

# Waste Management Report

## Energy from Waste Facility, Eastern Creek, NSW

Prepared for:
**The Next Generation NSW Pty Ltd**

Prepared by:
**ENVIRON Australia Pty Ltd**

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# Executive Summary

The proposed development (the Proposal) involves the construction of New South Wales' (NSW's) first Energy from Waste (EfW) facility (the Facility) for The Next Generation NSW Pty Ltd (TNG). This report is to be submitted as part of the Environmental Impact Statement for the Facility and aims to provide a comprehensive assessment of the potential waste management impacts of the proposed Facility. The Waste Management Report addresses the environmental assessment requirements of the Director-General and the NSW Environment Protection Authority (EPA), including compliance with the NSW EfW Policy Statement (Appendix A).

### Technology

The proposed facility is a state-of-the art EfW facility based on Hitachi Zosen Inova's (HZI) well proven moving grate technology providing renewable energy at highest efficiencies while strictly complying with all environmental standards. HZI has a reference list of more than 550 facilities world-wide and is a leading EfW turn-key technology supplier worldwide.

The TNG EfW Facility will be capable of converting combustible residual waste into energy. This can be electricity, hot water to heat buildings, or chilled water to cool buildings. The bottom ash of the process can be further processed off-site to be used as road aggregate, which is done in Europe. The raw gases from the process are cleaned according to environmental standards before being released into the atmosphere.

Phase 1, (Lines 1 and 2) corresponds to the use of 552,500tpa of residual waste fuel and will produce approximately 70MWe electricity supply to the grid. After the construction of phase 2, with Lines 3 and 4 in operation, all four lines will utilise 1,105,000tpa of residual waste fuel to produce approximately 140MWe.

### The process at the Materials Processing Centre

Upon operation of the EfW, the identified residual waste fuel will be received and sorted at the TNG EfW facility (instead of disposal to landfill). No material will be exhumed from landfill for the purpose of supplying fuel for the TNG EfW facility.

Classification of incoming waste is based on knowledge of its origin; advice from the carrier; inspection of the carrier's documentation prepared in accordance with the EPA (2008) *Waste Classification Guidelines;* and verification of this information by visual inspection.

Separation machinery used at the Genesis Xero Material Processing Centre (MPC) is state-of-the-art and is efficient at segregating wastes for further processing and recycling; and ensuring that recycling is maximised, whilst residual waste is minimised.

Of the waste loads received at the MPC that are classified as containing material capable of being recovered or recycled, it is estimated that, on average, 80% of materials will be recovered by sorting, separating and processing, and made available for resale or reuse by other processors.

The proposed incoming waste types, composition and categorisations with respect to the design residual waste fuel mix are summarised in Table 7 of the Report. The feedstock for the EfW is the residual waste sourced from municipal solid waste (MSW), commercial and

industrial (C&I) and construction and demolition (C&D) sources. In the case of chute residual waste (CRW), this comprises the residual waste fuel from the adjacent Genesis Xero MPC. The combined composition of these residual waste fuels produces a net calorific value (NCV) of 12.34 MJ/kg which means when the entire Facility with all 4 lines is in operation; a total of 1,105,000 tonnage per annum (tpa) of residual waste fuel would be supplied to the EfW facility. The Table below shows the tpa mix for Phase 1.

**Design fuel mix for Phase 1**

| Design Fuel | Description | Phase 1 Composition | tpa |
|---|---|---|---|
| **Chute Residual Waste - Residual Fuel** | Residual waste fuel from the MPC after initial sorting and separation process. | 23% | 129,105 |
| **C&D Waste -Residual Fuel** | C&D residual waste from authorised facilities including source separation on construction sites | 29% | 158,533 |
| **C&I Waste - Residual Fuel** | C&I residual waste from authorised facilities | 17% | 93,031 |
| **Steel Shredding Waste - Residual Fuel** | C&I metal recycling residual also known as Flock | 14% | 79,741 |
| **Paper Pulp – Residual Fuel** | Residual waste from paper pulp manufacturers processing post-consumer C&I and MSW paper | 5% | 26,580 |
| **Glass Recovery Waste Residual -Fuel Residual** | MSW glass recycling facility residual | 2% | 9,493 |
| **GO Waste -Residual Fuel** | MSW garden organics (GO) residual waste (domestic GO processing) | 2% | 11,392 |
| **AWT Waste - Residual Fuel** | MSW alternative waste treatment facility residual (residual composting) | 7% | 37,972 |
| **MRF Waste - Residual Fuel** | MSW material recovery facility residual (dry recyclables processing) | 1% | 6,645 |
| | **Total** | **100%** | **552,500** |

The main types of waste the Facility will generate from the EfW process are summarised in the table below.

**Estimation of Ash residue and recycle/disposal options**

| Type of Ash | Estimated amount generated | Waste Classification | Disposal Option(s) |
|---|---|---|---|
| Bottom ash | 270,000 tpa (20% moisture content) | General Solid Waste | - Potential reuse as aggregate in road-base products (common reuse option in Europe).<br>- Transported to the adjoining landfill facility for disposal |
| Boiler ash | 5,000 tpa | Restricted Solid Waste | - Potential reuse option to be used in road-base products.<br>- Transported off site by a licensed contractor and taken to a waste treatment facility licensed to treat such wastes. |
| APC ash | 55,000 tpa | Restricted Solid Waste | - Treatment to render APC ash usable in concrete products. |

| Estimation of Ash residue and recycle/disposal options | | | |
|---|---|---|---|
| **Type of Ash** | **Estimated amount generated** | **Waste Classification** | **Disposal Option(s)** |
| | | | - Transported off-site by a licensed contractor and taken to a waste treatment facility licensed to treat such wastes.<br>- Implementation of stabilisation techniques such as immobilisation or vitrification to reduce the residue to General Solid Waste classification |
| Total | 330,000 tonnes/year | | |

[1] Estimates based on the Facility processing 1,105,000 tonnes/year of residual waste fuel and a input mass flow of residual waste fuel load point of 34.5 tonnes/h.
[2] Waste classification were based on a chemical assessment and comparing results against the criterial set out in Table 2 – TCLP and SCC values for classifying waste by chemical assessment in the NSW Waste Classification Guidelines – Part 1: Classification of waste. Refer to Appendix H for assessment results.

## Energy from Waste Policy Statement

An authorised facility complies with the resource recovery requirements of the EfW Policy Statement to ensure that recyclables are recovered prior to energy recovery. Chute Residual Waste (CRW) is the residual waste fuel from the MPC and will make up 23% of the design fuel mix in Phase 1. The Landfill also receives residual waste fuel that is eligible to be used in EfW from other authorised recycling facilities but they are currently landfilled. Upon operation of the EfW, this residual waste fuel will then be received at the TNG EfW facility instead of being landfilled. No material will be exhumed from landfill for the purpose of the TNG EfW facility.

The Facility, in addition to providing a higher order (energy recovery) use of resources than landfill, will also preserve valuable landfill void space in Sydney's Class 2 landfills. A number of studies on available landfill capacity in Sydney has highlighted that the demand for void space for non-putrescible wastes remains high, while no new waste management facilities are expected to be developed. This has the potential to create a shortfall in residual waste management capacity within the next decade or sooner. Given that the Facility will both divert waste from landfill and achieve energy recovery, it is well placed to assist in alleviating this shortage.

TNG proposes to thermally treat waste or waste-derived materials that are not listed as eligible waste fuels and that therefore meet the requirements of an energy recovery facility. The Facility will target non-putrescible residual waste streams from the MSW, C&I and C&D sectors so as to comply with the EfW Policy Statement and the licensing and development consent requirements for the site. TNG has performed a detailed waste mapping study to identify the sources and composition of allowable non-eligible waste fuels in the market. It was found that sufficient allowable tonnes exist in the regulated area and in NSW as a whole for the proposed Facility.

It is expected that by the time the Facility has been commissioned, the Sydney Metropolitan Area (SMA) will have experienced significant population growth, particularly in the North West and South West Growth Centres, increasing the quantity of waste generated across all waste streams. Coupled with an increasing per capita consumption growth rate, the waste

mapping conducted provides a conservative outlook on waste generation and allowable waste tonnes for the proposed Facility. In order to ensure that all wastes received for energy recovery are compliant with the EfW Policy Statement, a detailed verification plan has been established.

TNG has committed to - and is continuing - an extensive community and stakeholder consultation process. This process will be ongoing to ensure the community understands the importance and impacts of the project.

The Proposal complies with the National waste framework, as it contributes to the aims of the National Waste Policy and Direct Action's emissions goals. The Proposal also complies with all NSW waste legislation, guidelines, development plans and strategies pertaining to waste management.

Sections 6 and 7 of this report fully address and satisfy the waste management requirements of the Director General and the NSW EPA. Detailed information is provided on:

- The types and volumes of waste to be processed at the TNG Facility;
- The resource recovery procedures and controls to be used to sort the feedstock (fuel) for the Facility;
- Fuel stockpiles;
- Management, classification and disposal of waste materials produced by the Facility;
- Details of output products from the Facility;
- Details of chemicals used at the Facility;
- The Facility's consistency with the WARR Strategy and the EfW Policy Statement; and
- Controls for environmental impacts of the Proposal.

# Contents

## List of Figures



### List of Tables

**List of Appendices**

# Acronyms and Abbreviations

| | |
|---|---|
| APC | Air pollution control |
| AWT | Alternative Waste Treatment |
| C&D | Construction and demolition waste |
| C&I | Commercial and industrial waste |
| CEMP | Construction Management Plan |
| CEMS | Continuous emissions monitoring system |
| $CO^2$ | Carbon dioxide |
| CO2e | Carbon dioxide equivalents |
| CRW | Chute residual waste (from the MPC) |
| CWMP | Construction waste management plan |
| DADI | Dial a Dump Industries |
| DAP | Direct Action Plan |
| DCP | Distributed Control System |
| DECCW | Department of Environment, Climate Change and Water |
| DGR | Director-General's environmental assessment requirements |
| DSI | Detailed Site Contamination Investigation |
| EfW | Energy from Waste |
| EIS | Environmental Impact Statement |
| EP&A | Environmental Planning and Assessment Act 1979 |
| EPA | Environment Protection Authority |
| ERA | Extended regulated area |
| ERF | Emissions Reduction Fund |
| Facility | The Next Generation Pty Ltd Energy from Waste Facility, Eastern Creek |
| FGT | Flue gas treatment |
| GHG | Greenhouse gases |
| GO | Garden organics |
| HIL | Health Based Investigation Levels |
| HZI | Hitachi Zosen Inova (technology provider) |
| IBA | Incinerator bottom ash |
| IED | Industrial Emissions Directive |
| Km | Kilometre |
| kV | kilovolt |
| LOI | Loss on ignition |
| M | Metre |
| MPC | Genesis Xero Material Processing Centre |
| MRA | MRA Consulting Group |
| MRF | Material Recovery Facility |
| MSW | Municipal solid waste |
| MW | Megawatt |
| MWe | Megawatt electrical |
| NCV | Net calorific value |
| NSW | New South Wales |
| OEH | Office of Environment and Heritage |

| | |
|---|---|
| PLC | Programmable Logic Controller |
| PoEO Act | Protection of the Environment Operations Act 1997 |
| PoEO CA Reg | The Protection of the Environment Operations (Clean Air) Regulation |
| PoEO WARW Reg | The Protection of the Environment Operations (Waste) Amendment (Residue Wastes) Regulation 2005 |
| PoEO Waste Reg | The Protection of the Environment Operations (Waste) Regulation 2014 |
| POP | Proof of performance |
| Proposal Eastern | The Next Generation Pty Ltd proposal of an Energy from Waste Facility, Creek |
| PSC | Pre-sort Centre |
| RRA | Regional regulated area |
| SMA | Sydney metropolitan area |
| SCADA | Supervisory Control and Data Acquisition |
| SSDA | State Significant Development Application |
| TNG | The Next Generation Pty Ltd |
| TOC | Total organic compounds |
| tpa | tonnes per annum |
| UK | United Kingdom |
| WARR | Waste Avoidance and Resource Recovery |
| WSEA SEPP | Western Sydney Employment Area State Environmental Planning Policy |
| WTS | Waste transfer station |

# 1 Introduction

## 1.1 Background

The proposed development (the Proposal) involves the construction of an Energy from Waste (EfW) electricity generation facility (the Facility) for The Next Generation NSW Pty Ltd (TNG), on land adjacent to the Genesis Xero Waste facility, located at Honeycomb Drive, Eastern Creek, New South Wales (NSW) approximately 36 kilometre (km) west of the Sydney Central Business District (CBD).

The Facility will recover energy from the residuals after recycling has taken place of municipal solid waste (MSW), commercial and industrial (C&I) and construction and demolition (C&D) residual waste streams that comply with the NSW EfW Policy Statement (Appendix A – NSW Energy from Waste Policy Statement). These waste streams include chute residual waste (CRW) from the Genesis Xero Material Processing Centre (MPC), flock waste, C&D residual and C&I residual waste streams that have been processed through an authorised facility and would otherwise be landfilled. The MPC and Waste Transfer Station (WTS) are located at the site adjacent to the proposed EfW Facility. A separate application to construct an undercover pre-sort centre (PSC) on its site to increase the amount of recycling achieved in particularly focused on C&I waste streams has also been lodged. This is to ensure that residual waste fuels will meet the EfW Policy criteria and that recycling is not cannibalised by the introduction of the EfW in NSW.

In order to facilitate the transfer of fuel between the MPC, PSC and TNG EfW Facilities they will be connected by an internal road and an electrically driven conveyor system that run under the precinct road.

It is proposed to build the facility in two phases.

Phase 1 will include the complete construction of the Tipping Hall and Waste Bunker and Combustion Lines 1 and 2 comprising of two independent Boilers, Flue Gas Treatment (FGT) systems, one Stack, one Turbine and one Air Cooled Condenser (ACC), and all other auxiliary equipment.

Phase 2 will comprise the installation of combustion lines 3 and 4 with again two independent Boilers, Flue Gas Treatment (FGT) systems, one Stack, one Turbine and one Air Cooled Condenser (ACC) and all other auxiliary equipment.

This two Phase approach has been adopted after receiving feedback from the various government agencies. Lines 3 and 4 will be constructed once the Department of Planning and Environment is satisfied that the required amount of eligible residual waste fuel is available to the TNG facility.

The Facility will have a capacity to process up to 1,350,000 tonnes per annum (tpa) of residual waste fuel and will recover energy from waste that would otherwise be landfilled. The Facility is designed to operate efficiently between a nominal calorific value (NCV) of 10 and 16.5 MJ/kg. At an NCV of 10, the Facility will process a maximum of 1,350,000 tpa. At a NCV of 16.5, the Facility would only require 820,000tpa to operate. Under the designed operating conditions based on the fuel type, the proposed Facility will operate at a NCV of

12.34 MJ/kg and with a residual waste fuel requirement of 1,105,000tpa for four operating lines. In Phase 1, this corresponds to 552,500tpa.

The proposed EfW Facility, upon operation, will provide employment to a total of up to 55 new staff working over three shifts. Indirectly, the proposal will support to hundreds of workers and support businesses. During construction, the site will provide approximately 500 construction worker jobs.

## 1.2 Purpose and objectives

This Waste Management Report is to address the Director-General's Environmental Assessment Requirements (DGRs) and NSW Environment Protection Authority (EPA) requirements in relation to waste management; and State and Commonwealth legislative and policy requirements that would apply to the Facility, including the NSW Energy from Waste Policy Statement released in January 2015. It would also ensure that the adequacy review comments provided by government agencies on the draft Waste Management report prepared by MRA Consulting Group for Dial a Dump Industries (DADI) are addressed.

The scope of the Waste Management report is limited to the follow areas:

- The delivery and temporary storage of waste that will be used as fuel (inputs) at the Facility. This includes consideration of issues around pre-sorting of materials before thermal treatment.
- The temporary storage and disposal of output waste generated from the Facility.

The Waste Management report has maximised the use of the content of the draft Waste Management report prepared by MRA Consulting Group in October 2014 for Dial a Dump Industries (DADI). It has been developed in consultation with the Ramboll and Hitachi Zosen Inova (HZI) team members to incorporate the applicable technical information.

## 1.3 Director-General's Requirements (DGRs)

The relevant DGRs around waste management for the Proposal are listed in the Table below. The table identifies where each requirement is addressed in this report.

**Table 1: Director-General's Requirements (Waste Management)**

| # | Director-General Requirement | Report Section |
|---|---|---|
| **1** | A description of the classes and quantities of waste that would be thermally treated at the facility. | Section 6.1 |
| **2** | Demonstrate that waste used as a feedstock in the waste to energy plant would be the residual from a resource recovery process that maximises the recovery of material, in accordance with EPA guidelines. | Section 6.2 |
| **3** | Procedures that would be implemented to control the inputs to the waste to energy plant, including contingency measures that would be implemented if inappropriate materials are identified. | Section 6.3 |
| **4** | Details of the location and size of stockpiles of unprocessed and processed recycled waste at the site. | Section 6.4 |
| **5** | Demonstrate any waste material produced from the waste to energy facility for land application is fit-for-purpose and poses minimal risk of harm to the environment in order to meet the requirements for consideration of a resource recovery exemption by the EPA under Clause 51A of the *Protection of the Environment Operations (Waste)* | Section 6.5 |

| | | |
|---|---|---|
| | *Regulation 2005*. | |
| **6** | Procedures for the management of other solid, liquid and gaseous waste streams. | Section 6.6 |
| **7** | Describe how waste would be treated, stored, used, disposed and handled on site, and transported to and from the site, and the potential impacts associated with these issues, including current and future offsite waste disposal methods. | Section 6.7 |
| **8** | Identify the measures that would be implemented to ensure that the development is consistent with the aims, objectives and guidance in the NSW Waste Avoidance and Resource Recovery Strategy 2007. | Section 6.8 |

## 1.4 NSW EPA requirements

Requirements of the NSW EPA for the Proposal are listed in Table 2. The table identifies where each requirement is addressed in this report.

**Table 2: NSW EPA Requirements (Waste Management)**

| # | EPA Requirement | Report Section |
|---|---|---|
| **1** | The proposed sources, types, quantities and classification of all wastes to be treated at the facility. This must Include details of how the input wastes will comply with the Resource Recovery Criteria contained in the NSW EfW Policy Statement. | Section 7.1 |
| **2** | Measures to be implemented to ensure that waste used as a feedstock at the facility is the residual from a resource recovery process that maximises the recovery of material. | Section 7.2 |
| **3** | How the process will meet the Thermal Efficiency and Technical Criteria in the NSW EfW Policy Statement. | Section 7.3 |
| **4** | The procedures for the assessment, handling, storage, transport and disposal of all hazardous waste produced by the Facility. | Section 7.4 |
| **5** | Provide details of the quantity and type of both liquid waste and non-liquid waste generated, handled, processed or disposed of at the premises. Waste must be classified according to the Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (NSW EPA, 1999). Details must include:<br>a. The transportation, assessment and handling of waste arriving at or generated at the Premises;<br>b. Any stockpiling of wastes or recovered materials at the site including stockpile footprints, heights and location;<br>c. Any waste processing related to the facility, including reuse, recycling, reprocessing or treatment both on- and off-site;<br>d. The method for disposing of residual waste from the Facility;<br>e. The emissions arising from the handling, storage, processing and reprocessing of waste at the Facility; and<br>f. The proposed controls for managing the environmental impacts of these activities. | Section 7.5 |
| **6** | The quantity, type and specifications for all output products proposed to be produced from the facility. The description should include the physical, chemical and biological characteristics (including contaminant concentrations) of those output products as well as relevant accredited standards against which the products would comply. In documenting or describing the composition of output products and/or wastes generated from the proposed facility reference should be made to the relevant EPA resource recovery exemption or the EPA Waste Classification Guidelines 2008. | Section 7.6 |

| Table 2: NSW EPA Requirements (Waste Management) | | |
|---|---|---|
| # | EPA Requirement | Report Section |
| **7** | Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations for the waste. | Section 7.7 |
| **8** | The procedures that will be implemented to control the inputs to the facility, including contingency measures that would implemented in the event that ineligible waste fuels are received at the Premises. | Section 7.8 |
| **9** | Identify the measures that would be implemented to ensure that the development is consistent with the aims, objectives and guidance in the *NSW Waste Avoidance and Resource Recovery Strategy* as issued from time to time. | Section 7.9 |
| **10** | Provide details of spoil disposal with particular attention to:<br>a) The quantity of spoil material likely to be generated;<br>b) Proposed strategies for the handling, stockpiling, reuse recycling and disposal of spoil;<br>c) The need to maximise reuse of spoil material in the construction industry;<br>d) Identification of the history of spoil material and whether there is any likelihood of contaminated material, and if so, measures for the management of any contaminated material; and<br>e) Designation of transportation routes for transport of spoil. | Section 7.10 |
| **11** | Provide details of procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials used, stored, processed or disposed of at the site, in addition to the requirements for liquid and non-liquid wastes. Reference should be made to the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes* (NSW EPA, 1999). | Section 7.11 |
| **12** | Provide details of the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage. Reference should be made to the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes* (NSW EPA, 1999). | Section 7.12 |

## 1.5 Scope of work

To address the above requirements, the following scope of work has been defined:

- Review of Proposal information and documentation;
- Collation of additional information;
- Assessment of regulatory compliance capability;
- Identification of processes, controls and procedures to address EfW Policy criteria; and
- Identification of opportunities to mitigate issues.

# 2 Waste management capacity in Sydney

MRA Consulting Group prepared the Draft Waste Management Report (October 2014), The Next Generation NSW Pty Ltd, (MRA WMR, 2014) whichincluded the following study on the capacity of Sydney's waste reserves.

## 2.1 Remaining landfill capacity

There are currently approximately ten NSW EPA approved facilities in the Western Sydney region that can accept non-putrescible (Class 2) General Solid Waste, the waste type to be accepted at the TNG Facility.

Overall, there is currently uncertainty in regard to remaining total capacity of existing Class 2 landfills. Access to individual facility tonnage data is extremely limited. While disclosure of data that might be held by government agencies, it is not permitted under the *Protection of the Environment Operations Act, 1997* S.319 (1)(a) unless consent has been granted by the owner/operator of the facility.

The NSW EPA has recently committed to conducting an infrastructure needs assessment, which builds upon the work conducted in 2011 by NSW EPA and will include landfills and C&D processing facilities in addition to the original analysis of MSW and C&I facilities. Until this is complete, the most recent studies examining Class 2 capacity are:

- The 2009 Hyder *Australian landfill capacities into the future* report commissioned by the Department of the Environment, Heritage, Water and the Arts;
- The Wright Corporate Strategy report *Strategic Review – Putrescible Landfill Demand and Capacity for the Sydney Region* which was prepared by and released by the NSW Government in 2010; and
- A 2010 independent assessment by MRA.

The MPC was granted project approval by the NSW Planning Assessment Commission on 22 November 2009. It commenced operation in June of 2012, followed by the landfill which commenced operations in November 2012 partly alleviating the sharp decline in landfill availability in the SMA.

### 2.1.1 Hyder report

At the lower end, Hyder reported an estimated 4.7 million tonnes of remaining solid waste capacity projected to be depleted by 2012 (Hyder 2009a). The *Australian landfill capacities into the future* report was commissioned by the Federal Department of the Environment, Water, Heritage and the Arts as part of a suite of research reports used to inform the *National Waste Policy - Less waste, more resources*. Estimates on landfill airspace were based on a WMAA survey. WMAA provided Hyder with aggregated data in order to maintain commercial confidentiality of landfill operators. However, 21% of the known facilities contacted by WMAA did not respond to the questionnaire and therefore the data gaps were significant, especially since there was no information on the relative size of the non-responders. Hyder summarised the issue of data availability as follows: *"None of the jurisdictional regulators appear to routinely collect and collate landfill capacity data. In general, landfill data was more difficult to obtain for private landfills and particularly private inert landfills."* It should be noted that at the time of writing of the Hyder report, the Light

Horse project had not been granted approval, therefore the 4.7 million tonnes estimate did not include that site's capacity.

### 2.1.2 Wright Corporate Strategy report

A report prepared by Wright Corporate Strategy Pty Ltd for the State Government of New South Wales reached a significantly different estimate (NSW Department of Planning, 2009). As evident from the title, The *Strategic Review-Putrescible Landfill Demand and Capacity for the Sydney Region* did not focus on Class 2 landfills. However, it made reference to Sydney's Metropolitan Area Class 2 landfill capacity, which was estimated at 35 million tonnes. The report is dated March 2009 but was only released a year later, therefore neither Hyder nor WMAA would have had access to it. In any case, this report does not include a breakdown of landfill capacity per facility or a methodology as to how the 35 million tonnes figure was derived. A likely reason could be the issue of confidentiality as explained above. As a result, the accuracy of this estimate cannot be assessed. However, since the NSW government endorsed this report, it could be regarded as a robust estimate. Wright Corporate Strategy assumed that annual disposal of Class 2 waste is 2.5 million tonnes, equating to 14 years of available Class 2 landfill space (taking into account expected future disposal trends). Now, nearly five years later, remaining capacity would be around 22.5 million tonnes or 9 years.

In assessing Justifiable Demand for the Light Horse facility in October 2009, Tony Wright estimated that the site's 14 million tonnes of Class 2 capacity would raise Sydney's contingency landfill space by 6 years to a total of 20 years and a total capacity of around 49 million tonnes in 2009 (NSW Department of Planning, 2009).

### 2.1.3 MRA 2010 independent assessment

MRA's 2010 research confirmed that the publicly available data on Sydney's landfill capacity is very limited, not consolidated and, in general, sources are not referenced. The data collected for this assessment was not sufficiently accurate to provide an undisputable estimate of total remaining capacity. However, a range and 'best estimates' were deduced. The three landfills for which MRA could not obtain reliable estimates on remaining capacity were quite small and believed to be nearing their capacity. Nevertheless, a generous 1 to 2 million tonnes capacity was allowed in order to model a best-case scenario. The total Class 2 landfill capacity for Sydney was estimated at 34.3 to 36.3 million tonnes. That figure included the then-approved Light Horse facility, and was considerably lower than Wright's 49 million tonnes in 2009.

Capacity in terms of tonnes is a different matter to capacity in terms of years. The former is absolute, while the latter is inextricably linked to the demand side of the equation. To find out whether there is justifiable demand for more Class 2 waste management facilities, volumetric capacity needs to be expressed in years. To achieve this it is important to examine the quantities of C&I and C&D waste landfilled annually.

## 2.2 Demand

### 2.2.1 Hyder report

The Hyder report assumed 3.38 million tonnes of C&I and C&D waste deposited in Class 2 landfills for 2006-07. At less than 19 million tonnes capacity (incorporating the Light Horse facility), Sydney's contingency landfill space would suffice for just over 5.5 years.

### 2.2.2 Wright Corporate Strategy report

Although it has been stated that throughout their analysis the authors assumed landfilling of 2.5 million tonnes annually, the source of this estimate was not referenced. At less than 46.5 million tonnes of landfill space (including the Light Horse facility), Sydney was calculated to have 18.5 years of contingency landfill space remaining in 2009.

### 2.2.3 MRA 2010 independent assessment

In order to evaluate whether a capacity of 34.3 to 36.3 million tonnes of landfill void space for Sydney Metropolitan Area was justified, the following information on Sydney C&I and C&D waste was extracted from the NSW Department of Environment, Climate Change and Water (DECCW) Waste Avoidance and Resource Recovery Progress Report 2010.

**Table 3: C&I and C&D waste management in the SMA**

| Waste stream | Year | Disposed (t) | Recycled (t) | Generated (t) | % Recycled |
|---|---|---|---|---|---|
| C&I | 2008–09 | 1,854,500 | 1,816,500 | 3,671,000 | 50% |
| | 2006–07 | 2,087,000 | 1,528,000 | 3,615,000 | 42% |
| | 2004–05 | 2,246,500 | 1,214,500 | 3,461,000 | 35% |
| | 2002–03 | 2,029,500 | 1,022,000 | 3,051,500 | 33% |
| C&D | 2008–09 | 1,075,500 | 3,684,500 | 4,760,000 | 77% |
| | 2006–07 | 1,286,000 | 2,978,500 | 4,264,500 | 70% |
| | 2004–05 | 1,306,500 | 2,508,000 | 3,814,500 | 66% |
| | **2002–03** | **1,177,000** | **2,505,000** | **3,682,000** | **68%** |

The table reveals a pattern of annual increases in total C&I and C&D waste generation in Sydney (putrescible and non-putrescible). The nationwide rate of increase is projected in the National Waste Report (2010) to be between 4.5% and 7% per year. Assuming that waste disposal stabilises at the calculated 3.37 million tonnes per year and remaining capacity is 34.3 to 36.3 million tonnes, Sydney's 2010 remaining capacity was calculated to be between 10.1 and 10.7 years.

