PROPOSED DRAFT OPERATING GUIDELINES

FOR

HAZARDOUS/INDUSTRIAL WASTE TREATMENT PRECINCTS

IN WESTERN AUSTRALIA

Prepared for

The Core Consultative Committee on Waste

Prepared by

Trevor Bridle

Technology Advisor

Technical Advisory Panel

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Preface

Proposed Draft Operating Guidelines for Hazardous / Industrial Waste Treatment Precincts in Western Australia, prepared for The Core Consultative Committee on Waste. Prepared by Trevor Bridle, Technology Adviser, Technical Advisory Panel, Version 2 Jan 05

Background

The 3C commissioned Trevor Bridle to:

- review the EU paper – "Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste" in the context of existing DoE waste Guidelines and the Western Australian waste operating environment, and
- to prepare an operating guideline for use by waste treatment companies that would be permitted to operate in precincts in accordance with existing Cabinet Decisions.

Mr Bridle prepared the document: *Proposed Draft Operating Guidelines for Hazardous / Industrial Waste Treatment Precincts in Western Australia* (Draft Guidelines) which was then circulated to 3C members for comment.

3C Majority View
(Community/Environment, Unions, Local Government Representatives)

As part of the WA State Cabinet endorsed "Stakeholder involvement program to establish *new and better* hazardous/ industrial waste treatment facilities in WA", the 3C commissioned the preparation of this guidance document to outline "World's Best Practice (WBP)" or "Best Available Techniques (BAT)" in the treatment of Hazardous and Industrial Wastes. This was due to the many questions that the 3C has received about the proposed operation and regulation of the Hazardous / Industrial Waste Precincts during the Stakeholder Involvement Program.

It is very important to the majority of the 3C, and many participants in the Stakeholder Program, that there be a clear and definitive statement, from the State Government, that all new Hazardous / Industrial Waste Treatment Facilities (and any existing Facilities that may continue to operate) comply with WBP and utilise BAT.

The Community and the Environment have borne the brunt of poor practices in Hazardous / Industrial Waste Management for as long as these wastes have been generated. The 'externalities', which are hidden costs associated with the treatment of hazardous waste, are illustrated (in part) by:

- Decreases in air and water quality,
- Stockpiles of hazardous / industrial waste,
- Contaminated sites,
- Illegal dumping of hazardous / industrial wastes,
- The Bellevue Fire and the Brookdale Waste Treatment Facility Closure and their associated public health and environmental problems

These externalities all add to the public cost of handling and treating hazardous and industrial waste through higher public health costs, the remediation of affected lands and waterways etc.

The European Union's document "Guidance for the Recovery and Disposal of Hazardous and Non-Hazardous Waste", was summarised to encompass the Technology Suitability Criteria that were developed in3C's Stakeholder Involvement Program and endorsed by State Cabinet. This document outlines best practice waste management so that waste management facilities will comply with the following principles:

- Do not cause pollution of the environment
- Do not cause harm to human health
- Do not become detrimental to the amenities of the locality.

It is the view of the majority of the 3C that to operate or regulate any waste treatment facility contrary to WBP or BAT would violate these principles.

The majority of the 3C are disappointed that there is not a whole-of-committee consensus that the way forward is to propose that any new Hazardous / Industrial Waste Treatment Facility be designed and operated to WBP / BAT, and also regulated to conform with WBP / BAT.

It is the view of the majority of the 3C that the real costs of the treatment of Hazardous / Industrial Waste should be borne by the generator of that waste. This may result in higher treatment costs, but will also reduce the costs of the externalities (ie: poorer public and environmental health). Anything less would be a step backwards in the progression to *new and better* hazardous / industrial waste treatment facilities.

3C Industry View
(Industry Representatives)

Industry members on the 3C forwarded the document to key waste generators and waste treaters for input. Waste generators and waste treaters met to discuss the Draft Guidelines and determined that while industry supports continuous improvement, best operating practices and where appropriate best available technology, industry can not support the Draft Guidelines because:

- The format of the guidelines is overly prescriptive and restrictive. Recent Western Australian guidelines, regulations, proposed Acts and the Environmental Operating License reform process (eg Health Bill, Contaminated Sites Act, new regulations supporting the Dangerous Goods Safety Act, Water Protection Quality Guidelines, Water Protection Quality Notes, Operating Licenses) take a risk management or outcomes based approach where desired or required environmental, operational and/or safety outcomes are clearly stated. Facility operators then determine the most suitable site specific methods to attain the outcomes. If guidelines are to be prepared, they should follow a format where desired outcomes are stated but operators are allowed the flexibility to determine how they will achieve those outcomes based on site specific issues such as waste streams and quantities, frequency of receival, distance to market, location of sensitive land uses.

- The document has been developed in isolation of current and emerging environmental policy. The document recommends monitoring of all emissions from the facility to all environmental media. However, under the current environmental license reform process emissions that do not pose unacceptable risk to human health or the environment will not require licensing (and therefore monitoring). If the technology suitability criteria are met in the precincts emissions will be eliminated or minimised and both licensing and monitoring is unlikely to be necessary, or only necessary for a small suite of emissions.
- The guideline is based on European expectations for BAT, within a European regulatory, social and market context. CCI members who operate in Europe advise that the EU Guidance is adopted in varying degrees depending on waste streams and quantities, location of the facility, location of sensitive land uses, distance to market and fate of treatment products/end points (i.e. incineration, landfill or reuse/recycling).
- The language used in the guideline is not consistent with a guideline, but rather is more consistent with a regulatory tool. Implementation of the document will result in a perception that the guideline is a much more substantive document than a guideline and is likely to create unrealistic expectations amongst some stakeholders. Industry would then need to expend significant and unnecessary resources on rationalising alternative methods.
- The language is consistent with a more detailed site specific document such as a work instruction rather than a operational guideline.
- The prescriptiveness of the document will result in increased costs without commensurate social or environmental benefits.
- Desired outcomes can be achieved by a range of means, however the document does not provide any guidance on alternative means.

Conclusion

Industry does not support the Draft Guidelines as they do not add any value to outcomes that can be achieved by existing regulatory and policy tools.

EXECUTIVE SUMMARY

The State Government expects to call for bids from companies wishing to establish and operate facilities in Hazardous/Industrial Waste Treatment Precincts (HIWTPs) in mid 2006. The 3C and its Technical Advisory Panel will then evaluate these bids against the 3C Technology Suitability Criteria (TSC). To provide guidance to companies expressing interest it would be beneficial for them to know in advance how the 3C interprets its TSC and the level of operational management that would be expected of them to operate in the precincts. This document has been prepared to fulfil this need.

Most environmental agencies and regulators now approach pollution control via an integrated approach, which is based on the elimination or minimisation of emissions, via use of best practice techniques. The WA Department of Environment (DoE) uses this approach in developing works approvals and licences for new facilities. Probably the most well-defined and described process using this approach is the European Commission (EC) Integrated Pollution Prevention and Control (IPPC) system. This system employs an integrated approach to control the environmental impacts of prescribed industrial activities. Operators of prescribed facilities can only gain an operating licence if they can clearly demonstrate that the techniques they are proposing to use are the Best Available Technique (BAT) for their industry and that they meet all statutory requirements, taking into account local factors. BAT includes technical components, process control requirements, and operational and management requirements for the facilities as well as defining benchmark emission levels.

