					60-250			72	34			227		140	
	TRS	mg H_2S/NDm^3		26-30					50		24					23		21	
	NO_x	mg NO_2/NDm^3		113-226															
	SO_2	mg S/NDm^3		6-34															
	PCDD/ PCDF	pg I-TEQ/NDm^3	100		100	100	100						150		80				
Power boiler	PM	mg/NDm^3	12-36						26-217							71		54	
	NO_x	mg NO_2/NDm^3	200-270																
	PCDD/ PCDF	pg I-TEQ/NDm^3	100		100	100	100						150		80				
All sources excluded power boiler	Sulfur	kg S/ADt						0.4		0.4									
All sources excluded power boiler	NO_x	kg NO_2/ADt						1.3		1.5									
All sources	Inorganic chlorinated compounds (excluded HCl)	mg Cl_2/NDm^3											33						

Notes:

a) PM, TRS, NO_x and SO_2 in the table are corrected to 3% oxygen level by volume for recovery boiler and lime kiln. The correction is to 8% oxygen level by volume for the power boiler.

b) Sweden has no specified % O_2 reference level in the limits (with the exception of CO_2 for the bark boiler). The reference level for normal operation is about 2–3% O_2. There are no national or provincial guidelines for air emissions from kraft pulp mills. Limits are set by the Environmental Court (Miljödomstolen) on an individual basis for each mill. Concentration limits for specified emission points are only given for particulate matter (PM). There are, however, H_2S concentration limits for the recovery boiler and the lime kiln that must not be exceeded for a given percentage of the operating time. Millwide limits for sulfur and NO_x emissions are given in kg/ADt.

c) In Finland, the O_2 reference level for recovery boiler, lime kiln and power boiler is usually 6%. There are no national or provincial guidelines for air emissions from kraft pulp mills. Limits are set by the Agency for Environmental Permits (Miljötillståndsverket) on an individual basis for each mill. Concentration limits for specified emission points are only given for particulate matter (PM). There are, however, H_2S concentration limits for the recovery boiler and the lime kiln that must not be exceeded for a given percentage of the operating time. Millwide limits for sulfur and NO_x emissions are given in kg/ADt.

d) NO_x are included in millwide NO_x from all sources excluding power boiler.

e) TRS and SO_2 are included in millwide sulfur from all sources excluding power boiler.

