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

Volume 2

August 2004 *Resource Planning and Development Commission*

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Published by:
Resource Planning and Development Commission
GPO Box 1691
Hobart Tasmania 7001

August 2004

Production by Artemis Publishing Consultants, Hobart, Tasmania
email address: enquiry@rpdc.tas.gov.au

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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
- Commissioner with public administration experience in regard to project implementation (Helen Hudson).

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Preamble

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.

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A. Executive overview

These guidelines for emission limits must be read in conjunction with the Tasmanian *Environmental Management and Pollution Control Act 1994*, the *State Policies and Projects Act 1993* (if applicable) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which describe environmental impact assessment processes.

Objectives

A.1 The objectives of these guidelines are:

(a) to ensure protection of the environment from emissions generated by any new bleached eucalypt kraft (BEK) pulp mills; and

(b) to clarify for Tasmanian government agencies, industry and potential investors the minimum environmental emission limit requirements for any new BEK pulp mill in Tasmania.

Strategy to meet these objectives

A.2 As technologies, techniques and environmental practices evolve for reducing emissions, they should be brought down, in any new mill, to levels that do not exceed the pre-operational concentrations. Once a mill is built, the only justification for requiring modifications to these limits for environmental reasons should be that a significant impact has been identified.

A.3 The strategy to achieve the primary objective of the guidelines is to:

(a) establish stringent emission limits based on accepted modern technology[a] (AMT), and best available techniques[b] (BAT), as may be required under the Stockholm Convention on Persistent Organic Pollutants 2001 (the Stockholm Convention),[c] and best practice environmental management[d] (BPEM), and specify site suitability, pre-operational and operational studies and monitoring prerequisites to:

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a 'Accepted modern technology' is defined in the *State Policy on Water Quality Management 1997* and the *Draft Environment Protection Policy (Air Quality) 2001* 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.'

b 'Best available techniques' is defined in Article 5 of the Stockholm Convention on Persistent Organic Pollutants 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.'

c Australia ratified the Stockholm Convention on Persistent Organic Pollutants on 20 May 2004.

d '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 minimisation of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity.'

(i) protect against any known scientifically demonstrated risks of environmental detriment;

(ii) detect and so avoid irreversible damage from any possible as yet unknown risks;

(b) maintain a comprehensive knowledge of the latest pulp and paper technology and its environmental effects; and

(c) review the guidelines regularly to ensure that they reflect AMT and BPEM, and BAT as regards those persistent organic pollutants that arise through pulp bleaching processes.

Key elements of Section D, The Guidelines

A.4 Section D, The Guidelines, contains the following key sub-sections:

D.1, Emission limits – defined emission limits for specified pollutants that may be discharged into the atmosphere or into receiving waters;

D.2, Solid waste disposal guidelines – an outline of the requirements to be met by a proponent in disposal of sludge from primary and secondary treatment processes;

D.3, Site suitability criteria – the guidelines specify meteorological, hydrodynamic and biological studies that will be required to demonstrate that specified environmental objectives can be met by the proposed development;

D.4, Monitoring – monitoring program requirements are outlined for atmospheric and effluent discharges and for the receiving environment, including specification of parameters/assays, frequency of monitoring and reporting requirements; and

D.5, Implementation, quality assurance and review – the guidelines specify:

(i) implementation and quality assurance requirements;

(ii) contingencies that can be defined before the mill start-up, such as the mill commissioning period, and other contingencies; and

(iii) that the continued mill operation will be reviewed, focusing on impact on the environment, efficacy of the monitoring program and adjusting the monitoring program if required.

A.5 A key element of Section D is the identification of general measures required to achieve BPEM, and the listing of technologies that are considered AMT for the reduction of emissions to the atmosphere, the marine environment, and solid waste disposal.

Reviewing these guidelines

A.6 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.

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B. Background

Guideline development process

B.1 In recognition of the advances in pulp mill technology and environmental management practices since the Commonwealth *Environmental Guidelines for Bleached Eucalypt Kraft Pulp Mills 1995* (1995 Commonwealth Guidelines) the Tasmanian Government commissioned the Resource Planning and Development Commission (the Commission) to develop new environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania. In developing the guidelines the Commission was required to review the emission limits, solid waste disposal criteria and site suitability criteria of the 1995 Commonwealth Guidelines.

B.2 An open and transparent process was adopted by the Commission to review the 1995 Commonwealth Guidelines and to develop new Tasmanian guidelines. Major stakeholders, interest groups and members of the public were given the opportunity to comment on the new Tasmanian guidelines. The Commission also received advice and assistance from an independent consultant.

B.3 These guidelines are based on the broad framework of the 1995 Commonwealth Guidelines and current Tasmanian legislation and statutory policies, including the *Environmental Management and Pollution Control Act 1994*, *State Policy on Water Quality Policy 1997* and *Draft Environment Protection Policy (Air Quality)*. Development of these guidelines has drawn on current international guidelines, standards and emission limits, with particular emphasis on Scandinavian, European and Canadian requirements. 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.

Other pulping and bleaching processes

B.4 The focus of these guidelines on the manufacture of high brightness BEK pulp does not imply that there are no other major pulp and paper investment opportunities based on other Tasmanian forest resources. In 2004, kraft is the dominant pulping process worldwide, accounting for some 70% of production, and producing the most valuable large volume of pulp. The kraft pulping process has been used as the subject of the largest programs of research and development with consequent improvements to the quality of environmental discharges to the environment and also energy conservation.

Definitions

B.5 Frequently used terms in this document are:

(a) accepted modern technology (AMT) – is defined in the *State Policy on Water Quality Management 1997* and the *Draft Environment Protection Policy (Air Quality) 2001* 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.'

(b) best available techniques (BAT) – is defined in Article 5 of the Stockholm Convention on Persistent Organic Pollutants 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.'

(c) 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 minimisation of the activity's environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity.'

Application of accepted modern technology (AMT), best available techniques (BAT) and best practice environmental management (BPEM)

B.6 In 2004 a mill using accepted modern technologies (AMT), best available techniques (BAT) as regards the Stockholm Convention, and best practice environmental management (BPEM) could be expected to reduce emissions of concern to a level below that which would produce any significant short-term detrimental effect on marine flora and fauna.

B.7 The emission limits set out in section D, The Guidelines, are based on the use of AMT, BAT as regards the Stockholm Convention 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 study report (Beca AMEC Ltd 2004), commissioned by the Commission, has been used as a source for identifying the technologies and practices that are considered AMT and BPEM in 2004.

B.8 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.

B.9 The main objective of these guidelines is to protect the environment by controlling the discharge of key pollutants. This is consistent with the objectives of the Tasmanian *State Policy on Water Quality Management 1997* and the *Draft Environment Protection Policy (Air Quality) 2001*. Both policies aim to limit emissions from point sources through a hierarchy of waste management, including waste avoidance, recycling/reclamation; waste re-use, waste treatment to reduce potentially degrading impacts and waste disposal. This is also consistent with the objectives of the Stockholm Convention.

B.10 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. This will ensure that the guidelines are reviewed regularly and reflect current AMT, BAT as regards the Stockholm Convention, and BPEM. This will enable new, more efficient technologies to be installed in new mills, as they are developed, consistent with AMT, BAT as regards the Stockholm Convention and BPEM.