The EC has issued a comprehensive BAT Reference document (BREF) for each main IPPC sector, which defines BAT for that sector. The BREF relevant to Hazardous Waste Treatment was issued in May 2005. This document defines BAT for essentially all of the treatment processes that are likely to be utilised in the new HIWTPs proposed for WA. Based on this definition of BAT, the UK Environment Agency has developed an IPPC Sector Guidance Document for the Hazardous Waste Treatment Industry.

This document recommends guidelines for the operation, control and management of the proposed WA HIWTPs, based on the relevant sections of the above-mentioned IPPC Sector Guidance Document and the EC BREF document, together with relevant Australian and WA guidelines and regulations.

It provides recommended guidelines that cover the following aspects of the HIWTPs:

- General management guidelines
- Waste acceptance and storage guidelines
- Waste treatment operational guidelines
- Guidelines for the management of facility emissions
- Monitoring requirements, and
- Facility decommissioning guidelines

LIST OF ACRONYMS

ADGC	Australian Dangerous Goods Code
AS	Australian Standard
ASLP	Australian Standard Leaching Procedure
BAT	Best Available Technique
BCD	Base Catalysed Dechlorination
BOD	Biological Oxygen Demand
BREF	BAT Reference Document
BTEX	Benzene, Toluene, Ethyl-benzene and Xylenes
3C	Core Consultative Committee on Waste
DoE	WA Department of Environment
EC	European Commission
EDTA	Ethylene Diamine Tetra-acetic Acid
EMS	Environmental Management System
EWC	European Waste Catalogue
EQS	Environmental Quality Standard
GRT	Gas Retention Time
HIWTP	Hazardous/Industrial Waste Treatment Precinct
IBC	Intermediate Bulk Container
IPPC	Integrated Pollution Prevention and Control
ISO	International Standardisation Organisation
JCBs	Small articulated multi-purpose vehicles
NATA	National Association of Testing Authorities
OCPs	Organochlorine Pesticides
O&G	Oil and Grease
ORP	Oxidation Reduction Potential
PAHs	Polycyclic Aromatic Hydrocarbons
PERC	Perchloroethylene
PCBs	Polychlorinated Biphenyls
Ppb	parts per billion
QAS	Quality Assurance System
RFO	Recovered Fuel Oil
SSC	Site Selection Criteria
SG	Specific Gravity
TAP	Technical Advisory Panel
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total petroleum Hydrocarbons
TSC	Technology Suitability Criteria
TSS	Total Suspended Solids
VOCs	Volatile Organic Compounds
WAD	Weak Acid Dissociable (cyanide)

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1. INTRODUCTION

The Core Consultative Committee on Waste (3C) was established by the Waste Management Board of WA in October 2002. One specific objective for the 3C is to "facilitate a stakeholder involvement program to advise government on establishing new and better hazardous waste treatment facilities in WA, within a broader framework of minimising hazardous waste generation and regulating hazardous waste more effectively". Two specific aims of the stakeholder involvement program were to develop:

- Technology Suitability Criteria (TSC) to define what types of waste treatment technologies and processes are acceptable (or unacceptable) for new hazardous /industrial waste treatment precincts; and
- Site Selection Criteria (SSC) to use to identify suitable sites for such precincts.

Two public forums were held to assist the development of the TSC and SSC for new hazardous waste treatment facilities in WA. Using the SSC, the 3C has now placed 8 sites on public exhibition to allow further public input into the decision-making process. During this exhibition period it is expected that the public will ask many questions, including how the sites will be managed and regulated to ensure they comply with the TSC.

1.1 Purpose of this Document

The State Government expects to call for bids in mid 2006 from companies wishing to establish and operate in the hazardous/industrial waste treatment precincts. The 3C and its Technical Advisory Panel (TAP) will then evaluate these bids against the TSC. To provide guidance to companies making bids it would be beneficial for them to know in advance how the 3C interprets its TSC and the level of operational management that would be expected of them if they were to operate in the precincts.

This document has been prepared to fulfil this need.

This document recommends guidelines for the operation, control and management of the proposed WA HIWTPs based on the relevant sections of the above-mentioned IPPC Sector Guidance Document and the EC BREF document, together with relevant Australian and WA guidelines and regulations.

It must be emphasised that these are recommendations only.

2. GENESIS OF THESE GUIDELINES

Most environmental agencies and regulators now approach pollution control via an integrated approach, which is based on the elimination or minimisation of emissions, via use of best practice techniques.

Probably the most well-defined and -described process using this approach is the EC Integrated Pollution Prevention and Control (IPPC) system[1]. This system employs an integrated approach to control the environmental impacts of prescribed industrial activities. Operators of prescribed facilities can only gain an operating licence if they can clearly demonstrate that the techniques they are proposing to use are the Best Available Technique (BAT) for their industry and that they meet all statutory requirements, taking into account local factors. BAT includes technical components, process control requirements, and operational and management requirements for the facilities as well as defining benchmark emission levels.

In the EC BAT approach, the techniques selected to protect the environment are designed to achieve an appropriate balance between environmental benefits and the costs incurred by the operator. While individual company profitability is NOT taken into account in defining BAT, the European Waste Catalogue recognises that, to be viable, commercial waste treatment facilities must deal with variable waste streams, and it would not always be desirable or effective to over complicate design and operation of a waste process. Any determination of BAT cannot be simply seen as a means of implementing the highest available levels of technology.

The BAT approach to licensing of facilities differs from, but complements the traditional regulatory approach based on Environmental Quality Standards (EQS). Essentially BAT requires control measures to be taken to **prevent** emissions. Measures that simply **reduce** emissions are acceptable only where **prevention is not practicable.** The BAT approach is thus more precautionary since the emissions achieved may be lower than those simply required to meet a specific EQS.

2.1 BAT for the Proposed Hazardous/Industrial Waste Treatment Precincts

The EC has issued a comprehensive BAT Reference document (BREF) for each main IPPC sector, which defines BAT for that sector. The BREF relevant to Hazardous Waste Treatment was issued in May 2005[2]. This document defines BAT for essentially all of the hazardous waste treatment processes that are likely to be utilised in the new Hazardous/Industrial Waste Treatment Precincts proposed for WA. Based on this definition of BAT, the UK Environment Agency has developed an IPPC Sector Guidance Document for the Hazardous Waste Treatment Industry[3].

[1] EC, Directive on IPPC (96/61/EC)
[2] EC, Draft Reference Document on Best Available Techniques for the Waste Treatments Industries (May 2005)
[3] Environment Agency, "Guidance for the Recovery and Disposal of Hazardous and Non Hazardous Waste", Sector Guidance Note IPPC S5.06, Issue 3 (December 2004)

The recommended guidelines for the operation, control and management of the proposed WA Hazardous/Industrial Waste Treatment Precincts (HWITPs) are based on the relevant sections of the above-mentioned IPPC Sector Guidance Document and the EC BREF document, together with relevant Australian and WA guidelines and regulations.