To verify this estimate, additional data sources were researched. The 2009 Hyder report on *Waste and Recycling in Australia*[1], and the *National Waste Report 2010*[2] based on Hyder data, agree on 4.98 million tonnes of waste being landfilled annually in NSW. Sydney's population is 65% of the state's total therefore it was assumed that it landfills 65% of all landfilled waste (3.23 million tonnes annually, see Table 4). At this rate of disposal the 34.3 to 36.3 million tonnes of remaining capacity would last for between 10.6 and 11.2 years.

**Table 4: C&I and C&D waste disposal in NSW and Sydney**

| 2006-2007 | C&I (M tpa) | C&D (M tpa) | Source |
|---|---|---|---|
| NSW | 2.92 | 2.04 | Waste & Recycling in Australia (Hyder 2009b) |
| Sydney | 1.9 | 1.33 | National Waste Report 2010 (EPHC, 2010) |

## 2.3 Capacity and demand analysis

These three research projects estimated 2010 remaining Class 2 landfill capacity in the Sydney region at between 18.7 and 56.5 million tonnes, translated to 5.5 to 18.5 years of available landfill. This estimate is heavily dependent on the amount of waste landfilled annually. Table 8 summarises the different estimates produced on the basis of these reports.

| **Table 5: Estimates of remaining and projected capacity of Class 2 solid waste landfill space in Sydney** | | | |
|---|---|---|---|
| **Source** | **2010 remaining capacity (M tpa)** | **Annual waste to landfill (M tpa)** | **2010 capacity in years** |
| **Hyder 2009** | 18.71 | 3.38 | 5.53 |
| **Wright Corporate Strategy** | 46.51 | 2.5 | 18.5 |
| **MRA 2010 research** | 34.3-36.3 | 3.37 (NSW DECCW, 2009) | 10.1-10.7 |
| | | 3.23 (EPHC, 2010) | 10.6-11.2 |

The Wright report provided the most optimistic scenario in terms of remaining volumetric capacity. However, the annual waste to landfill quantities assumed is considerably lower than the NSW DECCW figures that were also backed up by a 2010 C&I audit. The waste data presented in Table 3 is considered the most reliable data set as it:

- Was the most recent one at the time of the study;
- Is compiled and published by the NSW DECCW; and
- Was used in guiding NSW waste policy.

The combination of the most optimistic remaining capacity (46.5 million tonnes) data with the most realistic waste disposal data (3.37 million tonnes per year) yields a remaining Class 2 landfill capacity for Sydney in 2010 of less than 14 years. This is considered as the most accurate estimate that can be obtained with the available literature.

Tony Wright and the Department of Planning and Environment have stipulated that the maximum capacity for Class 2 landfill space should be between 20 and 30 years (NSW Department of Planning, 2009). This would indicate that the additional residual waste management capacity offered by TNG is essential since the approved capacity (estimated by Tony Wright in 2010 at 18.5 years) does not even cover the lower end of this period. Given the above, and that landfill capacity has been significantly depleted since 2010, the TNG facility is well placed to provide the required Class 2 General Solid Waste management capacity.

Therefore, the EfW facility proposed by TNG will help Sydney's Class 2 landfills, as any waste processed through it will also be diverted, to a large extent from landfill, further preserving valuable landfill void.

[1] Adjusted to reflect 2010 numbers.

# 3 Proposed development

## 3.1 The Site

The site for the proposed TNG EfW Facility, is located off Honeycomb Drive at Eastern Creek, is surrounded by land owned by the Corporate Group Alexandria Landfill Pty Ltd, Thaquarry Pty Ltd, Australand, Hanson, Jacfin, the Department of Planning and Environment and Sargents. All the surrounding land is earmarked under the *Western Sydney Employment Area State Environmental Planning Policy* (WSEA SEPP) to be redeveloped for higher-end industrial and employment uses over the next decade.

The site has a total area of approximately 56 hectares including the Riparian Corridor, with a specific development area of approximately 9 hectares. The EfW facility is proposed to be located on Lots 2 and 3, Deposited Plan (DP) 1145808.

The EfW Facility, includes the adoption of a plan of subdivision and the following ancillary works:

- Earthworks associated with the balance of the site;
- Internal roadways;
- Provision of a direct underpass connection (Precast Arch and Conveyor Culvert) between the TNG Facility and the MPC;
- Staff amenities and ablutions;
- Staff car parking facilities;
- Water detention and treatment basins; and
- Services (Sewerage, Water Supply, Communications, Power Supply).

## 3.2 The Facility and its process

The proposed facility is a state-of-the art EfW facility based on Hitachi Zosen Inova's (HZI) proven moving grate technology providing renewable energy at high efficiencies while complying with environmental standards and industry best available technology (BAT). HZI has a reference list of more than 550 facilities world-wide and is a leading EfW turn-key technology supplier worldwide.

The TNG EfW Facility will be capable of converting combustible residual waste into energy. This can be electricity, hot water to heat buildings, or chilled water to cool buildings. The bottom ash of the process can be further processed off-site to be used as road aggregate, which is done in Europe. The raw gases from the process are cleaned according to environmental standards before being released into the atmosphere.

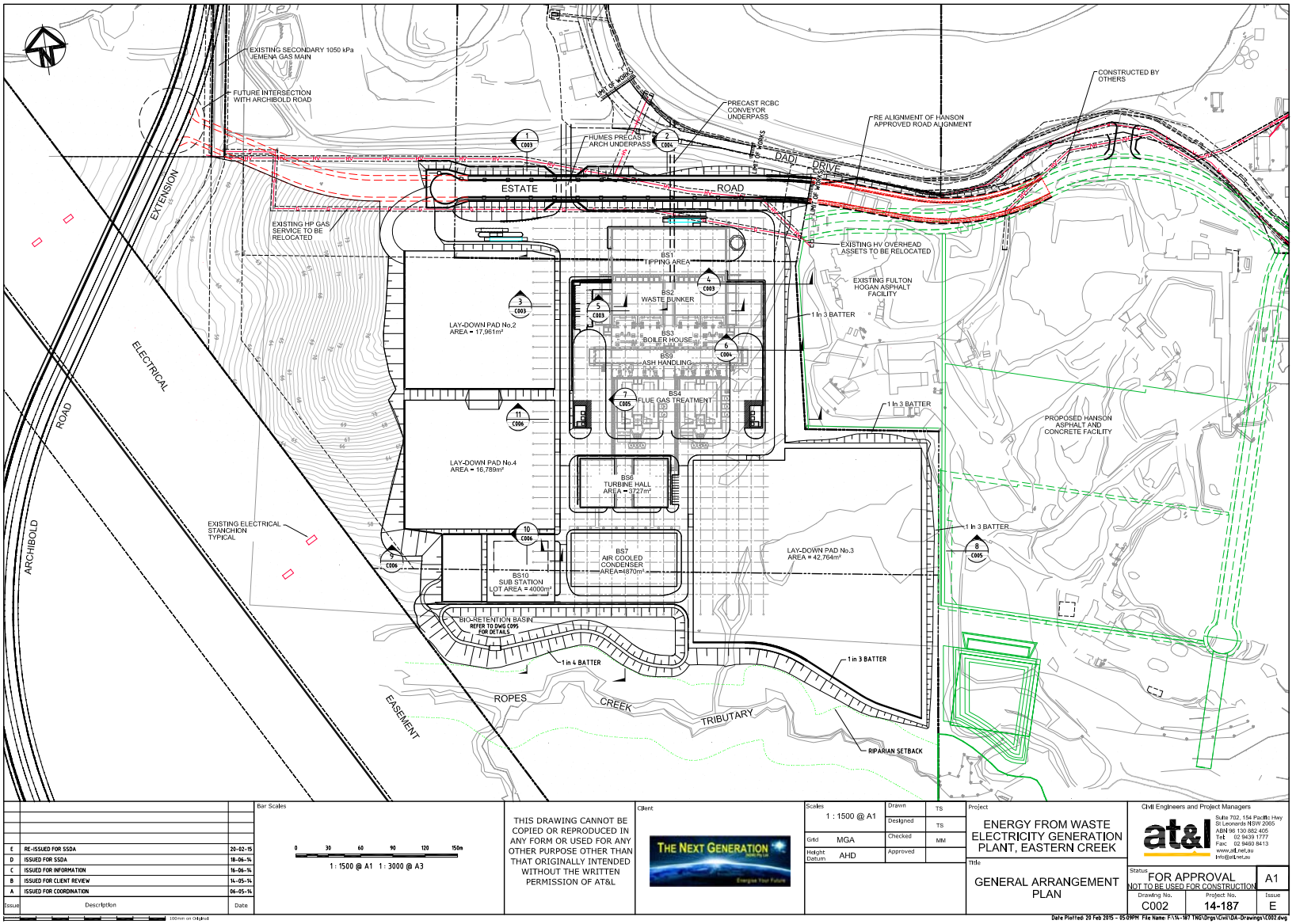
The primary infrastructure components of the Facility will be:

- Weighbridges;
- Tipping hall – Waste fuel will be delivered by truck or conveyor underpass to the tipping hall;

- Waste fuel bunker – Storage and supply of fuel to the combustion process;
- Boiler and flue gas treatment (FGT) – Energy recovered from the combustion of fuel, steam generation and the associated flue gases treated;
- Bottom Ash Bunker– for the storage and handling of residual combustion ash;
- Sealed silos for the storage and handling of Air Pollution Control (APC) residue ash;
- Turbine hall – Houses turbine for the conversion of steam to electricity.
- Air Cooled Condenser (ACC);
- Substation; and
- Stack.

Figure 1 below shows the proposed Facility site layout.

## Figure 1: TNG EfW Facility Site Layout



## 3.3 Operational Process

All of the eligible residual waste fuel required for the Phase 1 of the development (552,500tpa) is currently received and/or processed by the extensive waste and resource recovery infrastructure owned by DADI. This material is either:

- Residual waste fuel generated by the MPC (approximately 23% of the facility of input tonnes); and
- Residual waste fuel received from third party authorised facilities that meet the eligibility criteria.

Residual waste fuel from the MPC will be delivered to the EfW Facility by two methods: via a covered conveyor system or by vehicle through the integrated underpass.

All incoming fuel from the MPC entering via conveyor will be pre-weighed and its details recorded at the MPC before being transported to the TNG EfW Facility.

Waste fuels from external transfer stations and recycling facilities will be delivered via road vehicle. These will enter the EfW site through the main entrance and will proceed to the weighbridge where the quantity of incoming fuel will be checked and recorded. Inspections of all vehicle loads will be undertaken at the weighbridge to confirm the nature of incoming fuel and only approved fuel will proceed to the tipping hall of the Facility. Once reaching the tipping hall a second and third checking procedure takes place at which point the loads not meeting the eligible criteria will be rejected. The tipping hall is large enough to quarantine any suspect loads if required.

Approved incoming waste will be delivered to the Facility tipping hall and then discharged into the waste bunker. The bunker has the capacity to store 5-7 days' worth of residual waste fuel. Waste in the bunker is first mixed before being loaded into a hopper using overhead cranes. The hopper then feeds the waste fuel onto the continually moving grate below the furnace. This continuous movement promotes mixing of the waste with the combustion air.

Ash from the grate is discharged into a water filled quench and is moved by conveyor to the enclosed bottom ash storage bunker prior to being transported off-site. All bottom ash will be taken to landfill for disposal or sent to the adjoining MPC for aggregate and road-base production. Air Pollution Control (APC) residue ash will be collected into sealed storage silos and transported off-site in sealed tankers for further treatment or disposal.

Boiler ash is also generated by the facility. Its chemical composition falls between that of bottom ash and APC. The characterisation of boiler ash is dependent on in which boiler pass it is accumulated. The boiler ash from all passes will be conservatively disposed of with the APC residues, unless it can be proven to be reusable following rigorous testing procedures in compliance with EPA regulations.

Hot gases from the combustion of the waste will pass through a heat recovery boiler. The energy from the hot gases will be transferred to the boiler to produce high-pressure steam. This steam will be fed to the steam turbine driven generator. In the first phase, the facility will be capable of generating approximately 79MW of electricity, which, after supplying the site

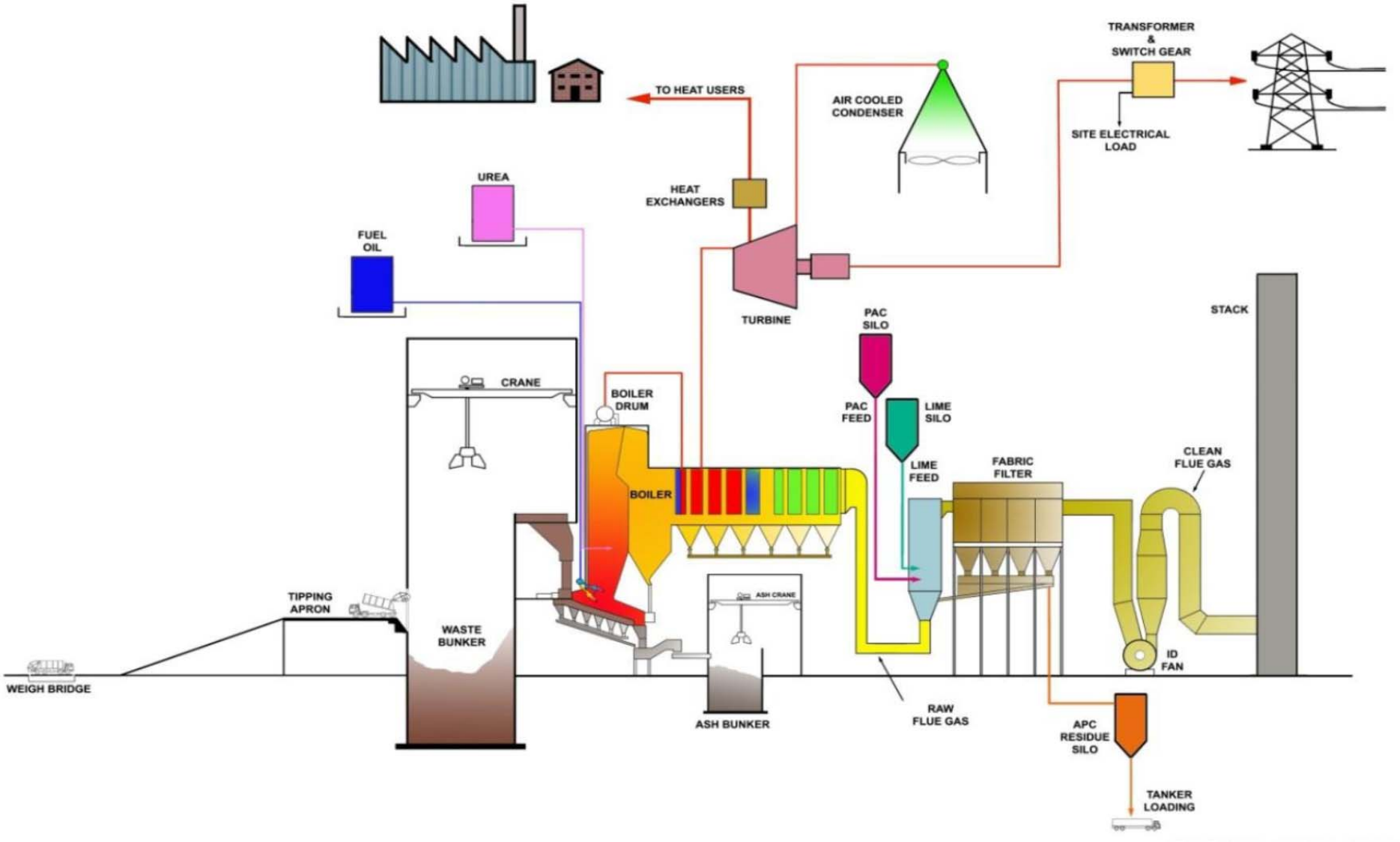
electrical load, will be exported to the grid providing a net supply of approximately 70MW. In the second phase, this will increase to 158MW of electricity and a net supply of 140MW.

The facility will operate 24 hours a day, 7 days a week, with occasional offline periods for maintenance. Over the entire year, it is assumed that the facility would be operational for approximately 8,000 hours. A fully automated Distributed Control System (DCS) manages the Facility. The DCS is used to operate the plant and ensures the safety of personnel and equipment. In addition to the DCS, the Plant Operation Outline details the supervisory control and data acquisition (SCADA) system. They also detail the setup of the control system, process monitoring and automation degree as well as safety precautions within the DCS and safety Programmable Logic Controller (PLC). This includes start-up and shutdown of the plant and emergency operations.

Figure **2** below depicts a basic schematic diagram of the operational process of the proposed EfW Facility

TNG has also prepared and disseminated a video detailing the Facility and its process for the purpose of communicating the Facility's complex operations and regulatory framework to the general public. Although it does not constitute a formal component of the Proposal, all concerns from the EPA and the Department of Planning and Environment relating to the wording used in the video have been noted. The current video will be replaced with a more detailed video and will include an amended voice over.

**Figure 2: TNG EfW Facility operational process**



## 3.4 Gate Fees

The gate fee for the facility will be determined at the time of commissioning and will take into consideration landfill prices and waste policy at all levels of government. This constitutes a commercial decision for TNG that cannot be accurately quantified for the purpose of this application. Gate fees are also typically negotiated on a per customer basis and are commercial in confidence.

## 3.5 Material input streams

### 3.5.1 Summary

The Facility is designed to operate at maximum thermal load and thus power production between a net calorific value (NCV) of 10 and 16.5 MJ/kg. At an NCV of 10, the Facility will process the maximum of 1,350,000tpa. At a NCV of 16.5 MJ/kg, the Facility will only require 820,000tpa to generate maximum power output. At the nominal design NCV of 12.34 MJ/kg this will correspond to 552,500 tpa in Phase 1 or 1,105,000 tpa in total for Phase 1 and Phase 2.

TNG proposes to delay the construction of the lines 3 and 4 until eligible material inputs for these lines can be confirmed to the satisfaction of the Department of Planning and Environment and the EPA. As lines 1 and 2 operate independently from lines 3 and 4, they can be successfully operated as per the 'tried and tested' approach adopted and operating at similar facilities in the UK and Continental Europe. The eligible tonnes received currently across DADI's extensive waste asset portfolio exceed the tonnes required for lines 1 and 2 (552,500tpa).

TNG has identified and quantified the number of eligible tonnes that are received currently at DADI's facility at Eastern Creek from third party "authorised facilities", in addition to the residual from the MPC. The design fuel mix has been determined using the waste sources that would be available to TNG today, however the technology employed allows for significant flexibility in composition and quantity of material. The design fuel mix is summarised in Table 6 below. TNG has committed to providing the breakdown of these waste streams by:

- DADI customer;
- Authorised facility location;
- Resource recovery rate of facility (which exceeds the resource recovery rate criteria of the EfW Policy Statement); and
- Total tonnes per annum (tpa).

This detailed information will be provided in confidence to the EPA and the Department of Planning and Environment. For the purpose of this report, these tonnes have been aggregated into the design fuel components.

| Table 6: Design fuel mix for Phase 1 | | | |
|---|---|---|---|
| **Design Fuel** | **Description** | **Phase 1 Composition** | **tpa** |
| **Chute Residual Waste - Residual Fuel** | Residual waste fuel from the MPC after initial sorting and separation process. | 23% | 129,105 |
| **C&D Waste - Residual Fuel** | C&D residual waste from authorised facilities including source separation on construction sites | 29% | 158,533 |
| **C&I Waste - Residual Fuel** | C&I residual waste from authorised facilities | 17% | 93,031 |
| **Steel Shredding Waste - Residual Fuel** | C&I metal recycling residual also known as Flock | 14% | 79,741 |
| **Paper Pulp – Residual Fuel** | Residual waste from paper pulp manufacturers processing post-consumer C&I and MSW paper | 5% | 26,580 |
| **Glass Recovery Waste Residual - Fuel Residual** | MSW glass recycling facility residual | 2% | 9,493 |
| **GO Waste - Residual Fuel** | MSW garden organics (GO) residual waste (domestic GO processing) | 2% | 11,392 |
| **AWT Waste - Residual Fuel** | MSW alternative waste treatment (AWT) facility residual (residual composting) | 7% | 37,972 |
| **MRF Waste - Residual Fuel** | MSW material recovery facility residual (dry recyclables processing) | 1% | 6,645 |
| | **Total** | **100%** | **552,500** |

An authorised facility complies with the resource recovery requirements of the EfW Policy Statement to ensure that recyclables are recovered prior to energy recovery. The composition of each of the waste streams is provided in Table 7 in accordance with the EfW Policy Statement. The composition of all waste streams is obtained from Australian sources (publically available documents and confidential data sourced from operators of authorised waste facilities).

**Table 7: Design fuel mix and composition by eligible EfW Policy Statement categories**

| Phase 1 | EfW Policy: Waste Sources - Resource Recovery Criteria | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mixed C&D | | Mixed C&I | | | | Source Separated MSW | | | | | |
| | 116,194 | 158,533 | 12,910 | 79,741 | 93,031 | 13,290 | 6,645 | 9,493 | 11,392 | 37,972 | 13,290 | 552,500 |
| | 21% | 29% | 2% | 14% | 17% | 2.5% | 1% | 2% | 2% | 7% | 2.5% | 100% |
| **Material Type** | **CRW** | **C&D** | **CRW** | **Flock Waste** | **C&I** | **Paper Pulp** | **MRF Residual** | **Glass Residual** | **GO Residual** | **AWT Residual** | **Paper Pulp** | **-** |
| **Paper/card** | 4.3% | 14.1% | 4.3% | 3.9% | 22.4% | 78.4% | 38.5% | 62.0% | 30.0% | 21.1% | 78.4% | - |
| **Plastic film** | 10.2% | 6.4% | 10.2% | 16.9% | 10.9% | 21.6% | 26.9% | 3.8% | 2.5% | 20.0% | 21.6% | - |
| **Dense plastic** | 0.0% | 6.4% | 0.0% | 1.1% | 10.9% | 0.0% | 0.0% | 34.2% | 2.5% | 21.1% | 0.0% | - |
| **Textiles** | 5.3% | 0.0% | 5.3% | 0.2% | 12.9% | 0.0% | 0.0% | 0.0% | 0.0% | 10.5% | 0.0% | - |
| **Glass** | 0.0% | 0.0% | 0.0% | 0.0% | 1.8% | 0.0% | 8.5% | 0.0% | 4.0% | 0.0% | 0.0% | - |
| **Vegetation** | 8.3% | 0.0% | 8.3% | 0.0% | 1.7% | 0.0% | 0.0% | 0.0% | 35.0% | 3.2% | 0.0% | - |
| **Other combustibles** | 0.0% | 0.0% | 0.0% | 67.2% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | - |
| **Metal** | 1.8% | 1.1% | 1.8% | 0.0% | 0.4% | 0.0% | 7.6% | 0.0% | 5.0% | 0.0% | 0.0% | - |
| **Fines** | 0.0% | 0.9% | 0.0% | 0.0% | 0.2% | 0.0% | 0.0% | 0.0% | 0.0% | 11.6% | 0.0% | - |
| **Wood** | 58.2% | 43.9% | 58.2% | 0.9% | 21.5% | 0.0% | 0.0% | 0.0% | 0.0% | 4.2% | 0.0% | - |
| **Combustibles** | 0.0% | 0.0% | 0.0% | 9.8% | 2.8% | 0.0% | 0.0% | 0.0% | 0.0% | 2.1% | 0.0% | - |
| **Non-combustibles** | 4.5% | 0.0% | 4.5% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 21.0% | 1.1% | 0.0% | - |
| **Hazardous** | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | - |
| **Gyprock** | 2.4% | 6.5% | 2.4% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | - |
| **Other** | 5.0% | 20.7% | 5.0% | 0.0% | 14.4% | 0.0% | 18.4% | 0.0% | 0.0% | 5.3% | 0.0% | - |
| **Total** | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 0.0% | 100.0% | 100.0% | - |

### 3.5.2 CRW: Fuel originating from the MPC

The process at the MPC is described below.

***Materials Receivable Delivery, Inspection and Classification***

Waste materials are currently delivered to the MPC by a combination of light, medium and heavy vehicles, with loads typically varying from approximately 1 to 40 tonnes in weight and the waste received at the MPC is co-mingled.

Upon operation of the EfW, the identified residual waste fuel will be received and sorted at the TNG EfW facility (instead of going to landfill). No material will be exhumed from landfill for the purpose of the TNG EfW Facility.

Classification of incoming waste is based on knowing its origin; advice from the carrier; inspection of the carrier's documentation prepared in accordance with the EPA (2008) *Waste Classification Guidelines;* and verification of this information by visual inspection using the weighbridge camera ('Check Point 1').

Small mixed loads that can be unloaded by hand are directed to the hand unloading area at the western end of the MPC. These loads are also visually inspected at multiple check points. Larger mixed loads are directed to be tipped at the MPC work floor. Upon arriving at the MPC a close up visual inspection then takes place before the vehicle enters if passed the co-mingled load is then tipped onto the floor within the MPC, where a the third visual inspection takes place of the contents. Unacceptable wastes which may have eluded identification at the weighbridge or spotter 2 are identified at this point and rejected. The waste inspection procedure is provided (Appendix B – Waste Inspection Procedure).

Current operations are subject to extensive audits conducted on behalf of Green Star accreditors, the EPA, key waste generators and other interested parties. TNG proposes to verify the recovery rates of the MPC and any other DADI owned processing facilities using the same methodologies for the purpose of compliance with the EfW Policy. TNG will also request receipt of reports from third party facilities to verify the reported resource recovery rates of each facility. TNG will also have independent audits performed on third party facilities using the same criteria as the Green Star reporting scheme to ensure residual waste fuels are eligible for acceptance at the TNG EfW Facility. This approach has been discussed with the EPA.

All waste is classified at the weighbridge. For all waste streams that are mixed and processed via a single facility (either owned by DADI or a third party), the most conservative EfW Policy resource recovery criteria will be applied to the residual waste fuels. The current diversion rate through the MPC achieves the required EfW threshold for C&D material, which comprises the majority of the processed material. This ensures that the required recovery rate for C&I waste sufficiently exceeds (50%).

***Sorting***

Where practicable, mixed loads delivered to the MPC are first segregated by material type and placed in adequate, appropriately labelled bays and bins for transport to appropriate stockpiles for recycling, or to landfill or off-site (as required).

The larger loads tipped at the work floor after inspection and verification are mechanically pre-sorted and inspected by working from the western to the eastern end of the building.

This process ensures the early removal of items that are:

- Easy to remove; and/or
- Unnecessary or undesirable to shred and process through the Facility that effect production or increase wear:
    - Large ferrous and non-ferrous metals
    - Large film plastic and hard plastics including PVC
    - Reusable pallets and timbers
    - Mattresses and carpet rolls
    - Large concrete and rubble
    - Gyprock

Following this pre-sorting process, these recovered items are stored in bins within the MPC from where they are later transported for further processing at the landfill or taken off site for processing by others.

The remaining co-mingled waste is then fed into the MPC Facility for automatic separation.

***Efficient Separation and Processing***
Separation machinery used at the MPC is state-of-the-art and is efficient at segregating wastes for further processing and recycling; and ensuring that recycling is maximised, while residual waste is minimised.

Of the waste loads received at the MPC that are classified as containing material capable of being recovered or recycled, it is estimated that, on average, 80% of materials will be recovered by sorting, separating and processing, and made available for resale or reuse by other processors. This represents the better and higher re-use of the material indicated by the Waste Avoidance and Resource Recovery Act.

The following waste streams are recovered for reuse:

- Ferrous and Non-ferrous metals;
- Plastics;
- Brick, concrete, sand, soil;
- Road base, Aggregates, Bitumen;
- Timber;
- Green waste;
- Paper, Cardboard;

- Gyprock;
- Polystyrene; and
- Reusable goods.

In accordance with the Resource Recovery Criteria of the EfW Policy, 25% of the total C&D waste processed by the MPC (the residual) will be used as residual waste fuel for the TNG Facility and 50% of the total C&I waste processed can be used as residual waste fuel for the TNG Facility (see Section 5.7). This allowable residual rate is higher than the residual material from than MPC's, as the facility achieves a recovery rate of between 75% and 80%.

The CRW waste from the MPC was audited in 2014. The results of this audit have been used to determine the composition of the material for the purposes of the design fuel mix for the Facility.