Continued reduction of organochlorines

B.11 Current evidence suggests that at the low levels of organochlorines produced by AMT, BAT as regards the Stockholm Convention and BPEM there is no consistent relationship between adsorbable organic halide (AOX) and toxicity, and that other compounds may be causing toxicity in effluents. The National Pulp Mills Research Program (Fandry, Johannes and Nelson 1989) has shown that 2,3,7,8 TCDD (dioxins), 2,3,7,8 TCDF (furans) and certain polychlorinated biphenyls are not detectable in modern pulp mill effluent, even using the improved analyses now available. The issues of concern are now related to the possibility of long-term or short-term sublethal impacts from any effluent. Not all technologies now available use chlorine-based bleach compounds and it is now recognised that some of the toxicity in kraft pulp mill effluents, bleached or unbleached, originates from natural compounds in the wood.

B.12 Several studies have shown considerable concentrations of chlorinated organic material resulting from microbial activities and, thus, occurring as natural background levels in surface waters. Natural production varies with geographic location, but it should be recognised that organisms have evolved in environments containing natural chlorinated compounds. Natural background levels of organic chlorinated compounds will need to be taken into account when determining emission limits.

Implications of various feedstocks

B.13 The results of the National Pulp Mills Research Program have borne out the conclusions that effluents from processing eucalypts are generally similar to effluents from pulping and bleaching northern hemisphere hardwoods. However, the research has demonstrated some differences in the specific chemical composition between BEK effluents and effluents produced from other feedstocks. For instance, the composition of chlorophenols produced from processing eucalypts in the laboratory differs from that found in effluents from processing northern hemisphere softwoods. The proportion of the different chlorophenols present varies with the feedstock and processes used. These guidelines focus on emission limits and it will be up to any new pulp mill proponent to evaluate the capabilty of a potential mill to meet these limits. Feedstock characteristics will need to be taken into account when considering potential environmental impacts in the Australian context and in selecting particular chemical components to be monitored in the effluents.

Current technologies

B.14 Pulping processes using elemental chlorine free (ECF) bleaching and totally chlorine free (TCF) bleaching are both considered AMT (Beca AMEC Ltd 2004). Studies have shown that 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. Pulp produced using ECF bleaching has 75% of the world market share of total bleached kraft pulp production; pulp produced using TCF bleaching has 5% of the world market share.

Emerging technologies

B.15 Technology changes since publication of the 1995 Commonwealth Guidelines include a new chip feed system and a new cooking system called Compact Cooking. Activated sludge treatment is now considered AMT while aerated lagoon treatment is no longer considered AMT. Work continues to be carried out on system closure research and chemical recovery (Beca AMEC Ltd 2004).

B.16 The application of closed-cycle technologies to eucalypt processing was studied under the National Pulp Mills Research Program (Galloway, L, Gleadow, P, Hastings, C, & Lownertz, P 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.' While significant progress has been made in closed-cycle technology, it appears that those conclusions remain valid (Beca AMEC Ltd 2004).

C. Guidelines strategy

These guidelines for emission limits must be read in conjunction with the Tasmanian *Environmental Management and Pollution Control Act 1994*, the *State Policies and Projects Act 1993* (if applicable) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, which describe environmental impact assessment processes.

Objective

C.1 The primary objective of these guidelines is to ensure protection of the environment from emissions generated by any new bleached eucalypt kraft (BEK) pulp mill.

C.2 As accepted modern technologies (AMT), best available techniques (BAT) as regards the Stockholm Convention and best practice environmental management (BPEM) evolve for reducing emissions, emission limits should be brought down to levels which do not exceed the pre-operational concentrations.

Strategy to meet this objective

C.3 The strategy to achieve the primary objective of the guidelines is to:

(a) establish stringent emission limits based on AMT, BAT as regards the Stockholm Convention, and BPEM, and specify site suitability, pre-operational and operational studies and monitoring prerequisites to:

(i) protect against any known scientifically demonstrated risks of environmental detriment; and

(ii) detect and so avoid irreversible damage from any possible as yet unknown risks.

(b) maintain a comprehensive knowledge of the latest pulp and paper technology and its environmental effects; and

(c) review the guidelines regularly to ensure that they reflect AMT, BAT as regards the Stockholm Convention, and BPEM.

C.4 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.

C.5 The guidelines are also intended to clarify for Tasmanian government agencies, industry and potential investors the minimum environmental requirements for any new BEK pulp mill proposal in Tasmania. Any mill will ultimately require Tasmanian Government approval before construction can proceed. Furthermore, approval could depend on meeting more stringent Australian Government or Tasmanian Government requirements and will depend on consideration in the environmental impact assessment (EIA) and planning approval process of a wider range of impacts than are included in these guidelines.

Scope of guidelines

C.6 These environmental guidelines only relate to new BEK pulp mills whose liquid effluents are to be discharged into the marine environment.[e] They do not apply to the case of such a mill being integrated with another type of pulp mill or a paper mill. However, in no circumstance would any less stringent approach be taken to environmental controls applying to the BEK pulp mill component.

C.7 These guidelines do not apply to any mills in existence at the time of their release or where major contracts have been let. Nor have they been developed for direct application for major upgrades of existing mills.

C.8 Where these guidelines include specific emission limits, meeting these limits will satisfy Tasmanian requirements in regard to these emissions unless environmentally critical site specific characteristics demand more stringent requirements. Section D.3, Site suitability criteria, outlines essential elements of the Tasmanian Government's approach to site suitability considerations.

C.9 It is the Tasmanian Government's objective that these guidelines will be reflected in Tasmanian EIA and planning approval processes and permit conditions for any new BEK pulp mill in Tasmania.

Approvals

C.10 In Tasmania a new BEK pulp mill would be a major development that would be likely to be assessed as a project of State significance under the *State Policies and Projects Act 1993*. An integrated assessment of environmental, social, economic and community issues relevant to the project would be undertaken. The Tasmanian Government has entered into a bilateral agreement with the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*, which accredits the assessment processes under the *State Policies and Projects Act 1993*, thus avoiding duplication of assessment processes. In instances where the *Environment Protection and Biodiversity Conservation Act 1999* is triggered, only one assessment will be undertaken, however approvals from both the Australian Government and the Tasmanian Government would be required.

C.11 As part of the integrated assessment process the proponent would be required to prepare documentation addressing a detailed set of guidelines for environmental, social, economic and community issues relevant to the project. Any proposal will have to comply with 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.

e It is not expected that any new BEK mill in Tasmania will discharge liquid effluents into inland waters; therefore the implications of such a discharge have not been considered.

C.12 Approvals required by the Australian Government and its role in the assessment and approval process will be determined if and when a proponent submits a proposal for a new BEK pulp mill. International treaties, conventions such as the Stockholm Convention, and protocols may be relevant as well as Australian Government legislation such as the *Environment Protection and Biodiversity Conservation Act 1999*.

Need for wide consultation

C.13 Proponents need to take into account community concern over environmental impacts of large-scale pulp mill developments. Community acceptance and support for such developments is very dependent on the proponent's preparedness to consult widely and its willingness to effectively address sensitive issues that emerge. These guidelines and the Tasmanian EIA and planning approval processes have been developed to assist proponents in addressing these issues. They do not, however, relieve the proponent of the responsibility for such wider consultation, nor, in particular, of the need to consult the bodies representing other industries, such as fishing and tourism, that may be affected by a proposed BEK pulp mill.

Review of these guidelines

C.14 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. This will ensure that the guidelines are reviewed regularly and take into account technological improvements and new knowledge on AMT, BAT as regards the Stockholm Convention, and BPEM. This will enable new, more efficient technologies to be installed in new mills, as they are developed, consistent with AMT, BAT as regards the Stockholm Convention and BPEM. The review could be brought forward if particular environmental concerns have arisen, major new developments in AMT, BAT as regards the Stockholm Convention and BPEM have occurred, or a major new mill was about to be considered close to a scheduled review date.