3. RELEVANT AUSTRALIAN GUIDELINES AND REGULATIONS

In development of these guidelines reference to and use of relevant Australian and Western Australian guidelines and regulations is always made. Of most significance are the relevant Australian Standards (AS), for example, those relating to bunding requirements[4], the Australian Dangerous Goods Code[5] (ADGC) and the relevant DoE regulations and guidelines. The most notable of the latter are the Controlled Waste Regulations[6] and the Landfill Waste Acceptance Criteria[7]. The DoE has developed a number of Guidance Documents with respect to the Controlled Waste Regulations and the most important, with respect to the development of these guidelines, are:

- Guidance for Controlled Waste Carriers;
- Users Guide: Controlled Waste Tracking System;
- Guidance for Controlled Waste Generators; and
- Guidance for Controlled Waste Treatment and Disposal Sites

[4] AS1940B "The Storage and Handling of Toxic Substances" (1997).
[5] Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), Fifth Edition (1992)
[6] DoE, Environmental Protection (Controlled Waste) Regulations (2004)
[7] DoE, Landfill Waste Classifications and Waste Definitions, 1996 (as amended)

4. GENERAL OPERATIONAL/MANAGEMENT GUIDELINES

It is recommended that operators in the proposed HWITPs have a formal Quality Assurance System (QAS) and Environmental Management System (EMS) that are independently audited by nationally-accredited organisations on an annual basis. It is highly recommended that operators obtain ISO 14001 accreditation, which covers all aspects of a sound EMS. Accreditation to ISO 14001 ensures that the EMS is verified and conforms to an auditable standard.

The QAS should, at minimum, include the following elements:

- Work Instructions for all activities on the site, including management of accidents, incidents and non-conformances. This should include a Job Safety Analysis for all work/maintenance procedures;
- Design review and approval procedures for all new processes implemented on site;
- Procedures for managing engineering change on the site;
- A documented purchasing policy;
- Identification and documentation of the skills/competency required for the key staff on site; and
- A record of staff training/competency activities completed.

All relevant staff should undertake training, which covers at minimum the following elements:

- Suitable skill competencies for the work to be done
- Awareness of all potential environmental effects from operations on site, under both normal and abnormal conditions;
- Awareness of the regulatory implications of the Works Approval/Licence for the site and the potential impact from their work activities;
- Awareness of requirements to report deviations from Licence conditions; and
- Prevention of accidental emissions and action to be taken when accidental emissions occur.

Finally, it is recommended that the on-site laboratory be NATA certified.

5. WASTE ACCEPTANCE AND STORAGE GUIDELINES

This section identifies BAT for the pre-acceptance, acceptance and short-term storage of hazardous wastes on the site.

5.1 Pre-acceptance Waste Assessment Procedures

To ensure that the treatment plant can treat the waste in question, to the requirements as set out in the licence conditions, without adverse consequences, pre-acceptance testing is required for **all** wastes to be treated at the precinct. This testing is to be managed by qualified professionals, such as staff with a degree in chemical engineering, chemistry or an equivalent degree or diploma. Such testing is to be done on representative samples of the waste, as supplied by the generator. The indicative BAT requirements for Pre-acceptance testing of waste are shown in Table 5.1.

Table 5.1 Pre-acceptance Testing BAT Requirements

1. The waste treatment operator should obtain, in writing, the following information from the waste generator for each waste stream tested:
    - The specific process generating the waste;
    - The expected waste volume per year;
    - The form of the waste (liquid, solid, sludge);
    - A complete chemical analysis of the waste. If this is not possible, the operator must conduct his own analysis, using a NATA-registered laboratory;
    - Hazards associated with the waste; and
    - Sample storage and preservation techniques.
2. The operator should ensure that the sample is representative of the waste stream and has been obtained by a person who is technically competent to undertake such sampling of the waste. Information such as location of sampling point, method of sampling, number of aliquots taken, compositing technique etc must be reported and recorded.
3. The chemical and physical parameters requiring analysis will be waste specific, but should include the parameters that may be required for regulatory purposes (eg, the contaminants as specified in the DoE Landfill Waste Acceptance Criteria).
4. Waste treatability testing must be conducted at a scale suitable for engineering scale-up to the proposed commercial scale to be utilised. In addition, the testing must replicate the conditions to be used during commercial scale treatment of the waste.

5.2 Waste Acceptance Procedures

The bulk of the waste characterisation work will have been conducted during the pre-acceptance testing phase. Consequently, the waste acceptance procedures, when the waste arrives on site, should serve to confirm that the waste conforms to the required waste specifications. This will minimise the time required for the waste carrier to remain on site until waste transfer is completed.

All of the hazardous waste to be treated in the proposed HIWTPs is defined as Controlled Waste by the DoE Controlled Waste Regulations of 2004. Consequently, waste transport, tracking and acceptance by the treatment plant operator must be conducted to the requirements of the relevant DoE guidance documents. Key guidance documents include the users guide to the controlled waste tracking system[8], the guidance document for controlled waste treatment and disposal sites[9] and the guidance for controlled waste carriers[10]. The major components of these requirements, as they relate to the transport and acceptance of waste at the hazardous waste treatment precincts are summarised in Table 5.2.

Table 5.2 DoE Waste Tracking, Transport and Acceptance Requirements

1. Waste carriers must be licensed by DoE as Controlled Waste Carriers.
2. The DoE must license the vehicles and containers.
3. A unique waste tracking number must be used for each waste consignment greater than 200 L or 200 kg.
4. Tracking Forms (both paper and electronic) must be kept for three years.
5. Bulk waste must be treated/disposed within seven days of consignment.
6. Bulk waste can only be transported from the generator's site provided it meets the following criteria:
    - The flash point must be >61 ^{0}C
    - The pH must be between 2 and 12.5
    - Cr^{6+} must be <100 mg/L
    - Free CN^{-} must be <5 mg/L
7. The waste generator must ensure the bulk waste meets the above criteria and the truck driver must see a certificate to this effect.
8. Packaged waste (in drums or other sealable containers) must be treated/disposed of within 21 days of consignment.
9. Provided the waste meets criteria, the operator at the site accepts the load and executes the on-line electronic tracking form.
10. If the load does not meet criteria (ie is a non-conforming load) the operator follows the DoE non-conforming load procedure (defined in Table 5.3).

In addition to these DoE guidelines for waste acceptance, the indicative BAT requirements for waste acceptance are shown in Table 5.3.

[8] DoE, Users Guide: Controlled Waste Tracking System, 2004
[9] DoE, Guidance for Controlled Waste Treatment and Disposal, 2004
[10] DoE, Guidance for Controlled Waste Carriers, 2004

Table 5.3 Waste Acceptance BAT Requirements

1. On arrival waste loads should:
   - Be weighed using the site weighbridge and the weight recorded;
   - Not be accepted if insufficient storage volume is available;
   - Be inspected and processed as per the DoE electronic waste tracking requirements; and
   - Be sampled and tested for bulk parameters (eg SG, pH, conductivity) to verify that the waste is as per the description in the waste tracking documentation. Note for drummed waste, each drum is to be sampled but samples can be composited prior to analysis.
2. Waste rejection
   - The operators should develop their own documented waste rejection criteria.
   - At minimum the DoE non-conforming load criteria must be applied. If a load is deemed non-conforming, eg drums/containers are leaking or not sealed properly, the DoE is to be contacted immediately using the 24h/d phone numbers and the driver is to follow the DoE instructions.
   - It is recommended that off-spec storage tanks be provided including emergency treatment to neutralise such loads.
3. Waste samples must be retained on site until the entire batch of waste has been treated or transferred off-site.