APPENDIX F

Recommended emission limits for the Tasmanian Guidelines

Recommended limits for the Tasmanian Guidelines

Emission point	Pollutant	Units[a]	Annual average	Monthly average	Daily maximum	Any one test	Testing frequency	Rationale for limits	Rationale for testing frequency	Test methods
Final effluent	TSS	kg/ADt		2.6	4.5		Daily[c]	See note g)	See note o)	SMEWW-APHA[z] GFC filter (1.2 microns)
	BOD_5	kg/ADt		2.1	3.6		3 times per week[c]	See note g)	See note o)	SMEWW-APHA
	COD	kg/ADt		20	34		Daily[c]	See note g)	See note o)	SMEWW-APHA
	AOX	kg/ADt		0.2	0.4		Once per week[c,ak]	See note g)	See note o)	EN 1485:1996[aa]
	Colour[w]	kg/ADt		42	72		Once per week[c]	See note g)	See note o)	SMEWW-APHA
	Acute toxicity	LC^{50}/EC^{50}				See note h)	Once per month[c]	See note h)	See note o)	See note ab)
	Chronic toxicity	EC^{50}				See note I)	Once per month[c]	See note i)	See note o)	See note ab)
	2,3,7,8-TCDD	pg/L				10	See note al)	See note j)	See note o)	See note ac)
	2,3,7,8-TCDF	pg/L				30	See note al)	See note j)	See note o)	See note ac)
	Chlorate[an]	mg/L				10	See note al) and ak)	See note am)	See note o)	TAPPI method T700 om-93
	Trihalomethanes including chloroform	mg/L				2	See note al) and ak)	See note am)	See note o)	US EPA test method 0501
	Oil and grease	-				No visible contamination	Daily[c]	See note j)	See note o)	SMEWW-APHA
Recovery boiler	PM	mg/NDm^3		50 @ 3% O_2			See note aj)	See note k)	See note m)	See note ad)
	TRS	$mg\ H_2S/NDm^3$		7 @ 3% O_2 for >99% of the time[d]	See note p)		Continuous	See note l)	See note m)	See note ad)
	NO_x	$mg\ NO_2/NDm^3$		See note q)			Continuous	See note l)	See note m)	See note ad)
	SO_2	$mg\ S/NDm^3$		See note p)			Continuous	See note l)	See note m)	See note ad)
	PCDD/ PCDF	$pg\ I\text{-}TEQ/NDm^3$		100 @ 3% O_2			See note af)	See note ag)	See note ag)	See note ah)
Lime kiln	PM	mg/NDm^3		40 @ 3% O_2			See note aj)	See note k)	See note m)	See note ad)
	TRS	$mg\ H_2S/NDm^3$		16 @ 3% O_2 for >95% of the time[d]	See note p)		Continuous	See note l)	See note m)	See note ad)
	NO_x	$mg\ NO_2/NDm^3$		See note q)			Continuous	See note l)	See note m)	See note ad)
	SO_2	$mg\ S/NDm^3$		See note p)			Continuous	See note l)	See note m)	See note ad)
	PCDD/ PCDF	$pg\ I\text{-}TEQ/NDm^3$		100 @ 3% O_2			See note af)	See note ag)	See note ag)	See note ah)
CNCG incinerator[e]	TRS	$mg\ H_2S/NDm^3$		7 @ 3% O_2 for >99% of the time[d]	See notes p) and ai)		Continuous	See note m)	See note m)	See note ad)
	NO_x	$mg\ NO_2/NDm^3$		See note q)			Continuous	See note m)	See note m)	See note ad)
	SO_2	$mg\ S/NDm^3$		See note p)			Continuous	See note m)	See note m)	See note ad)
	$SO_2 + SO_3$	$mg\ S/NDm^3$		See note p)			Twice yearly	See note m)	See note m)	See note ad)
	H_2SO_4 mist	$mg\ SO_3/NDm^3$		See note p)			Twice yearly	See note m)	See note m)	See note ad)
CNCG emergency incinerator[b]	TRS	$mg\ H_2S/NDm^3$		See notes p) and ai)			To be calculated[ae]	See note m)	See note m)	See note ad)
	NO_x	$mg\ NO_2/NDm^3$		See note q)			To be calculated[ae]	See note m)	See note m)	See note ad)
	SO_2	$mg\ S/NDm^3$		See note p)			To be calculated[ae]	See note m)	See note m)	See note ad)
	$SO_2 + SO_3$	$mg\ S/NDm^3$		See note p)			To be calculated[ae]	See note m)	See note m)	See note ad)
Power boiler	PM	mg/NDm^3		30 @ 8% O_2			See note aj)	See note k)	See note m)	See note ad)
	NO_x	$mg\ NO_2$/MJ fuel input		80	See note r)		Continuous	See note m)	See note m)	See note ad)
		$mg\ NO_2/NDm^3$		*~200 @ 8% O_2*[f]						
	SO_2	$mg\ S/NDm^3$		See note s)			Continuous	See note m)	See note m)	See note ad)
	PCDD/ PCDF	$pg\ I\text{-}TEQ/NDm^3$		100 @ 8% O_2			See note af)	See note ag)	See note ag)	See note ah)
All sources	Sulfur	kg S/ADt	0.4	See note t)			Continuous & manual	See note l)	See note m)	See note ad)
All sources	NO_x	$kg\ NO_2/ADt$	1.3	See note u)			Continuous & manual	See note l)	See note m)	See note ad)
All sources	H_2SO_4 mist	$mg\ SO_3/NDm^3$		See note p)			Twice yearly	See note m)	See note m)	See note ad)
All sources	Hydrogen chloride (HCl)	$mg\ HCl/NDm^3$		See note v)			Continuous	See note n)	See note n)	See note ad)
All sources	Odour	$mg\ H_2S/NDm^3$		See note p)			See note x)	See note m)	See note m)	See note x)
All sources	Inorganic chlorinated compounds	$mg\ Cl_2/NDm^3$		50			Continuous[ak]	See note n)	See note n)	See note ad)