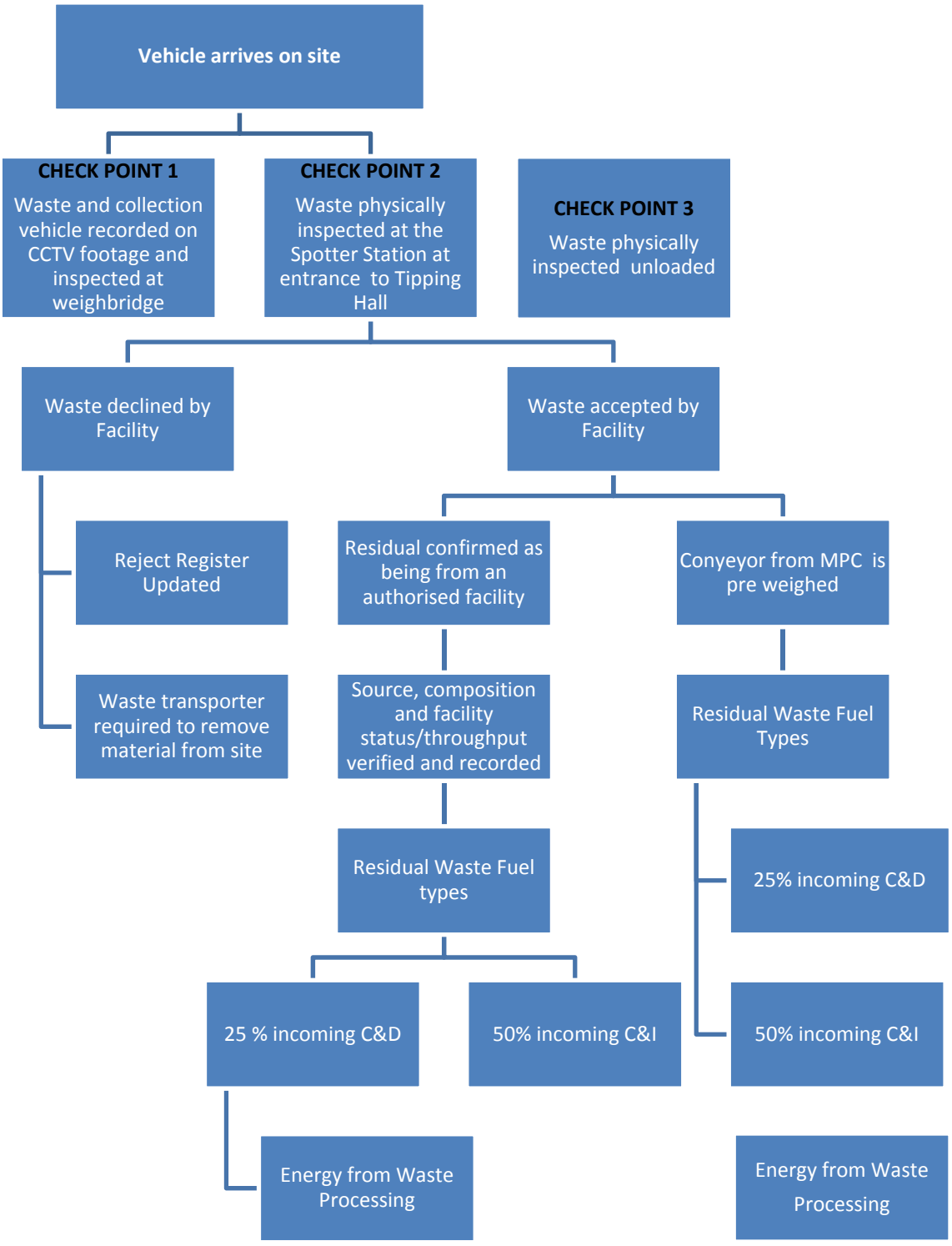
### 3.5.3 Fuel originating from other sources

In addition to the 'best practice' process conducted at the MPC, TNG will conduct independent audits using the Green Star criteria for assessment to ensure that all waste streams sent to the Facility comply with the EfW Policy Statement resource recovery criteria.

*The new POEO (Waste) Regulations 2014* will require additional reporting from resource recovery facilities. This data can be used by the EPA to assist in ensuring third party facilities achieve the diversion rates in the EfW Policy.

The resource recovery criteria verification process for all residual waste fuels received on site is summarised in Figure 3 below.

**Figure 3: Resource recovery verification process prior to Energy from Waste processing**



***C&D residual***

The waste characterisation for C&D residual material from external "authorised facilities" in Table 7 has been calculated by:

- Defining the composition of general C&D waste (Department of Environment and Climate Change NSW, 2007);
- Defining appropriate resource recovery rates likely to be achieved for each waste stream via a purpose built C&D resource recovery facility or via source separation achieved at demolition sites;
- Data from sites; and
- Recalculating the composition of the waste using the remaining residual material.

In DADI's experience, up to 90% of C&D waste is successfully sorted on site during large to medium demolitions. The MPC is independently audited under the GreenStar reporting guidelines to verify its resource recovery rate and will expand this method to its suppliers.

C&D residue may contain treated timber (including copper chrome arsenate and creosote). For example, the CRW audit data in Appendix D shows that this stream, which is derived mainly from C&D waste, contains 6.5% treated timber (1.9% of total of total waste composition). TNG will need to monitor treated timber amounts for total fuel composition. This will be undertaken through general screening, waste composition audits and analytical analysis of ash residue. If the treated timber percentage rises greater than 5% of total waste composition then treated timber sorting practices and monitoring will need to be reassessed as the rise in treated timber may give rise to arsenic in the APC residue, and copper and chrome in the bottom ash. Excess treated timber (i.e. greater than 5%) will be diverted at waste reception as part of the scanning of incoming loads and sent to landfill / an alternate waste facility. Currently treated timber is extracted by hand at the checking station and dropped in the chutes of the waste conveyor.

***C&I residual***

The waste characterisation for C&I residual material from external "authorised facilities" in Table 7 has been calculated by:

- Defining the composition for C&I waste (Department of Environment and Climate Change NSW, 2007);
- Removing putrescible waste from the composition;
- Defining appropriate resource recovery rates likely to be achieved for each waste stream via a purpose built C&I resource recovery facility;
- Data from facilities and
- Recalculating the composition of the waste using the remaining residual material.

***Flock waste***

Flock waste is not identified as an independent waste stream in the NSW EfW Policy, but can be classified as a residual C&I waste stream.

The EPA has confirmed that flock is not excluded from EfW and will potentially be included in an amended version of the NSW EfW Policy (Appendix G). The likely resource recovery

threshold will be 25%, in accordance with current metal recycling operations.

***Paper pulp***
Paper pulp is not identified as an independent waste stream in the NSW EfW Policy, but can be classified as a mix of C&I and MSW residual from paper recycling operations. The composition of paper pulp has been obtained from a post-consumer paper recycling operation in Sydney.

***Glass residual***
Glass residual is not identified as an independent waste stream in the NSW EfW Policy, but can be classified as MSW residual from post-consumer glass recycling operations. The composition of glass residuals has been obtained from a glass recycling operation in Sydney.

***GO residual***
Green Organic (GO) residual is classified as the residual from domestic source separated GO waste. The composition of this residual waste was obtained from council audit data for GO bins prior to processing.

***AWT residual***
Alternative Waste Treatment (AWT) residual is classified as the residual waste after processing domestic residual waste (red bin) from a two bin system. Processing thus removes dry recyclables, food, GO and other organic material via processing, leaving a high calorific residual waste stream.

***MRF Residual***
MRF residual is classified as the residual from domestic dry recycling operations. The composition of this residual waste was obtained from a material recovery facility operator in Sydney.

## 3.6 Commodity markets

All facility outputs are valuable commodities destined for market.

### 3.6.1 Electricity

The Facility will be capable of exporting approximately 140MW of electricity to the grid, amounting to the use of approximately 1,105,000 tonnes of residual waste fuel per annum. The export of electricity is being negotiated as part of a separate connection study with the electricity distribution network operator, Transgrid. It has been established that the proposed connection is feasible and well within the capability of Sydney West 330/132kV substation. TNG has already passed through the concept planning with Transgrid and is into the detailed design stage to work through the final connection details, which will be followed by a firm connection offer.

### 3.6.2 Heat and Cooling

Without any changes to the main plant design, the Facility can be configured so that it can export heat to nearby neighbours for heating or cooling. Depending on the requirements, it will be possible to export heat from the Facility as either steam or hot water. In addition, for

cooling purposes, the heat can be passed through an absorption chiller to create cooling for air-conditioning, cool rooms and other like purposes.

Potential export of heat has been considered in the turbine design. Whilst a dedicated extraction is not necessarily required, allowance has been made for the additional steam extraction required for heat export. Since at this stage heat export is only a possibility, the turbine design is being optimised for electricity generation. One or more of the bleed ports and connecting pipework are being designed to incorporate additional steam flow for heat export if required.

Although common in colder climates such as Europe, heating of hot water in Sydney is unlikely to be required. The more likely outcome is the supply of heat to local business such as Fulton Hogan or the Austral Brick Company where heat is required in their manufacturing process. Increased steam extraction leads to increased mechanical loading on the upstream turbine blades and this has been modelled in the initial design. Adequate space for the installation of heat exchangers has been allowed for in the layout of the Facility.

## 3.7 Processing Residuals Generated

The facility will generate the following residues as described in Sections 3.7.1 to 3.7.6

### 3.7.1 Ash Residue

Facility generates three types of residual ash.

1. Bottom ash;

Bottom ash is the burnt-out residue from the combustion process. Bottom ash from the grate is quenched with water and moved by conveyor to the enclosed ash storage bunker where it is stored prior to being transported off-site. The conveyor passes under a magnetic separator to remove ferrous materials.

2. Boiler ash;

Boiler ash is the residue generated in the combustion, comprising fine particles which rise with the flue gas. Its chemical composition falls between that of bottom ash and APC ash. The characterisation of boiler ash is depending on in which boiler pass it is accumulated. The boiler ash of all passes will be conservatively disposed of with the APC residues, unless it can be proven to be reusable following rigorous testing procedures in compliance with EPA regulations.

3. Air pollution control (APC) ash

APC residues comprise fine particles of ash and residues from the APC process. APC residue ash will be collected into sealed storage silos and transported via sealed tanker off-site for further treatment or disposal at landfill. If TCLP testing shows it is leachable then it will be stabilised with cement.

Ramboll produced a Memo (Appendix H) which provides calculation on the '*Estimation of ash and residue composition'.* A summary of the MEMO is provided in the Table 8 below.

**Table 8: Estimation of Ash residue and recycle/disposal options.**

| Type of Ash | Estimated amount generated | Waste Classification | Disposal Option(s) |
|---|---|---|---|
| Bottom ash | 270,000 tpa (20% moisture content) | General Solid Waste | - Potential reuse as aggregate in road-base products (common reuse option in Europe).<br>- Transported to the adjoining landfill facility for disposal |
| Boiler ash | 5,000 tpa | Restricted Solid Waste | - Potential reuse in road-base products.<br>- Transported off site by a licenced contractor and taken to a waste treatment facility licenced to treat such wastes. |
| APC ash | 55,000 tpa | Restricted Solid Waste | - Treatment to render APC ash usable in concrete products.<br>- Transported off site by a licensed contractor and taken to a waste treatment facility licensed to treat such wastes.<br>- Implementation of stabilisation techniques such as immobilisation or vitrification to reduce the residue to General Solid Waste classification |
| Total | 330,000 tpa | | |

[1] Estimates based on the Facility processing 1,105,000 tonnes/year of residual waste fuel and an input mass flow of residual waste fuel of 34.5 tonnes/h.
[2] Waste classifications were based on a chemical assessment and comparing results against the criterial set out in Table 2 – TCLP and SCC values for classifying waste by chemical assessment in the NSW Waste Classification Guidelines – Part 1: Classification of waste. Refer to Appendix H for assessment results.

The APC ash silos at the facility will be elevated, allowing the residue transport vehicles to park underneath the silo and use gravity to load the ash residue. No manual handling is required.

TNG will actively engage with the NSW EPA and waste service providers to discuss reuse and treatment options. One of the preferable options is to include bottom ash and boiler ash in road base and aggregate. The technique employed will be dependent on the ultimate composition of the bottom ash determined by chemical composition testing after commissioning of the Facility.

Further compositional testing of APC ash will be conducted to classify this waste stream. Options under consideration to recycle or dispose of APC ash include:

- Treatment to render APC ash usable in concrete products;
- Disposal to waste landfill that is licensed to accept the appropriate class of waste; and
- Implementation of stabilisation techniques such as immobilisation or vitrification to reduce the waste classification to an appropriate level for disposal at landfill. APC residues require a general solid waste classification for disposal at the Landfill and a restricted solid waste classification for disposal at the Kemps Creek Landfill. Other options such as salt cavern storage will be explored as required.

- Because of the potentially alkalinity of APC residue, there is a potential the waste may be classified as Hazardous Waste (although current analysis Restricted Solid Waste). In the event the waste exceeds the criteria for Restricted Solid Waste then the residue will be taken off site to a Hazardous Waste Treatment facility.

Please refer to Appendix B and 6.6.2 for detailed procedures for each ash type.

All waste that cannot be reused will be classified and transported in accordance with the *Environment Operations (Waste) Regulation 2014.*

A listing of other types of waste generated is described below.

### 3.7.2 Ferrous material residue

In the process of bottom ash being discharged to the conveyor system, the conveyor passes under a magnetic separator to remove ferrous materials and discharged to an indoor storage bunker with adequate capacity for storing bottom ash and metal recovered for a minimum of 5 days.

Any ferrous material recovered will be recycled. Depending on the degree of pre-treatment carried out on the CRW, C&I and C&D waste, TNG may consider that magnetic separators are not required.

It is anticipated that ferrous metals will be collected by a scrap metal recycler for recycling.

### 3.7.3 Liquid Effluent

Liquid effluents will be produced from the boiler water treatment system and from the boiler blow-down. All boiler blow-down and liquid effluent produced is fed to the bottom ash discharger via the process water system.

Under normal operating conditions, no effluent is disposed of to the sewer or stormwater systems but returned to the Facility for re-use. In this way, the liquid effluent produced on site will either be evaporated or absorbed into the ash for disposal or re-use off site.

Liquid effluent will be collected in a storage tank to balance the amounts generated and disposed of to the ash quench. This will consist of boiler blowdown, boiler water treatment, swilling down water, occasional maintenance discharges and drain water from contaminated areas.

The re-use of the different water streams within the process results in a liquid-effluent free EfW Facility during normal operation.

### 3.7.4 Gaseous emissions (pyrolysis gas)

Pyrolytic gas produced in the combustion process pass is mixed with secondary air and recirculated flue gas, which are injected at high velocity into the secondary combustion chamber above the grate, resulting in intensive mixing and the complete burnout of the pyrolytic gas.

Within the flue gas treatment (FGT) system the flue gas is scrubbed and treated before being vented to the atmosphere through a stack. The flue gas is treated within a reactor with a combination of lime and activated carbon and filtered through a fabric bag filter.

Further details are provided in Section 6.6.5 and Table 12: Energy from Waste Policy Statement technical criteria as well as Appendix K (Air Quality and Greenhouse Gases) of the EIS.

### 3.7.5 Staff Waste

The offices on site generate negligible commercial and industrial waste in the offices and staff rooms. SITA is currently engaged to remove waste generated by staff members. The waste is stored in a three metre cubic skip bin on site and is removed weekly.

### 3.7.6 Other Waste

The following chemicals are kept on site in low quantities and will generate empty packaging / drums / containers which will require disposal post use:

- Waste lubricant oil;
- Used lubricant oil drum;
- Scrap metal from the workshop.

Small quantities of maintenance materials will be held on site and maintenance activities may generate small quantities of waste (waste oil, etc.) that will sent for recycling or appropriate disposal following waste classification

Any spilled chemical substances the bunded area that are required to leave site as waste will be classified and transported in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes*.

Packaging / drums / containers will be collected by the supplier or disposed of in accordance with their waste classification.

# 4 Legislation and policy framework

The draft Waste Management Report (MRA WMR, 2014 Draft) summarised legislative and policy framework that apply to waste and resource management (specifically relating to an EfW facility). This Section is based upon the MRA summary with additions made to address recent regulatory changes.

State Governments in Australia have long focused on waste and resource management within each jurisdiction through legislation, guidelines and the development of strategies, plans and policies. The Australian Government, through the Environmental Protection and Heritage Council, produced the first National Waste Policy for Australia in 2009 (released in 2010). State Government efforts have fed into the National Waste Policy, which in turn shapes State strategies.

## 4.1 National framework

The Commonwealth Government has limited constitutional powers to engage directly in domestic waste management issues. This responsibility rests largely with the state and territory and through them, local governments. However, the Commonwealth has recently taken on a strategic involvement in waste policy development, releasing the National Waste Policy in 2010. Table 9 gives a brief overview of key National policies relating to waste.

**Table 9: National Regulatory Framework**

| Policy/Regulatory Instrument | Relevant goals and targets |
|---|---|
| **The National Waste Policy** | The aims of the National Waste Policy are to:<br>*Avoid the generation of waste, reduce the amount of waste (including hazardous waste) for disposal, manage waste as a resource and ensure that waste treatment, disposal, recovery and re-use is undertaken in a safe, scientific and environmentally sound manner, and contribute to the reduction in greenhouse gas emissions, energy conservation and production, water efficiency and the productivity of the land.*<br>A number of strategies have been identified within the National Waste Policy, which are to be pursued through a multi-jurisdictional approach. These include a national framework for product stewardship and extended producer responsibility.<br><br>The product stewardship framework will provide support through voluntary accreditation of community and industry run recycling schemes. Key areas of focus will include mercury containing lights, tyres, packaging, workplace recycling, public place recycling, television and computer recycling. |
| **Direct Action Plan** | The objective of the Direct Action Plan is to help Australia to meet its emissions reduction target 5% below 2000 levels by 2020. Direct Action consists of a number of initiatives including:<br>• A $2.5 billion Emissions Reduction Fund to support direct action by business to reduce emissions.<br>• Boosting renewable energy, especially solar.<br>• Support for emerging technologies through the Renewable Energy Target.<br>Through the ERF, the Government will purchase lowest cost abatement (in |

| Table 9: National Regulatory Framework | |
|---|---|
| **Policy/Regulatory Instrument** | **Relevant goals and targets** |
| | the form of Australian carbon credit units) from a wide range of sources, providing an incentive to businesses, households and landowners to proactively reduce their emissions. This includes the manufacture of process engineered fuels. Subject to the finalisation of methodology determinations under the ERF, there are possible opportunities for TNG to participate in the ERF and generate carbon credits. |

**Compliance to the National Regulatory Framework:** The Proposal complies with the National waste framework, as it contributes to the aims of the National Waste Policy and Direct Action's emissions goals.

## 4.2 State framework

The relevant New South Wales State Framework consists of legislation, guidelines, development plans and strategies pertaining to waste management, as summarised in Table 10. The NSW Government's objective is to provide a clear and consistent regulatory and policy framework that minimises harm to the environment and encourages waste avoidance and resource recovery. This framework uses a mix of legislative, policy, educational and economic tools.

| Table 10: Relevant NSW Waste Controls | |
|---|---|
| **Legislation** | **Plans, Guidelines and Strategies** |
| • Environmental Planning and Assessment (EP&A) Act 1979<br>• Protection of the Environment Operations (PoEO) Act 1997<br>• Waste Avoidance and Resource Recovery (WARR) Act 2001<br>• Protection of the Environment Operations (Waste) Regulation 2014 | • Energy from Waste Policy Statement 2015<br>• Waste Avoidance and Resource Recovery Strategy (WARR) 2014 – 2021<br>• Waste Classification Guidelines (EPA, 2014)<br>• Environmental guidelines: Composting and Related Organics Processing Facilities (DEC) (2004)<br>• Environmental guidelines: Use and Disposal of Biosolid Products (NSW EPA) |

### 4.2.1 NSW Energy from Waste Policy Statement

In 2014, the NSW EPA released its finalised EfW Policy Statement to replace the 2005 Guidance Note: Assessment of Non-Standard Fuels. The statement sets a framework for the operation of purpose-built facilities to recover energy from residual wastes that are not able to be recycled and would otherwise be disposed of to landfill.

The policy also facilitates the use of certain low-risk wastes as fuels which, due to their origin, have low levels of contaminants, homogeneity and consistency over time, and are considered by the EPA to pose a minimal risk of harm to human health and the environment.

The NSW EfW Policy Statement is designed to encourage the recovery of the embodied energy from waste while offsetting the use of non-renewable energy sources and avoiding methane emissions from landfill. It will ensure that this energy recovery:

- Has minimal risk of harm to human health and the environment; and
- Will not undermine higher order waste management options, such as avoidance, reuse or recycling.

A full copy of the NSW EfW Policy Statement has been provided in Appendix A.

**Compliance to the NSW Energy from Waste Policy Statement:** The Proposal compiles with the EfW Policy, as it favourably responds to the policy controls, as described in detail in Section 5

### 4.2.2 Protection of Environment Operations Act (1979)

The NSW *Protection of the Environment Operations Act 1997* (PoEO Act) provides an integrated system of licences administered by the NSW EPA, to set out protection of the environment policies and to adopt more innovative approaches to reduce pollution in the environment.

The objectives of the PoEO Act include:

- To protect, restore and enhance the quality of the environment in NSW, having regard to the need to maintain ecologically sustainable development;
- To provide increased opportunities for public involvement and participation in environment protection;
- To ensure that the community has access to relevant and meaningful information about pollution;
- To reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following:
  - Pollution prevention and cleaner production
  - The reduction to harmless levels of the discharge of substances likely to cause harm to the environment
  - The elimination of harmful wastes
  - The reduction in the use of materials and the re-use, recovery or recycling of materials
  - The making of progressive environmental improvements, including the reduction of pollution at source
  - The monitoring and reporting of environmental quality on a regular basis
- To rationalise, simplify and strengthen the regulatory framework for environment protection;
- To improve the efficiency of administration of the environment protection legislation;

- To assist in the achievement of the objectives of the Waste Avoidance and Resource Recovery Act 2001.

The State Significant Development Application (SSDA) Environmental Impact Statement (EIS) prepared for this Proposal, and in particular the Ecologically Sustainable Development Assessment (Section 8.16 of the EIS), documents that the Proposal wholly satisfies the objectives of the PoEO Act through the provision of state of the art technology for resource recovery and electricity generation operation.

Sections 48 and 49 of the PoEO Act require certain premises-based and non-premises-based activities to obtain licences for their operation. These activities and their licencing thresholds are listed in Schedule 1 to the PoEO Act.

- Clause 17 of Schedule 1 – Electricity generation triggers the criteria for a scheduled activity under this Act for general electricity works with a capacity to generate more than 30 megawatts of electrical power;
- Clause 18 of Schedule 1 – Energy recovery triggers the criteria for a scheduled activity under this Act for energy recovery from general waste involving processing more than 200 tonnes per year of waste (other than hazardous waste, restricted waste solid waste, liquid waste or special waste).

Given the above, an Environment Protection Licence is required for the operation of the Facility as a premises-based scheduled activity.

**Compliance to the NSW PoEO Act:** The Proposal satisfies the objectives of the PoEO Act, and will actively comply with its licencing requirements.

### 4.2.3 Protection of Environment Operations (Waste) Regulation 2014

The *Protection of the Environment Operations (Waste) Regulation 2014* (PoEO Waste Reg) relates to the regulation of waste and resource recovery in NSW. It gives effect to the broad objectives and specific provisions within the PoEO Act relating to waste, including:

- The administration of the section 88 contribution (the waste levy) within the POEO Act;
- Provides for reporting and record-keeping requirements in relation to scheduled waste facilities and scheduled landfill sites;
- Waste tracking and transportation requirements and obligations;
- Makes special requirements including reporting requirements relating to asbestos waste as well as prohibiting the re-use and recycling of asbestos waste;
- Imposes requirements on brand owners and retailers to recover, re-use and recycle packaging;
- Allows the EPA to issue exemptions from certain provisions of the Act and Regulations;
- Allows the EPA to approve the immobilisation of contaminants in waste; and
- Makes it an offence to apply, or to cause or permit the application of, residue waste to land that is used for the purpose of growing vegetation, subject to any exemptions.

Resource recovery exemptions are granted by the EPA where the land application or use as fuel of a waste material is a bona-fide, fit for purpose, reuse opportunity that causes no harm

to the environment or human health, rather than a means of waste disposal. An exemption facilitates the use of these waste materials outside of certain requirements of the waste regulatory framework.

The EPA encourages the recovery of resources from waste by issuing resource recovery orders and exemptions. These are updated from time to time on the EPA website and in the event that a waste type is not covered by an existing resource recovery order then an application can be made to the EPA for a resource recovery order and exemption.

Resource recovery orders include conditions which processors and generators must meet to supply the waste for land application, use as fuel or in connection with a process of thermal treatment. They may include specifications, record-keeping, reporting and other requirements. All resource recovery orders are made under clause 93 of the Waste Regulation 2014.

Resource recovery exemptions contain the conditions which consumers must meet to apply waste to land, or use the waste as fuel or in connection with a process of thermal treatment outside certain requirements of the waste regulatory framework. They may include requirements on how to re-use or apply the waste, and record-keeping, reporting and other requirements. All resource recovery exemptions are made under clauses 91 and 92 of the 2014 Waste Regulation.

**Compliance to the NSW PoEO (Waste) Regulation:** The Proposal satisfies the objectives of the PoEO (Waste) Regulation which include classification of waste and resource recovery hierarchy.

### 4.2.4 Waste Avoidance and Resource Recovery Act 2001

The waste hierarchy, established under *the Waste Avoidance and Resource Recovery Act 2001* (WARR Act), is one that ensures that resource management options are considered against the following priorities:

- Avoidance including action to reduce the amount of waste generated by households, industry and all levels of government;
- Resource recovery including reuse, recycling, reprocessing and energy recovery, consistent with the most efficient use of the recovered resources; and
- Disposal including management of all disposal options in the most environmentally responsible manner.

The highest priority, avoidance, encourages the community, industry and government to reduce the amount of virgin materials extracted and used and waste generated and to be more efficient in their use of resources.

Resource recovery maximises the options for reuse, recycling, reprocessing and energy recovery at the highest net value of the recovered material. This encourages the efficient use of recovered resources while supporting the principles of improved environmental outcomes and ecologically sustainable development. Resource recovery can also embrace new and emerging technologies.

An end-of-pipe solution, disposal, is the least desirable option and must be carefully handled to minimise negative environmental outcomes.

The waste hierarchy lists, in order of preference, the approaches needed to achieve efficient resource use with disposal being the least preferred method and waste avoidance the most preferred. The place of EfW in the hierarchy established under the WARR Act is as follows (from most preferable to least preferable):

1. Avoid and reduce;
2. Reuse waste;
3. Recycle waste;
4. Recover energy;
5. Treat waste;
6. Disposal.

**Compliance to the NSWWARR Act:** The Proposal compiles with the principles of the WARR Act, as it only uses waste (as fuel) that is destined to be landfilled. Under controlled circumstances, recovery of energy is preferable to treatment and disposal of waste, which are the only other alternatives available for such waste.

### 4.2.5 Protection of the Environment Operations (Clean Air) Regulation 2010

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (PoEO CA Reg) provides regulatory measures to control emissions from wood heaters, open burning, motor vehicles and fuels and industry. In relation to industry, the PoEO CA Reg:

- Sets maximum limits on emissions from activities and Facility for a number of substances, including chlorine, dioxins, furans, smoke, solid particles and sulphur;
- Deals with the transport and storage of volatile organic liquids;
- Restricts the use of high sulphur liquid fuel; and
- Imposes operational requirements for certain afterburners, flares, vapour recovery units and other treatment Facility.

Part 3 of the PoEO CA Reg controls burning in the open, including burning in incinerators. Councils may choose to be listed in Schedule 8 of the PoEO CA Reg, which allows them to apply a level of control that is appropriate to local circumstances. Exemptions are provided for emergency bushfire hazard reduction work and burning that is authorised by a bushfire hazard reduction certificate. The Clean Air Regulation also:

- Allows the EPA and local councils to grant approvals for burning in the open in certain circumstances;
- Prohibits the burning of specified articles, including tyres, coated wire, paint and solvent containers and certain treated timbers; and

- Imposes a general duty to prevent or minimise air pollution when burning in the open or an incinerator.

Appendix K (Air Quality and Greenhouse Gas Emissions) of the EIS address air quality related legislation and guidelines.

The emissions relating to the proposal are discussed in Section 6.6 and in detail in Pacific Environment's Air Quality and Greenhouse Gas Assessment.

The EfW Policy states that facilities proposing to thermally treat wastes that are not listed as an eligible waste fuel (such as this Facility) must meet the requirements of an energy recovery facility, that is – must meet international best practice with respect to:

- Process design and control;
- Emission control equipment;
- Emission monitoring with real time feedback to process controls;
- Arrangements for receipt of waste; and
- Management of residues.

In addition to implementing current best practice techniques, energy recovery facilities must ensure that they meet the following technical, thermal efficiency and resource recovery criteria.

The EfW Policy notes that meeting international best practice will ensure that air toxics and particulate emissions are below levels that may pose a risk of harm to the community or environment.