5.3 Waste Storage Procedures

The storage of hazardous waste within the proposed HIWTPs must comply with the requirements as identified in the Australian Dangerous Goods Code (see reference 5 on page 3) and in the relevant Australian Standards, notably AS 1940B (The Storage and Handling of Flammable and Combustible Liquids) and AS 4452B (The Storage and Handling of Toxic Substances). These specify appropriate separation distances for different classes of wastes as well as bunding requirements. The basic AS requirements for bunding of hazardous liquid wastes within the precinct are:

- Bunds should be impervious and preferentially constructed of concrete, bricks or stones;
- Bunds should be designed to contain 100% of the volume of the largest vessel within the bund (note DoE require 105%);
- Vessels should be at least 1 m from the bund walls; and
- Bund walls should preferably be between 0.5 and 1.5 m in height

Proposed precincts should be required to provide emergency storage capacity. This is to handle hazardous wastes recovered from transport accidents and unexpected events. {NB: This proposal does not oblige any particular operator to do so, and is a matter the 3C should consider recommending to govt}

Additional indicative BAT requirements for waste storage are shown in Table 5.4.

Table 5.4 Waste Storage BAT Requirements

1. Waste unloading should take place under cover and on an impervious surface with self-contained drainage to ensure all spillages are contained within the unloading area.
2. Unloading and transfer of bulk liquid waste should be conducted using piping equipped with quick-connect fittings to minimise spillage. Appropriate vapour balance controls, connected to suitable emission control equipment are to be used. Tankers are to be grounded to prevent a build up of static electricity.
3. The waste transfer system is to be designed to ensure that the correct discharge point or storage area (vessel) is used. This can be achieved, for example, by use of colour-coded piping, a ticket system or a keyed system.
4. Storage areas and vessels should be clearly marked to identify the waste type, hazards and volumes.
5. The licensed site waste storage volumes, for each waste type, are not to be exceeded. This is to be recorded daily and audited.
6. The storage area drainage system should ensure that spillage and run-off is contained, does not cross-contaminate waste types and that fire cannot spread through the drainage system.
7. There should be daily inspections of the storage areas and any leakage of waste is to be reported. If required, the DoE is to be notified of spillages and leakages. Leaking drums are to be over-drummed or the contents transferred to another drum immediately. All spillage or leaked waste is to be collected and transferred to containers.
8. For drummed and palleted waste there is to be vehicular (eg fork-lift) and pedestrian access at all times to the entire storage area, such that access and/or waste transfer is not reliant on moving of other drums or pallets.
9. As indicated in Table 5.2, the maximum storage time for bulk waste is seven days and for drummed/packaged waste, 21 days.
10. All bulk liquid waste is to be stored in sealed vessels with appropriate vents/vapour balance lines and emission controls.
11. All drummed and packaged waste is to be stored within buildings, with bunding to contain any leakage and spillage.
12. Transfer of liquid waste from drums or Intermediate Bulk Containers (IBCs), to bulk storage vessels should be via a pumped dip-pipe system to minimise splashing, fumes and odours.
13. All bulk liquid storage vessels are to be designed to the appropriate AS. All bulk storage vessels should be fitted with level indicators connected to both audible and visual high-level alarms.
14. If underground storage tanks are proposed they must provide secondary containment.
15. Silos are to be fitted with dust abatement systems, level indicators and high level alarms, both audible and visual.

6. WASTE TREATMENT OPERATIONAL GUIDELINES

The recommended operational guidelines for the specific waste treatment operations that are likely to take place within the proposed HIWTPs are described in this section. The 3C has identified and described the technologies most likely to operate in the HIWTPs[11],[12] and this Section addresses those technologies. The information provided here has been taken primarily from the EC Waste Treatment Industry BREF document (reference 2 on page 2) and the Environment Agency Guidance document for the disposal of hazardous wastes (reference 3 on page 2).

6.1 General Waste Treatment Principles

General waste treatment operating guidelines, which apply to most of the specific waste treatment operations discussed later on, are identified in Table 6.1

Table 6.1 General Waste Treatment Guidelines

1. The operator must identify the waste types to be subject to each treatment process, including all the contaminants to be treated.
2. The chemistry/physics of each process is to be clearly documented and the fate of all contaminants, during the treatment process, is to be defined.
3. All treatment processes must have well-defined end points, which can be monitored via appropriate on-line analysers such as time, pH, conductivity, temperature, ORP (oxidation reduction potential), free cyanide etc. This data is to be continuously recorded and linked to clear displays in the control room.
4. Any new processes, or process modifications, must first be trialled and evaluated via use of laboratory scale testing.
5. All treatment/reaction vessels are to be enclosed or under negative pressure and vented to appropriate gas scrubbing/cleaning systems.

6.2 Waste Neutralisation and Precipitation

A significant volume of waste acids, alkalis and heavy metal containing wastewaters are likely to require treatment in the proposed HIWTPs. The treatment operations of waste neutralisation and heavy metal precipitation have been described and reviewed in the relevant 3C papers (references 11 and 12). The recommended BAT operating guidelines for these processes are identified in Table 6.2.

[11] The Core Consultative Committee on Waste, "Possible Treatment Technologies in the HWTPs", (2005)

[12] The Core Consultative Committee on Waste, Technical Paper A: Possible Technologies on Hazardous / Industrial Waste Treatment Precinct, (2005)

Table 6.2 Neutralisation and Precipitation BAT Requirements

1. When neutralising wastewaters containing heavy metals, try to avoid wastes that contain organic metal complexing agents such as cyanide and EDTA. Preferably wastes containing such organic complexing agents would be pre-treated to destroy the complexing agent.
2. Ensure that the pH electrode(s) are routinely cleaned and calibrated as per the manufacturer's recommendations.
3. Ensure that neutralised wastewater is aged before discharge or blending to allow monitoring of possible secondary reactions.
4. Metal precipitation process optimisation test work must be conducted at laboratory scale for each waste accepted on site. Factors such as best precipitation additive, optimal pH for maximum metal removal efficiency and reaction times are to be developed for each waste processed.
5. Avoid the input of organic complexing agents, cyanide and chromates to the precipitation process.
6. Chromate wastes must first be reduced and cyanides destroyed before processing in the precipitation reactor.
7. Precipitation reactors should incorporate a clarification zone to produce a relatively concentrated metal sludge for subsequent dewatering and/or stabilisation.

6.3 Chemical Oxidation

The most significant wastes likely to be received at the proposed HIWTPs that require chemical oxidation will be cyanide wastes, predominately from the metal plating industry. Organicallycontaminated wastewaters (eg phenolics) may also be received for treatment.

The most likely treatment process will be batch chemical oxidation using oxidants such as sodium hypochlorite, chlorine gas, hydrogen peroxide, ozone and ozone plus UV light. Other processes such as wet air oxidation and electrochemical oxidation could also be applied. Chemical oxidation can reduce the cyanide concentration in the treated waste to less than 0.1 mg/L

The recommended BAT operating guidelines in Table 6.3 are based on batch chemical oxidation of cyanide wastes using conventional chemical oxidants as identified above.