Recommended limits for the Tasmanian Guidelines

Notes:

a) NDm^3 = Normal cubic metre of dry gas measured at atmospheric pressure (101.325 kPa) and 273.15 K (0 ^{o}C).
b) ÅF-Celpap believes the CNCG emergency incinerator need not be regulated.
c) Based on a 24-h composite effluent sample.
d) For >95% (99%) of the time = the limit may be exceeded for a total of ~36 (7) hours in a month. The emission limit concentrations for TRS are higher than those proposed for hydrogen sulfide in the *Draft Environment Protection Policy (Air Quality) 2001*, a fact that reflects what AMT can achieve in this industry. It should be noted that the objective for ground level concentration of TRS is ten times more stringent than that proposed in the Draft Environmental Proection Policy (Air Quality) 2001 for two of the major components of TRS, namely hydrogen sulfide and methyl mercaptan.
e) The CNCG incinerator does not emit significant amounts of PM.
f) Recalculated for a 8% O_2 reference level.
g) The limits are calculated by multiplying long term average values (LTA) by appropriate variability factors (VF). AMEC and ÅF-Celpap consider these LTA and VF to be associated with AMT.
h) Acute toxicity should be measured in 100% effluent. The effect from the effluent should be less than 50%.
i) Chronic toxicity should be measured in effluent at various dilutions above and below the dilution expected at the edge of the mixing zone. The concentration at which a 50% effect is obtained should be determined.
The Lowest Observed Effect Concentration (LOEC) and the No Observed Effect Concentration (NOEC) should also be determined. The discharge limit will be set such that the NOEC is not exceeded at the edge of the mixing zone.
j) Recommended by AMEC.
k) Based on promulgated Maximum Achievable Control Technology (MACT) II standards for new sources (US EPA).
l) Based on Swedish and Finnish best practice.
m) Based on Swedish best practice.
n) Based on promulgated National Emission Standards for Hazardous Air Pollutants (NESHAP) standards for new sources (US EPA).
o) ÅF-Celpap and AMEC consider these testing frequencies to be a combination of best Swedish and North American practice.
p) Included in millwide sulfur from all sources excluding power boiler.
q) Included in millwide NO_x from all sources excluding power boiler.
r) Not included in millwide NO_x from all sources.
s) Dependent on fuel sulfur content. Not included in millwide sulfur from all sources.
t) Includes lower-strength sulfur point sources.
u) Includes lower-strength NOx point sources.
v) Included in inorganic chlorinated compounds from all sources.
w) Notwithstanding the recommended colour limits, any proponent of a BEKP mill to be built in Tasmania should ensure that the colour emissions will not affect the visual amenity of the local beaches and environs.
x) Depending on results of spot monitoring program carried out by measuring odour with a mobile gas chromatograph/ mass spectrometer (GC-MS). Testing will be more frequent initially and less frequent later in the program. Results to be added to the results from continuous emission monitoring (CEM).
y) Any odorous emissions from the effluent treatment plant are not included in millwide sulfur from all sources but are covered by a general regulation on odour and the mill has to take appropriate action to reduce or eliminate them.
z) Standard Methods for the Examination of Water and Wastewater, 20th or later Edition, published by the American Public Health Association.
aa) European Standard (CEN or Comité Européen de Normalisation).
ab) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, ANZECC and ARMCANZ, October (2000):Volume 1, Table 3.4.1 - Trigger Values for Toxicants at Alternative Levels of Protection, Volume 2, Table 8.3.5 - Summary of the Major Toxicity Bioassays used in Australia for Direct Toxicity Assessment (DTA) Purposes for Marine Test Organisms. Test organisms should be agreed upon by the proponent and the Tasmanian Department of Primary Industries, Water and Environment (DPIWE).
ac) US EPA and New Zealand's Environmental Science Research Institute methods are acceptable.
ad) USA CFR 40 - Part 60, Appendix A or equivalent.
ae) From the CNCG emergency incinerator sulfur and nitrogen loads and the operating time.
af) Quarterly in the first year of operation, twice yearly thereafter. Average value over sampling period of 4-8 hours.
ag) Based on European Union Limit and Canada Wide Standard 2001.
ah) The test method for PCDD/ PCDF will be European Standard (CEN or Comité Européen de Normalisation) method EN 1948:1997 with sampling period of 4 hours minimum and 8 hours maximum.
ai) As the CNCG incinerator and CNCG emergency incinerator can be sources of odour at times of process instability, it is strongly recommended that the stacks for these incinerators be taken to the same height as the recovery boiler stack to facilitate optimum dispersion of any adventitious TRS release. Furthermore, it is good practice for the lime kiln and the power boiler stacks to be taken to the same height as the recovery boiler stack. If practical, these stacks should be supported by a common structure.
aj) Manual testing carried out initially once a month and less frequently later depending on results.
ak) Testing not required for BEKP mills employing a TCF bleaching sequence.
al) These parameters should be tested monthly. If the parameter's concentration is below the permitted level for 3 consecutive months, frequency of testing can be reduced to quarterly. If the parameter's concentration is below the permitted level for 3 consecutive quarters, frequency of testing can be reduced to annually.
am) Recommended by the Commission.
an) If the proponent proposes to use the ECF bleaching method in the mill process, the environmental impact assessment must include a study of the effects of chlorate ion on any sensitive marine flora and fauna species living within a 1 kilometre radius of the proposed discharge point for treated mill effluent. The discharge limit for chlorate will be set based on the results of this study so that no detectable environmental damage occurs beyond the dilution zone. Laboratory tests suggest that concentrations required to protect brown algae are less than 10 µg/L [Rosemarin *et al.* 1986]. It is strongly recommended that the EIS include specific study of the effects of appropriate levels of chlorate on algal communities in the particular discharge zones.