Under the EfW Policy the stack emissions from the Facility are required, as a minimum, to meet the Group 6 standard of concentration set out in the PoEO CA Reg.

The proposed flue gas treatment for the Facility has been designed to employ Best Available Technology (BAT) and achieve the emission limits specified by the Industrial Emissions Directive (IED) (2010/75/EU). The IED emissions limits (refer Table 11) are generally more stringent than the PoEO CA Reg limits. The proposed technology is based on existing facilities operated throughout Europe, which are required to meet the IED limits.

As discussed above, the PoEO CA Reg sets standards for various activities and those that are applicable to an EfW facility are outlined in Table 11. The final column of Table 11, also indicates the IED air emission limit values to which the Proposal conforms, demonstrating that they are equal to or more stringent than those in the PoEO CA Reg.

| Table 11: PoEO Clean Air Regulation Standards of Concentration and IED Air Emission Limit Values | | | | | |
|---|---|---|---|---|---|
| **Pollutant** | **Standard ($mg/Nm^3$)** | **Source** | **Activity** | **IED Air Emission Limit Values** | **The Next Generation** |
| **Solid particles (total)** | 50 | Electricity generation | Any activity of plant using liquid or solid standard fuel or non-standard fuel | 10 | ✓ |
| **HCl** | 100 | General standards | Any activity | 10 | ✓ |
| **HF** | 50 | | Any activity of plant using liquid or solid standard fuel or non-standard fuel | 1 | ✓ |
| **$SO_2$** | No applicable standard | | | 50 | ✓ |
| **$NO_2$** | 500 | Electricity generation | Any boiler operating on a fuel other than gas, including a boiler used in connection with an electricity generator that forms part of an electricity generating system with a capacity of 30MWe or more | 200 | ✓ |
| **Type 1 & 2 substances (in aggregate)** | 1 | Electricity generation | Any activity of plant using non-standard fuel | 0.5 | ✓ |
| **Cd or Hg (individually)** | 0.2 | Electricity generation | Any activity of plant using non-standard fuel | 0.05 | ✓ |
| **Dioxins or furans** | 1E-07 ($0.1ng/m^3$) | Electricity generation | Any activity of plant using non-standard fuel that contains precursors of dioxin or furan formation | 1E-07 ($0.1ng/m^3$) | ✓ |
| **VOC** | 40 (VOC) or 125 (CO) | Electricity generation | Any activity of plant using non-standard fuel | - | ✓ |

**Compliance to the Protection of the Environment Operations (Clean Air) Regulation 2010:** Refer to Appendix K (Air Quality and Greenhouse Gas Emissions) of the EIS for compliance to the *Protection of the Environment Operations (Clean Air) Regulation 2010*.

# 5 Response to Energy From Waste Policy Controls

The draft Waste Management Report (MRA WMR, 2014 Draft) presented that in consultation with TNG., MRA developed the following response to energy from waste control policies.

## 5.1 Choice of policy framework

TNG recognises that the EPA facilitates a risk-based approach to the recovery of EfW. The EPA has applied the following overarching principles to waste avoidance and recovery:

- Higher value resource recovery outcomes are maximised;
- Air quality and human health are protected;
- 'Mass burn' disposal outcomes are avoided; and
- Scope is provided for industry innovation.

The TNG Facility has been designed to recover energy from waste or waste-derived materials that are not listed as eligible waste fuels. Additional information regarding the use of eligible and non-eligible waste fuels is summarised in the following sections.

## 5.2 Eligible waste fuels

Waste or waste-derived materials that pose minimal risk of harm to human health and the environment due to their origin, low levels of contaminants and consistency over time are categorised as eligible wastes. The following wastes are categorised by the EPA as eligible waste fuels:

- Biomass from agriculture;
- Forestry and sawmilling residues;
- Uncontaminated wood waste;
- Recovered waste oil;
- Organic residues from virgin paper pulp activities;
- Landfill gas and biogas;
- Source-separated green waste (used only in processes to produce char); and
- Tyres (used only in approved cement kilns).

From the above list, the MPC facility generates uncontaminated wood waste and source-separated green waste. These eligible waste fuels that are recovered through the MPC are saleable recycled products destined for market. Therefore, these potential waste fuels thus have a higher value resource recovery outcome than would be achieved if these materials were processed through the proposed TNG Facility and recovered for energy and therefore will not be used as fuel.

In the event that the residual waste fuel that the MPC produces changes and/or it makes operational and economic sense to thermally treat eligible waste fuels through the EfW facility, TNG will seek a resource recovery exemption from the EPA. TNG will ensure that the origin, composition and consistency of these wastes are recorded before seeking an

exemption to ensure that the emissions from thermal treatment will be known and consistent over time.

### 5.2.1 Non-eligible waste fuels

TNG proposes to primarily treat waste or waste-derived materials that are not listed as eligible waste fuels and that meet the requirements of an energy recovery facility. TNG has performed detailed waste mapping to identify the sources and composition of allowable non-eligible waste fuels in the market. The analysis is conducted at a state level, considering waste generated in the Sydney Metropolitan Area (SMA), Extended Regulated Area (ERA), Regional Regulated Area (RRA) and the Rest of NSW to map allowable waste streams at a state level.

All calculations, assumptions regarding the EfW Policy interpretation, and data sources are detailed in Section 5.7.

## 5.3 Public consultation and good neighbour test

TNG has committed to - and is continuing - an extensive community and stakeholder consultation process. This process will be ongoing to ensure the community understands the importance and impacts of the project. MRA reported that TNG understands its obligation to provide effective information and public consultation regarding the EfW proposal, from concept to detailed development assessment and commissioning. TNG engaged in dialogue with the community commencing in late October 2013, at the same time as the DGRs were requested from the Department.

## 5.4 Stakeholder Consultation Strategy

TNG has developed a stakeholder consultation strategy to engage stakeholders over the life of the project in order to keep them informed and to respond to any concerns. TNG acknowledges that different aspects of the proposed project will concern different stakeholders. TNG is committed to:

- Mitigating risks and stakeholder concerns during the planning stages of the project;
- Providing information to all stakeholders and seeking feedback prior to implementation; and
- Maintaining open and transparent communication channels with all stakeholders.

TNG has engaged KJA Pty Ltd to develop a Communications and Consultation Strategy to guide stakeholder and community engagement during the preparation and the public exhibition of the EIS (KJA Pty Ltd 2014). The following information provides a summary of the progress achieved by the stakeholder consultation strategy to date.

***Stakeholder Identification***

Stakeholders were identified through consultation with local community groups, individuals and organisations with an interest in the project. Stakeholders were also identified with aerial mapping and site visits. A detailed database has been maintained of all interactions with identified stakeholders including phone calls and correspondence.

### *Communication Strategy and Engagement Tools*

Commencing in November 2013, the engagement tools and activities have been specifically directed toward the local consultation tasks and, where applicable, complemented by an active media and government relations program. Emphasis has been placed on different target groups with an interest in the project. The key tools utilised to engage stakeholders include:

- Project Website: A dedicated website (www.tngnsw.com.au) has been created to offer general information on the proposal, together with a project flyer, video, and answers to general frequently asked questions.
- 1800 community line and project email: A dedicated, toll-free 1800 community information line (1800 252 040) and email address (info@tngnsw.com.au) was established from the inception of the consultation to provide an immediately available and central point of contact for stakeholder and community enquiries. Questions raised by residents over phone and email form the basis of FAQs listed on the website.
- Key stakeholder correspondence: Correspondence has been sent via post and/or email to the identified key stakeholders and community groups. The correspondence was distributed in early December 2013.
- Letter notification: Letter notifications were sent to local residents to provide information about the project. An additional flyer was mailed to invite residents to a community information and site tour. A total of 4,000 residents received project flyers.
- Briefings: Personal briefings have been undertaken with local government, state government and Minchinbury Residents Action Group representatives.
- Door knocks: As an additional strategy to engage with neighbouring businesses, a door knock was conducted:
- Community information day and site tour: On 22 February 2014, approximately 32 people attended a community information afternoon hosted by TNG. The community information session was followed by a site tour.
- Media: Local newspapers were briefed and provided direct contact numbers for further questions.
- Waste Avoidance and Resource Recovery Conference – 6-8 May 2014: TNG attended and presented at the above conference where representatives from federal, state and local government, industry leaders and the EPA NSW were in attendance.

### *Feedback*

The Communication and Consultation Strategy has generated useful feedback from stakeholders, which has been considered in preparation of this EIS, as well as future communications with stakeholders. Common comments and concerns raised include:

- Traffic concerns including routes, access and cumulative impacts;
- The number of vehicle movements that will be generated by the proposed facility;
- Potential emissions and emission monitoring;
- Health impacts;
- Noise and dust concerns;
- Timeframe for development; and
- Odour management.

## 5.5 Technical criteria

To ensure emissions are below levels that may pose a risk of harm to the community, facilities proposing to recover energy from waste will need to meet current international best practice techniques (BAT). The Europe Union has developed a reference document for best available techniques on waste incineration - *Integrated Pollution Prevention and Control, Reference Document on the Best Available, Techniques for Waste Incineration, August 2006, European Commission (BREF, 2006).* This directive is now incorporated in and replaced by the Industrial Emissions Directive (IED) of 2010.

The technical design of the Facility incorporates emission limit values and operational requirements that are listed in the IED and BREF, 2006. The Concept Design Report prepared by Fichtner provides a plain English version of the technical information regarding the project (Fichtner 2014a). This document also provides the initial platform briefing for all other consultants and construction teams to work from to finalise detailed design, which is why it is called the concept report. The project has been designed to comply with the IED and meet the technical criteria established in the EfW Policy Statement.

A summary of the technical criteria document in the EfW Policy Statement and TNG's proposed design is summarised in Table 12.

| **Table 12: Energy from Waste Policy Statement technical criteria** | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| The gas resulting from the process should be raised, after the last injection of combustion air, in a controlled and homogenous fashion and even under the most unfavourable conditions to a minimum temperature of 850°C for at least 2 seconds (as measured near the inner wall or at another representative point of the combustion chamber). | The furnaces will be fitted with auxiliary burners, fired on low sulphur gas-oil or the preferred which is natural gas which will automatically, if required, maintain the combustion chamber temperature above 850°C for 2 seconds to ensure the destruction of dioxins, furans and other undesirable combustion products. Combustion chambers, casings, ducts, and ancillary equipment will be maintained under negative pressure to prevent the release of gases (Fichtner 2014a).<br><br>The facility is designed to safely fulfil this requirement WITHOUT any auxiliary burners. Only at start-up and shut-down the auxiliary burners will automatically be used to further comply safely with this requirement, even under no further fuel supply or only up-starting fuel supply.<br><br>Continuous temperature measurements will be recorded in the roof of the first boiler pass to provide data at a representative point in the combustion chamber. Additional temperature measurements can be installed as required. | IED Article 50 (2) |
| If a waste has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1,100°C for at least 2 seconds after the last injection of air. | In the EU regulation the following is stated in the IED (Industrial Emissions Directive): If hazardous waste with a content of more than 1% of halogenated organic substances, expressed as chlorine, is incinerated, the temperature has to be raised to 1,100°C for at least two seconds.<br>In the NSW EfW Policy the following is stated: If a waste has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1,100°C for at least 2 seconds after the last injection of air. There is a small, but significant difference between these two texts, with considerable implications for EfW in Australia (“hazardous waste” versus “waste”).<br>PVC is not classified as a hazardous waste in both jurisdictions. Moreover, the IED regulation is not concerned about “chlorine”, but about “hazardous waste with halogenated organic substances”.<br><br>In the European EfW experience it has been found that EfW typically has to cope with concentrations of PVC of around 1% (MSW) with around 0.4% as background chlorine (not PVC related). Residual fractions from recycling, C&D and C&I can reach up to nearly 10% in the | IED Article 50 (2) |

| **Table 12: Energy from Waste Policy Statement technical criteria** | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| | European experience. If TNG would find similar chlorine level of around 1% in MSW as per European experience, the current NSW EfW Policy would require burning at 1,100°C/2s instead of 850°C/2s. Current technology (from all EfW providers) doesn't allow efficient energy recovery at the higher temperature. In consequence, the energy efficiency requirement of R1>0.65 cannot be achieved. Hence, the NSW EfW Policy will contradict itself unless the wording is changed (back to the European IED).<br><br>TNG believes that the text of the NSW EfW Policy needs to be amended to reflect the EU regulation and the European experience of safe EfW at chlorine concentrations of typically around 1% with some waste fractions up to 8%. The issue of chlorine is purely technical, e.g. the capability of the flue gas treatment to cope with short-term chlorine peaks as well as long-term chlorine concentrations – whatever level they are. The NSW EPA will consider this proposal of a change to the NSW EfW Policy Appendix G. Potentially the NSW EfW Policy Statement will be modified, as discussed with NSW EPA on 12th February 2015. | |
| The process and air emissions from the facility must satisfy at a minimum the requirements of the Group 6 emission standards within the Protection of the Environment Operations (Clean Air) Regulation 2010. | The IED daily emission standards set out in Annex VI Part 3 exceed the requirements of group 6 emission standards set out in Schedule 2 of the Protection of the Environment Operations (Clean Air) Regulation 2010.<br><br>The flue gas treatment system has been designed to meet the requirements of the European Commission Directive on Industrial Emissions (IED). The combustion control system will regulate the combustion conditions, and thereby minimise the levels of pollutants and particulates in the flue gas before the flue gas treatment.<br><br>The proposed flue gas treatment system will consist of a Selective Non-Catalytic Reduction (SNCR) of $NO_x$, activated carbon injection, dry lime scrubbing and fabric bag filters. | POEO Act 2010 |
| Continuous measurements of $NO_x$, CO, particles (total), total organic compounds, HCl, HF and $SO_2$. | The following parameters will be monitored and recorded continuously at each stack using a Continuous Emissions Monitoring System (CEMS):<br><br>(1) Oxygen;<br>(2) **Carbon monoxide**; | IED Annex VI Part 6 point 2.1 (a) and point 2.3 |

| **Table 12: Energy from Waste Policy Statement technical criteria** | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| The continuous measurement of HF may be omitted if treatment stages for HCl are used which ensure that the emission limit value for HCl is not being exceeded. | (3) **Hydrogen chloride**;<br>(4) **Sulphur dioxide**;<br>(5) **Nitrogen oxides**;<br>(6) Ammonia;<br>(7) **VOCs (volatile organic compounds)***; and<br>(8) **Particulates.**<br><br>The following parameters will be monitored by means of spot sampling at frequencies agreed with the relevant regulator.<br><br>(1) Nitrous oxide;<br>(2) Heavy metals; and<br>(3) Dioxins and furans.<br><br>Emission concentrations will be verified by an independent testing company at frequencies agreed upon with the relevant regulator (Fichtner 2014a).<br><br>*VOCs and total organic compounds (TOCs) in cleaned flue gas are used interchangeably in all technical reports prepared by HZI. Thus, TOCs and VOCs are continuously monitored. All particles and elementary, *un-burnt* carbon are completely removed from the flue gas by the installed bag filter. | |
| This data must be made available to the EPA in real-time graphical publication and a weekly summary of continuous monitoring data and compliance with emissions limits published on the internet. | Emissions from the stack will be monitored continuously by an automatic computerised system and reported to the NSW EPA as part of the anticipated Environmental Protection Licence for the Facility. Sampling and analysis of all pollutants will be carried out to European Committee for Standardization (CEN) or equivalent standards (e.g. International Organization for Standardization (ISO), national, or international standards). This ensures the provision of data of an equivalent scientific quality (Fichtner 2014a). | N/A |

| Table 12: Energy from Waste Policy Statement technical criteria | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| | This monitoring has three main objectives;<br><br>(1) to provide the information necessary for the facilities automatic control system to ensure safe and efficient facility operation;<br>(2) to warn the operator if any emissions deviate from predefined ranges; and<br>(3) to provide records of emissions and events for the purposes of demonstrating regulatory compliance.<br><br>All continuous monitoring records will be made available to NSW EPA in real-time using the preferred data access platform and reporting frequency for publication. | |
| There must be continuous measurements of the following operational parameters: temperature at a representative point in the combustion chamber; concentration of oxygen; pressure and temperature in the stack; and water vapour content of the exhaust gas.<br><br>This must be conducted and held by the proponent for a period of three years. | During operation, the temperature in the combustion chamber will be continuously monitored and recorded to demonstrate compliance with the requirements of the IED. The combustion control system will be an automated system, including monitoring of:<br><br>(1) Steam flow;<br>(2) **Oxygen content;**<br>(3) **Temperature conditions of the grate;**<br>(4) Modification of the fuel feed rates; and<br>(5) Control of primary and secondary air.<br><br>Continuous temperature measurements will also be recorded in the roof of the first boiler pass to provide data at a representative point in the combustion chamber. Additional temperature measurements can be installed as required.<br><br>In addition, the following parameters will be monitored so that emission concentrations can be reported in accordance with the IED: | IED Annex VI Part 6 point 2.1 (b) |

| Table 12: Energy from Waste Policy Statement technical criteria | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| | (1) **Water vapour content of the flue gas**; and<br>(2) **Temperature and pressure of the flue gases (assumed to be in the stack)**.<br><br>All data will be kept for a minimum of five years by TNG and will be available to the EPA at all times. | |
| Proof of performance (POP) trials to demonstrate compliance with air emissions standards.<br><br>There must be at least two measurements per year of heavy metals, polycyclic aromatic hydrocarbons, and chlorinated dioxins and furans. One measurement at least every three months shall be carried out for the first 12 months of operation. If and when appropriate measurement techniques are available, continuous monitoring of these pollutants will be required. | TNG will fully comply with all EPA requirements, allowing independent personnel to conduct proof of performance trials at any time.<br><br>The following parameters will be monitored by means of spot sampling at frequencies agreed with the relevant regulator.<br><br>(1) Nitrous oxide;<br>(2) Hydrogen fluoride;<br>(3) **Heavy metals**; and<br>(4) **Dioxins and furans**.<br><br>Emission concentrations will be verified by an independent testing company at frequencies agreed with the relevant regulator (Fichtner 2014a).<br><br>Polycyclic aromatic hydrocarbons are monitored continuously in all VOC measurements. TNG will conduct specific polycyclic aromatic hydrocarbon analyses at least twice a year in accordance with best practice operations internationally. | IED Annex VI Part 6 point 2.1 (c) |
| The total organic carbon (TOC) or loss on ignition (LOI) content of the slag and bottom ashes must not be greater than 3% or 5%, respectively, of the dry | The assessment of Hazard Classification of UK IBA (Incinerated Bottom Ash) 2011 states that (WRc plc 2012): | IED Article 50 (1) |

**Table 12: Energy from Waste Policy Statement technical criteria**

| Energy from Waste Policy Statement Technical Criteria | Facility Characteristics | Reference Standard |
|---|---|---|
| weight of the material. | <table><tr><th>Parameter</th><th>Average</th><th>95th Percentile</th><th>Maximum</th></tr><tr><td>LOI (%)</td><td>1.87</td><td>2.93</td><td>3.79</td></tr><tr><td>TOC (%)</td><td>1.03</td><td>2</td><td>2.41</td></tr></table><br>This analysis is consistent with IED Article 50 (1) and the EfW Policy Statement.<br><br>HZI technology specifically complies with TOC and LOI content requirements in the bottom ash in accordance with the NSW EfW Policy Statement. | |
| Waste feed interlocks are required to prevent waste from being fed to the facility when the required temperature has not been reached either at start-up or during operation. | Control of emissions from the Facility is given highest priority. Carbon monoxide and oxygen levels are continuously monitored to ensure combustion is good and the Facility maintains a flue gas temperature of 850°C automatically. If this is not met, auxiliary burners will start up to raise temperatures and if problems continue, fuel feeding will be stopped automatically.<br><br>The control process is fully automated with safety interlocks. If any parameter such as temperature, pressure or oxygen level reaches a set level, an alarm sounds and if the problem persists, the Facility will be stopped automatically.<br><br>If any emergency condition is reached, or if a rapid facility shut down is required, the Facility will stop automatically in a rapid manner. Fuel flows and airflows are stopped instantly, which causes combustion to cease. The boiler can be depressurised via safety valves if required. This system is fully interlocked to prevent manual intervention unless it is safe to do so (Fichtner 2012a). | N/A |
| An air quality impact assessment must be undertaken in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW. | TNG engaged Pacific Environment Limited to prepare the Air Quality and Greenhouse Gas Assessment in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Pacific Environment 2014).<br><br>The proposed technology for the EfW facility is based on existing facilities in the United Kingdom and mainland Europe and will incorporate best available technology for the flue gas treatment. The flue | Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (Pacific |

| Table 12: Energy from Waste Policy Statement technical criteria | | |
|---|---|---|
| **Energy from Waste Policy Statement Technical Criteria** | **Facility Characteristics** | **Reference Standard** |
| | gas treatment is designed to meet the in-stack concentrations limits for waste incineration set by the IED, which are generally more stringent than the Clean Air Regulations. The flue gas treatment system includes:<br><br>(1) Selective Non-Catalytic Reduction (SNCR) for reducing emissions of oxides of nitrogen;<br>(2) Lime scrubbing for reducing emissions of acid gases, including hydrogen chloride (HCl) and sulphur dioxide ($SO_2$);<br>(3) Activated carbon injection for reducing emissions of dioxins and mercury;<br>(4) Fabric bag filters for reducing emissions of particles and metals; and<br>(5) Following the flue gas treatment, cleaned flue gas will be dispersed via a 100m stack.<br><br>There are no exceedances of the EPA criteria when the Project contribution is added to the maximum background, with the exception of PM, which results in a cumulative concentration marginally over the 24-hour PM10 criteria of 50 µg/$m^3$. However, this occurs on a day when the background is already high (at 49.2 µg/$m^3$) and further analysis demonstrates that no additional exceedances would occur as a result of the facility.<br><br>The operation of the facility would have a net positive greenhouse gas effect, potentially eliminating one million tonnes of $CO_2$-e per annum. The emission intensity for electricity generated from the facility is lower than other generators in NSW. | Environment 2014) |

## 5.6 Thermal efficiency criteria

The EfW Policy Statement is restricted in its scope to facilities that are designed to thermally treat waste for the recovery of energy rather than as a means of disposal. The net energy produced from thermally treating waste, including the energy used in applying best practice techniques, must therefore be positive.

To meet the thermal efficiency criteria, facilities must demonstrate that at least 25% of the energy generated from the thermal treatment of the material will be captured as electricity (or an equivalent level of recovery for facilities generating heat alone).

Energy recovery facilities must also demonstrate that any heat generated by the thermal processing of waste is recovered as far as practicable, including use of waste heat for steam or electricity generation or for process heating of combined heat and power schemes.

The Facility has been designed to have a thermal input of 469.6MWe (117.4MWe for each incineration line) at the design point. The Facility has an assumed net electrical efficiency of 30% which is above the 25% efficiency criteria rate. The Facility has been designed to export approximately 140MWe (30% X 469.6MW). High net electrical efficiency is a priority for TNG, and there are a number of options that could be incorporated into the design to increase the efficiency further including steam reheating and flue gas cooling. The export voltage will be set to match the requirements of the local high voltage electricity grid (Fichtner 2014a).

The facility complies with the energy recovery requirements of the EfW Policy. Although markets for heat recovery may exist (Fulton Hogan, Austral Brick) and the TNG EfW Facility has the ability to supply heat, the facility is predominantly an electricity generator, which complies with EPA requirements of an EfW. Documenting potential users of heat is not relevant. TNG will be exporting electricity to the grid.

## 5.7 Resource recovery criteria

The EPA considers energy recovery to be a complementary waste management option for the residual waste produced from material recovery processes or source-separated collection systems. The EfW Policy Statement's objectives in setting resource recovery criteria are to:

- promote the source separation of waste where technically and economically achievable;
- drive the use of best practice material recovery processes; and
- ensure only the residual from bona-fide resource recovery operations are eligible for use as a feedstock for an energy recovery facility.

TNG will only receive feedstock from authorised waste facilities or collection systems that meet the criteria outlined in Table 13 and are compliant with the Facility's licences to accept non-putrescible waste streams.

### 5.7.1 Potential Tonnes

MRA Consulting Group investigated the potential feedstock in the market for the Facility which is mapped in Table 13 and Table 14 below. All assumptions regarding the interpretation of the EfW Policy Statement are summarised and have been interpreted with

the assistance of NSW EPA during meetings conducted between MRA Consulting Group and NSW EPA on 8th September 2014, and between TNG and NSW EPA on 12th February 2015 (Appendix G).

All separated waste streams (excluding bio solids and source-separated food and GO) referenced in the EfW Policy Statement (wood waste, tyres and textiles) are assumed to be included in the existing tonnes reported in the mixed waste streams. These allowable waste streams are not considered additional to the mixed waste streams detailed in Table 13.

## 5.7.2 Potential feedstock

**Table 13: Potential tonnes for energy from waste processing 2015**

| Waste Source | | Process | Waste Stream | Available residuals (t) | | | | | Policy Allowance | Allowable (t) | | | | | Assumptions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | SMA | ERA | RRA | Rest of NSW | Total | All | SMA | ERA | RRA | Rest of NSW | Total | |
| Mixed Waste Stream | MSW | 3 bin FOGO | MSW | 32,753 | - | 50,253 | 7,108 | 90,114 | 100% | 32,753 | - | 50,253 | 7,108 | 90,114 | • Data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report and the NSW Local Government Waste and Resource Recovery Data Report 2011-12 |
| | | 3 bin GO | MSW | 744,858 | 209,121 | 107,053 | 101,382 | 1,162,414 | 40% | 297,943 | 83,648 | 42,821 | 40,553 | 464,966 | |
| | | 2 bin | MSW | 251,779 | 221,682 | 69,034 | 220,692 | 763,187 | 25% | 62,945 | 55,421 | 17,259 | 55,173 | 190,797 | |
| | C&I | Mixed | C&I | 1,854,500 | 358,000 | 376,000 | 376,000 | 2,964,500 | 50% | 927,250 | 179,000 | 188,000 | 188,000 | 1,482,250 | • Landfill data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report<br>• 100% of landfilled C&I is conservatively assumed to NOT be sourced from an entity that has separate collections systems for all relevant waste streams and can be processed through an authorised facility<br>• Data does not distinguish between tonnes disposed of in the RRA and the Rest of NSW. The difference between total tonnes and the SMA and ERA has been equally allocated to the RRA and Rest of NSW |
| | | Separate collection for all "relevant waste streams" residual | C&I | - | - | - | - | - | 100% | - | - | - | - | - | |
| | C&D | Processing facility residual | C&D | 1,075,500 | 460,500 | 223,500 | 223,500 | 1,983,000 | 25% | 268,875 | 115,125 | 55,875 | 55,875 | 495,750 | • Landfill data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report<br>• 100% of landfilled C&D can be processed through an |

## Table 13: Potential tonnes for energy from waste processing 2015

| Waste Source | Process | Waste Stream | Available residuals (t) | | | | | Policy Allowance | Allowable (t) | | | | | Assumptions |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SMA | ERA | RRA | Rest of NSW | Total | All | SMA | ERA | RRA | Rest of NSW | Total | |
| | | | | | | | | | | | | | | authorised facility<br>• Data does not distinguish between tonnes disposed of in the RRA and the Rest of NSW. The difference between total tonnes and the SMA and ERA has been equally allocated to the RRA and Rest of NSW. |
| Source-separated recyclables: MSW | Processing facility residual | MSW | 418,978 | 154,127 | 104,185 | 102,959 | 780,249 | 10% | 41,898 | 15,413 | 10,419 | 10,296 | 78,025 | • Landfill data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report<br>• Source separated recyclables does NOT extend to C&I and C&D |
| Source-separated garden waste: MSW | Processing facility residual | MSW | 316,729 | 155,696 | 81,566 | 89,633 | 643,624 | 5% | 15,836 | 7,785 | 4,078 | 4,482 | 32,181 | • Landfill data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report |
| Source-separated food or food and garden waste | Processing facility residual | MSW | 33,913 | - | 40,070 | 9,275 | 83,258 | 10% | 3,391 | - | 4,007 | 928 | 8,326 | • Landfill data obtained from 2010 Waste Avoidance and Resource Recovery Strategy Progress Report<br>• C&I tonnes from Earthpower |
| | | C&I | 40,000 | - | - | - | 40,000 | 10% | 4,000 | - | - | - | 4,000 | |
| **Total** | **-** | **-** | **4,769,010** | **1,559,126** | **1,051,661** | **1,130,549** | **8,510,346** | | **1,654,892** | **456,391** | **372,712** | **362,414** | **2,846,408** | |

The total amount of waste generated in NSW increased from 16.3 million tonnes in 2008–09 to 17.1 million tonnes in 2010–11, an increase of 5.2% per annum. Waste generation rates continued to outstrip the population growth of 3.4% during this period (EPA, 2014). Assuming a 2.4% per annum waste generation growth rate (taking into consideration compounding growth), a revised potential waste total for 2020 was estimated.