C.15 Revised guidelines will not apply retrospectively.

Environmental impact assessment

C.16 Through the EIA and planning approval processes the pulp mill proponent will satisfy the Tasmanian Government that a particular site is suitable for a pulp mill development based on meteorological, hydrodynamic and biological studies of the site, as outlined in these guidelines and any other studies required as part of an assessment. The Tasmanian Government will be satisfied that the discharges will cause no unacceptable risk of environmental detriment if:

(a) these studies demonstrate the suitability of the site;

(b) the proponent satisfies the Tasmanian Government that the proposed mill will operate within the emission limits and ambient environmental performance criteria defined in this document; and

(c) agreement is reached amongst the proponent, the Tasmanian Government and the Australian Government on a suitable environmental management plan, comprising effective monitoring and regulatory arrangements.

Monitoring program responsibilities

C.17 A monitoring program for any pulp mill will be determined by the Tasmanian Government with the following responsibilities:

(a) the Australian Government will be closely consulted, where necessary, and agree to the monitoring, reporting and regulatory procedures (including auditing arrangements) developed between the Tasmanian regulating authority and the proponent – they will be consistent with these guidelines;

(b) the company operating the pulp mill will be required to monitor and report regularly on effluent composition and environmental impacts; and

(c) the Tasmanian regulatory authority will develop and agree on a mechanism to assure the Australian Government of the efficacy of the monitoring, reporting and regulatory arrangements referred to in (a) above.

Public reporting of mill performance

C.18 As part of its reporting obligations, the mill operator will be required to provide an annual report on the environmental performance of the mill, to be placed on the public record within two months of the end of the reporting period unless otherwise agreed. While the detailed nature of this report will be agreed in consultation with the Tasmanian regulatory authority and the Australian Government, where necessary, at a minimum it will include:

(a) the raw data[f] and the performance record over the year, in graphical form, of all emission level measurements required under these guidelines;

(b) a report, in detail equal to that in (a), of the results of the monitoring program required under these guidelines; and

(c) other matters required by the regulatory authorities.

f For 'continuously monitored' emissions (see Table 9) the volume of raw data would make reporting of all measurements impractical. In these cases the exact form of reporting of representative data will be agreed between the proponent and the regulatory authority.

D. The Guidelines

D.1 Emission limits

D.1.1 The emission limits defined below are considered to be minimum standards that any new BEK pulp mill proposed to be built in Tasmania will be required to meet. This will ensure that AMT and BPEM are used in any new mill. It is expected that any such mill will install pulping and bleaching technology augmented with effluent treatment systems which will minimise the discharge of pollutants of environmental concern. AMT to control emissions to the atmosphere, marine environment and land will be mandatory. This will include effective systems for the control of accidental spills and releases, and stack and diffuser systems designed to optimise the dispersal of all emissions that are produced. For emissions to the marine environment, emission limits will be set at levels that can be achieved by using AMT, unless lower limits are required to protect recognised water quality objectives.[g] Water quality objectives will need to be determined in accordance with the *State Policy on Water Quality Management 1997* for the discharge site for a specific pulp mill proposal.

D.1.2 More stringent standards may be required to mitigate any deleterious environmental impacts identified during the environmental impact assessment for the proposed mill.

General measures for best practice environmental management

D.1.3 Any new mill will be required to implement the general measures for BPEM listed in Table 1, which are aimed at achieving ongoing minimisation of emissions.

Table 1 General measures for best practice environmental management[h]

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

g Clause 17.1 of the *State Policy on Water Quality Management 1997*.

h These measures are consistent with the measures listed in section 4(2) of the *Environmental Management and Pollution Control Act 1994*.

Table 1 General measures for best practice environmental management (continued)

	• 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 • Development of an incident/emergency response plan to ensure appropriate response measures in relation to non-compliance events
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

Accepted modern technology (AMT) for the reduction of emissions to the atmosphere

D.1.4 Any new mill will be required to incorporate technologies listed in Table 2, which are considered AMT for the reduction of emissions to the atmosphere, or equivalent.

Table 2 AMT for the reduction of emissions to the atmosphere

Pollutant(s)	Description of AMT
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

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

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

Pollutant(s)	Description of AMT
Nitrogen oxides (NOx)	• 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.

D.1.5 A proponent will ensure that all reasonable and practical measures are taken to avoid the production of wastes that might be emitted to the atmosphere including:

(a) avoidance;

(b) reuse;

(c) recycling;

(d) recovery of energy;

(e) treatment;

(f) containment; and

(g) disposal.[i]

i Clause 10 of the *Draft Environment Protection Policy (Air Quality) 2001*.

Emission limits to the atmosphere

D.1.6 The following limits listed in Table 3 are set on pollutants discharged to the atmosphere. The limits are derived from the Beca AMEC Study Report (Beca AMEC Ltd 2004) and are based on the analysis carried out by Beca AMEC. Millwide process limits for sulfur and oxides of nitrogen (NO_x) emissions from all sources excluding the power boiler are given in kilograms per air-dried metric tonne (kg/ADt). The oxygen reference levels[j] have been selected to be as close as possible to the actual operating conditions. This is in accordance with Swedish and Finnish practice. Oxygen reference levels of 3% O_2 for all sources except the bark boiler and 8% O_2 for the bark boiler are recommended. In addition to these millwide limits there will be concentration limits set for significant emissions from point sources within the pulping progress, e.g. recovery boiler, lime kiln, CNCG incinerator. In-plant air emission levels will have to meet relevant Occupational Health and Safety criteria.

D.1.7 Concentration limits for specified emission points[k] 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 the recovery boiler, the lime kiln and the 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
- chlorine dioxide and related compounds expressed as chlorine (Cl_2) for all sources.

D.1.8 With the exception of odour, 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. Test methods 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 mobile gas chromatograph/mass spectrometer (GC-MS) or instrumentation of equivalent sensitivity. 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.

j 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.

k Total reduced sulfur, sulfur dioxide (SO_2), sulfur trioxide (SO_3) and sulfuric acid mist are included in millwide sulfur from all sources excluding power boiler. Nitrogen oxides are included in millwide NOx from all sources excluding power boiler. 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.

Table 3 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 3 Emission limits to the atmosphere (continued)

Emission point	Pollutant	Units[a]	Annual average	Monthly average	Testing frequency
Power boiler	PM	mg/NDm^3		30 @ 8% O_2	See note s
	NO_x	mg NO_2/MJ fuel input		80 See note h	Continuous
		mg NO_2/NDm^3		~200 @ 8% O_2[i]	
	SO_2	mg S/NDm^3		See note j	Continuous
	PCDD/PCDF	pg I-TEQ/NDm^3		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/NDm^3		See note d	Twice yearly
All sources	Hydrogen chloride (HCl)	mg HCl/NDm^3		See note m	Continuous
All sources	Odour	mg H_2S/NDm^3		See note d	See note n
All sources	Inorganic chlorinated compounds	mg Cl_2/NDm^3		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 NOx 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 NOx from all sources.*

i *Recalculated for a 8% O2 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 NOx point sources.*

m *Included in chlorine dioxide and related 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. Furtheremore, 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.*

Volume 2

Accepted modern technology for the reduction of emissions to the marine environment

D.1.9 Any new mill will be required to incorporate technologies listed in Table 4, which are considered AMT for the reduction of emissions to the marine environment, or equivalent.