APPENDIX G

Comparison between Tasmanian Guidelines and 1995 Commonwealth Guidelines

Emission limit comparison between recommended Tasmanian Guidelines and 1995 Commonwealth Guidelines

Emission point	Pollutant	Units[a)]	Recommended Tasmanian Guidelines				1995 Commonwealth Guidelines						
			Annual average	Monthly average	Daily maximum	Any one test	Annual average	Monthly average	Daily maximum	Continuous		Any one test	
Final effluent	TSS	kg/ADt		2.6	4.5				8				
	BOD_5	kg/ADt		2.1	3.6				6				
	COD	kg/ADt		20	34			25.4	35.7				
	AOX	kg/ADt		0.2	0.4		0.3					1.5	
	Colour[o)]	kg/ADt		42	72		Colour properties at the edge of the mixing zone defined in Site Suitability Criteria						
	Acute toxicity	LC_{50}/EC_{50}				See note r)						100	
	Chronic toxicity	EC_{50}				See note s)						Range of dilutions	
	2,3,7,8-TCDD	pg/L				10						15	
	2,3,7,8-TCDD[b)]	ng/L										5	
	2,3,7,8-TCDF	pg/L				30							
	Chlorate	mg/L				10							
	Trihalomethanes including chloroform	mg/L				2							
	Oil and grease	-				No visible contamination						No visible contamination	
Recovery boiler	Opacity	% obscuration		See note n)						35%			
	PM	mg/NDm^3		50 @ 3% O_2								100 @ 12% CO_2[d)]	*129 @ 3% O_2*
	TRS	mg H_2S/NDm^3		7 @ 3% O_2 for >99% of the time[e)]	See note g)					5 @ 8% O_2	*7 @ 3% O_2*		
	NO_x	mg NO_2/NDm^3		See note h)								500 @ 7% O_2	*643 @ 3% O_2*
	SO_2	mg S/NDm^3		See note g)			Ground level concentrations in Site Suitability Criteria[f)]						
	PCDD/ PCDF	pg I-TEQ/NDm^3		100 @ 3% O_2									
Lime kiln	Opacity	% obscuration		See note n)						10%			
	PM	mg/NDm^3		40 @ 3% O_2								100 @ 10% O_2	*164 @ 3% O_2*
	TRS	mg H_2S/NDm^3		16 @ 3% O_2 for >95% of the time[e)]	See note g)					10 @ 10% O_2	*16 @ 3% O_2*		
	NO_x	mg NO_2/NDm^3		See note h)								500 @ 7% O_2	*643 @ 3% O_2*
	SO_2	mg S/NDm^3		See note g)			Ground level concentrations in Site Suitability Criteria[f)]						
	PCDD/ PCDF	pg I-TEQ/NDm^3		100 @ 3% O_2									
CNCG incinerator	TRS	mg H_2S/NDm^3		7 @ 3% O_2 for >99% of the time[e)]	See notes g) and q)								
	NO_x	mg NO_2/NDm^3		See note h)								500 @ 7% O_2	*643 @ 3% O_2*
	SO_2	mg S/NDm^3		See note g)			Ground level concentrations in Site Suitability Criteria[h)]						
	$SO_2 + SO_3$	mg S/NDm^3		See note g)									
	H_2SO_4 mist	mg SO_3/NDm^3		See note g)									
CNCG emergency incinerator[c)]	TRS	mg H_2S/NDm^3		See notes g) and q)									
	NO_x	mg NO_2/NDm^3		See note h)									
	SO_2	mg S/NDm^3		See note g)									
	$SO_2 + SO_3$	mg S/NDm^3		See note g)									