**Table 14: Potential tonnes for energy from waste processing 2020**

| Waste Source | | Process | Waste Stream | 2015: Total Potential | 2020: Total Potential |
|---|---|---|---|---|---|
| Mixed Waste Stream | MSW | 3 bin FOGO | MSW | 90,114 | 101,459 |
| | | 3 bin GO | MSW | 464,966 | 523,505 |
| | | 2 bin | MSW | 190,797 | 214,818 |
| | C&I | Mixed | C&I | 1,482,250 | 1,668,865 |
| | | Separate collection for all "relevant waste streams" residual | C&I | - | - |
| | C&D | Processing facility residual | C&D | 495,750 | 558,165 |
| | Source-separated recyclables: MSW | Processing facility residual | MSW | 78,025 | 87,848 |
| | Source-separated garden waste: MSW | Processing facility residual | MSW | 32,181 | 36,233 |
| | Source-separated food or food and garden waste | Processing facility residual | MSW | 8,326 | 9,374 |
| | | | C&I | 4,000 | 4,504 |
| | | | **Total** | **2,846,408** | **3,204,771** |

A summary of the current authorised facilities in the market is provided, however the processing capacity of each of these facilities, in addition to their recovery rates and blended supply streams is not readily available. The number of authorised facilities will also significantly increase following the roll out of the $467.5million in *Waste Less Recycle More* infrastructure package.

### 5.7.3 Current Tonnes

TNG proposes to delay the construction of lines 3 and 4 until eligible material inputs for these lines can be confirmed to the satisfaction of the Department Planning and Environment. The eligible tonnes received currently across DADI's extensive waste asset portfolio exceed the tonnes required for lines 1 and 2 (552,500 tpa).

TNG has identified and quantified the number of eligible tonnes that are received currently at Alexandria and at Eastern Creek from third party "authorised facilities", in addition to the residual from DADI's own Material Processing Centre. The design fuel mix has been determined using the waste sources available to TNG today, however the technology employed allows for significant flexibility in composition and quantity of material. The design fuel mix is summarised in Table 7. TNG has committed to provide the breakdown of these waste streams by:

- DADI customer;
- Authorised facility location;
- Resource recovery rate of facility (which exceeds the resource recovery rate criteria of the EfW Policy Statement); and
- Total tonnes per annum.

This detailed information will be provided in confidence to the EPA, given the commercially sensitive nature of the information. For the purpose of this report, these tonnes have been aggregated into the design fuel components summarised in Table 6 and Table 7.

The TNG Facility will target non-putrescible residual waste streams in the MSW, C&I and C&D sectors for EfW processing in order to comply with the EfW Policy Statement and the licensing and development consent requirements for the site residual waste fuels originating from MSW sources have had organic fractions removed and are regarded as dry wastes.

### 5.7.4 Summary

The analyses performed demonstrate that:

- DADI currently receives enough eligible material to operate lines 1 and 2 of the Facility; and
- There is sufficient potential material in the market to operate the Facility at full capacity, conservatively assuming that only 50% of landfilled C&I waste is eligible and excluding any additional waste resulting from population growth and consumption rate increases.
- Upon operation of the EfW this residual waste fuel instead of being landfilled will then be received at the TNG EfW facility. No material will be exhumed from landfill for the purpose of the TNG EfW facility.

# 6 Addressing the Director-General's Requirements

Each of the DGRs is considered in detail below.

## 6.1 Classes and Quantities of Waste to be Treated

***DGR1: Description of the classes and quantities of waste that would be thermally treated at the facility***

All wastes to be processed through the Facility are classed as General Solid Waste (non-putrescible) under the NSW EPA Waste Classification Guidelines. No special waste, hazardous waste, liquid waste, restricted solid waste or general solid waste (putrescible) will be used as feedstock in accordance with the site's current development consent and licence.

Incoming waste will be sourced from the adjacent MPC and other authorised facilities, therefore ensuring all recoverable recyclables will have been removed prior to thermal treatment.

Government Polices and Market forces (landfill prices, recycling operating costs and commodity prices) result in waste being recycled or landfilled. The EfW Policy is underpinned by the waste hierarchy and states that recycling cannot be cannibalised. As the facility complies with the policy, only uneconomical material is recycled.

Section 3.5 details the quantities and design mix of residual general solid waste (non putrescible) that will be utilised in the Facility. A description of each TNG waste composition category is provided below.

### 6.1.1 CRW

Following pre-sorting, waste is shredded at the MPC and screened for further resource recovery. Residual waste is a typical mix of light wastes that are uneconomical to recycle further (i.e. the cost to conduct additional sorting and haulage to market exceeds the cost to landfill the material). This material is approximately 450mm or less in size and is currently transported to the landfill base via chute and is the residual of both C&D and C&I waste streams. CRW wastes that are not processed via the MPC are typically the residual of other authorised facilities and are currently landfilled.

Refer to Appendix D for Chute Residual Waste Audit Data

CRW from the MPC is expected to represent approximately 23% of the EfW Facility Phase 1 feedstock. Refer to Section 3.5.3 for further detail.

### 6.1.2 C&D

C&D waste is expected to represent almost 29% of Phase 1 feedstock, comprising C&D processing residual obtained from authorised C&D processing facilities.

### 6.1.3 C&I

C&I waste is expected to represent approximately 17% of Phase 1 feedstock, comprising C&I processing residual obtained from authorised C&I processing facilities.

### 6.1.4 Flock waste

Flock waste (shredder flock) is the residue resulting from shredding and crushing items such as motor vehicles and white goods. It is typically generated by metal recyclers and brought to the landfill for disposal, as limited further resource recovery is possible from this shredded material. The metal industry has successfully secured landfill levy exemptions to assist with the costs of disposing of this difficult waste stream.

Flock waste contains primarily plastics, seat foam, rubber, glass, and carpet and is therefore suitable for thermal recovery. Flock waste is expected to represent approximately 14% of the Phase 1 feedstock. This value can be increased to improve the NCV of the Facility feedstock as required.

The EPA has confirmed that flock is not excluded from EfW and will likely be potentially included in an amended version of the NSW EfW Policy and that the resource recovery threshold would be 25%, in accordance with current metal recycling operations Appendix G.

### 6.1.5 Paper Pulp

Paper pulp is not identified as an independent waste stream in the NSW EfW Policy, but can be classified as a mix of C&I and MSW residual from paper recycling operations. The composition of paper pulp has been obtained from a post-consumer paper recycling operation in Sydney. Paper pulp is expected to represent approximately 5% of the Phase 1 feedstock.

### 6.1.6 Glass Recovery

Glass residual is not identified as an independent waste stream in the NSW EfW Policy, but can be classified as MSW residual from post-consumer glass recycling operations. The composition of glass residuals has been obtained from a glass recycling operation in Sydney.

### 6.1.7 Garden Organics

GO residual is classified as the residual from domestic source separated GO waste. The composition of this residual waste was obtained from council audit data for GO bins prior to processing.

### 6.1.8 AWT Residuals

AWT residual is classified as the residual waste after processing domestic residual waste (red bin) from a two bin system. Processing thus removes dry recyclables, food, GO and other organic material via processing, leaving a high calorific residual waste stream. AWT residual is expected to represent approximately 7% of the Phase 1 feedstock.

### 6.1.9 MRF Waste

MRF residual is classified as the residual from domestic dry recycling operations. The composition of this residual waste was obtained from a material recovery facility operator in Sydney.

## 6.2 Maximising Recovery of Material

***DGR2: Demonstrate that waste used as a feedstock in the EfW plant would be the residual from a resource recovery process that maximises the recovery of material, in accordance with EPA guidelines***

As detailed in Sections 3.5 and 6.1, input fuel to the Facility originates in part from the MPC. The MPC and landfill is the largest integrated facility of its type in Australia and was approved and opened in 2012. It uses modern state of the art facility and equipment in pursuit of its goal “Towards Zero Waste”. Its compliance is verified by independent environmental audits to the satisfaction of the NSW Government Departments. The MPC satisfies the criteria set out in the EfW Policy Guidelines, in that it achieves a diversion rate equal to or greater than 75% (the more conservative resource recovery criteria of mixed C&I and C&D). The MPC holds a licence by Environment Protection Licence (EPL) 20121 and the Landfill holds a licence EPL 13426.

CRW from the MPC is expected to represent approximately 23% of the EfW Phase 1 feedstock.

The new POEO regulations will require additional reporting from resource recovery facilities, which are now liable for the levy. This data can be used by the EPA and/or TNG to ensure third party facilities achieve the diversion rates in the EfW Policy. TNG will also request receipt of reports from third party facilities to verify the reported resource recovery rates of each facility. Details regarding the source of each waste stream with respect to incoming feedstock are documented in Section 3.5. Auditing and management processes are detailed in Figure 3.

## 6.3 Control of Inputs

***DGR3: Procedures that would be implemented to control the inputs to EfW plant, including contingency measures that would be implemented if inappropriate materials are identified***

Figure 3 presents the methods to be employed for controlling the inputs to the EfW Facility. This section expands on the figure, details the procedures that will be implemented to control the inputs to the Facility and presents the contingency measures to be implemented if inappropriate materials are identified.

Waste that do not meet the eligible residual waste fuel criteria is received at the MPC from third party providers undergoes recovery processes before it reaches the EfW facility. This waste will be classified as either:

a. Requiring more processing for further recovery in which case it will be put through the MPC, PSF or other on-site authorised facility; or
b. Determined to be non-recoverable and “fuel ready” in which case it will be delivered to the EfW Facility.

Classification of wastes is based on knowing the source, advice from the carrier, inspection of the carrier’s documentation (prepared in accordance with EPA Waste Classification

Guidelines), and verification of this information by visual inspection using the weighbridge camera ('Check Point 1').

All residual waste fuel from the MPC will be pre-weighed and details recorded before being transported via conveyor to the EfW Facility.

Eligible residual waste fuels from external third party recycling facilities and sites will be delivered via road vehicle directly to the EfW. These will enter the site through the main entrance and will proceed to the weighbridge where the quantity of incoming fuel will be checked and recorded. Inspections of all vehicle loads will be undertaken at three checkpoints to confirm the nature of incoming residual waste fuel (refer to Figure 3):

1. At the weighbridge by the operators and also by CCTV ('Check Point 1');

2. At the spotter station a physical inspection is taken of the top of the load ('Check Point 2'); and

3. Further inspection when the load is tipped off ('Check Point 3').

The waste inspection procedure has been provided in Appendix B. All residue waste streams must be processed through a resource recovery facility (as defined by the EfW Policy), which will remove all contaminants. In addition, all loads are visually inspected at multiple check points.

Only approved residue waste fuel will be allowed to proceed to the tipping hall. Any deviation from the fuel specification will be entered in the computerised load reject register, and the load will be rejected.

The waste bunker has a capacity of 5-7 days to provide a buffer to cater for disruptions in fuel supply or unplanned outages of the Facility.

Waste fuel will be mixed in the waste bunker using the overhead cranes to ensure homogeneity in the fuel.

## 6.4 Location and Size of Stockpiles

***DGR4: Details on the location and size of stockpiles of unprocessed and processed recycled waste at the site***

No stockpiles of unprocessed waste or recycled waste will be held externally at the TNG EfW Facility.

All waste fuel will be delivered directly into the tipping hall after inspection and verification and then unloaded into the waste bunker which has a storage capacity of 5 to 7 days. The location of the bunker is shown in

Figure 2The approximate required size of the bunker has been determined during the concept design stage, and is based on the following:

- Fuel requirements of the Facility;
- Ventilation requirements;
- Supply stream considerations; and
- Fire risk mitigation.

The bunker will have a maximum capacity of approximately 68,900m$^3$. The bunker will have an approximate footprint of 31.5m x 109m, with a stacking height up to 30 metres.

## 6.5 Waste for Land Application

***DGR5: Demonstrate any waste material produced from the EfW facility for land application is fit-for-purpose and poses minimal risk of harm to the environment in order to meet the requirements for consideration of a resource recovery exemption by the EPA under Clause 51A of the POEO (Waste) Regulation 2005.***

It is TNG's intention to recycle approximately 270,000 tpa of bottom ash via a crushing and screening process to produce aggregate for road base. This will likely require a resource recovery order and resource recovery exemption to be issued by the EPA under Clause 92 of the PoEO Waste Reg. (also refer to Section 6.6.1 below for further detail of the residue ash from the Facility).

## 6.6 Management of Other Waste Streams

***DGR6: Procedures for the management of other solid, liquid and gaseous waste streams***

The Facility will generate the following solid, liquid and gaseous waste streams:

- Bottom ash;
- APC residue;
- Boiler ash;
- Liquid effluent from the boiler water treatment system and from the boiler blow-down; and
- Gaseous emissions (pyrolytic gas).

The quantity of these waste ash streams is summarised in Table 8.

While significant quantities of process materials (ammonium hydroxide, diesel, powdered activated carbon and calcium hydroxide) will be held on site, these will generally be consumed in the process or end up in the APC residue and will not generate separate waste streams. Small quantities of maintenance materials will be held on site and maintenance activities may generate small quantities of waste (waste oil, etc.).

In addition to these waste streams, the facility will generate operational waste in its offices.

TNG will comply with the EPA's reporting requirements for all of these waste streams. It is understood that the EPA will determine the following:

- Frequency of testing;
- Parameters for each waste stream; and
- Reporting processes.

TNG will engage an independent NATA approved laboratory to prepare and test all samples. The theoretical analysis of all three ash types has been conducted Appendix H.

### 6.6.1 Bottom ashes

The bottom ash from the grate will be discharged onto a conveyor system. The conveyor will pass under a magnetic separator to remove ferrous materials. The ash will then be discharged to a bottom ash bunker for storage. Bottom ash will either be recycled as road base/aggregate or landfilled.

In the absence of Facility samples, MRA took typical compositions of EfW incineration bottom ash (IBA) as a proxy to classify the bottom ash and identify ways to recycle or dispose it off. The proxy composition was taken from a study of EfW Incinerator Bottom Ash, *Assessment of Hazard Classification of UK IBA 2011*, conducted in the United Kingdom (UK). The study analyses the composition of bottom ashes from 18 EfW Facilities located in the UK for the period January 2011 – June 2011. The analysis was based on MSW incineration, thus providing a very conservative contamination profile as C&I and C&D wastes are less variable in comparison to MSW.

The NSW EPA Waste Classification Guidelines were used to classify the proxy bottom ash sample. The results were tested against the specific contaminant concentration (SCC) thresholds using maximum contaminant concentrations provided in the samples. The results of the classification process are shown in Appendix B.

As shown in the results, the proxy sample would be classified as 'hazardous waste' under Step 5 of the Waste Classification Guidelines due to high levels of lead and nickel in both proxy samples; however, this assessment was based only on SCC and did not take into account leachability using the toxicity characteristics leaching procedure (TCLP).

Ramboll and HZI undertook an assessment of the ash fractions from the Facility, based on the expected Phase 1 residual waste fuel composition. The SCC values obtained for bottom ash by Ramboll/HZI were similar to the average values obtained by MRA; however; Ramboll/HZI also derived TCLP values. This assessment shows that the bottom ash would be classified as General Solid Waste. Results of this assessment are shown in Appendix H.

As shown in Table 9 of Section 3.6, Ramboll/HZI calculated the amount of bottom ash that would be generated at the nominal load (based on 8,000 hours of operation and feed of 1,104,000tpa at design waste composition with a NCV of 12.34 MJ/kg and ash content of approximately 20%) to be 270,000tpa (20% moisture).

To minimise the concentration of metals, particularly lead and nickel, in the bottom ash residual waste of the Facility, the following measures will be taken:

1. Acceptance of C&I and C&D waste streams only from third party authorised facilities;
2. Preliminary inspection of waste, source verification and CCTV footage;
3. Visual inspection post tipping;
4. Contractual tools such as penalties or right of refusal for delivery of waste with high lead or nickel concentrations;
5. Pre-screening, sorting and separation processes to remove hazardous materials at MPC, PSC and/or other authorised facilities;
6. Options to immobilise waste will be examined in the event that sorting does not reduce lead and nickel concentrations to be able to achieve a 'restricted solid waste' classification; and
7. Periodic testing of bottom ash.

Operation of the Facility will be fully automatically controlled from a stand-alone control room. The proposed main control and supervision system will consist of a Distributed Control System (DCS). Further detail of the DCS is provided in Appendix E.

Due to the inherent value of lead-acid and nickel-cadmium batteries, this waste stream is typically recycled in Australia. Batteries have also been listed as a core waste stream that must be collected at the 86 new community recycling centres (CRCs) that are being established through the $467.5m Waste Less Recycle More Grant Program. This investment in recycling infrastructure will serve to further reduce the number of batteries, the dominant source of nickel and lead, from the residual waste streams currently received at the MPC.

Disposal of these materials will occur as per the detail described in Table 8 of Section 3.7.

### 6.6.2 Air Pollution Control (APC) residue

As shown in Table 9 of Section 3.6, Ramboll/HZI calculated the amount of APC residue that would be generated at the nominal load (based on 8,000 hours of operation and feed of 1,104,000tpa at design waste composition with a NCV of 12.34 MJ/kg and ash content of approximately 20%) to be 55,000tpa.

Flue gas treatment (FGT) residues comprise fine particles of ash and residues from the flue gas treatment process, which are collected in bag filters and form a component of APC residue. APC residues will be stored in sealed silos adjacent to the flue gas treatment facility.

APC residue is generally more hazardous than boiler ash. The actions described in section 6.6.1 to minimise the concentration of metals in the bottom ash waste stream will also ensure that metals concentrations in APC residue remain low to comply with a 'restricted solid waste' classification (Appendix H). Future verification to make APC residue reusable in concrete products may also be possible. In the meantime, APC residue is destined for disposal in a licensed facility either in NSW or interstate depending on the waste classification.

Because of the potentially alkalinity of APC residue, there is a potential the waste may be classified as Hazardous Waste (although current analysis Restricted Solid Waste). In the event the waste exceeds the criteria for Restricted Solid Waste then the residue will be taken off site to a Hazardous Waste Treatment facility.

### 6.6.3 Boiler ash

As shown in Table 9 of Section 3.6, Ramboll/NZI calculated the amount of boiler ash that would be generated at the nominal load (based on 8,000 hours of operation and feed of 1,104,000tpa at design waste composition with a NCV of 12.34 MJ/kg and ash content of approximately 20%) to be 5,000tpa.

Boiler ash is also generated by the facility. Its chemical composition falls between that of bottom ash and APC residue. The characterisation of boiler ash is depending on in which boiler pass (from two to five) it is accumulated. The boiler ash of all four passes will be conservatively disposed of with APC residues, following rigorous testing procedures.

### 6.6.4 Liquid Effluent

Liquid effluents will be produced from the boiler water treatment system and from the boiler blow-down. All boiler blow-down and liquid effluent produced is fed to the bottom ash discharger via the process water system.

Under normal operating conditions, no effluent is disposed of to the sewer or stormwater systems but returned to the Facility for re-use. In this way, the liquid effluent produced on site will either be evaporated or absorbed into the ash for disposal or re-use off site.

Liquid effluent will be collected in a storage tank to balance the amounts generated and disposed of to the ash quench. This will consist of boiler blowdown, boiler water treatment, swilling down water, occasional maintenance discharges and drain water from contaminated areas.

The re-use of the different water streams within the process results in a liquid effluent free EfW Facility during normal operation.

### 6.6.5 Gaseous emissions (pyrolytic gas)

Pyrolytic gas produced in the combustion process pass is mixed with secondary air and recirculated flue gas, which are injected at high velocity into the secondary combustion chamber above the grate, resulting in intensive mixing and the complete burnout of the pyrolytic gas.

Within the flue gas treatment (FGT) system the flue gas is scrubbed and treated before being vented to the atmosphere through a stack. The flue gas is treated within a reactor with a combination of lime and activated carbon and filtered through a fabric bag filter.

Further details are provided in Section 4.2.5 and Table 12.

### 6.6.6 Staff waste

The offices on site generate negligible commercial and industrial waste in the offices and staff rooms. SITA is currently engaged to remove waste generated by staff members. The waste is stored in a three metre cubic skip bin on site and is removed weekly.

### 6.6.7 Other wastes

The following chemicals are kept on site in low quantities and will generate empty packaging / drums / containers which will require disposal post use:

- Waste lubricant oil.
- Used lubricant oil drum.
- Scrap metal from the workshop.

Small quantities of maintenance materials will be held on site and maintenance activities may generate small quantities of waste (waste oil, etc.) that will sent for recycling or appropriate disposal following waste classification.

Any spilled chemical substances the bunded area that are required to leave site as waste will be classified and transported in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes*.

Packaging / drums / containers will be collected by the supplier or disposed of in accordance with their waste classification.

The hazards associated with storage of these materials and other dangerous goods are addressed in full in Appendix U (Preliminary Hazard Analysis and Fire Risk Assessment) of the EIS. With the exception of transformer oil, these will generally be consumed in the process or end up in the APC residue and will not generate separate waste streams.

## 6.7 Storage, Handling and Disposal of Waste

***Describe how waste would be treated, stored, used, disposed and handled on site, and transported to and from the site, and the potential impacts associated with these issues, including current and future off-site waste disposal methods.***

Bottom ash from the grate will be discharged onto a conveyor system. The conveyor will pass under a magnetic separator to remove ferrous materials. The ash will then be discharged to a bottom ash bunker for storage. Bottom ash is expected to be classified as General Solid Waste and will either be transported by truck for landfill disposal or returned to the MPC to be recycled as an aggregate.

APC residue is expected to be classified as Restricted Solid Waste and will be stored in sealed silos adjacent to the flue gas treatment facility before being transported by road in a sealed tanker to an appropriate waste and/or treatment facility. Because of the potentially alkalinity of APC reside there is a potential the waste may be classified as Hazardous Waste (although current analysis Restricted Solid Waste). In the event the waste exceeds the criteria for Restricted Solid Waste and is classified as ‘hazardous’ then the residue will be taken off site for treatment at a Hazardous Waste Treatment facility.

Boiler ash is expected to be classified as Restricted Solid Waste and will be directed to the same sealed silos as APC residue for disposal unless reuse opportunities are identified.

Staff waste will be help in a three metre cubic skip bin on site and removed weekly by a waste contractor. Small quantities of maintenance materials waste will be held on site with

secondary containment where required until sent for recycling or appropriate disposal on an as needs basis.

## 6.8 Waste Avoidance and Resource Recovery Strategy

***Identify the measures that would be implemented to ensure that the development is consistent with the aims, objectives and guidance in the* NSW Waste Avoidance and Resource Recovery Strategy 2007**

The NSW Waste Avoidance and Resource Recovery Strategy 2007 is informed and driven by the waste hierarchy, which also underpins the objectives of the WARR Act (see Section 4.2.4). The NSW WARR Strategy's vision is to:

*Enable the whole NSW community to improve environment and community well-being by:*

- *Reducing the environmental impact of waste; and*
- *Using resources more efficiently.*

The objectives and targets of the draft WARR Strategy are summarised in Table 15.

**Table 15: WARR Strategy objectives and targets**

| Objectives | Targets |
|---|---|
| **1. Avoid and reduce waste generation** | By 2021/22, reduce the rate of waste generation per capita |
| **2. Increase recycling** | By 2021/22, increase recycling rates for:<br>• Municipal solid waste from 52% (in 2010/11) to 70%<br>• Commercial and industrial waste from 57% (in 2010/11) to 70%<br>• Construction and demolition waste (C&D) from 75% (in 2010/11) to 80% |
| **3. Divert more waste from landfill** | By 2021/22 increase waste diverted from landfill from 63% to 75% |
| **4. Manage problem waste better** | By 2021/22 establish or upgrade 86 drop off facilities or services for managing household problem waste state-wide |
| **5. Reduce litter** | By 2016/2017 reduce the number of litter items by 40% compared to 2011/12 levels and then continue to reduce litter items to 2021/22 |
| **6. Reduce illegal dumping** | Implement the NSW Illegal Dumping Strategy 2013-15.<br>By 2016/17 establish baseline data to allow for setting targets. |

The Proposal is an EfW facility, designed to convert waste that cannot be avoided, reused or recycled into electricity. As such it diverts waste from landfill and is fully consistent with Objective 3. The facility will remove a maximum of 1,350,000 tpa of waste from landfill.

In 2008–09, the Department of Environment, Climate Change and Water (DECCW) had estimated that approximately 16.3 million tonnes of waste were generated in NSW (or 2,329 kilograms per capita per year). Of that, 9.5 million tonnes were recycled (58%) and 6.7 million tonnes (42%) went to landfill.

As such, the Proposal will itself contribute approximately an additional 20% diversion from landfill in accordance with the EfW Policy Statement.

Measures implemented at the Facility to ensure ongoing compliance with Objective 3 are:

- Exclusion of waste that has not undergone resource recovery;
- Seek waste for residual waste fuel from resource recovery facilities; and
- Upon arrival at the Facility, all loads will are weighed and checked inspections procedures of all incoming vehicle loads commencing at the weighbridge and continuing to the tipping hall and tip off point to confirm that resource recovery has taken place and that load contains residual waste fuel. Only loads confirmed to consist of residual waste fuel will be allowed otherwise they will be rejected (the tipping hall is also large enough to quarantine any suspect loads to ensure loads can still be rejected if required); and

Additional information regarding the compliance of the Facility can be seen in Section 6.3 and in Figure 3. The Proposal does not compromise any of the Objectives detailed in Table 15.

The energy from waste facility fits within the broader government objectives and policies and by complying with the EfW Policy Statement will not undermine current and future resource recovery opportunities.

# 7 Addressing the NSW EPA Requirements

The following address the EPA requirement given to TNG in relation to waste management. In addition a meeting between TNG and NSW was undertaken on 12 February 2015 (Appendix G) which discussed and agreed upon the approach to address a number of the EPA requirements.

## 7.1 The proposed sources, types, quantities and classification of all wastes

***EPA 1:*** *The proposed sources, types, quantities and classification of all wastes to be treated at the facility. This must include details of how the input wastes will comply with the Resource Recovery Criteria contained in the NSW EfW Policy Statement.*

Refer to Sections 6.1.

## 7.2 Maximising the recovery of material

***EPA 2: Measures to be implemented to ensure that waste used as a feedstock at the facility is the residual from a resource recovery process that maximises the recovery of material.***

Refer to Sections 6.2 and 6.3

## 7.3 Thermal Efficiency

***EPA 3: How the process will meet the Thermal Efficiency and Technical Criteria in the NSW Energy from Waste Policy Statement***

The project has been designed to meet European directives that establish Best Available Technology (BAT) for waste incineration. Additionally, a summary of the technical criteria document in the EfW Policy Statement and how TNG's proposal is designed to meet the technical criteria is summarised Table 12: Energy from Waste Policy Statement technical criteria

The Facility has been designed to have a thermal input of 469.6MWe (117.4MWe for each incineration line) at the design point. The Facility has an assumed net electrical efficiency of 30% which is above the 25% efficiency criteria rate. The Facility has been designed to export approximately 140MWe (30% X 469.6MW). High net electrical efficiency is a priority for TNG, and there are a number of options that could be incorporated into the design to increase the efficiency further including steam reheat and flue gas cooling. The export voltage will be set to match the requirements of the local high voltage electricity grid (Fichtner 2014a).

Refer to Sections 5.5 and 5.6 for further detail.

## 7.4 Hazardous Waste Procedures

***EPA 4: Procedures for the assessment, handling, storage, transport and disposal of all hazardous waste produced by the Facility.***

Refer to Section 6.6.

## 7.5 Liquid and non-liquid waste management at the Facility

***EPA* 5: *Provide details of the quantity and type of both liquid waste and non-liquid waste generated, handled, processed or disposed of at the premises. Waste must be classified according to the Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (NSW EPA, 1999). Details must include:***

- ***a) The transportation, assessment and handling of waste arriving at or generated at the Premises;***
- ***b) Any stockpiling of wastes or recovered materials at the site including stockpile footprints, heights and location;***
- ***c) Any waste processing related to the facility, including reuse, recycling, reprocessing or treatment both on- and off-site;***
- ***d) The method for disposing of residual waste from the Facility;***
- ***e) The emissions arising from the handling, storage, processing and reprocessing of waste at the Facility; and***
- ***f) The proposed controls for managing the environmental impacts of these activities.***

### 7.5.1 The transportation, assessment and handling of waste

**EPA 5.1: The transportation, assessment and handling of waste arriving at or generated at the Premise**

Refer to Sections 3.5.2, 3.5.3 and 6.7.

### 7.5.2 Stockpiling of wastes or recovered materials

**NSW EPA Requirement 5.2:** *Any stockpiling of wastes or recovered materials at the site including stockpile footprints, heights and location*.