Table 4 AMT for the reduction of emissions to the marine 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

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

Topic or mill area	Description of AMT
Bleaching	• ECF or TCF bleaching • Extraction stage reinforced by either oxygen (EO) or hydrogen peroxide (EP), or both (EOP) • High shear chemical mixing (i.e. with high power dissipation) • Partial bleach plant closure (i.e. increased recycle of filtrates within the bleach plant and possibly recycle of some bleach plant filtrate to the brown stock area and to chemical recovery) • Efficient washing of pulp
Bleaching chemical preparation	• On-site generation of chlorine dioxide with low contamination of elemental chlorine (methanol or hydrogen peroxide processes)
Effluent treatment	• Primary and secondary (biological) treatment of all process effluent, excluding uncontaminated cooling watera • 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.

Emission limits to the marine environment

D.1.10 A proponent will ensure that emission limits of pollutants from point sources are consistent with the following key principles:

(a) the discharge limits must be set at levels which will not prejudice the achievement of water quality objectives; and

(b) Pollutant discharges to the environment should be reduced to the maximum extent that is reasonable and practical having regard to best practice environmental management, and in accordance with the following hierarchy of waste management, arranged in decreasing order of desirability:

(1) waste avoidance;

(2) recycling/reclamation;

(3) waste re-use;

(4) waste treatment to reduce potentially degrading impacts; and

(5) waste disposal.[1]

D.1.11 The following limits are set for pollutants in the liquid effluent stream to be discharged into the marine environment and are derived from the Beca AMEC Study Report (Beca AMEC Ltd 2004). These guidelines include emission limits for key wastewater pollutants that are specific to BEK pulp mill wastewater effluent, but depending on the circumstances and characteristics of the receiving waters there may be justification for setting limits on other wastewater discharge parameters e.g. nutrients, pH, temperature and possibly flow. Limits for other wastewater discharge parameters will be set in accordance with Tasmanian regulations and protocols.

Discharge limits

D.1.12 Table 5 lists the recommended monthly average and daily limits for biologically treated effluent at the point of discharge.

Table 5 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 since their AOX is non-detectable.

D.1.13 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.

D.1.14 Table 6 lists additional parameters, and their discharge limits, which should be included in the effluent permit. These discharge limits apply to each individual biologically treated 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).

1 Clause 16 of the *State Policy on Water Quality Management 1997*.

Table 6 Discharge limits for each biologically treated 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]	mg/L	2
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.

Effluent permit limits

D.1.15 Daily maximum and monthly average maximum discharge limits for TSS, BOD_5, COD and colour should be specified in the effluent permit in units of kg/d. These limits should be calculated by multiplying the daily and monthly average limits from Table 5 by the nominal design capacity of the mill in ADt/d.

D.1.16 Daily maximum and monthly average maximum discharge limits for AOX from a mill employing an ECF bleaching sequence can be specified in kg/ADt with the proviso that reference is made to bleached pulp.

Test methods

D.1.17 The test methods suggested for the environmental parameters listed above are presented in Table 7. Other approved methods equivalent to, or better than, those listed may be used.

Table 7 Suggested test methods for analysis of liquid effluent pollutants

Parameter	Test method
Total suspended solids (TSS)	SMEWW-APHA[a] GFC filter (1.2 µ)
Biochemical oxygen demand (BOD_5)	SMEWW-APHA
Chemical oxygen demand (COD)	SMEWW-APHA
Organochlorines measured as adsorbable organic halide (AOX)	EN 1485:1996[b]
Colour	SMEWW-APHA
Acute toxicity	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 regulatory authority
Chronic toxicity	As for acute toxicity
Dioxins, 2,3,7,8-TCDD	Australian Government Analytical Laboratory US EPA and New Zealand's Environmental Science Research Institute methods are acceptable
Chlorate	TAPPI[c] method T700 om-93
Trihalomethanes including chloroform	USA EPA test method 0501
Oil and grease	SMEWW-APHA
Furans, 2,3,7,8-TCDF	Australian Government Analytical Laboratory US EPA and New Zealand's Environmental Science Research Institute methods are acceptable

Notes:

a Standard Methods for the Examination of Water and Wastewater, 20th or later Edition, published by the American Public Health Association.

b European Standard (CEN or Comité Européen de Normalisation).

c Technical Association for the Pulp and Paper Industry.

D.2 Solid waste disposal guidelines

Accepted modern technology for the reduction and handling of solid waste

D.2.1 Any new mill will be required to incorporate technologies listed in Table 8, which are considered AMT for the reduction and handling of solid waste, or equivalent.

Table 8 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
• Transport and disposal of controlled wastes must be undertaken only by persons authorised to do so under the *Environmental Management and Pollution Control Act 1994* or the *Waste Management Regulations 2000*
• Material that cannot be reused, recovered or has to be handled differently should be taken to a landfill that is approved to receive the type of waste to be disposed of. Only inert, primarily inorganic waste should be landfilled. 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 controlled 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*

D.2.2 As pulp mill technology moves towards 'closed-cycle' processes, it is likely that disposal of solid wastes will become more significant in the future, and may require further investigation if such a mill was proposed.

D.2.3 All wastes, solid and otherwise, will be managed in accordance with the waste hierarchy:

(a) avoidance;

(b) reuse;

(c) recycling;

(d) recovery of energy;

(e) treatment;

(f) containment; and

(g) disposal.[m]

D.2.3 The disposal of solid wastes should be reduced by minimising the generated amounts and by recovering, recycling and re-using potential waste fractions wherever practicable. Separate collection and intermediate storage of different fractions should be applied to meet this aim.

D.2.4 Transport and disposal of controlled wastes must be undertaken only by persons authorised to do so under the *Environmental Management and Pollution Control Act 1994* (EMPCA) or the *Waste Management Regulations 2000*.

D.2.5 Bark, fibres, wood residues and other organic material which cannot be reused should be burned and the energy recovered. When burning mixed organic waste of different origin in power and recovery boilers, the formation of dioxins and furans within the boiler must be inhibited 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. The boiler must also be equipped with adequate flue gas cleaning (i.e. electrostatic precipitators).

D.2.6 Disposal of any solid waste that is not inert and primarily inorganic and that cannot be reused, recovered or burned for fuel must be undertaken by persons authorised to do so under EMPCA or the *Waste Management Regulations 2000*. Prior to disposal the waste must be dewatered to the maximum extent possible using high intensity press.

D.2.7 Any landfill sites used by the mill operator for disposal of solid wastes that are water soluble should be chosen and managed in agreement with relevant State agencies. They should include, as a minimum, cut-off drains, leachate collection drains and storage and subterranean collectors capable of accommodating run off from the site of a volume equal to a 10-year recurrence interval storm, and from areas surrounding the site of a volume equal to a 50-year recurrence interval storm. Sufficient groundwater monitoring wells per site to satisfy the regulatory authorities that adequate monitoring and reporting of leachate, if identified, will be possible should also be included.

D.2.8 Sections of the landfill that have been completely filled should be covered and sealed according to appropriate procedures.

D.2.9 Liquid wastes are not permitted to be disposed of at a landfill.

m Clause 10 of the *Draft Environment Protection Policy (Air Quality) 2001*.

D.3 Site suitability criteria

D.3.1 Of key Tasmanian concern is the impact on the environment of any potential mill. Consequently, while the preceding sections ensure that only mills incorporating AMT, BAT as regards the Stockholm Convention, and BPEM – and therefore having minimum discharges of effluents into the environment – are built in Tasmania, meeting those requirements is not in itself sufficient to gain approval to build a mill.

D.3.2 As part of the EIA and planning approval process, proponents of pulp mills will be required to undertake studies that will enable them to demonstrate the suitability of a proposed site in terms of the mill's ability to meet specified ambient criteria for air quality, water quality and biological condition. This would form part of the environmental impact statement. These site-specific studies and ensuing model development would enable companies to determine what special design criteria are necessary for such items as the air emission stack and ocean outfall pipe, to ensure conformity with the ambient air and water quality criteria defined below.