Table 6.3 BAT Requirements for the Chemical Oxidation of Cyanide Wastes

1. The pH of the waste stream MUST be maintained above 10. It is recommended that an excess of sodium hydroxide be added to ensure the pH does not fall below 10. On-line pH monitoring of the process is required.
2. Cyanide wastes must NOT be mixed with acidic wastes since this will release the highly toxic gas, hydrogen cyanide (HCN).
3. On-line monitoring of ORP is recommended to determine the reaction end-point (ie all the cyanide destroyed).
4. It is recommended that ozone or hydrogen peroxide be used as the oxidant as this does not increase the salt content of the treated effluent.
5. On-line HCN analysers are recommended to monitor for potential build-up of this highly toxic gas in the work environment.
6. Off-gas abatement equipment is required for this treatment process.

6.4 Chemical Reduction

Whilst chemical reduction is used widely within the waste treatment industry the most likely wastes requiring chemical reduction in the proposed HIWTPs will be chromate wastes from the metal plating industry. It is unlikely that many organics will be destroyed via chemical reduction within the HWTPs. Chromate wastes, which contain chromium in the highly-toxic hexavalent state (Cr^{6+}) is chemically reduced to the less toxic trivalent (Cr^{3+}) state. The trivalent chromium can then be precipitated from solution by the process identified in Section 6.1. Typical reduction agents are sodium metabisulphite, sulphur dioxide and sodium dithionate. This process can reduce the Cr^{6+} concentration to less than 0.1 mg/L. The recommended BAT requirements for chromium reduction are shown in Table 6.4. As noted in Table 5.2, the transport of bulk chromium wastes requires the reduction of Cr^{6+} to Cr^{3+} at a concentration of less than 100mg/L prior to transport.

Table 6.4 BAT Requirements for the Chemical Reduction of Cr^{6+} Wastes

1. The mixing of Cr^{6+} wastes with other wastes should be avoided.
2. Reducing the Cr^{6+} to the less toxic Cr^{3+} and then precipitating the trivalent chromium from solution
3. Provision of on-line H_2S gas analysers to monitor for any build up of this toxic by-product.
4. Off-gas abatement equipment is required for this treatment process.

6.5 Sludge Dewatering

The treatment of both aqueous and oily wastes within the proposed HIWTPs will generate sludges that will require further treatment before disposal or reuse. Typically the moisture content of the sludges as produced will be between 95 and 99 %. The first step is to decrease the moisture content of these sludges via mechanical dewatering to produce spadable sludges (moisture content of 60 to 80%) that can be further treated by processes such as immobilisation/solidification or transported for off-site disposal via landfilling. The most common equipment used for dewatering sludges is belt filter presses, plate and frame filter presses and centrifuges. Filter presses operate in batch mode whereas belt filter presses and centrifuges operate in a continuous mode. Gaseous emissions from centrifuge dewatering are easiest controlled. The recommended BAT requirements for sludge dewatering are shown in Table 6.5.

Table 6.5 Sludge Dewatering BAT Requirements

1. When highly odorous sludges (containing ammonia, sulphur compounds or other odorous VOCs) are dewatered, centrifuges are the preferred technology. When processing highly odorous sludges centrifuges should be under negative pressure with the off gas being treated in an appropriate gas cleaning/odour control unit. If filter or belt filter presses are used to process highly odorous sludges, they should be in a building with an appropriate air extraction system connected to a gas cleaning/odour control system.
2. When odorous sludges are dewatered, the cake should be contained within a building or in vented containers, with appropriate gas cleaning/odour control.
3. Provision should be made to prevent dewatered cake from being carried out of the storage area, for example on vehicle tyres.
4. The sludge cake moisture content should be analysed routinely to confirm that optimal dewatering is being achieved.

6.6 Sludge Immobilisation/Stabilisation

The objective of these processes is to reduce the mobility of contaminants, typically heavy metals, in sludges and solids prior to final disposal, normally in a landfill. This is achieved by chemically reducing the solubility of the contaminants and also reducing their diffusivity in the matrix, by producing products with a concrete- like structure. These processes are generally referred to as stabilisation. The term ‘solidification’ refers to processes where the chemical speciation of the contaminants in the waste is not modified (to reduce their solubility) and only the physical nature of the sludge is modified.

The European Waste Catalogue[13] (EWC), which the 3C has used to define hazardous waste in WA, classifies stabilised and solidified waste as mirror entries. That is, they are, depending on their properties, potentially hazardous wastes. The EC defines ‘totally-stabilised waste’ as a waste that was previously hazardous and after processing does not exhibit any of the 14 hazardous properties[14] that are used to classify a waste as being hazardous. That is, totally stabilised wastes are no longer classified as hazardous wastes. By contrast a partially-stabilised waste still exhibits some hazardous properties and hence is classified as a hazardous waste. However, in WA the solidified wastes will require classification using the DoE Landfill Waste

[13] EC, European Waste Catalogue, (2002)
[14] EC, Directive 91/689/EEC, Annex III, (1991)

Classifications (see reference 7 on page 3), which includes assessing mobility (leachability) using the Australian Standard Leaching Procedure (ASLP).

It should be noted that the EC does not consider stabilisation of aerosols, clinical waste, explosives, laboratory smalls, flammable wastes and shredded drums and containers as BAT.

The recommended BAT requirements for waste stabilisation are shown in Table 6.6.

Table 6.6 BAT Requirements for Waste Stabilisation

1. Simple absorption of liquids onto a matrix such as sawdust is not acceptable as a pre-treatment for landfill.
2. Each waste stream to be stabilised must be assessed via laboratory scale test work to optimise the additives and process conditions. At minimum the waste needs to be analysed for those contaminants identified in the DoE Landfill Waste Classifications document that are likely to occur in the waste stream.
3. All stabilisation processes should take place in suitably-designed reaction vessels with off-gas venting and control.
4. Controlled and enclosed methods of charging the reactor should be employed. Manual charging of wastes or mixing with JCBs etc should not take place.
5. Bulk transfer of dry ingredients or waste should be by engineered handling systems such as conveyors.
6. Pre-mixed liquid additives or pumpable sludges should be delivered to the reactor via pumped pipelines.
7. Operators must demonstrate that foreseeable vapour emissions can be handled by the vapour extraction/abatement system.
8. The objective of stabilisation should be to produce a waste suitable for disposal to a Class II or Class III landfill.
9. The stabilised products should be monitored via the on-site laboratory to confirm they meet product quality objectives. The site QAS should specify the testing requirements for the solidified products.
10. Wastes high in VOCs or odorous compounds should not be processed.
11. The operator must define how non-compliant batches of stabilised products are to be handled.

6.7 Solvent Recovery

The preferred method of processing waste solvents is via recovery of the solven(s[15]. This approach is also defined as BAT by the UK Environment Agency (see reference 3 on page 3). The most common waste solvent likely to be processed within the proposed HIWTPs is used dry cleaning fluids which contain the halogenated solvent perchloroethylene.

[15] The Core Consultative Committee on Waste, “Non-Incineration Alternative Treatment Technologies for Specified Hazardous Wastes”, (2004)

The EC BREF document (reference 2 on page 3) identifies distillation (azeotropic and vacuum), together with evaporators as BAT for solvent recovery. Other BAT requirements for solvent recovery are shown in Table 6.7.