Refer to Section 6.4.

### 7.5.3 Waste processing

***EPA 5.3: Any waste processing related to the facility, including reuse, recycling, reprocessing or treatment both on- and off-site.***

The proposed TNG Facility will process only waste that has already undergone a comprehensive resource recovery procedure. Details of this procedure are provided in Sections 3.5 and 6.6.

### 7.5.4 Disposing of residual waste from the Facility

***EPA 5.4: The method for disposing of residual waste from the Facility.***

The APC residue ash waste silos at the facility will be elevated, allowing the waste transport vehicles to park underneath the silo and use gravity to load the ash residue. No manual handling is required.

TNG will actively engage with the NSW EPA and waste service providers to discuss reuse and treatment options. One of the preferable options is to include bottom ash and boiler ash in road base and aggregate. The technique employed will be dependent on the ultimate composition of the bottom ash determined by chemical composition testing after commissioning of the Facility.

Further compositional testing of APC ash will be conducted to classify this waste stream. Options under consideration to recycle or dispose of APC ash include:

- Treatment to render APC ash usable in concrete products;
- Disposal to waste landfill that is licensed to accept the appropriate class of waste; and
- Implementation of stabilisation techniques such as immobilisation or vitrification to reduce the waste classification to an appropriate level for disposal at landfill.
- Because of the potentially alkalinity of APC residue, there is a potential the waste may be classified as Hazardous Waste (although current analysis Restricted Solid Waste). In the event the waste exceeds the criteria for Restricted Solid Waste then the residue will be taken off site to a Hazardous Waste Treatment facility.

All waste that cannot be reused will be classified and transported in accordance with the *Environment Operations (Waste) Regulation 2014.*

In addition the Facility will generate the following wastes:

Refer to Sections 3.7 for more detail.

### 7.5.5 The emissions from the Facility

***EPA 5.5: The emission arising from the handling, storage, processing and reprocessing of waste at the Facility.***

**Emissions from TNG Facility**

Refer to Appendix K of the EIS.

The flue gas treatment process will be continuously monitored to avoid operating at levels above the set limits.

Oxides of nitrogen will be controlled using the SNCR system. More or less ammonia will be dosed to adjust the NOx levels. The system will respond within a few seconds of changing the ammonia level.

Acid gases will be controlled by the addition of lime. If acid gas levels rise, more lime can be added. Heavy metals and dioxins will be removed by adding activated carbon.

Dust will be controlled by the fabric filter, which provides a barrier to remove fine particles. As this is a physical barrier, dust removal is fixed. In the event that the fabric breaks, the dust monitor will immediately detect higher dust levels. The operator would then shut off the area of the fabric filter that is leaking. The fabric filter will be sized to allow one section of the

bag filter to be isolated and still operate at full load. The leaking section of the filter can then be replaced by removing and replacing the leaking bag.

The following process variables have particular potential to influence emissions and will be monitored continuously:

- Waste throughput will be recorded to enable comparison with the design throughput. As a minimum, hourly and annual throughput is recorded;
- Flue gas temperature after injection of secondary air;
- Oxygen content of the flue gases exiting the boiler;
- Differential pressure across fabric filters;
- Reagent feed rates;
- Upstream HCl concentration, in order to optimise the performance of the emissions abatement equipment; and
- Ammonia concentration in flue gases, in order to optimise the performance of the SNCR system.

**Emissions from general Facility operations**

All plant and equipment selected for use on site are fuel-efficient and are subject to strict maintenance schedules to optimise performance and reduce emissions.

### 7.5.6 Waste Management of Environmental Impacts.

***EPA 5.6: The proposed controls for managing the environmental impacts of these activities (handling, storage, processing and reprocessing of waste at the Facility).***

The controls proposed for the management of environmental impacts of the Proposal are documented in Section 6.6.

An Environmental Management Plan will be prepared for the Proposal, which will further detail these mitigation and control measures.

## 7.6 Output products proposed to be produced from the facility

**EPA 6:** ***The quantity, type and specifications for all output products proposed to be produced from the facility. The description should include the physical, chemical and biological characteristics (including contaminant concentrations) of those output products as well as relevant accredited standards against which the products would comply. In documenting or describing the composition of output products and/or wastes generated from the proposed facility reference should be made to the relevant EPA resource recovery exemption or the EPA Waste Classification Guidelines 2008.***

The outputs (other than waste) from the operation of the Facility are electricity and heat. Heat can be run through an absorption chiller to create cooling for air-conditioning, cool rooms and other like purposes. Due to the nature of these output products, a description of their physical, chemical and biological characteristics is not deemed to be relevant. In addition, no EPA resource recovery exemptions or waste classification is appropriate in this case. The Facility is designed to optimise the output of electricity.

### 7.6.1 Electricity

The quantity of electricity that will be generated by the TNG Facility is approximately 158MWe gross and 140MWe net.

### 7.6.2 Hot and chilled water

Without any changes to the main Facility design, the Facility can be configured so that it can export heat to nearby neighbours for space heating or cooling.

If heat is required in the form of hot water, the typical temperatures are at 110-115°C. The turbine design allows for sufficient steam extraction at sufficiently high pressure to provide the anticipated maximum quantity of hot water at these temperatures. Adequate space for the installation of district heating scheme heat exchangers has been allowed for in the layout of the Facility and will be dependent on the on-site and off-site demand for the output.

## 7.7 Waste Disposal

***EPA 7: Identify, characterise and classify all waste that is proposed to be disposed of to an offsite location including proposed quantities of the waste and the disposal locations for the waste***

Solid by-products and a liquid by-product will be produced as waste from the operation of the Facility. Refer to Section 3.7 for further detail.

## 7.8 Procedures that will be implemented to control the inputs to the facility

***EPA 8: Procedures that will be implemented to control the inputs to the facility including contingency measures that would implemented in the event that ineligible waste fuels are received at the Premises:***

Refer to Section 3.5 and Figure 3 in addition to Section 6.3.

The Facility will have storage capacity for at least 5-7 days of fuel. The Facility will, as a minimum keep 5 days of fuel, so that it can continue to operate if there are any short term supply issues and over a Public Holiday weekend. Refer to Concept Design Report.

## 7.9 Compliance NSW Waste Avoidance and Resource Recovery Strategy

***EPA 9: Identify the measures that would be implemented to ensure that the development is consistent with the aims, objectives and guidance in the NSW Waste Avoidance and Resource Recovery Strategy as issued from time to time.***

The Proposal is an EfW facility, designed to convert waste that cannot be avoided, reused or recycled into electricity. As such it diverts waste from landfill and is fully consistent with Objective 3 *NSW Waste Avoidance and Resource Recovery Strategy*. The facility will remove a maximum of 1,350,000 tpa of waste from landfill.

Measures implemented at the Facility to ensure ongoing compliance with Objective 3 are:

- Exclusion of waste that has not undergone resource recovery;
- Seek waste for residual waste fuel from resource recovery facilities;

- Upon arrival at the Facility, all loads will are weighed and checked inspections procedures of all incoming vehicle loads commencing at the weighbridge and continuing to the tipping hall and tip off point to confirm that resource recovery has taken place and that load contains residual waste fuel. Only loads confirmed to consist of residual waste fuel will be allowed otherwise they will be rejected(the tipping hall is also large enough to quarantine any suspect loads to ensure loads can still be rejected if required);

Refer to Section 4.2.4 and 6.8.

## 7.10 Provide details of spoil disposal

***EPA 10: Provide details of spoil disposal with particular attention to:***

***a) The quantity of spoil material likely to be generated;***

***b) Proposed strategies for the handling, stockpiling, reuse recycling and disposal of spoil;***

***c) The need to maximise reuse of spoil material in the construction industry;***

***d) Identification of the history of spoil material and whether there is any likelihood of contaminated material, and if so, measures for the management of any contaminated material; and***

***e) Designation of transportation routes for transport of spoil.***

### 7.10.1 Quantity of spoil

Spoil will be generated during the construction phase of the project and a Construction Waste Management Plan (CWMP) will be prepared before construction commences. Further details are provided in Appendix X (CEMP) of the EIS.

### 7.10.2 Proposed Strategies for handling, stockpiling, reuse, recycling and disposal

The CWMP will detail the strategies for handling, stockpiling, reuse, recycling and disposal. It is anticipated that spoil may be reused within the development for landscaping purposes, where appropriate. Further details are provided in Appendix X (CEMP) of the EIS.

### 7.10.3 Maximise reuse of spoil material in the construction industry

The CWMP will detail the reuse and disposal of spoil. It is anticipated that spoil may be reused within the development for landscaping purposes, where appropriate, as soil on site is not contaminated with hazardous materials. Further details are provided in Appendix X (CEMP) of the EIS.

### 7.10.4 Identification of the history of spoil material and whether there is any likelihood of contaminated material

AD Envirotech Australia Pty Ltd (ADE) was engaged by TNG to undertake a Targeted Phase II Detailed Site Contamination Investigation (DSI) to assess the current level of contamination of the site of the proposed EfW facility. Soil and sediment samples were taken from boreholes, stockpiles and creek beds. Criteria applied included the NEPM Schedule B (1) Health Based Investigation Levels (HIL) D, Ecological Screening Levels (commercial/industrial), NSW EPA Waste Classification Guidelines Part 1: Classifying Waste for off-site disposal and ANZECC Guidelines for Fresh and Marine Water Quality.

The study found no evidence of historical contamination at the site. The concentrations of the potential contaminants within the soil, sediment and surface water samples collected were below the NEPM Schedule B (1) HIL D, Ecological Screening Levels (commercial/industrial) and ANZECC Guidelines for Fresh and Marine Water Quality assessment criteria's. The samples taken indicate that spoil would satisfy a 'general solid waste' classification. Therefore, spoil generated is suitable for recycling on site for landscaping purposes.

In addition, the Preliminary Contamination Assessment of stockpiled material and land quality commissioned during the construction of the existing MPC facility indicated that stockpiled material and existing soil were suitable for use on-site (Douglas Partners, 2006).

Based on the information provided, it is expected that there is a low likelihood of contaminated material entering spoil and a low probability of acid sulphate soils being present on site.

### 7.10.5 Designation of transportation routes

All excavated materials transported from the site will be removed in accordance with transportation routes designated in the CWMP.

## 7.11 Hazardous and Dangerous Materials Procedures

***EPA 11: Provide details of procedures for the assessment, handling, storage, transport and disposal of all hazardous and dangerous materials used, stored, processed or disposed of at the site, in addition to the requirements for liquid and non-liquid wastes. Reference should be made to the Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (NSW EPA, 1999).***

Refer to Section 6.6.

## 7.12 Description of Chemical Substances

***EPA 12: Provide details of the type and quantity of any chemical substances to be used or stored and describe arrangements for their safe use and storage. Reference should be made to the Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes (NSW EPA, 1999).***

The Facility will use various raw materials during operation. Primarily, these include hydrated lime, ammonium hydroxide/ammonia water, activated carbon, gas oil, diesel (for the emergency diesel generator) and water. These will be delivered to the Facility in bulk transportation vehicles (except for water). The minimum on site storage capacity is set to reflect the process requirements and local delivery capability. Table 16 shows the approximate number of deliveries anticipated.

In addition, various other materials will be used for the operation and maintenance of the Facility including:

- Hydraulic oils and silicone based oils;
- Gas emptying and filling equipment;

- Refrigerant gases for air conditioning plant;
- Glycol/anti-freeze for cooling; and
- Boiler water dosing chemicals.

**Table 16: Waste and chemical operations summary**

| Raw material | Process | Typical usage (tpa) | Typical delivery (tonnes) | Annual deliveries | Average weekly delivery |
|---|---|---|---|---|---|
| Hydrated Lime | Flue gas treatment – acid gas scrubbing | 19,800 | 22 | 900 | 17 |
| Ammonium hydroxide (24.9% solution) | Flue gas treatment – NOx reduction | 2200 | 22 | 103 | 2 |
| Activated carbon | Flue gas treatment – dioxins/ heavy metal | 420 | 22 | 19 | 0.4 |
| Low Sulphur gas oil | System firing | 1,900 | 30 | 47 | 1 |
| Totals by road | | 24,000 | 96 | 1,080 | 20 |
| Water | Boiler and FGT | 200,000 | | | |

In order to minimise the risks of contamination to process and surface water, all liquid chemicals stored on site will be kept in bunded controlled areas and or double skinned tanks with a volume of 110% of stored capacity as per the Work Health and Safety Regulation 2011 and the NSW Code of Practice for the storage and handling of dangerous goods. Gas oil will be held in a bunded storage tank and any spillages or leaks will be retained in this area and treated locally. Any spilled chemical substances from the bunded area that are required to leave site as waste will be classified and transported in accordance with the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes.*

Packaging / drums / containers will be collected by the supplier or disposed of in accordance with their waste classification.

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# Appendix A

## NSW Energy to Waste Policy Statement

# NSW Energy from Waste Policy Statement

www.epa.nsw.gov.au

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Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.epa.nsw.gov.au

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# Contents

# Definitions

| | |
|---|---|
| **Eligible waste fuels** | Waste or waste-derived materials considered by the EPA to pose a low risk of harm to the environment and human health due to their origin, low levels of contaminants and consistency over time |
| **Energy recovery facility** | A facility that thermally treats a waste or waste-derived material that does not meet the definition of an eligible waste fuel. These facilities must be able to demonstrate that they will be using current international best practice techniques. |
| **Processing Facility** | Facility undertaking bona-fide resource recovery operations producing separate output material streams for reuse or recovery. Facility may be separate to or on the same site as energy from waste facility. |
| **Resource recovery order and exemption** | Resource recovery orders and exemptions are issued by the EPA under Part 9 of the Protection of the Environment Operations (Waste) Regulation 2014 and exempt a person from the various waste regulatory requirements that apply to the use of a waste fuel (e.g. waste disposal licensing, levy payments, etc.). The exemptions apply to waste fuels determined by the EPA to be fit-for-purpose, bona-fide energy recovery opportunities. |
| **Thermal treatment** | In accordance with Schedule 1 of the *Protection of the Environment Operations Act 1997*, thermal treatment means the processing of waste by burning, incineration, thermal oxidation, gasification, pyrolysis, plasma or other thermal treatment processes. |
| **Waste** | As defined in the dictionary of the *Protection of the Environment Operations Act* 1997 |

# 1. Introduction

The Environment Protection Authority (EPA) recognises that the recovery of energy and resources from the thermal processing of waste has the potential, as part of an integrated waste management strategy, to deliver positive outcomes for the community and the environment. Energy from waste can be a valid pathway for residual waste where:

- further material recovery through reuse, reprocessing or recycling is not financially sustainable or technically achievable
- community acceptance to operate such a process has been obtained.

In NSW, two key policy objectives are enshrined in the state's waste legislation. Firstly, the *Protection of the Environment Operations Act 1997* (POEO Act) sets the framework to ensure that human health and the environment are protected from the inappropriate use of waste. Secondly, the *Waste Avoidance and Resource Recovery Act 2001* (WaRR Act) aims to ensure that consideration of resource management options occurs in the following order:

1. avoidance of unnecessary resource consumption
2. resource recovery (including reuse, reprocessing, recycling and energy recovery)
3. disposal.

Where waste cannot be avoided or products reused, various recovery technologies are available to maximise resource efficiencies and increase the sustainability of our communities, businesses and industries.

The EPA has applied the following overarching principles to waste avoidance and recovery:

- higher value resource recovery outcomes are maximised
- air quality and human health are protected
- 'mass burn' disposal outcomes are avoided
- scope is provided for industry innovation.

The thermal treatment of waste provides an opportunity to recover the embodied energy from waste, offset the use of non-renewable energy sources, and avoid methane emissions from landfill.

However, these outcomes are contingent on ensuring that any energy recovery proposals represent the most efficient use of the resource and are achieved with no increase in the risk of harm to human health or the environment. Clean air is fundamental to everyone's wellbeing: poor air quality can be particularly critical to the health of children and chronically ill and older people, as well as affecting the natural environment and amenity of communities.

To ensure emissions are below levels that may pose a risk of harm to the community, facilities proposing to recover energy from waste will need to meet current international best practice techniques, particularly with respect to:

- process design and control
- emission control equipment design and control
- emission monitoring with real-time feedback to the controls of the process.

The NSW Energy from Waste Policy Statement sets out the policy framework and overarching criteria that apply to facilities in NSW proposing to thermally treat waste or waste-derived materials for the recovery of energy and in doing so provides regulatory clarity to industry and the community.

## 2. Energy recovery framework and scope

The NSW Energy from Waste Policy Statement outlines the policy framework and technical criteria that apply to facilities proposing to recover energy from waste in NSW.

### *Scope of the policy statement*

The scope of the policy statement covers all facilities undertaking the thermal treatment of any waste[1] or waste-derived materials, where thermal treatment means the processing of wastes by combustion, thermal oxidation, thermal or plasma gasification, pyrolysis and torrefaction. Where a thermal process, such as pyrolysis or gasification, produces a gas for subsequent combustion (for example, a syngas), the facility where that gas is combusted will also be subject to this framework.

However, there are some thermal treatment applications that fall outside the scope of this policy statement. The following facilities are excluded as they are not considered to be undertaking genuine energy recovery:

- incineration facilities for the destruction of waste
- facilities for the thermal treatment of contaminated soil
- facilities proposing the thermal treatment of unprocessed mixed waste streams
- facilities proposing the thermal treatment of waste that has been exhumed from landfills
- facilities proposing the thermal treatment of hazardous waste materials.

Other facilities excluded from this policy statement include those that are undertaking a form of thermal treatment to which the technical or resource recovery criteria contained within the statement are not relevant or for which other regulatory frameworks already apply, namely:

- thermal processes where there is no change in the chemical composition of the waste
- transport fuels produced from waste
- autoclaving processes
- biological processes, such as anaerobic digestion and composting of waste.

### *Policy framework*

The definition of waste covers a range of materials that vary in their origin, composition, contamination and risk profile. The EPA recognises that a framework that facilitates a risk-based approach to the recovery of energy from waste will deliver certainty for industry, the community and the environment.

This policy statement establishes a two-tiered framework separating the requirements for low-risk wastes proposed for thermal treatment from all other wastes.

Waste or waste-derived materials that pose a minimal risk of harm to human health and the environment due to their origin, low levels of contaminants and consistency over time will be categorised as **eligible waste fuels** and listed in the policy statement. As information about certain waste and waste-derived streams improves, the EPA will review the eligible waste fuels list from time to time. Further information

[1] As defined in the *Protection of the Environment Operations Act 1997*

regarding the requirements to be met by eligible waste fuels is available in Section 3 of this policy statement.

Facilities proposing to thermally treat any waste or waste-derived materials that are *not* listed as an eligible waste fuel must meet the requirements of an **energy recovery facility**. Further information regarding the requirements for energy recovery facilities is available in Section 4 of this policy statement.

### *Public consultation and the good neighbour principle*

Regardless of whether a facility plans to proceed with a proposal under Section 3 or 4 of this policy statement, it will be essential that proponents provide effective information and public consultation about energy from waste proposals. As proposals progress from the concept to detailed development assessment stage, proponents should engage in a genuine dialogue with the community and ensure that planning consent and other approval authorities are provided with accurate and reliable information.

The operators of an energy from waste facility will need to be 'good neighbours' – particularly if near a residential setting but also where there are workers in other facilities. This would apply to waste deliveries and operating hours, but most importantly with respect to readily available information about emissions and resource recovery outcomes.

## 3. Eligible waste fuels

Eligible waste fuels are those that are considered by the EPA to pose a low risk of harm to human health and the environment due to their origin, composition and consistency.

The following wastes are categorised by the EPA as eligible waste fuels:

1. biomass from agriculture
2. forestry and sawmilling residues
3. uncontaminated wood waste
4. recovered waste oil
5. organic residues from virgin paper pulp activities
6. landfill gas and biogas
7. source-separated green waste (used only in processes to produce char)
8. tyres (used only in approved cement kilns).

The EPA may update the list of eligible waste fuels from time to time.

Eligible waste fuels may be thermally treated using a range of treatment technologies, provided a resource recovery order and exemption has been granted by the EPA. The origin, composition and consistency of these wastes must ensure that emissions from thermal treatment will be known and consistent over time.

Facilities proposing to use eligible waste fuels must meet the following criteria:

- ability to demonstrate to the EPA that the proposed waste consistently meets the definition of an EPA-approved eligible waste fuel
- confirm there are no practical, higher order reuse opportunities for the waste
- fully characterise the waste and/or undertake proof of performance
- meet the relevant emission standards as set out in the Protection of the Environment Operations (Clean Air) Regulation 2010.

> **Note:** Eligible waste fuels that also fall under the definition of a standard fuel as defined in the Protection of the Environment Operations (Clean Air) Regulation 2010 would not need to meet the above criteria but will still require appropriate approval for their use.

Further details, including how to apply for a resource recovery order and exemption for the use of an eligible waste fuel and definitions for each of the listed eligible waste fuels, are provided in the EPA's *Eligible Waste Fuels Guidelines*.

# 4. Energy recovery facilities

Any facility proposing to thermally treat a waste or waste-derived material that is not a listed eligible waste fuel (Section 3) must meet the requirements to be an energy recovery facility. If the facility is proposing to thermally treat a combination of eligible and other waste fuels, it will be subject to the requirements of an energy recovery facility.

Energy recovery facilities refer to facilities that thermally treat waste-derived materials that fall outside of the low-risk 'eligible waste fuels'. These facilities must therefore demonstrate that they will be using current international best practice techniques, particularly with respect to:

- process design and control
- emission control equipment design and control
- emission monitoring with real-time feedback to the controls of the process
- arrangements for the receipt of waste
- management of residues from the energy recovery process.

The above- listed considerations will ensure that air toxics and particulate emissions are below levels that may pose a risk of harm to the community or environment.

Energy recovery facilities must use technologies that are proven, well understood and capable of handling the expected variability and type of waste feedstock. This must be demonstrated through reference to fully operational plants using the same technologies and treating like waste streams in other similar jurisdictions.

In addition to implementing current best practice techniques, energy recovery facilities must ensure that they meet the following technical, thermal efficiency and resource recovery criteria as discussed below.

### *Technical criteria*

The gas resulting from the process should be raised, after the last injection of combustion air, in a controlled and homogenous fashion and even under the most unfavourable conditions to a minimum temperature of 850°C for at least 2 seconds (as measured near the inner wall or at another representative point of the combustion chamber). If a waste has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1100°C for at least 2 seconds after the last injection of air.

The process and air emissions from the facility must satisfy **at a minimum** the requirements of the Group 6 emission standards within the Protection of the Environment Operations (Clean Air) Regulation 2010.[2]

There must be **continuous measurements** of **$NO_x$, CO, particles (total), total organic compounds, HCl, HF** and **$SO_2$**. This data must be made available to the EPA in real-time graphical publication and a weekly summary of continuous monitoring data and compliance with emissions limits published on the internet. The continuous measurement of HF may be omitted if treatment stages for HCl are used which ensure that the emission limit value for HCl is not being exceeded.

[2] Note: An existing facility may apply to the EPA for an alternative $NO_x$ and VOCs emission standard in accordance with clause 36 of the Protection of the Environment Operations (Clean Air) Regulation 2010.

There must be **continuous measurements** of the following operational parameters: **temperature** at a representative point **in the combustion chamber**; concentration of **oxygen**; **pressure** and **temperature in the stack**; and **water vapour** content of the exhaust gas. This must be conducted and held by the proponent for a period of three years.

As part of the environment protection licence conditions of any energy recovery facilities, the EPA will require operators to undertake proof of performance (POP) trials to demonstrate compliance with air emissions standards. Following successful POP trials, there must be **at least two measurements per year of heavy metals**, **polycyclic aromatic hydrocarbons**, and **chlorinated dioxins and furans**. One measurement at least every three months shall be carried out for the first 12 months of operation. If and when appropriate measurement techniques are available, continuous monitoring of these pollutants will be required.

The total organic carbon (TOC) or loss on ignition (LOI) content of the slag and bottom ashes must not be greater than 3% or 5%, respectively, of the dry weight of the material.

Waste feed interlocks are required to prevent waste from being fed to the facility when the required temperature has not been reached either at start-up or during operation.

An air quality impact assessment must be undertaken in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

An energy recovery facility processing wastes other than 'eligible waste fuels' must satisfy all of the above requirements, regardless of whether the facility is an existing or purpose-built facility and the waste input is the sole feedstock or a fuel for co-firing.

### *Thermal efficiency criteria*

This policy statement is restricted in its scope to facilities that are designed to thermally treat waste for the recovery of energy rather than as a means of disposal. The *net* energy produced from thermally treating that waste, including the energy used in applying best practice techniques, must therefore be positive.

To meet the thermal efficiency criteria, facilities must demonstrate that at least 25% of the energy generated from the thermal treatment of the material will be captured as electricity (or an equivalent level of recovery for facilities generating heat alone).

Energy recovery facilities must also demonstrate that any heat generated by the thermal processing of waste is recovered as far as practicable, including use of waste heat for steam or electricity generation or for process heating of combined heat and power schemes.

### *Resource recovery criteria*

The EPA considers energy recovery to be a complementary waste management option for the residual waste produced from material recovery processes or source-separated collection systems.

The policy statement's objectives in setting resource recovery criteria are to:

- promote the source separation of waste where technically and economically achievable
- drive the use of best practice material recovery processes
- ensure only the residual from bona-fide resource recovery operations are eligible for use as a feedstock for an energy recovery facility.

Energy recovery facilities may only receive feedstock from waste processing facilities or collection systems that meet the criteria outlined in Table 1.

Proponents wishing to use waste or waste-derived materials for energy recovery that are not defined in Table 1 must contact the EPA to discuss their proposal. The EPA will consider any such proposals on a case-by-case basis in accordance with the energy from waste considerations outlined in this policy statement and the principles set out in the POEO Act and WaRR Act.

**Table 1: Resource recovery criteria for energy recovery facilities**

| **Mixed wastes** | | |
|---|---|---|
| **Waste stream** | **Processing facility** | **% residual waste allowed for energy recovery** |
| Mixed municipal waste (MSW) | Facility processing mixed MSW waste where a council has separate collection systems for dry recyclables and food and garden waste | No limit by weight of the waste stream received at a processing facility |
| | Facility processing mixed MSW waste where a council has separate collection systems for dry recyclables and garden waste | Up to 40% by weight of the waste stream received at a processing facility |
| | Facility processing mixed MSW waste where a council has a separate collection system for dry recyclables | Up to 25% by weight of the waste stream received at a processing facility |
| Mixed commercial and industrial waste (C&I) | Facility processing mixed C&I waste | Up to 50% by weight of the waste stream received at a processing facility |
| | Facility processing mixed C&I waste where a business has separate collection systems for all relevant waste streams | No limit by weight of the waste stream received at a processing facility |
| Mixed construction and demolition waste (C&D) | Facility processing mixed C&D waste | Up to 25% by weight of the waste stream received at a processing facility |
| **Residuals from source-separated materials** | | |
| Source-separated recyclables from MSW | Facility processing source-separated recyclables from MSW | Up to 10% by weight of the waste stream received at a processing facility |
| Source-separated garden waste | Facility processing garden waste | Up to 5% by weight of the waste stream received at a processing facility |
| Source-separated food waste (or food and garden waste) | Facility processing source-separated food or source-separated food and garden waste | Up to 10% by weight of the waste stream received at a processing facility |

| Separated waste streams | |
|---|---|
| **Waste stream** | **Feedstock able to be used at an energy recovery facility** |
| Waste wood | Residual wood waste sourced directly from a waste generator e.g. manufacturing facility |
| Textiles | Residual textiles sourced directly from a waste generator |
| Waste tyres | End-of-life tyres |
| Biosolids | Used only in a process to produce a char for land application |
| Source-separated food and garden organics | Used only in a process to produce a char for land application |

**Notes**

1. The EPA may give consideration to increases to the maximum allowable percentage of residuals from facilities receiving mixed municipal and commercial and industrial waste where a facility intends to use the biomass component from that process for energy recovery, rather than land application and the facility can demonstrate they are using best available technologies for material recovery of that stream.
2. Waste streams proposed for energy recovery should not contain contaminants such as batteries, light bulbs or other electrical or hazardous wastes.
3. Bio-char or char materials produced from facilities using mixed waste streams will not be able to be considered for land application as a soil amendment or improvement agent.
4. The C&I no limit category is likely to apply only to mixed waste collected from single generators of large volumes of waste (e.g. supermarkets) or precinct based businesses (e.g. shopping centers). Proponents will need to demonstrate that each entity generating waste has effective and operating collection systems for **all** waste streams they generate that have reuse or recycling opportunities (e.g. paper/cardboard collection; organic collection; and residual waste collection). Proponents wishing to use the C&I no limit category will need to contact the EPA to determine the eligibility of each entity.