D.3.3 In respect of the emissions covered by these guidelines there is no scientific evidence to suggest that a BEK pulp mill operating within the emission levels set in these guidelines would have unacceptable environmental impacts.

Meteorological studies

D.3.4 There are concerns with atmospheric emissions, particularly with reduced sulfur compounds.[n] While they are extremely smelly and can be detected by the human senses at extremely low levels, they can be controlled but cannot be eliminated entirely given the nature of the process. The guidelines require a study of meteorological and topographical characteristics of the site based on adequate data from at least one year which, combined with emission stack design, will demonstrate that the ambient levels can be met at the site, or at site boundaries.

D.3.5 Where several sites are being considered for their suitability, knowledge of their topography and meteorological characteristics, such as air stability and prevailing winds, will be required to discriminate between the sites.

D.3.6 It will be necessary to measure appropriate meteorological parameters, to allow estimation of concentrations of pollutants at ground level in the vicinity of a proposed pulp mill. Meteorological stations should be located, and measurements undertaken, in accordance with Australian Standard AS 2923. Parameters should include the following, measured at the nominal heights shown:

n Principally hydrogen sulfide and a group of compounds known as organic sulfides that include mercaptans.

- Wind speed 10 m
- Wind direction 10 m
- Air temperature 2 m
- Temperature difference Between heights of 2 m and 10 m
- Humidity or dew point 2 m
- Solar radiation As convenient
- Net radiation 1 to 1.5 m
- Rainfall Near ground
- Barometric pressure 2 m

D.3.7 A minimum of 12 months' data is considered essential if these parameters for air quality monitoring are to be used with reasonable confidence. In the absence of other pollutant sources, background levels could be assumed to equal existing ground level concentrations of particular pollutants.

D.3.8 Data from the meteorological studies should be incorporated into a model that will allow demonstration that the proposal complies with the *Draft Environment Protection Policy (Air Quality) 2001*.

Air quality design criteria[o]

D.3.9 For stack design purposes only, it must be shown that outside the mill property boundary the following design criteria concentrations[p] (including background but excluding background levels as determined during pre-operational studies) shall not be exceeded for the following pollutants[q]:

(a) **sulfur dioxide**, measured as µg/NDm^3

1 hr moving average 200

(b) **TRS** (total reduced sulfur) expressed as hydrogen sulfide (µg/NDm3)[r]

3 min moving average 1.5[s]

o Specified in Schedule 2 of the *Draft Environment Protection Policy (Air Quality) 2001*, with the exception of TRS expressed as hydrogen sulfide.

p The proponent must consult the regulatory authority on the selection of the predicted maximum concentration.

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.

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.

s At these low levels, emission controls exist primarily so that ambient concentrations are below those levels which humans can detect. The Australian Government has been advised that the most sensitive humans can detect hydrogen sulfide at 0.2-2.0 µg/NDm^3, and that concentrations which average 7.0 µg/NDm^3 in a 30-minute period could cause annoyance.

(c) **inorganic chlorinated compounds** (µg/NDm^3)

3 min moving average 10

(d) **nitrogen dioxide** (µg/NDm^3)

one hour moving average 160

(e) With the changes in bleaching technology, some additional compounds may be produced. If so, the particular additional compounds that are monitored should reflect the technology proposed and be agreed at the time when the guidelines are to be implemented.

D.3.10 To retain a reserve capacity for airsheds, no point source activity should be permitted to emit a pollutant in a manner or quantity that, allowing for other reasonable emissions to the relevant airshed, would prejudice compliance with the National Environment Protection Measure for Air Quality (National Environment Protection Council 1998).[t]

D.3.11 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.

Hydrodynamic studies

D.3.12 Where several sites are being considered for their suitability, knowledge of the physical characteristics of the oceanic receiving waters such as bathymetry, stratification and typical prevailing currents will be required to aid in choosing between the sites.

D.3.13 At the preferred site, studies shall be conducted to predict the dispersion of effluent in the receiving waters. In particular the influence of water currents on the effluent plume distribution must be considered.

D.3.14 It is expected that the studies will require the use of a hydrodynamic model and appropriate wind, current and water density measurements to determine the effluent dispersion characteristics under a variety of weather conditions, and allow for seasonal variability.

D.3.15 The hydrodynamic studies will need to provide an adequate level of detail required to determine an appropriate mixing zone (if necessary) and an appropriate post-commissioning monitoring program. The proponent will be responsible for undertaking the hydrodynamic studies to the required standard.

D.3.16 Data from the hydrodynamic studies should be utilised to define a mixing zone for the dilution of mill effluent at the point of discharge, in accordance with the *State Policy on Water Quality Management 1997*. The size of the mixing zone is site-specific and could be varied if site-specific environmental factors indicate some change of size.

t Clause 11(1)(b) of the *Draft Environment Protection Policy (Air Quality) 2001*.

Ambient water quality criteria

D.3.17 Water quality objectives for the receiving waters will be set in accordance with the *State Policy on Water Quality Management 1997*, and hydrodynamic studies should be utilised to assist demonstration that these objectives can be met at or beyond the edge of the mixing zone.

D.3.18 A mixture of effluent and receiving water, in a proportion equal to the agreed minimum dilution at the edge of the mixing zone, should have the following properties[u] in comparison to the receiving water alone:

(a) **colour**[v]

(i) the visual clarity is not reduced by more than 20%;

(ii) the hue is not reduced by more than 10 points on the Munsell Scale;

(iii) the reflectance is not changed by more than 50%; and

(iv) the horizontal sighting of a 200 mm black Secchi disc is more than 1.6 m.

(b) **optical quality**

(i) natural euphotic depth: no more than 10% change; and

(ii) seasonal mean nephelometric turbidity: no more than 10% change.

D.3.19 All potential pollutants will meet the Australian Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000a).

Biological studies

D.3.20 The marine environment will need to be surveyed to characterise the distribution of marine habitats within an expected zone of influence around the proposed outfall. This will require mapping of benthic and littoral communities, species of commercial, ecological and conservation significance and approximate indices of species diversity and sediment types.[w] In addition to providing necessary information to assess the development proposal it will also enable informed selection of sampling sites and of species to be studied in the pre-operational and operational monitoring program. Species for subsequent monitoring must be selected from common species in the area that are likely to be among those most sensitive to mill effluents.

D.3.21 Consultation with the regulatory authorities prior to conducting the survey will ensure the methods used and information collected are appropriate.

D.3.22 The study should include an assessment of background levels in sediments and selected biota of substances that may represent pollutants.

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u These properties are recommended in the Australian Water Quality Guidelines for Fresh and Marine Waters.

v While colour is an aesthetic rather than a toxic parameter, the colour intensity specified will ensure no significant restriction of light to marine organisms.

w Distribution of depositional and transport bottoms based on sediment characteristics should be determined and sediment sampling stations subsequently sited on depositional bottoms (for rationale, see *Biological Effects of Bleached Pulp Mill Effluent*, National Swedish Environmental Protection Board Report 35858, 1989).

D.3.23 The proponent will be responsible for providing baseline biological data with a sufficient level of statistical rigour to allow potential impacts on biological communities to be predicted and monitored with a high level of confidence.

D.4 Monitoring

D.4.1 All parameters specified in these guidelines will need to be monitored pre- and post-operation so that demonstrable evidence can be provided that the mill is not exceeding the limits set out in the mill's permit conditions.