Table 6.7 BAT Requirements for Solvent Recovery

1. If the waste solvent contains water, the waste must first be dewatered, preferably using decanter or tri-canter centrifuges.
2. The use of vapour balancing systems with off-gas treatment, typically via activated carbon adsorption.
3. Applying a highest net value cascade reuse of the solvent. For example, the recovered solvent should be reused for its original intended purpose if it meets quality requirements. If not, it should be reused as a solvent where pure solvents are not required and only used as a fuel as the last preference.
4. Where economical, still bottoms should be processed via vacuum drying or an equivalent thermal process, which will recover at least 90% of the solvent in this waste stream.

6.8 Oily Waste Treatment

There are three major potential recovery options for oily wastes, namely:

- Regeneration of used transformer oil
- Re-refining of used engine oil
- Production of Recovered Fuel Oil (RFO)

The regeneration of used transformer oil, contaminated with PCBs, is unlikely to take place within the proposed HIWTPs. These wastes are normally defined as Scheduled Wastes and are managed by the National PCB Waste Management Plan[16]. Similarly it is unlikely that waste oils will be re-refined to produce engine oils or lubricants due to the limited volumes of waste oils available in WA. The most likely process to be used within the HIWTPs is thus processing of oily wastes to produce RFO, as is currently being practised in WA.

The processes most likely to be used within the HIWTPs to produce RFO from waste oils and oily wastewaters is dehydration or a combination of heating, and potentially acid cracking to break emulsions, allowing oil/water separation followed by filtration/centrifuging of the recovered warm oil to remove solids, including heavy metals.

The BAT requirements for this form of oily waste treatment are shown in Table 6.8.

[16] Environment Australia, "Polychlorinated Biphenyls Management Plan" (November 1996)

Table 6.8 BAT Requirements for Oily Waste Treatment

1. The reactors used for breaking emulsions should be enclosed and vented to a suitable VOC/odour control system such as condensation or carbon adsorption.
2. Process conditions in the reactor should be controlled via on-line monitors for temperature and if acid cracking is involved, pH as well.
3. The oil filtration process should be under negative pressure and the foul air vented to a VOC/odour control unit.
4. The wastewater from the process should undergo secondary oil recovery before being discharged to the facility drainage (sewer) system. This would typically be via oil/water interceptors or inclined plate separators.
5. The produced RFO should be routinely analysed to confirm it meets product quality specifications.

6.9 Thermal Desorption

Thermal desorption is used to remove organic contaminants from soils, sludges and other solid wastes. This is achieved by heating (either directly or indirectly) the soil/solid waste to a temperature at which the contaminants of concern are vaporised and are transferred to the gas phase. Rotary kilns, furnaces and indirectly-heated reactors are used for thermal desorption. Typically temperatures of between 250 and 500C are used. In directly-heated systems the off-gas, containing the organic contaminants, is combusted in an afterburner, usually at temperatures of over 850C with a gas retention time (GRT) of greater than 2 seconds to ensure complete destruction of the organics. Note that directly-heated systems are essentially incinerators and thus would NOT be allowed within the precincts. In indirectly-heated systems the off gas is cooled to condense the vaporised organics, which are then recovered for reuse or destroyed by secondary processes, such as the BCD process which is used to destroy PCBs and OCPs. In indirectly-heated systems, the cooled off gas is usually passed through activated carbon filters to remove trace quantities of VOCs.

The BAT requirements for thermal desorption are shown in Table 6.9

Table 6.9 BAT Requirements for Thermal Desorption

1. Each waste must be assessed via laboratory scale testing to identify optimal processing conditions (time and temperature) to meet the required treatment objectives.

2. Indirectly heated systems are preferable when processing wastes containing PAHs and chlorinated organics such as chlorinated solvents, OCPs and PCBs.
3. Off-gases from indirectly heated systems should preferably be cooled to at most 5 ^{0}C and then polished via activated carbon filtration.

6.10 Clinical Waste Treatment

The EC hazardous waste treatment Guidance and BREF documents do not address clinical wastes since these are normally incinerated in Europe. However, in Australia infectious wastes, a sub-set of the broader clinical wastes are often processed by non-incineration technologies such as autoclaving, microwaving and chemical sterilisation. Both the National Health and Medical Research Council[17] (NHMRC) and the Australia and New Zealand Clinical Waste Management Industry Group[18] (ANZCWMIG) have approved such processes for the treatment of infectious waste. Furthermore, the 3C has also endorsed the use of these non-incineration technologies for the treatment of infectious wastes (see reference 15 on page 13). At this stage there do not appear to be any approved non-incineration technologies for the treatment of cytotoxic or pharmaceutical wastes in Australia. Thus recommended BAT requirements for the treatment of infectious waste via autoclaving, microwaving or chemical sterilisation are taken from the ANZCWMIG document. These, with modifications, are shown in Table 6.10.

[17] NHMRC, "National Guidelines for Waste Management in the Health Care Industry", ISBN 1864960256, (1999)
[18] ANZCWMIG, "Industry Code of Practice for the Management of Clinical and Related Wastes, 3rd edition", ISBN 0-9580886-0-8, (2002)

Table 6.10 BAT Requirements for Non-incineration Treatment of Infectious Waste

1. The equipment shall be:
    - designed in accordance with Australian Standards;
    - fitted with necessary process controls and interlocks which will not allow waste processing unless specified process conditions are met;
    - fitted with an appropriate ventilation and off gas treatment system to minimise staff exposure to bio-aerosols and pathogens;
    - fitted with suitable wastewater containment systems; and
    - fitted with suitable audible high pressure and temperature alarms
2. Loading of waste into the equipment should be via mechanical means
3. The plant must be supervised by suitably-qualified staff
4. After autoclaving the residues must be shredded to produce unrecognisable particles
5. Autoclaving should be conducted at a minimum of 140C for 40 minutes
6. Recognisable body parts cannot be autoclaved
7. Microwaving should be conducted at temperatures of at least 95C for at least 45 minutes
8. Anatomical wastes cannot be microwaved
9. When using lime as the chemical disinfective, a pH of greater than 9 and a temperature of greater than 55C must be maintained for a time sufficient to achieve a 6 log reduction in bacteria

6.11 Bioremediation of Contaminated Soils

Bioremediation of contaminated soils within the proposed HIWTPs will most likely be conducted via the methodology of biopiles. In this treatment system the contaminated soil is placed on a concrete bunded area which has an array of aeration pipes at the bottom of the soil pile, much like the system used in forced aeration composting of organic waste. Air required for the biological treatment (destruction) of the organic contaminants in the soil is withdrawn through the soil pile into the pipes, which are connected to an air blower which exhausts the air through appropriate gas cleaning equipment. These engineered bioremediation systems also have a nutrient addition system, which sprays a solution containing the required nutrients (normally nitrogen and phosphorus) onto the pile. This system also provides the necessary water to maintain the pile at the optimal moisture content to ensure microbial degradation is maximised. Bioremediation is best suited to soils contaminated with readily biodegradable organic contaminants such as petroleum hydrocarbons from petrol, diesel and oil spills. Soils contaminated with PAHs and chlorinated hydrocarbons are much more difficult to treat via bioremediation and it is recommended that other processes, such as indirect thermal desorption be utilised for the treatment of such soils.

Well-engineered biopiles have been demonstrated to achieve over 99% degradation of petroleum hydrocarbons to carbon dioxide and water[19]. Consequently VOC emissions are minimised via use of this engineered treatment system. Data from the BREF document (reference 19) has indicated VOC emissions are as low as 1 ppb (part per billion) of BTEX after 35 days of treatment of petroleum contaminated soils.