# Appendix B

## Waste Inspection Procedures

GENESIS XERO WASTE

DIAL A DUMP INDUSTRIES
KEEPING AUSTRALIA CLEAN

ALEXANDRIA LANDFILL
PREMIER WASTE MANAGEMENT FACILITY

# DIAL A DUMP INDUSTRIES

# SPOTTERS TRAINING MANUAL


**This training manual is YOUR guide on the practices to be followed during your daily activities to ensure that BOTH you and your co-worker work in a safe and productive environment.**

# TABLE OF CONTENTS

# *INTRODUCTION*

The area with the Alexandria Landfill and Genesis Waste Management Facility that you will be working in is overall known as the **Recycling Area** and you will be required to perform your duties under one or more divisions of this Area**.** Highlighted below are the Recycling Areas for both these sites.


*Recycling Area – Alexandria Landfill*


*Recycling Area – Genesis, Eastern Creek*

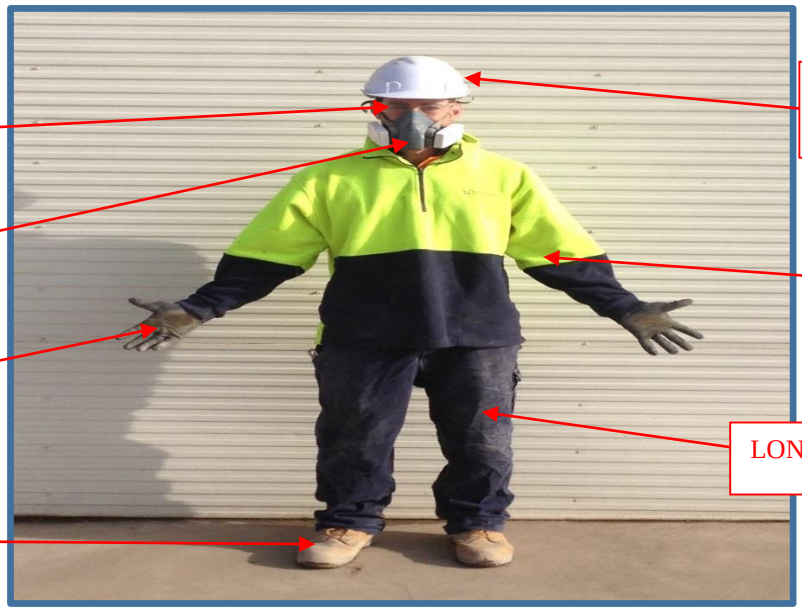
In the Recycling Area mixed building and dry waste is brought in and tipped onto the ground where it is sorted and various materials are recovered for re-use.

# *SAFETY CLOTHING AND PPE*

Dial a Dump Industries is always striving for best practices in safety both in the working environment and to its employees.

**SAFETY IS EVERYONE'S RESPONSIBILITY. IT IS IMPORTANT TO LEAD BY EXAMPLE AND PAY HIGH ATTENTION TO YOUR PERSONAL PROTECTIVE EQUIPMENT (PPE)**

You must ALWAYS wear your PPE correctly.




The following items are necessary for your duties:

- High visibility clothing
- Safety boots
- Hard Hat
- Safety Gloves
- Ear Protection
- Dust Mask
- Eye Protection

- You must wear LONG pants and LONG sleeve shirts for safety.
- Your appearance must be neat, tidy and presentable at all times.
- You must NOT wear tracksuit pants or garments that are ripped or unpresentable.

## *OPERATING A TWO WAY RADIO*

In this role you will be required to operate a two way radio as it is used to communicate with the weighbridge and other staff on site. This is a very important means of communication and needs to be taken care of at all times.

You will be issued with a 2-way radio on the commencement of your role and will be responsible for its daily working and charging and also for reporting any damages, loss or malfunction.

There are different internal frequencies used on both sites which are mentioned as below:

**Genesis, Eastern Creek**:

Channel 1 – Landfill and Weighbridge

Channel 2 – MPC Floor operations and Crushing Area

Channel 3 – MPC Production and Maintenance

**Alexandria Landfill:**

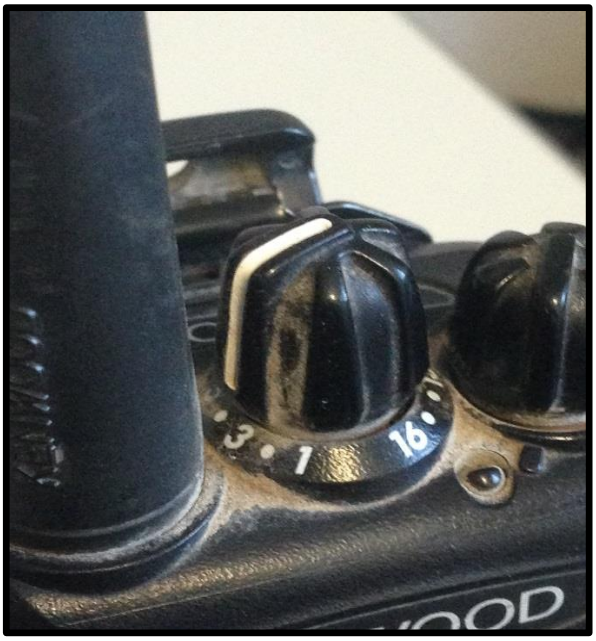
Channel 1 – Dial A Dump Industries Bin Trucks

Channel 2 – Crushing and additional projects

Channel 3 – Weighbridge and rest of site

Below are a couple of photos showing a 2-way radio similar to the one that will be issued to you.


2-way Radio

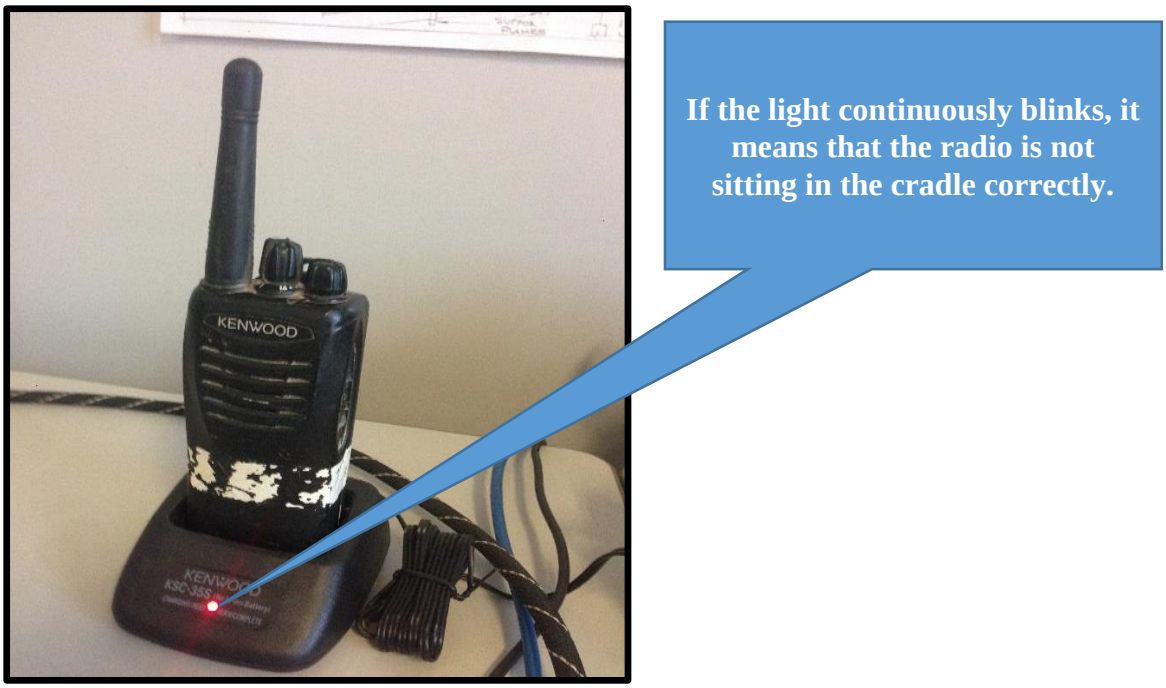



Radio showing different channels

You will receive some basic training on how to use the radio from your supervisor. A summary of your daily use is provided below:

- Turn on radio
- Select channel required.
- To set squelch turn knob until crackling sound stops

- When you want to call another person hold call button down and hold radio approximately 15cms from your mouth and speak clearly, hold the button for 2 seconds after you have finished speaking
- You do not need to yell at radio when speaking.
- When you have finished what you have to say, end your conversation by saying "OVER".
- If someone is speaking to you and you need acknowledge their instructions use the same procedure only that you will say "ROGER THAT" when they have finished speaking.
- Make sure 2way is kept in your possession at all times
- At the end of shift make sure you put it on charge. A red light on the charger indicates that the radio is being charged and a green light indicates that the radio is fully charged.



It is important to remember that basic radio etiquettes are expected to be observed at all times. Dial A Dump Industries has a zero tolerance for the use of any offensive language, gestures or behaviour at any of its sites and offenders will be dealt with accordingly.

## *THE CHECKPOINT/ SPOTTER STATION*

Once the vehicles clear the Provisional Inspections at the Weighbridge and enter the site, their entrance to the Recycling Area is via the Checkpoint or Spotter Station. This is where your role as a Spotter will commence.

*Checkpoint at Alexandria Landfill*

*Spotter Station 1 at Genesis, EC*

YOUR ROLE AS A SPOTTER INCLUDES BUT IS NOT LIMITED TO:

- Ensuring that the Waste is acceptable to be tipped and subsequently processed in the Recycling Area.
- Make sure the safe delivery of loads to the appropriate tip face or stockpiles based on the type and composition of the load.
- Make sure that recycled materials do not get contaminated with unsuitable materials such as paint, chemicals or asbestos.
- Sort and recover the various materials for reuse.

Your role also includes directing traffic as per the Site Traffic Management Plans to ensure the safety of all the customers and staff members on site. You can contact your Supervisor for details on the site traffic management plans or view them in Appendix III of this document.

As a major point of contact for the vehicles on site, your work, presentation and behaviour are very important in the smooth running of the Recycling Area and in ensuring safe and efficient practices.

# *SPOTTER'S ROLES AND RESPONSIBILITIES*

## 1. STOPPING THE VEHICLE IN THE RIGHT LOCATION

The Checkpoint or Spotter Station is a very important point of contact with the Customer. Every single vehicle, including the Dial A Dump trucks will need to be stopped and have a Primary Inspection conducted on their loads.

To ensure this inspection is carried out smoothly and safely, ensure you are physically present at the entrance or beginning of the Checkpoint with a STOP sign and signal the vehicle to stop.

Make sure you are aware of ALL MOVING VEHICLES and mobile equipment around the area while stopping the Customer vehicles.

You must signal to the approaching vehicle to slowly stop at the Checkpoint by raising your hand forward or motioning the vehicle to slow down and stop near the appropriate viewing deck.

Keep in mind that approaching vehicles can vary from domestic cars and trailers to utility vehicles, skip trucks and heavy haulage trucks so always be aware of your surroundings.

## 2. CHECK THE DOCKET

Your first step in the Primary Inspection stage is to greet the Customer and check his docket provided by the Weighbridge.


This step is required for 3 main purposes:

- It serves as a documented proof that the Customer has commenced a legitimate transaction with the company and has not bypassed the

Weighbridge. If you receive a customer that does not have a docket, contact the Weighbridge immediately.

- The docket also reveals what is the type of material the customer has indicated that he is bringing in. Verifying this is very important as different materials have different prices so it is your duty to ensure the Customer pays for exactly what he is bringing in.
- Lastly, once you have verified the above 2 steps, the type of material on the docket will help you guide the Customer to the right tipping location on site or within the Recycling Area.

Having said that, there will be occasions when majority of the load will be as per the docket and generally acceptable within the Recycling Area but it may contain traces or small evidence of certain hazardous or putrescible material which can result in the load being classified as an Unacceptable Load.

Identification of such material not only ensures the site safety and the safety of its employees and customers, but also ensures our compliance with the site licenses. This makes the following step of the Primary Inspections a very crucial step.

## 3. PRIMARY INSPECTIONS

Primary inspections are extremely important and are your first opportunity to spot and prevent any Hazardous or Putrescible Waste entering the Recycling Area. This involves a basic but thorough visual

inspection of the load in as much detail as possible before the load gets tipped.

Thus, it is very important you request the driver to uncover the load by removing the tarp and have a good look, feel and smell of the incoming loads.



In case the Customer's vehicle is larger, you may be required to use the viewing deck to conduct the Primary Inspection as shown below:


However, it is equally important that these inspections are done safely so please remember and abide by the below:

i) You have to always be wearing the appropriate Personal Protective Equipment (PPE) while carrying out the inspections.
ii) You are never to climb on top of loads or into bins to conduct the inspections.
iii) Always be aware of moving machineries or mobile equipment around you while carrying out the inspections.

Before we move any further, let us now understand the various types of unacceptable materials that you might come across during the Primary Inspections and their corresponding action plans.

## 4. UNACCEPTABLE MATERIAL

Below are the details regarding the unacceptable materials and the respective protocols following their identification:

- *Food waste*

No food scraps, food bags, garbage bags or household rubbish containing food scraps should be accepted.




Sometimes loads can be scattered with hidden food waste in them as shown below.

There can be quite heavy penalties applicable to the site if found accepting food waste. Thus it is very important to follow the below mentioned steps:

- In case you find a load scattered with food waste, it needs to be rejected. Inform the Weighbridge immediately over the 2-way radio and provide photographs of the load and the vehicle via email.
- In case you find 1 or more sealed food waste bags in an otherwise acceptable load, there are 2 options. The load can either be completely rejected, sent back to the Weighbridge or the customer can tip the acceptable load and take the sealed food waste bags with him. In case of the latter, conduct a thorough inspection of the tipped load to ensure there are no traces of food waste in the load.
- If you do find a small amount of food waste in the load and are unsure of whether the load is acceptable or not, do not allow the load to be tipped and request for assistance from your Supervisor.

### *Hazardous material*

Hazardous waste normally comprises of any unidentified liquids, any soil or sand with paint mixed in it, oil or any type of fuel.

Examples of such waste include Paint containers, spray paint, fuel cans, oil containers, acids and explosives.

A good way to identify hazardous waste is to look for relative signage on the containers.




If such materials are scattered or spilled throughout the load, the load must be rejected, inform the Weighbridge via the 2-way radio and send photographs via email.

If there are only a few cans which can be hand-picked and have not affected or contaminated the rest of the load, the customer must remove the items from the load and take them off site.

In case you are unsure of the load, contact your Supervisor immediately.

In certain extreme cases, Hazardous materials may also cause you to feel ill, dizzy or experience any other feeling that is not normal. These may include funny smells, stinging in the eyes or a burning sensation on the skin.

In such an event, leave the area immediately, ask for the customer to leave the area as well and contact your Supervisor immediately.

## *Asbestos Containing Materials (ACM)*

Dial a Dump Industries notifies all its customers that "**NO ASBESTOS IS ACCEPTED IN THE RECYCLING FACILITY"**. This makes the timely identification and handling of all Asbestos Containing Materials (ACM) extremely important not only from a compliance perspective, but also from a health and safety point of view for everyone on site.

Please ensure you request your supervisor to provide you with a copy of the Dial A Dump Industries Asbestos Management Plan to better understand the affects Asbestos Containing Materials can have an individual's health if it is not carefully identified and removed in time.

Hence from an identification and removal point of view, it is very important that every new load that enters the Recycling Area is tipped as a physically separate load from the processing stockpiles that have already been previously inspected and cleared as shown below.

The Asbestos Handling protocol consists of 3 scenarios, each of which are outlined below along with their corresponding action plans:

<u>Scenario 1:</u> Asbestos or ACM is spotted during the Primary Inspection from the Spotter Station or just before the load is tipped.

**Action Plans:**

1) YOU MUST INFORM YOUR SUPERVISOR IMMEDIATELY
2) It is imperative that you or any other staff member DO NOT HANDLE ASBESTOS OR ASBESTOS CONTAINING MATERIALS (ACM) WITHOUT PERSONAL PROTECTIVE EQUIPMENT which includes gloves, safety glasses and a P3 grade dust filtration mask or equivalent breathing apparatus.

3) Once the material has been determined as Asbestos or ACM, the load immediately classifies as a "Rejected Load". Write the term 'Rejected Load' on the docket, sign it and take photos of the load, the ACM, truck registration and the Docket.
4) Notify the Weighbridge of the Rejected Load immediately, send the photos to the Weighbridge via email and redirect the truck with his signed docket back to the Weighbridge.

**Scenario 2:** Asbestos or ACM is spotted during the Secondary Inspection (details of which are provided on page 22 of this document) once the load has been tipped and the vehicle has not left the tipping area.

**Action Plans:**

1) Ensure you do not sign the docket and that the truck/ vehicle does not leave the tipping area.
2) YOU MUST INFORM YOUR SUPERVISOR IMMEDIATELY.
3) It is imperative that you or any other staff member DO NOT HANDLE ASBESTOS OR ACM WITHOUT PERSONAL PROTECTIVE EQUIPMENT which includes gloves, safety glasses and a P3 grade dust filtration mask or equivalent breathing apparatus.
4) Once the material has been determined as Asbestos or ACM, the load immediately classifies as a "Rejected Load" and it will be required to be reloaded. You must **first isolate the load** using barriers or

witches' hats as shown below and mark the load as contaminated.

5) Once the load is isolated, contact the relevant operator to carry out the reload.
6) Write the term 'Rejected Load' on the docket, indicate the additional reload fee on the docket that needs to be charged, sign it and **BEFORE the reloading commences** take photos of the load, the ACM, truck registration and the Docket.
7) Notify the Weighbridge of the Rejected Load immediately, send the photos to the Weighbridge via email and redirect the truck with his signed docket back to the Weighbridge.

<u>Scenario 3:</u> Asbestos or ACM is spotted in the stockpile once the vehicle has left the site and load has been pushed up.

**Action Plans:**

1) YOU MUST INFORM YOUR SUPERVISOR IMMEDIATELY.
2) It is imperative that you or any other staff member DO NOT HANDLE ASBESTOS OR ACM WITHOUT PERSONAL PROTECTIVE EQUIPMENT which includes gloves, safety glasses and a P3 grade dust filtration mask or equivalent breathing apparatus.
3) Isolate the area immediately and communicate any available or known information regarding the load to the Weighbridge regarding the Customer name, Vehicle Registration, type of truck, time of tipping, etc. DO NOT assume or guess any information and only provide the information you are certain of.
4) You will need to ensure that no more loads are pushed up on top or in front of the contaminated area and you **<u>MUST</u> follow the Asbestos handling protocol mentioned in the "Designated Clean Area" section mentioned in the Asbestos Protocol Training Manual for Dial A Dump Industries.**


**Fully covered hook bins can be used to store ACM in the Designed Clean Areas**

5) Ensure photos are taken and a record of the actions taken are filed in the relevant Spotter Stations or at Checkpoint.

For further details on Asbestos and the Company's policies regarding Asbestos, please refer to the DADI Asbestos Management Plan, Feb 2014.

**All Spotters must read and adhere to the EHS – Work Instruction Landfill Spotters – Asbestos Identification and Handling and the Asbestos Protocol Training Manual for Dial A Dump Industries.**

## 5. NOTIFIABLE ITEMS

There are certain types of waste which are acceptable to be received into the Recycling Area but involve additional costs to handle. These items can be tipped by Customers by paying an additional charge at the Weighbridge on their way out.

It is therefore important that you identify these items that can be brought in with a typical load.


**Single and Double Mattresses (Each)**


**Car and/or Truck tyres (Each)**

Insulation (By m3)

Carpet Rolls (per roll)

Fibro Sheeting (By m3)

Car Batteries (Each)

Rubber Conveyors or piping

Fire Extinguishers

Tree stumps

Gas Bottles

Oversize Concrete

Rubbish in load (Crushing only)

In case you identify any of the above items in a load, you must:

- <u>Inform the Customer</u> of the presence of the particular item in the load and the fact that it will carry an additional charge.
- Do not let the customer unload or tip the items if they do not accept the additional charge.
- You will need to inform the Weighbridge of the material and quantity of the Additional Charge over the 2-way radio and email the photographs through.

- If you are unsure about any procedures, charges or materials contact your Supervisor.

## 6. RAW STOCKPILE MATERIALS

Raw stockpile materials are those materials that need not be tipped along with General Rubbish as they might be clean and can be processed at much lower costs.

Proper identification, classification and direction can not only help us ensure the quality of our stockpiles is maintained but can also result in a significant reduction in Operational Expenses.

On inspection of certain loads, you might find that the load is devoid of any general rubbish and is similar to the Raw Stockpile Materials as shown below:

**Concrete**


**Brick**

## Sand


## Green waste


## Clean Hard


## GSW-R

## Timber


## Timber Yard

Should you do determine that the incoming load is clean enough to be sent to one of the Raw Stockpiles, please ensure:

- Confirm with your Supervisor if you have any doubts regarding the integrity or classification of the material
- Walk or drive the Customer to the correct stockpile for unloading. If there is another spotter in one of the designated areas, such as Spotter Station 2 at Genesis, Eastern Creek then ensure you inform the Spotter over the 2-way radio of the incoming vehicle.
- Inform your Supervisor in case you have to leave the Spotter Station or Checkpoint to direct the Customer.
- A spotter will need to remain with the customer while the load is being tipped.
- Carry out a thorough Secondary Inspection on the load for any contaminations or general rubbish.
- You must inform the Weighbridge of any changes to the classification of the material, write it on the docket and email the photos through. For example change from Brick to General Waste or change from General Waste to Timber.
- In the Crushing Area there is often some confusion regarding the changing of Brick loads to General Rubbish or Rubbish in Load.
- As a rule of thumb, any skip bin that comes to the Crushing Area with a load classified as clean brick and has even a little amount of rubbish in it will be classified as a General Rubbish Load.
- For any larger loads such as hook bins or truck and dogs, classify the loads as General Rubbish only if it would take more than 10 minutes

to pick the load clean. Otherwise, contact the Weighbridge and mark the dock as Rubbish in Load.

## 7. SECONDARY INSPECTIONS

Secondary Inspections are carried out once the vehicle has cleared the Provisional Inspection at the Weighbridge and the Primary Inspection at the Spotter Station or Checkpoint.

These inspections have to be detailed and very thorough and are to be carried out once the load has been tipped and spread out for inspection in the Recycling Area.

For the safety of all staff personnel and Customers, please ensure the following precautions are taken while the load is being tipped:

- All Customers along with the employees need to wear their Personal Protective Equipment which includes but is not limited to their hard hats, steel-toe boots and high-visibility vests.
- All customers and employees are clear and a safe distance from where the load is being tipped.
- All mobile equipment and machineries are clear from the tipping area.

Once the load has been safely tipped in the appropriate area, the load will need to be spread out for the Secondary Inspection. Contact the appropriate operator to spread the load out via the 2-way radio.

Inspect the load thoroughly for any contaminations, unacceptable material and additional charges.

In case you find any unacceptable materials or additional charge items in the load, you will need to follow the protocols mentioned above based on the appropriate material and redirect the vehicle back to the Weighbridge.

Always remember that the Customers should not be allowed to leave the Recycling Area until the Secondary Inspection of their load is satisfactory. The Customers are obligated to return their docket, signed by you, back to the Weighbridge once they have tipped so the transaction can be finalised. Do not sign or hand over the Customers their dockets until you have thoroughly completed the Secondary Inspection.

## 8. UNLOADING VEHICLES IN THE HAND UNLOAD AREA

The Hand Unload Area is a specific area designed for smaller vehicles, Utes, cars, etc. to unload their waste by hand rather than it being tipped.

This ensures that such smaller vehicles have a safer and easier tipping area which helps them avoid high traffic areas where mostly larger trucks and heavy mobile equipment are in operation.

When directing a vehicle to the Hand Unload Area, it is very important that you stay with the vehicle whilst it is unloading and not leave it unattended. This ensures the safety of the Customers and prevents them from wandering anywhere away from the safety of the Hand Unload Area and enable you to spot the load while it is being unloaded.

## 9. MAINTAINING YOUR CONDUCT

Although not too frequent, but there is always the possibility of an occasional dispute with the customer, ranging from bringing in hazardous material to deductions in the load.

As a representative of Dial A Dump Industries, it is important you always remember to maintain a good conduct and follow the necessary protocol.

In case a customer gets angry, argumentative or abusive with you or any other colleague or even another customer, ensure you speak to them in a professional and decent manner and try to calm them down.

If necessary, explain it to them that you would need assistance in making a final decision regarding the matter or dealing with the situation better and immediately request the aid of your Supervisor or Manager.

## 10. HAND SORTING DUTIES

Hand sorting is a very important part of the overall sorting operations and needs to be conducted diligently.
However, before you commence any hand sorting activities, please ensure the following:

- You must be wearing the appropriate PPE which includes Steel-toe boots, picking gloves, hard hat, safety glasses, dust masks, high visibility full sleeves shirt or vest and long pants.
- Ensure you alert all operators on mobile equipment or heavy machinery around you of your intentions to commence the hand sorting.
- You are not to climb over stockpiles to hand sort any loads. Request the operators to spread the load out for you before you enter the area.
- Ensure that the area where you are hand sorting is closed off by the use of witches' hats while the hand sorting is in progress.

- Ensure that you have the appropriate bins into which you will be placing the sorted material close by.
- Do not attempt to lift, drag or pull and weights over 20kgs. It may result in unnecessary and avoidable injuries or strains.
- DO NOT stick your hand in unclear loads WITHOUT GLOVES or EYE MASKS.
- Be aware of potential hazards such as needle sticks, broken glass and sharp objects.
- DO NOT stick hands in to containers or suspicious loads.

Below is a list of materials that can be extracted from a load efficiently using hand sorting:

Copper

Alloys

Aluminium

Reo missed by magnet grab

Wire Cables

Gas Bottles

Fire Extinguishers

Stainless Steel

Cardboard

Polystyrene

Hard Plastics

Clear Plastics

- ✓ The hand sorting process needs to be performed in an organised manner. Each material that is pulled out needs to be placed in it respective marked location or bin.
- ✓ If you are unsure of where a particular item is to be placed, contact your supervisor.
- ✓ Take extreme precaution when dealing with hazardous items such as fire extinguishers, gas bottles and batteries. Ensure that they are never left or in or anywhere near the path of heavy machineries.

- ✓ The hand sorting responsibilities can vary between sites and between spotter stations. Please ensure you receive clear and precise instructions from your supervisor regarding the same.

## 11. MACHINERIES AND SAFETY

The types of machinery that you will be working around will include, but not be limited to the following:

### Magnet Excavator


### Fuchs Grab

### Front End Loader


### Mobile Screens

Forklifts

Bobcat

Working around such machinery can be challenging if the correct protocol is not followed. To ensure everyone's safety, please ensure the following:

- You are not to use or try to use any of the machines without the appropriate ticket(s) and prior consent from your Supervisor.
- Ensure you and everyone around you is dressed in the appropriate PPE especially high visibility vest/clothing and hard hat.
- DO NOT cross the path of an operating machinery or stand behind an operating machinery.
- Be aware at all times the operation and location of Machine and equipment in the Recycling Area.
- Always use 2-way radio communication when working around such machinery.

## 12. General Maintenance and House Keeping duties

Dial A Dump Industries is proud to own and operate 2 of the finest state of the art Waste Management and Recycling Facilities in Sydney. As a representative of Dial A Dump Industries, you are expected to maintain

the same standards in the eyes of the customers coming into the site by paying attention to the general house-keeping around the Spotter Stations and Checkpoint.


By ensuring that your area is always clean and tidy, you will help provide a safe and healthy work environment for everyone invloved.

## FIRST AID

The **closest** first aid stations at Alexandria Landfill are at the Site Office building.

The closest first aid station at Genesis, Eastern Creek is located in Spotter Station 1 and Spotter Station 2.


Spotter Station 1

Site Office at Alexandria

For a full list of First aid supplies and a list of all Safety Officers on site, contact your Supervisor.

In the event that you, any other employee or a customer is injured during any activity on site, you are expected to follow the below mentioned protocol:

- Check for Danger and assess the situation to ensure there is no danger to the person attending the injured person. Dangers could include Fire, Traffic, Gas, etc.

- Contact a First Aid Officer to assess the injury.

- Contact your Supervisor immediately.

- For any serious Injuries – call the emergency number **"000".**

**The Site Address for Alexandria Landfill is: 10 – 16 Albert Street, St Peters NSW 2015. The nearest cross street is Campbell Rd.**

**The site address for Genesis, Eastern creek is: End of Honeycomb drive, off Wonderland Drive, Eastern Creek NSW 2766.**

Once the injured person has been attended to and is in a safe and stable condition, you will be required to fill out an injury report. These forms are located in the First Aid tool boxes in the site office, Spotters Station and Checkpoint.