D.4.2 In addition to monitoring emissions at the end of the outfall pipe and emissions stack(s), the operator of the pulp mill will need to carry out a monitoring program that assesses the effects of the pulp mill discharges on the receiving atmosphere, water, biological communities and marine sediments.

D.4.3 The design of the monitoring program, variables to be measured, the frequency of sampling, location of study sites and controls, degree of replication and the desired statistical power should all be considered and agreed amongst the regulatory authorities and the proponent before the program begins.

D.4.4 The pre-operational and ongoing operational monitoring studies should be designed as one exercise and allow for a minimum of 2.5 years pre-operational data. Pre-operational and operational monitoring should measure the same parameters under the same methodology, at the same frequencies, to provide the best statistical outcome before assessment and review of the continuing monitoring program.

D.4.5 Table 9 contains indicative core parameters to be monitored at all new mills. If it is suspected that contamination from other sources is affecting the area of expected influence of the mill outfall, then such contamination must also be adequately documented to enable future monitoring to differentiate those environmental effects due to other pollution sources from those due to pulp mill effluents. Table 10 contains some of the parameters that might have to be monitored in such circumstances.

D.4.6 Where proponents plan to use surfactants in their pulping or treatment processes, monitoring will be carried out in accordance with the requirements of the Tasmanian licensing authority.

Table 9 Indicative core chemical, biological and other parameters to be monitored

(Sampling frequencies: C, continuous; I, as specified by the regulatory authority; D, daily; X, three times per week; W, weekly; M, monthly; S, twice yearly; T, three monthly; Y, yearly; 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; -, not applicable. Samples taken for chemical analysis of liquid emissions must be 24 hour composite samples that are collected using an autosampler approved by the regulatory authority that uses flow weighting in its sampling protocol.)

Parameter/assay	Discharge	Receiving environment[a]		
		Water	Sediments	Biota
Air emissions				
Particulates (PM)	M			
H_2SO_4 Mist	S			
SO_2 + SO_3	I			
SO_2	I			
TRS	C			
HCl	C			
Cl_2	C			
Chlorinated dioxins and furans	T, S[n]			
Inorganic chlorinated compounds	C			
NO_X	C			
Volume discharged	D	–	–	–
TSS	D[b]	–[b]	–	–
BOD	X			
COD	D	–	–	–
Oil & grease (visual)	D	–	–	–
Chlorate[c,d]	V	V[c]		
AOX[d]	W		–	–
2,3,7,8-TCDD and 2,3,7,8-TCDF	V	–	Y	Y
Chlorinated phenols[d,e]				
– total	I[e]		V[e]	V[e]
– 2-chlorosyringaldehyde[e]	I[e]	–	V[e]	V[e]
Trihalomethanes including chloroform[d]	V	–	–	–

Table 9 Indicative core chemical, biological and other parameters to be monitored (continued)

Parameter/assay	Discharge	Receiving environment[a]		
		Water	Sediments	Biota
Effluent toxicity tests[f]				
– on 100% effluent				
[f]Microtox®	W[f]			
Others[f]	M[f]			
– more sensitive tests[g]	T		[g]	
Optical properties		I[i]		
Tainting of seafood	–	–	–	T[j]
Histopathology – fish gill, liver, external[k]	–	–	–	Y[k]
Fish physical abnormalities (sores, malformation, fin erosion)[l]	–	–	–	S[l]
Population status of benthic biota[m]	–	–	–	Y[m]

Notes:

a For water, sediments and biota, these sampling protocols pertain only to the receiving environment immediately outside the mixing zone. Sampling sites should be selected as part of the design of the monitoring program, in consultation with the Tasmanian regulatory authorities.

b Improved technology and best practice for bleached kraft pulp mills has significantly reduced the amount of TSS discharged from a modern mill. While monitoring TSS in the effluent provides a measure of operational efficiency, there is little value in monitoring TSS outside the pre-determined mixing zone, particularly in marine waters. Total suspended solids from modern discharges are not expected to have unacceptable environmental impacts.

c Monitoring of chlorate is not necessary if the process does not use chlorine-based bleaching. A site-specific limit for chlorate should be determined following pre-operational studies of local nitrate concentrations. The method used for chlorate measurement should be chosen from the several approved methods and that method used consistently throughout the monitoring program. Laboratory tests suggest that concentrations required to protect brown algae are less than 10 µg/L (Rosemarin et al.*1986)*

d Chlorate, AOX, chlorinated phenols and trihalomethanes need only be measured in effluents from mills using chlorine-based bleaching processes. At the levels of discharge from mills using current best practice in 2004, AOX is not an indicator of potential environmental impact. Given the levels of AOX discharged from modern mills, there is no known environmental reason to monitor the AOX concentration in the receiving waters as frequently as previously thought. However, for ECF mills, the AOX level in the effluent discharge is considered a good indicator of mill performance.

e Measurement of chlorinated phenols including 2-chlorosyringaldehyde is not necessary for non-chlorine based bleaching processes. Research conducted for the National Pulp Mills Research Program has shown that chloroguaiacols and chlorocatechols are not present in significant quantities in effluents from bleaching eucalypts

by modern sequences. The major chlorinated phenol detected in laboratory effluents from chlorine dioxide bleaching of eucalypts is 2-chlorosyringaldehyde. Secondary treatment reduces the concentration of this compound in treated effluent and it is not likely to be detectable in receiving waters or the environment. However, should AOX levels be detected exceeding the monthly average maximum of 0.2 kg/ADt, total chlorophenols and the distribution of the particular components of the chlorophenols should be monitored in the effluent immediately, as part of the investigation of the cause of the elevated levels of organochlorines. Total chlorinated phenols should be measured in the biota and sediments annually, to monitor any potential bioaccumulation of otherwise undetectable chlorophenols.

f *Microtox® tests can be performed rapidly and provide a good routine indication of mill performance. Weekly tests should enable any significant fluctuations in effluent quality to be detected and remedied. However, Microtox® tests alone cannot ensure that the full range of potential toxicant functions on higher organisms are detected if present. An invertebrate and a vertebrate test should be conducted monthly to ensure other possible types of toxicity are detected. Appropriate tests should be chosen as part of the monitoring program at such time as implementation is required. Other tests that have been validated for pulp mill effluents may also be available when the guidelines are required to be implemented.*

g *A suite of short-term sublethal toxicity tests using organisms from at least three trophic levels represented by different taxonomic groups (e.g. algae, invertebrates and fish) and a range of potential mechanistic effects should be conducted at three-monthly intervals in effluents. Research conducted for the National Pulp Mills Research Program has developed short-term sublethal toxicity tests using* Nitzschia, Hormosira *fertilisation, sea urchin fertilisation, doughboy scallop larval development and* Allorchestes *larval development. With the exception of the Allorchestes test, these bioassays have been trialed with modern laboratory bleached eucalypt kraft effluents for both ECF and TCF bleaching sequences. The test protocols are available and are being published as part of the Technical Report series of the National Pulp Mills Research Program (e.g. Stauber* et al. *1994). Other research conducted by the Program has seen some progress in designing tests of larval development using Tisbe.*