Emission limit comparison between recommended Tasmanian Guidelines and 1995 Commonwealth Guidelines

Emission point	Pollutant	Units[a)]	Recommended Tasmanian Guidelines				1995 Commonwealth Guidelines					
			Annual average	Monthly average	Daily maximum	Any one test	Annual average	Monthly average	Daily maximum	Continuous	Any one test	
Power boiler	Opacity	% obscuration		See note n)						20%		
	PM	mg/NDm^3		30 @ 8% O_2							100 @ 12% CO_2[d)]	*93 @ 8% O_2*
	NO_x	mg NO_2/MJ fuel input		80	See note i)							
		mg NO_2/NDm^3		*~200 @ 8% O_2*							500 @ 7% O_2	*464 @ 8% O_2*
	SO_2	mg S/NDm^3		See note j)			Ground level concentrations in Site Suitability Criteria[f)]					
	PCDD/ PCDF	pg I-TEQ/NDm^3		100 @ 8% O_2								
All sources	Sulfur	kg S/ADt	0.4	See note k)								
All sources	NO_x	kg NO_2/ADt	1.3	See note l)								
All sources	H_2SO_4 mist	mg SO_3/NDm^3		See note g)							200	
All sources	Hydrogen chloride (HCl)	mg HCl/NDm^3		See note m)							400	
All sources	Odour	mg H_2S/NDm^3		See note g)								
All sources	Inorganic chlorinated compounds	mg Cl_2/NDm^3		50							200	

Notes:

a) NDm^3 = Normal cubic metre of dry gas measured at atmospheric pressure (101.325 kPa) and 273.15 K (0^oC).
b) In crustacean hepatopancreas (TEQ). AMEC believes this parameter need not be regulated.
c) ÅF-Celpap believes the CNCG emergency incinerator need not be regulated.
d) Commonly used equivalence for 12% CO_2 is 7% O_2.
e) For >95% (99%) of the time = the limit may be exceeded for a total of ~36 (7) hours in a month.
f) The 1995 Commonwealth Guidelines included ground level concentrations also for TRS, HCl, Cl_2, ClO_2 and NO_x in Site Suitability Criteria.
g) Included in millwide sulfur from all sources excluding power boiler.
h) Included in millwide NO_x from all sources excluding power boiler.
i) Not included in millwide NO_x from all sources.
j) Dependent on fuel sulfur content. Not included in millwide sulfur from all sources.
k) Includes lower-strength sulfur point sources.
l) Includes lower-strength NO_x point sources.
m) Included in inorganic chlorinated compounds from all sources.
n) ÅF-Celpap and AMEC believe opacity is an obsolete parameter for emissions to the atmosphere.
o) Notwithstanding the recommended colour limits, any proponent of a BEKP mill to be built in Tasmania should ensure that the colour emissions will not affect the visual amenity of the local beaches and environs.
p) Numbers in italics are recalculated to a certain O_2 reference level.
q) As the CNCG incinerator and CNCG emergency incinerator can be sources of odour at times of process instability, it is strongly recommended that the stacks for these incinerators be taken to the same height as the recovery boiler stack to facilitate optimum dispersion of any adventitious TRS release. Furthermore, it is good practice for the lime kiln and the power boiler stacks to be taken to the same height as the recovery boiler stack. If practical, these stacks should be supported by a common structure.
r) Acute toxicity should be measured in 100% effluent. The effect from the effluent should be less than 50%.
s) Chronic toxicity should be measured in effluent at various dilutions above and below the dilution expected at the edge of the mixing zone. The concentration at which a 50% effect is obtained should be determined. The Lowest Observed Effect Concentration (LOEC) and the No Observed Effect Concentration (NOEC) should also be determined. The discharge limit will bet set such that the NOEC is not