The recommended BAT requirements for bioremediation are shown in Table 6.11.

Table 6.11 BAT Requirements for Bioremediation of Contaminated Soils

1. The soils to be treated must have high permeability to ensure adequate aeration of the entire bed of soil (oxygen supply to the bacteria). Heavy clay soils should be milled to reduce maximum particle size to less than 5 mm and the addition of bulking agents (eg wood chips) is recommended.
2. Soils should be seeded with sewage sludge, or some other suitable source of inoculum, to provide an adequate initial supply of bacteria.
3. Biopiles should be under negative pressure, via use of an air suction system, to minimise fugitive air emissions.
4. Exhaust from the air supply blowers should be vented to an appropriate gas cleaning system such as a biofilter.
5. The biopile moisture content should be maintained at between 40 to 60 % of the water-holding capacity of the soil via use of the irrigation system.
6. Nutrients (nitrogen and phosphorus) must be supplied to meet biological demands. Monitoring of the recirculating irrigation water for nitrogen and phosphorus is required to confirm an adequate supply of nutrients is available.
7. The soil must be routinely monitored for the organic species being treated to confirm removal rates and determine the treatment end-point.

6.12 Evaporation Ponds

It is almost certain that most, if not all of the proposed HIWTPs will be located in areas without access to a sanitary sewer. Consequently the aqueous effluent generated within the precincts will require handling via evaporation ponds. The EC BREF document does not make any reference to evaporation ponds and thus there are no EC BAT recommendations for evaporation ponds. However, the 3C has prepared a document recommending suitable discharge criteria and management requirements to ensure the evaporation ponds do not create adverse environmental or health impacts[20]. The basic elements of those recommendations are outlined in Table 6.12.

[19] EU, "Draft Reference Document on Best Available Techniques for the Wastes Treatment Industries", Final Draft (May 2005).

[20] Core Consultative Committee on Waste, "Hazardous Waste Precinct(s) Evaporation Ponds: Draft Proposed Discharge Criteria and Management/Monitoring Issues", September 2004.

Table 6.12 Recommended Requirements for the Evaporation Ponds

1. Evaporation ponds should be constructed using a double liner system with an on-line leak detection system.
2. The following effluent discharge criteria to the ponds are recommended to minimise odours and VOC emissions as well as ensure that the residuals from the ponds are not classified as hazardous waste, at least from a heavy metals viewpoint:
    - BOD <50 mg/L
    - TPH <20 mg/L
    - O&G – no free or floating layers
- no unstable emulsions
< 30 mg/L emulsified O&G
    - BTEX <0.1 mg/L
    - BTEX+PERC <5 mg/L
    - CN (WAD) <1 mg/L
    - pH 6 to 9
    - TSS <50 mg/L
    - Arsenic, copper and nickel < 1 mg/L each
    - Cadmium and lead <0.1 mg/L each
    - Mercury <0.05 mg/L
    - Chromium and Zinc <2 mg/L each
3. Residues will require periodical removal from the ponds. These residues must be analysed to confirm they comply with the DoE requirements for disposal to landfill (The criteria above should ensure the solids will meet Class III landfill acceptance criteria).

6.13 Compliance with the 3C Technology Suitability Criteria

The 3C, with significant public participation, has developed criteria to be used for the selection of technologies that are deemed suitable for the treatment of the hazardous wastes in the precincts. A total of 16 criteria have been developed and these are found in Appendix 1. Of the 16 criteria developed, 10 are classified as essential and these ten criteria are listed in Table 6.13 below.

Table 6.13 Essential 3C Technology Suitability Criteria

Criterion Number	Descriptor
1	Technologies that eliminate or minimise risks to the health and safety of workers or the general public
2	Technologies that eliminate or minimise risks to the environment
3	Technologies that eliminate or minimise harmful emissions to soil, water or air
4	Technologies for which the social and environmental risk factors are well characterised and publicly available
5	Technologies that can be monitored under all operating conditions to maintain public transparency and accountability
6	Technologies that eliminate or minimise negative social impact including amenity
7	Technologies that eliminate or minimise the formation of dioxins, furans, other by-product POPs or other endocrine disruptors
8	Technologies that can incorporate public participation in the monitoring of their performance and in particular are not subject to commercial-in-confidence, terrorist risk factors or other constraints on the publics right to know
9	Technologies that operate in systems that are essentially closed, so that uncontrolled releases of pollutants are eliminated or minimised and all residues (gas, solid and/or liquid) from the treatment process can be contained, analysed and if necessary, be further treated prior to release
10	Where technologies are new or innovative they must have been demonstrated at a sufficiently large scale so that the risks associated with them are able to be well characterised

A review of the recommended operating guidelines for the technologies (processes) described in Sections 6.1 to 6.12, together with the proposed monitoring requirements (Section 8) clearly indicates that the BAT approach proposed will ensure that the essential 3C TSC listed in Table 6.13 are achieved. It is fair to say that the BAT approach proposed, which is based on eliminating (or minimising) emissions, essentially mirrors the requirements as outlined in the 3C TSC.

7. MANAGEMENT OF FACILITY EMISSIONS

This section addresses techniques to minimise air and water emissions from the proposed HIWTPs.

7.1 Air Emissions Management

The recommended BAT requirements to eliminate or minimise air emissions, mainly odour, dust, VOCs and some inorganic compounds, is shown in Table 7.1.

Table 7.1 BAT Recommendations to Minimise Air Emissions

1. Restricting the use of open topped tanks, vessels and pits. Such systems must be connected to negatively-vented gas cleaning equipment
2. Applying a suitably-sized extraction system to provide the required airflow to control the gaseous emissions from all sources on the site. Alternatively, providing separate extraction systems for specific treatment operations such as oil and solvent recovery, indirect thermal desorption etc.
3. Providing a combined gas cleaning system, or separate gas cleaning systems for individual treatment processes, designed to adequately remove the contaminants of concern.
4. Correctly operating and maintaining the gas cleaning equipment, including the handling and disposal of gas cleaning residues.
5. Having leak detection and repair systems in place for the abatement processes.
6. Reducing point source air emissions to the following values (I’m not sure where the figures below come from, but they seem to be emphasising minimisation over elimination):
    - VOCs <20 mg/Nm^3
    - Dust <20 mg/Nm^3
    - Odours: to values that ensure the boundary levels are non-detectable

7.2 Wastewater Management

The recommended BAT requirements to minimise wastewater volumes and contaminants is shown in Table 7.2.

Table 7.2 BAT Requirements to Minimise Wastewater Emissions

1. Reduce water use and contamination of water by:
   - Use of hardstand for all areas where waste is processed, with appropriate bunding
   - Performing regular water audits to reduce consumption and contamination
   - Carrying out regular checks on tanks, sumps and pits to ensure they are not leaking
   - Segregating clean water such as roof run-off for reuse in the plant
2. Optimise treatment processes to minimise generation of wastewater and the contaminants in the wastewater.
3. Maximise the reuse of treated wastewater, for example for hose-down purposes within the sealed areas

8. MONITORING REQUIREMENTS

The recommended monitoring requirements for all emissions from the facility to all environmental media are covered in this Section.

8.1 Point-source Emissions Monitoring

The recommended monitoring requirements for point-source emissions to air and water are shown in Table 8.1.