There should be yearly short-term sublethal toxicity tests on sediments as soon as suitable tests are available. Developing such tests has proved to be an extensive and difficult task for all countries. Environment Canada has begun an extended five year program to focus on developing sediment toxicity tests suitable for their pulp and paper industry. The National Pulp Mills Research Program also recognised the need for suitable sediment tests. However, appropriate expertise was not forthcoming and suitable tests have not yet been developed for Australian conditions. Some methods are described in Dickson et al. *(1987). Environment Canada (1992) has published a method using amphipods. This is an important area which needs to be addressed to ensure appropriate monitoring of potential long-term effects of any effluents. Choice of tests will need to be assessed when the guidelines are required to be implemented.*

h *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 anoxic wastewater treatment plant 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.*

i *Neither the natural euphotic depth, nor the seasonal mean nephelometric turbidity should change by more than 10% in the receiving water.*

j *A taste panel test of the most sensitive edible and available biota should be conducted. Fat content of fish varies with season and this may influence detectability of tainting. Tests should be conducted more frequently than annually.*

k *There is no information to show if modern BEK effluents, either ECF or TCF, will elicit a histopathological response. Work done elsewhere on effluents from other feedstocks is inconclusive. Histopathological responses have been shown for other effluents, but other tests may reveal effects on the organism before the histopathological response is manifested. It is recommended that yearly histopathological tests be conducted during the initial monitoring program to provide data on whether such responses occur. Should a response be detected during this time, additional monitoring may be required. Continuation of the histopathological monitoring may be reviewed following the initial monitoring period.*

l *The frequency of testing should be twice yearly, little additional information being expected from more frequent monitoring. The timing of the tests should correspond to the upper and lower limits of the annual water temperature. These are the periods of most natural stress for the fish populations, when any additional potential stress from effluent discharge would be expected to have the most effect.*

m *Surveys of population status should occur annually, unless local site information indicates a greater frequency is required. Information from other monitoring programs in Victoria suggests that annual surveys are sufficient to detect any significant variation in benthic communities. In practice, logistical constraints can reduce the statistical significance of more frequent monitoring.*

n *Three monthly for the first 12 months then twice yearly.*

Table 10 Some provisional measurements which may be required in connection with certain pre-operational or operational monitoring programs

(Sampling frequencies: Y yearly; – not applicable.)

Parameter/assay[a]	Discharge	Measurement zone		
		Water[b]	Sediments	Biota
Pesticides	–	–	Y	Y
PAHs	–	–	Y	Y
PCBs	–	–	Y	Y
Heavy metals[c]	–[c]	–	Y	Y
Surfactants	–	Y	Y	Y

Notes:

a *The parameters noted here are indicative examples only. The particular components to be monitored should be agreed at such time as the proposed process is known, as not all parameters will be appropriate for all processes.*

b *Taken at stations immediately outside the pre-determined mixing zone.*

c *As technology moves towards 'closed-cycle' processes, the heavy metal concentrations in effluents may increase and the monitoring frequency of such compounds should reflect the expected level of discharge.*

D.4.7 If operational monitoring reveals rising concentrations of pollutants or significant response to biological tests, the monitoring program may require modification. Any modification should maintain the statistical validity of the monitoring program.

Marine environmental effects monitoring

D.4.8 Mill proponents will need to monitor waters near to, but outside of, the designated mixing zone for the mill outfall. Monitoring should begin immediately following the selection of the mill location.

D.4.9 The methodology for conducting the monitoring program should follow that described in the Australian and New Zealand Guidelines for Water Quality Monitoring and Reporting (ANZECC & ARMCANZ 2000b).

Atmospheric environmental effects monitoring

D.4.10 Mill proponents will need to monitor the atmospheric conditions at the mill property boundary. Monitoring should begin immediately following the selection of the mill location.

D.4.11 The methodology for conducting the monitoring program should follow that described in the *Draft Environment Protection Policy (Air Quality) 2001*.

D.4.12 The operator of the mill will be required to establish a program of nuisance TRS odour monitoring. In addition to compliance with environmental discharge limits, the mill operator will be required, as part of BPEM, to establish a program of nuisance odour monitoring with the aim of ensuring that discharges of nuisance TRS odours beyond the mill boundary are progressively decreased over as short a period as possible to a level that is consistent with BPEM. This program will be agreed as part of the EIS and will include:

(a) establishment of a panel of at least 10 local residents who are willing to be trained to provide regular an systematic feedback on the type and level of any nuisance odours emanating from the mill that are detectable on their properties;

(b) acquisition and use by the mill operator of at least one portable gas chromatograph – mass spectrometer (GCMS) (or instrumentation of similar or greater sensitivity and utility) to characterise, identify, locate and eliminate diffuse sources of TRS odour within the mill. It is expected that the mill operator will show progressive reduction in the reported frequency of escape of TRS odours beyond the mill boundary over the first 12 months of routine operation (excluding the initial commissioning period) to a level of not more than 10 days per year in accord with world's best operating practice.

Biological monitoring

D.4.13 The comprehensive pre-operational study of the distribution, abundance and diversity of marine plants, animals and sediments, and of their seasonal and inter-annual change, will be used to establish pre-operational conditions in the probable zone of influence around the outfall.

D.4.14 Species to be studied and locations of sampling sites will be chosen based on a sound knowledge of the physical oceanography and distribution of marine biota within the possible zone of influence of the mill. Those will be provided by site suitability, sample site and species selection studies.

D.4.15 Species chosen should have life spans and behavioural patterns appropriate to detection of potential short-term sublethal toxicity effects on populations. Individuals of the species should potentially be resident in the area of the sampling site for a considerable proportion of their adult life.

D.4.16 Selection of the number and location of control sites is an integral part of the design of the monitoring program and should be considered during the design phase, in consultation with regulatory authorities.[y] Control sites should be outside the zone of influence of the mill, but in areas with closely matched oceanographic, sedimentary and biological characteristics where that is feasible.

D.4.17 Sampling must facilitate the determination of natural spatial, seasonal and interannual variation in the biological characteristics of the area. The survey design[z] must therefore facilitate sound statistical analysis of variations in measured parameters. Replication levels will need to be determined on the basis of the preliminary survey.

D.4.18 A suite of bioassays to monitor the toxicity of effluents from BEK mills has been designed and incorporated in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000a).

y Ideally there should be at least two control sites outside the zone of influence of the mill. There might be outfall sites where this requirement becomes difficult to fulfill, or where there is insufficient marine life to allow for meaningful comparisons of populations over time.

z Methodology for conducting the monitoring program should follow that described in *Protocols for designing marine ecological monitoring programs associated with BEK mills*, by M.J. Keough and B.D. Mapstone (1995), National Pulp Mills Research Program Technical Report No.11.

D.5 Implementation, quality assurance and review

Implementation and quality assurance

D.5.1 The proponent's licence to operate will normally include a comprehensive listing of the conditions under which the mill must operate, and a requirement for a major review by the Tasmanian licensing authority every five years, to ensure the mill is using current BPEM. However, it is recognised that the authority might be required to make changes more frequently.

D.5.2 The conditions attached to a licence are fundamental to the ability of the regulatory authority to regulate the performance of a mill. They normally set out a comprehensive list of the matters that will fall under the authority's scrutiny and actions that are to be taken in the event of a breach (for example). Given the importance of accurate public perception of the regulatory practices that will apply to a mill, it is considered desirable that the licence conditions be publicly accessible.

D.5.3 Chemical and biological analytical procedures should be able to be validated against appropriate quality assurance criteria.

D.5.4 A process should be defined that allows the environmental performance of each mill to be subjected to independent audits. These should address not only the manner in which the mill is operated, but should also review the information collected in the monitoring program.

D.5.5 In the event of the monitoring program disclosing some short-term sublethal impact, where unless some action is taken irreversible damage appears probable, the mill operator will be required to undertake an urgent investigation to establish the cause of the impact. The mill operator will investigate options for remedial action and take any action of an urgent nature, concurrent with reporting to the regulatory authority. The regulatory authority will be the final arbiter on the extent of remedial action required and will inform the Australian Government, if appropriate.