Table 8.1 Recommended Point-source Emissions Monitoring Requirements

1. Routine monitoring is required for all continuous or semi-continuous emissions to air or wastewater effluents. Typically this will be for air emissions from abatement systems (ie biofilters and gas scrubbing units from soil bioremediation, oil and solvent recovery, indirect thermal desorption and clinical waste treatment) and effluents from the treatment of aqueous and oily wastewaters.
2. Point-source air emissions from abatement systems, including evaporation ponds, should be monitored weekly for surrogate parameters that can be measured by the on-site NATA-registered laboratory. Typical surrogate parameters will be likely to include TPH, H_2S, CN, NH_3, BTEX etc.
3. Wastewater discharges from the individual major aqueous/oily waste processing operations, namely acid/alkali neutralisation, heavy metal precipitation and oil recovery must be continuously monitored for pH, temperature, turbidity and TOC.
4. The combined wastewater discharge to the evaporation ponds must be continuously monitored for flow rate, temperature, pH, turbidity and TOC.
5. Independent NATA laboratories must analyse all point source air emissions, including the evaporation ponds, for odour, VOCs and any other DoE required parameters, on a quarterly basis. This monitoring frequency should be reviewed after two years of operational data has been gathered
6. Independent NATA laboratories must analyse the final wastewater discharge to the evaporation ponds for the analytes specified in the 3C evaporation ponds document (and re-stated in Table 6.12), on a quarterly basis. This monitoring frequency should be reviewed after two years of operational data has been gathered.

8.2 Ambient Environmental Monitoring

One of the 3C SSC stipulates a minimum essential public acceptability buffer distance of 3 km for the HIWTPs. This highly-conservative factor, together with application of the 3C TSC and use of BAT for the operation of the treatment processes means that measurable off-site environmental impacts are very unlikely. Nonetheless, routine ambient environmental monitoring of the site is required. At minimum, ambient air monitoring at the site perimeter boundary as well as groundwater monitoring, both upstream and downstream of the facility is recommended. The recommended monitoring requirements are shown in Table 8.2.

Table 8.2 Recommended Ambient Environmental Monitoring Requirements

1. Ambient air monitoring, at the facility boundary, should be conducted annually. Parameters to monitor should include, at minimum, odours and VOCs. (*Quarterly for first two years. Should any parameters be measured continuously, or on a campaign basis, for public reassurance?)*
2. Groundwater samples, from both upstream (at minimum 2 bores) and downstream (at minimum 3 bores) of the facility should be analysed annually. *(Again seems to me to be too infrequent, partic in early years)* Parameters to monitor should include, at minimum, TDS, TPH, BTEX, arsenic, cadmium, chromium, mercury, nickel, lead and zinc.

8.3 Monitoring Methodology

Wherever possible the sampling and analytical methodology used for emissions monitoring should be based on recognised Australian or International standards or guidelines. The most relevant standards or guidelines, which should be followed, are outlined in Table 8.3. If there is any uncertainty regarding monitoring methodology the DoE should be consulted .

Table 8.3 Recommended Monitoring Methodology

1. All water and wastewater samples should be analysed as per the American Public Health Association (APHA) standard methods[21].
2. Odour should be analysed using dynamic olfactometry as per the Australian Standard[22].
3. Sampling of air-borne emissions from the evaporation ponds should be via the wind-tunnel methodology developed by the University of NSW[23].
4. Where appropriate it is recommended that the latest USEPA methodologies be used for monitoring point source air emissions. The old AEC/NHMRC guidelines[24] for emissions monitoring are now all but obsolete and most regulatory agencies, including DoE now recommend using the latest USEPA methodology for monitoring air emissions.

8.4 Public Access to Monitoring Data

It is recommended that all monitoring data gathered by the operators of proposed HIWTPs be made readily available to the public.

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[21] APHA, "Standard Methods for the Analysis of Water and Wastewater", (2001)
[22] AS 4323.3, "Determination of Odour Concentrations by Dynamic Olfactometry", (2001)
[23] Wang, X, et al, "Improvement of Wind Tunnel Sampling System for Odour and VOCs", Proceedings 1st IWA International Conference on Odour and VOCs: Measurement, Regulation and Control Techniques, (2001)
[24] AEC/NHMRC, "National Guidelines for the Control of Emission of Air Pollutants from New Stationary Sources and Recommended Methods for Monitoring Air Pollutants in the Environment", (1985)

9. DECOMMISSIONING

The proposed HIWTPs operators should be required to develop a decommissioning plan for the site as a component of their Environmental approvals. Typical indicative BAT requirements for such a decommissioning plan are shown in Table 9.1.

Table 9.1 BAT Recommendation for a Decommissioning Plan

1. Operations during the life of the site should not lead to any deterioration of the site
2. Care should be taken at the design stage of the site to minimise the risks during decommissioning. Designs should ensure that:
    - Underground tanks and pipe work should be minimised wherever possible
    - Provision should be made for draining and cleaning of all vessels, tanks and pipes prior to dismantling
    - Tank and vessel insulation should be easily dismantled without creating dusts or hazards
    - Provision is made for the complete decommissioning and restoration of the evaporation ponds via removal of all residues.
3. Experienced contractors are used for decommissioning of the site.
4. Provision is made for testing of soil, fauna and flora on and around the site to confirm no contamination has occurred.

APPENDIX 1. 3C TECHNOLOGY SUITABILITY CRITERIA

Criterion	Essential
1	Technologies that eliminate or minimise[25] risks to the health and safety of workers and the general public.
2	Technologies that eliminate or minimise risks to the environment.
3	Technologies that eliminate or minimise harmful emissions to soil, water or air.
4	Technologies for which the social and environmental risk factors are well characterised and publicly available.
5	Technologies that can be monitored under all operating conditions to maintain public transparency and accountability.
6	Technologies that eliminate or minimise negative social impact including amenity.
7	Technologies that eliminate or minimise the formation of dioxins, furans, other by-product POPs (persistent organic pollutants) and other endocrine disruptors.
8	Technologies that can incorporate public participation in the monitoring of their performance – and, in particular are not subject to commercial-in-confidence, terrorist risk factors or other constraints on the public's right to know.
9	Technologies that operate in systems that are essentially closed, so that uncontrolled releases of pollutants are minimised or eliminated and all residues (gas, solid and/or liquid) from the treatment process can be contained, analysed and, if necessary, be further treated prior to release.
10	Where technologies are new or innovative they must have been demonstrated at a sufficiently large scale so that the risks associated with them are able to be well characterised.
	Desirable
11	Technologies that are proven and commercially available.
12	Technologies that favour re-use and recycling rather than destruction and/or disposal.
13	Technologies that eliminate or minimise the generation of further wastes.
14	Technologies with the capacity to synergise with other potential activities in a hazardous/industrial waste precinct.
15	Technologies that are commercially viable without externalising social (including health) or environmental costs (to ensure that waste generators pay the full costs of any treatment/disposal)
16	Technologies with the ability to treat waste streams produced in WA now and those expected in the future, so as to minimise interstate transport of hazardous waste for treatment/disposal.

[25] The phrase "eliminate or minimise" appears throughout these criteria. Where this phrase appears elimination is the first preference, but where elimination is not possible the level to which the factor is minimised will be the basis of assessment against the criterion.