D.5.6 In the case of a breach of an emission limit, the operator will:

(a) notify the regulatory authority of the breach immediately;

(b) provide a statement within 24 hours describing the reasons for the breach and proposed methods for correcting the problem; and

(c) comply with the regulatory authority's requirements on the method of addressing the problem, as soon as possible.

D.5.7 The option of suspension of mill operations is available to the Tasmanian regulatory authorities in the event of unacceptable breaches.

Pre-defined contingencies

D.5.8 There will be contingencies, some of which can be defined in advance of the mill start-up, which will cause the emission limits set out above and emission of nuisance TRS odours to be exceeded for short periods.

D.5.9 The clearest example is the mill commissioning period, which is a time of fine tuning mill production and effluent control processes. During this period it is probable that the composition of mill effluents will be more variable than when the mill has been operating for some time. The following paragraphs define action required during this period and set out some other contingencies needing special arrangements.

Commissioning period

D.5.10 In the period during start up of either a new mill or a new major item of equipment or technology, the following special arrangements shall apply:

(a) a definition of the commissioning period will be agreed upon between the proponent or operator and the regulatory authority in advance of the start-up date;

(b) the proponent/operator will describe to the regulatory authority all action and contingency plans which will be implemented to limit emissions to the environment during the commissioning period;

(c) as far as practicable all emission control equipment shall be on-line during the commissioning period;

(d) during the commissioning period, the proponent/operator will take all practicable steps to achieve the emission limits defined, which, for this period, may be regarded as targets only; and

(e) the public should be informed when commissioning commences, particularly if highly visible or audible emissions may occur.

D.5.11 There is also the possibility that mill operators might wish to start the mill before it is complete; for example, to start the pulping plant before commissioning the bleaching plant. In these circumstances, account must be taken of the relationship between the composition of the effluent and the need for and nature of external treatment. As a general rule, the effluent treatment plants in operation need to be appropriate to the operative parts of the mill.

Other contingencies

D.5.12 There may be special arrangements to cover other contingencies, such as annual shut downs, maintenance of significant items of plant, especially the recovery furnace and precipitators, and the decommissioning period.

Review of continued mill operation

D.5.13 Limited reviews of the monitoring program should take place one year after the commencement of pre-commissioning monitoring and one year after commencement of commercial operation.

D.5.14 The review will re-evaluate the monitoring program in the light of any new information available on parameters, assays, knowledge of previously unidentified components. It will examine the biological conditions at the stations sampled during the pre-operational phase and throughout the probable zone of influence of the effluent. It will assess the mill's performance as well as the relevance/operation of the guidelines or other relevant factors.

D.5.15 If the mill operator has not made satisfactory progress (as judged by the Tasmanian regulatory authority) in limiting nuisance TRS odour emissions beyond the mill boundary 2 years after mill start-up, the Tasmanian regulatory authority 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. The costs of this review and the costs of any measures required to implement the recommendations to the satisfaction of the expert(s) will be borne by the mill operator. In extreme circumstances, failure of the operator to comply with this requirement may cause the provisions of section D.5.7 to be invoked.

D.5.16 If any revision of the sampling procedure and monitoring program is considered necessary, any advantages expected from modifying the regime or updating the techniques should be weighed carefully against the inherent difficulties this would introduce in comparing past and future trends with statistical rigour.

D.5.17 The subsequent period for review of the monitoring program and mill performance should be considered during the design of the next phase of the monitoring program.

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Glossary of terms and abbreviations

µ	micro = 10^{-6}
Abiotic	the non-living components of a system
Activated sludge	a particular form of secondary treatment
ADt	air dry metric tonne
Ambient levels	those in the general environment outside the influence of specific discharges
AMT	accepted modern technology: 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
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 (ClO3-); 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
AOX	adsorbable organic halide
AS	Australian Standard
BAT	best available techniques: 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 of the Stockholm Convention on Persistent Organic Pollutants and their impact on the environment as a whole
BATEA	best available technology economically achievable
BEK	bleached eucalypt kraft
Bioassay	a biological test
Biomarker	biological indicator of environmental stress
Bleach plant	mill department where pulp is bleached
BOD_5	biochemical oxygen demand: a laboratory test used to measure the amount of organic material in a sample of water that can lead to a depletion of oxygen by biological processes. Tested over five days
BPEM	best practice environmental management: the combination of management, technology and processes of a pulp mill which best achieves ongoing minimisation of emissions
CEM	continuous emission monitoring

CEN	Comité Européen de Normalisation
Closed-cycle	a mill or industrial plant that has little or no process effluent
CNCG	concentrated non condensable gases
CO	carbon monoxide
COD	chemical oxygen demand: a laboratory test used to measure the amount of organic material in a sample of water that can lead to a depletion of oxygen by both biological and chemical processes
Dioxin	type of organochlorine compound which occurs naturally and is produced in a number of industrial processes
DNCG	dilute non condensable gases
DPIWE	Tasmanian Department of Primary Industries, Water and Environment
EC_{50}	the concentration of a toxic material that causes a specific effect in 50% of the test organisms in a specified time
ECF	elemental chlorine free: refers to bleaching processes that use no chlorine gas
Effluent	out-flowing stream from a process
EIA	environmental impact assessment
EMPCA	Environmental Management and Pollution Control Act 1994
EMS	environmental management system
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
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
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}
Furan	type of organochlorine compound which occurs naturally and is produced in a wide variety of oxidation processes
GC-MS	gas chromatograph/mass spectrometer
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
HCl	hydrogen chloride
Kg/ADt	kilograms per air-dried metric tonne
Kraft	chemical pulping process using sulfide and soda. Means 'strong' in German and Swedish

LC_{50}	the concentration of a toxic material that kills 50% of the test organisms in a specified time
LOEC	lowest observed effect concentration
m	milli = 10^{-3}
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 *(State Policy on Water Quality Management 1997)*
MLSS	mixed liquor suspended solids
NDm^3	normal cubic metre of dry gas, measured at atmospheric pressure (101.325 kPa) and 273.15 K (0°C)
NOEC	no observed effect concentration
NO_x	the sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2) expressed as NO_2
Organochlorines	group name for organic compounds containing chlorine, both those occurring naturally and those formed during bleaching with chlorinated compounds
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCDD	polychlorinated dibenzo-p-dioxins
PCDF	polychlorinated dibenzofurans
ppb	parts per billion (10^{-9})
ppq	parts per quadrillion (10^{-15})
ppt	parts per trillion (10^{-12})
Primary treatment	physical treatment of wastewater to reduce settleable and floatable solids
SDT	smelt dissolving tank
Secondary treatment	biological treatment of wastewater to reduce BOD and toxicity; it normally reduces TSS also
Short-term lethal toxicity	causing death after a short exposure (typically 4 days)
Short-term sublethal	causing effects, such as reproductive or physiological disturbance, toxicity after short exposure

SMEWW-APHA	Standard Methods for the Examination of Water and Wastewater, 20th or later Edition, published by the American Public Health Association
SO_2	sulfur dioxide
SO_3	sulfur trioxide
Stockholm Convention	Stockholm Convention on Persistent Organic Pollutants 2001
TAPPI	Technical Association for the Pulp and Paper Industry
TCDD	tetrachlorodibenzo-p-dioxin (a dioxin)
TCDF	tetrachlorodibenzofuran (a furan)
TCF	totally chlorine free: usually refers to bleaching processes that use no chlorine compounds
TEQ	toxicity equivalent
Toxicity	the inherent potential or capacity of a material to cause adverse effects in a living organism
TRS	total reduced sulfur (measured as hydrogen sulfide)
TSS	total suspended solids
US EPA	United States Environment Protection Agency
Whole mill effluent	undiluted effluent as it enters the environment