In the event that your Supervisor is unavailable at the time of the injury, the list of emergency contacts is listed below:

- ✓ **Rodney Johnson – 0408 919 562**
- ✓ **Ronan Dunlea – 0429 293 909**
- ✓ **Joi Feiertag – 0428 888 519**
- ✓ **Chris Biggs – 0438 902 021**

* *Serious Injury* includes back or head injuries, sprained or suspected broken bones and serious lacerations.

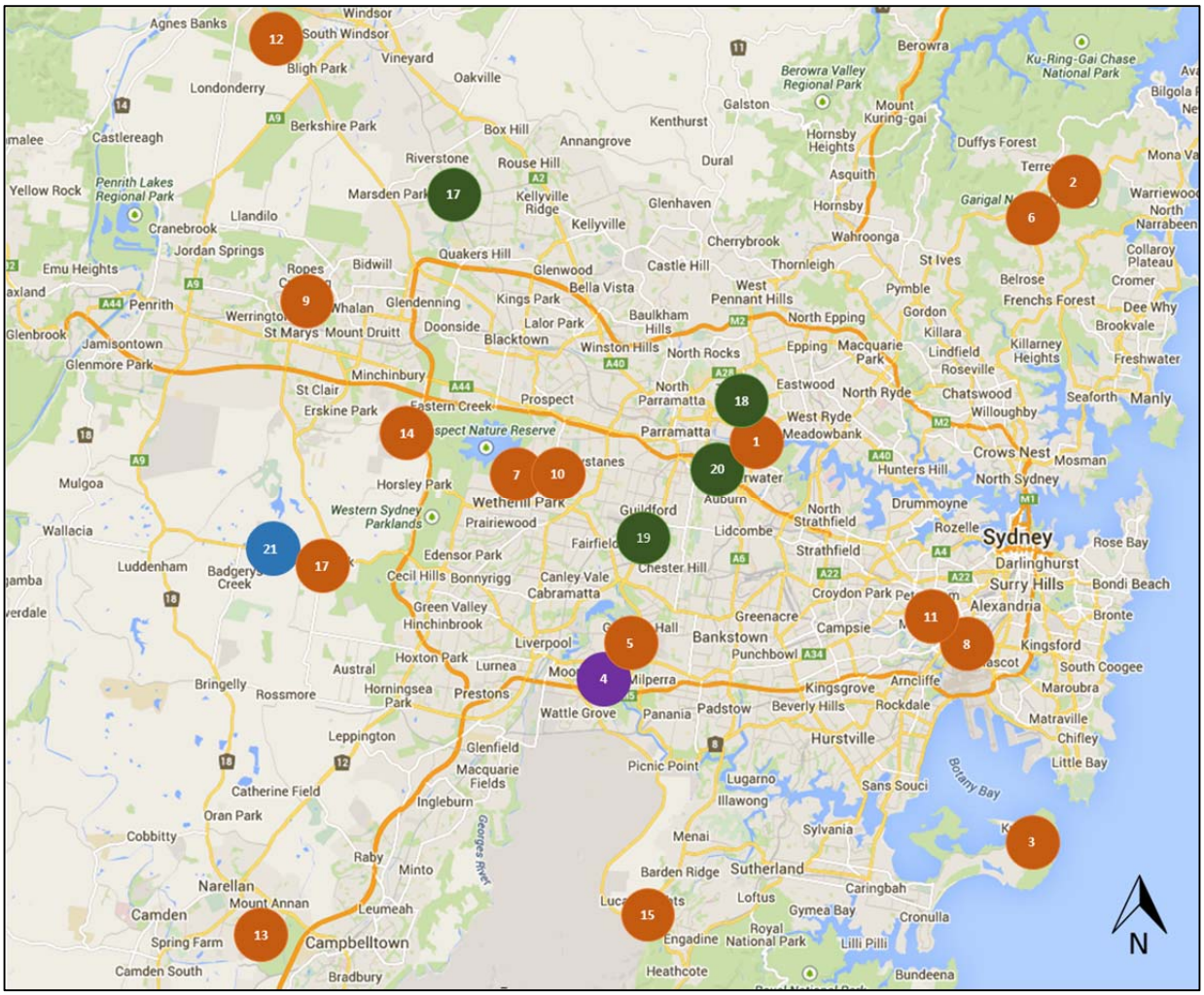
* *Minor Injury* includes minor cuts, abrasions, bumps, knocks and eye irritations.

# Appendix C

## Resource Recovery Facility Summary

# Resource Recovery Facility Summary

| | Facility | Type | Operation |
|---|---|---|---|
| **1** | Concrete Recyclers Camellia | C&D | Existing facility |
| **2** | Concrete Recyclers Kimbriki | C&D | Existing facility |
| **3** | Concrete Recyclers Kurnell | C&D | Existing facility |
| **4** | Concrete Recyclers Moorebank | C&D | Proposed facility |
| **5** | Benedicts | C&D | Existing facility |
| **6** | Benedicts | C&D | Existing facility |
| **7** | Boral | C&D | Existing facility |
| **8** | Boral | C&D | Existing facility |
| **9** | Hi Quality | C&D | Existing facility |
| **10** | Fairfield City Council (Sustainable Resource Centre) | C&D | Existing facility |
| **11** | Metropolitan Demolitions and Recycling | C&D | Existing facility |
| **12** | Rock and Dirt Recycling | C&D | Existing facility |
| **13** | Sita Spring Farm | C&D | Existing facility |
| **14** | Sita Eastern Creek | C&D | Existing facility |
| **15** | Sita Lucas Heights | C&D | Existing facility |
| **16** | Brandon | C&D | Existing facility |
| **17** | North West Recycling Centre | C&I | Existing facility |
| **18** | Polytrade Rydalmere | C&I | Existing facility |
| **19** | Doyle Bros | C&I | Existing facility |
| **20** | Bingo Group | C&I &C&D | Proposed facility |
| **21** | SAWT Facility | MSW | Existing facility |
| **22** | Veolia WASP Facility | MSW & C&I | Proposed facility |
| **23** | Sita Central Coast | C&I | Existing facility |
| **24** | Sita Resource Recovery Raymond Terrace | MSW & C&I | Existing facility |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Agnes Banks
Windsor
South Windsor
Bligh Park
Vineyard
Oakville
Londonderry
Berkshire Park
Box Hill
Annangrove
Kenthurst
Galston
Berowra
Berowra Valley Regional Park
Ku-Ring-Gai Chase National Park
Mount Kuring-gai
Hornsby Heights
Duffys Forest
Castlereagh
Riverstone
Rouse Hill
Dural
Asquith
Hornsby
Yellow Rock
Penrith Lakes Regional Park
Marsden Park
Kellyville Ridge
Glenhaven
Kellyville
Cherrybrook
Wahroonga
Warriewood
North Narrabeen
Collaroy Plateau
Cranebrook
Llandilo
Jordan Springs
Quakers Hill
Castle Hill
Thornleigh
St Ives
Belrose
Cromer
Emu Heights
Penrith
Ropes Crossing
Bidwill
Glenwood
Bella Vista
West Pennant Hills
Pymble
Frenchs Forest
Dee Why
Werrington
St Marys
Mount Druitt
Whalan
Glendenning
Kings Park
Doonside
Lalor Park
Blacktown
Baulkham Hills
North Epping
Gordon
Killara
Brookvale
Glenbrook
Jamisontown
Glenmore Park
Winston Hills
North Rocks
Epping
Macquarie Park
Lindfield
Roseville
Killarney Heights
Freshwater
Minchinbury
St Clair
Eastern Creek
Prospect
North Parramatta
Eastwood
North Ryde
Chatswood
Willoughby
Seaforth
Manly
Erskine Park
Parramatta
West Ryde
Meadowbank
Crows Nest
Mosman
Hunters Hill
North Sydney
Mulgoa
Horsley Park
Wetherill Park
Auburn
Drummoyne
Western Sydney Parklands
Prairiewood
Guildford
North Strathfield
Rozelle
Sydney
Wallacia
Lidcombe
Strathfield
Rose Bay
Luddenham
Badgerys Creek
Edensor Park
Cecil Hills
Bonnyrigg
Canley Vale
Cabramatta
Fairfield
Chester Hill
Darlinghurst
Surry Hills
Bondi Beach
Croydon Park
Alexandria
Bronte
Green Valley
Hinchinbrook
Greenacre
Campsie
Liverpool
Hall
Bankstown
Punchbowl
Kingsford
South Coogee
Hoxton Park
Lurnea
Milperra
Kingsgrove
Arncliffe
Maroubra
Austral
Bringelly
Rossmore
Horningsea Park
Prestons
Wattle Grove
Panania
Padstow
Beverly Hills
Rockdale
Matraville
Leppington
Hurstville
Chifley
Little Bay
Glenfield
Macquarie Fields
Picnic Point
Lugarno
Botany Bay
Catherine Field
Ingleburn
Illawong
Sans Souci
Oran Park
Cobbitty
Georges River
Sylvania
Menai
Raby
Minto
Barden Ridge
Sutherland
Caringbah
Narellan
Mount Annan
Camden
Leumeah
Loftus
Gymea Bay
Cronulla
Spring Farm
Campbelltown
Engadine
Royal National Park
Lilli Pilli
Camden South
Bradbury
Heathcote
Bundeena

# Appendix D

## Chute Residual Waste Audit Data

| Waste Type | % |
|---|---|
| **Timbers: (58.1%)** | |
| Particle board & MDF | 17.3% |
| Softwood | 13.0% |
| Builders Formwork & Plywood | 12.9% |
| Hardwood | 8.4% |
| Treated timber | 6.5% |
| **Organics: (8.3%)** | |
| Greenwaste, leaf, grass & branches | 8.3% |
| **Cardboard: (4.3%)** | |
| Paper / Cardboard | 4.3% |
| **Plastics: (10.2%)** | |
| Hard plastics (PVC) | 6.5% |
| Plastic Film coloured | 2.7% |
| Plastic Film clear | 1.0% |
| **Textiles: (10.3%)** | |
| Clothing, shoes, rags Leather | 3.0% |
| Carpet & Carpet underlay | 2.3% |
| Other Polystyrene, Insulation, hardiflex fibro | 5.0% |
| **Metals: (1.8%)** | |
| Non-ferrous Metals | 1.4% |
| Ferrous Metals and | 0.4% |
| **Low CV: (6.9%)** | |
| Gyprock | 2.4% |
| Fines / Grit / Aggregate | *4.5% |
| | |
| **Total** | 100% |

# Appendix E

## Distributed Control System

| Rev | Author (Initials Date, Signature) | Reviewer (Initials Date, Signature) | Approver (Initials Date, Signature) | Short description of change |
|---|---|---|---|---|
| **5.0** | | | | |
| **4.0** | | | | |
| **3.0** | | | | |
| **2.0** | | | | |
| **1.0** | | | | |
| **0.0** | Waha 07.01.2015 | Eic 07.01.2015 | | First draft |

# Technical Specification

| Project Nr | Project Name | Client | DocType | Supplier | HZI Document Nr - Rev |
|---|---|---|---|---|---|
| **YE-3267** | **Eastern Creek** | **DADI** | **AOF** | **HZI** | |


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# Table of contents

# 18 Distributed Control system (DCS)

## 18AAA1 DCS Description

The Distributed Control System (DCS) is an automation system for all functions – process, machine, drive and quality controls. It also covers information management and mechanical and field device condition monitoring. The system architecture saves on both costs and effort, at the same time ensuring open growth for your future challenges.

The DCS is used to operate the plant and ensures the safety of personnel and equipment.

The reliability is secured by using industrial components, an advanced spare part concept, redundancy and a stable network structure.

Security is essential in a real time production environment. Critical production automation demands high-standard and high-quality solutions. The layered security approach ensures that the needed security is provided at all levels.

This solution consists of the configuration, hardening and patching for all active components. The network design follows secure network architecture principles containing a firewall between DCS and the office networks with a demilitarised zone. Remote connections can be realised by SCS (Secure Connection Solution) with secured access through authorisation, authentication and accounting.

High availability of the processes is a key success factor at every production unit. Availability and cost-effectiveness of production processes can be remarkably improved by automation and related predictive, preventive and corrective maintenance services. High quality and focused services provide solid base for improving process performance solutions.

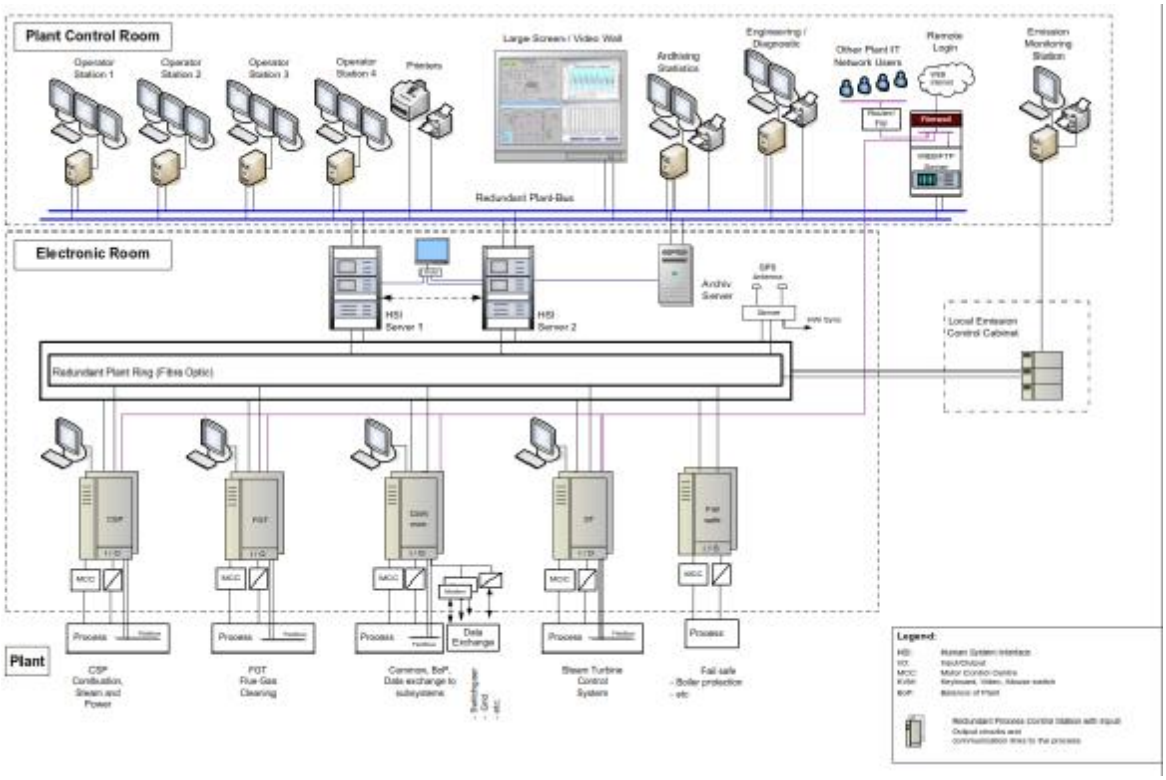
### Redundancy concept of DCS

The following equipment is designed redundant:

- Operator Level
- Server stations
- Process stations
- System network (redundant Ethernet network)
- Bus systems to Remote I/O stations
- Communication to HV system
- Link to Turbine package unit

## Typical and general DCS architecture

[will be adapted to reflect 4 incineration lines]




### The DCS consists of the following levels:

- Plant level: Process equipment, sensors, actuators, probes and analysis devices
- Automation level: Process control, automated devices and autonomous systems, safety systems (SIL = Safety Integrated Level)
- Process control level: Monitoring and controlling of process, data acquisition, programming tools
- Plant control level: Management, maintenance and supervision
- Interface to management systems and the office network.
- Interface for remote access eq.
    - o CEMS (Continuous Emission Measuring System)
    - o Remote maintenance
    - o Data and trends
    - o Etc.

### *Plant level*

The plant level consists of the following equipment and functions:

- Actuators (motors, valves etc.)
- Sensors, instruments and probes (level, flow, pressure, temperature, metering) which perform all monitoring of the process and of the system (control, supervision, safety etc.)
- Specific analysis devices
- Local wiring boxes for analogue, pulse or digital signals

- Control housings equipped with their accessories (switches, buttons, emergency PBs, safety switches), motors and electrical consumers (valves, solenoid valves)
- Cables for the control and information equipment to the remote I/O boxes
- Cables of all field devices

***Automation level***

The automation level consists of the following elements and functions:

- Equipment (automatic circuit breakers, contactors) that directly perform data processing, control and monitoring of the processes
- Controllers and elements of the safety system (SIL certificated)
- Integration cabinets, modular terminal strips, transmitters for the process
- The cabling from the local wiring boxes to the processing equipment
- Communications with the process control level

***Operating level***

The process control level consists of the following elements and functions:

- The user interface, access and control of the process and monitor the status alarm, event and colour printers
- The engineering system and software maintenance for client-server solutions
- Short time data storage for process management
- Video system for process
- Control room equipment

***Plant control level***

The plant control level consists of the following elements and functions:

- Hardware and software for long term data supervision, analysis and storage
- Weighing system for incoming waste
- Archiving (long time storage, historical data storage)
- Backup system
- Remote access (e.g. CEMS, remote service, etc.) protected by firewall
- Diagnostic and reports

***System Networks***

The System *Network* is built using redundant Ethernet.

***Office network***

The office network is separated from the system network with a firewall.

***Redundant process net***

| | |
|---|---|
| • Physical media | Twisted pair / fibre Ethernet |
| • Nodes / network | No practical limit |
| • Total length | No practical limit |
| • Protocol | Industrial switched Ethernet |
| • Data rate | Up to 1 Gbit/s, typically 100 Mbit/s |
| • Communication interval | Typically 0.1 … 1 s, fastest 0.01 s |

### *Fieldbus Network*

The system includes I/O fieldbus, PROFIBUS DP/PA, AS -Interface bus and Foundation Fieldbus HSE/H1 solutions.

### *Process Control Level (User Interfaces)*

This level includes the real time **H**uman **M**achine **I**nterface (HMI) = Operator stations for the operation, monitoring and visualisation of the process in all sections of the plant, e.g. waste treatment, incineration, flue gas treatment and common plant equipment. These functions are generally known as HMI.

The HMI provides the user with all the facilities and functions which are needed for the monitoring and control of the process.

Users of the HMI are:

- Operators for daily online-operation of the plant
- Process-Engineers for process analysis and parameter adjustment
- Maintenance staff for maintenance tasks

### *Description of the Operator Stations*

The communication on the plant control level is organised as a client-server-structure. Due to that, the system can be easily extended.

The plant network will be linked with the process network. This ensures that data storage, information and plant management incl. archiving can be performed with existing equipment. The process equipment database and printers may be shared.

The administrative network will be linked with the process network via router and a firewall.

The different process sections of the plant are displayed on the screen.

Each display consists of static and dynamic portions; both parts combined reflect the status of the process. To simplify the work of the operator on the monitor the plant is split up in process sections, whereby each section represents a certain technological unit.

Besides the above mentioned views of the plant the HMI provides additional pictures, e.g. trending and starting with preconditions and their status.

The HMI is installed in the central control room of the plant. All printers are shared from all stations.

For a high availability the HMI is built up dual (redundant system with two servers) which operate in parallel.

All modifications on displays and database can be performed online from the engineering station without influence of the plant operation. Modifications on one station are simultaneously valid for the other station.

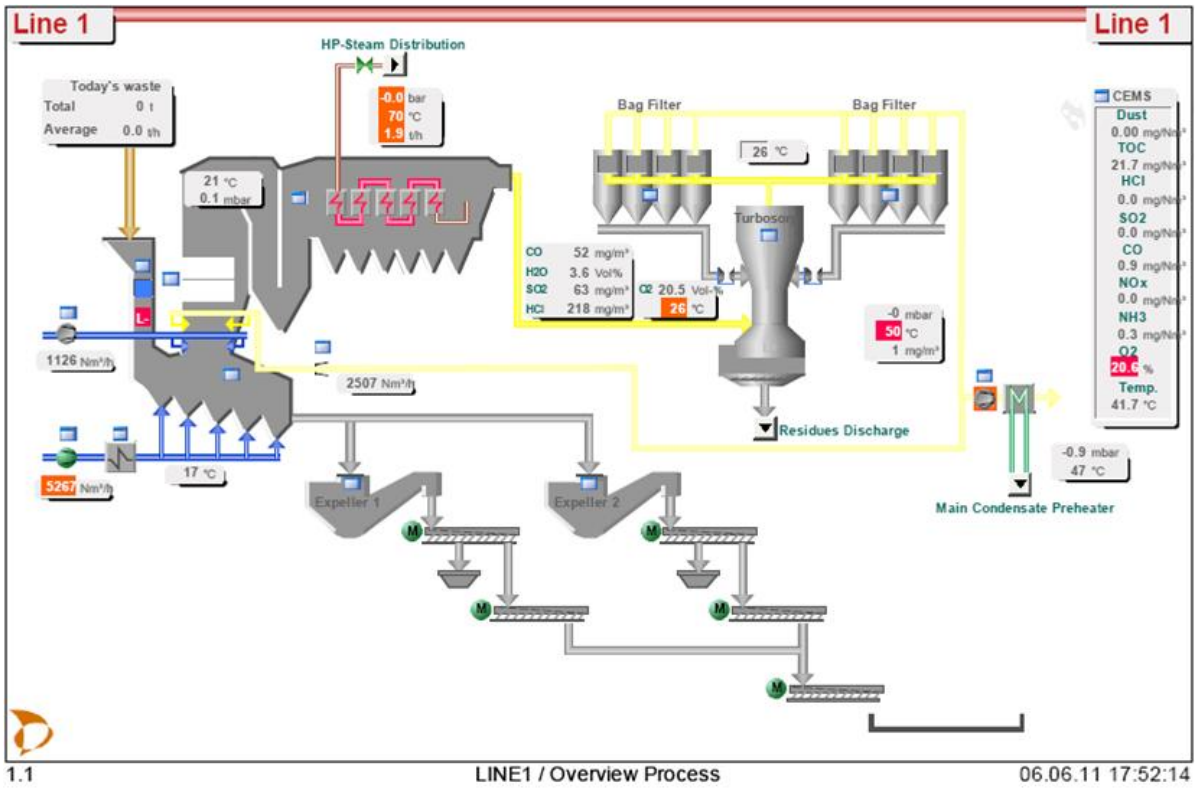



Figure 1: Typical screen of Operator Station

### *Technical data of the Operator Stations*

Operator stations are equipped with up to 4 monitors each ≥ 19" TFT, keyboard and mouse.

### *Presentation system*

For presentation purpose a large screen display minimum 77" will be installed. It will be located either in the main control room or in the conference room.

### *Engineering Station*

The engineering station is connected via LAN with all controllers and the servers. The engineering station is used for programming and software modifications. This statin can also be used as single operator station.

### *Server Station*

The HMI and the process communicate via the server stations. These stations have high availability and are designed redundant.

Both stations are in operation. Because one server is sufficient for the operation of the plant, the second station is in hot stand-by. Should the active server fail, an automatic switch over to the other server takes place without interruption or influence on the process. On return of a failed server a built-in tool synchronises the failed one.

If both servers are alive, an automated synchronisation guarantees an identical level of information. The data interchange between the servers will be independent from the plant bus.

***Automation Level***

The redundant controllers are dedicated to a certain process area. For this area the controller performs the control of motors, valves etc. and the monitoring of alarm / trip situations as well as the processing of digital and analogue signals.

All application software has a standard structure. The units to be controlled are handled as objects.

The whole program has a top-down structure with higher complexity on the lower level. All programs are based on graphical design (GFD), ladder logic or instruction list (according IEC 61131-3). The GFD allows personnel with basic knowledge in the electrical field to read and understand the programs. Program structures within an object are possibly programmed in another language due to the higher complexity.

All inputs, outputs and internal variables will be named clearly and structured to make knowledge of physical addresses needless. The whole program is transparent through titles and descriptions.

Closed loop controls are realised with modular standard PID-modules.

The Ethernet is used for the data transfer between the different controllers as well as for the communication between automation systems and plant control level.

The data transfer between remote I/O's and controllers will be performed with a redundant fibre optic bus. The breakdown or failure of the network is monitored and alarmed on the plant control level.

The basic layout of the DCS structure consists of the following controllers:

- Controller for incinerator and boiler
- Controller for thermal water/steam and general part
- Controller for safety requirements
- Controller for flue gas cleaning
- Controller for turbine

Prior to the shipping of the system a FAT (**F**actory **A**cceptance **T**est) will take place. During this test all automated sequences (sensible and at this stage) and programs will be checked.

***Technical data***

*Hardware*

- Control cabinet
- Redundant CPU
- Redundant Ethernet communication
- Redundant field bus communication
- Redundant power supply unit 230VAC / 24 VDC with surge protection

All process signals are wired to remote I/O stations (RIO) or are connected via a coupler / link directly to the controllers of the automation level. The local distributed I/O-stations are placed near the process equipment in order to optimise the cable length to the equipment.

Redundant signals will be wired to separate I/O-modules. A failure on single I/O modules will not lead to a shutdown of the plant.

***Coupling relays***

Depending on the current additional coupling relays will be installed. The relays will be pluggable with universal sockets. The contacts will be connected to terminals or terminal relays will be used. The supply voltage is generated in the I/O cabinets.

The connections with the MCC are realised with isolated input modules and relay output modules. A bus system will be used for signal transfer to the DCS (preferred Profibus). If intelligent MCC are used the connection will be Profibus. Safety Signals (e.g. Emergency stop) are hardwired.

***24 VDC Distribution***

The 24 V DC supply is generated within the cubicles from the redundant 400/230 VAC normal net and UPS sources.

***Analogue values (process)***

The signal level is 4 - 20 mA (HART protocol). RTD for motor windings and pulse counters may also be used.

The analogue input and output modules have the following specifications:

- Range of output signal 4 - 20 mA
- Each channel can be filtered separately
- Each channel has "out of range" status and "minimum value" programmable
- Each channel is short circuit proof
- Transient surge protected according to IEEE 472-1974
- Loop resistance up to 500 Ohm (analogue output)
- Channels on module are isolated

Analogue output modules are generally in 2-wire design and the supply is created in the module itself.

If a 4-wire design is necessary for measurements due to technical reasons the supply (230 VAC (UPS) will be fed from the remote I/O Box.

***Binary signals (process)***

The binary devices have two states and the signal is transmitted via contact or PNP signals.

This type of signals can be used to supervise closed loop controllers, produce alarms or for information / indication purposes only. The signals that trip the alarms or circuit breakers operate on the failsafe principle.

The I/O modules contain diagnostic functions that inform the user about:

- Module faults
- Signalling faults
- Removal when live

The binary input and output modules have the following functions:

- Galvanic isolation

- Local indication of status

## 18AAA1 DCS Performance Data

- Controller/Process station loop cycle times:
  - Ø Typical loops 200-500ms, Typical fast loops 10ms, fastest analogue control response time 5ms
- Control response time (control -> actuator movement):
  - Ø 2 x cycle time + 100ms
- Measurement response time (PV change -> display update):
  - Ø 1s + cycle time
- Alarm resolution, binary inputs (time stamping):
  - Ø 1ms
- Alarm resolution, other alarms:
  - Ø 1ms
- CPU load:
  - Ø maximum load 60%, allows expansion without any changes
- Load of the system network:
  - Ø maximum load 60%, allows expansion without any changes
- Number of graphic display windows open at the same time (including complete screen update):
  - Ø 20 windows
- Display update time (70 dynamic variables)
  - Ø Typically 1s

## 18AAA1 Remote Access and Process Analysis

***Remote access***

The remote access is separated from the system network by a firewall. The Remote Client enables remote access from a standard PC without specific software installed. It provides operation capabilities and access to historical information, plant information, emission data, with limited configuration capabilities. The same security concept used for a Workplace Client is used for the Remote Client.

***Remote Process analysis***

In favour of a more efficient and faster technical support / service of the plant, HZI Inova needs to obtain current operational data from the plant on a regular basis. The current data allow direct evaluation of the state of the plant and its operation. Conditions can be noticed earlier; the necessary measures can be taken faster.

The major advantages for the plant owner are:

- Competent and fast replies to questions on current situations since the current state of the plant is directly accessible for HZI;
- An active monitoring is feasible in case the customer asks for it; unplanned breakdowns may be avoided by early interventions;
- Shorter response time by HZI in case of irregularities.

***The Advantages are:***

- Easier access to operational data by means of an online evaluation tool
- Faster and simpler data collection allow more comprehensive analysis for future improvements
- Know-how feedback

***Data Export***

A separate computer with access to the data in the control system and in the emissions computer by the internal network of the plant is reserved solely for the generation and transmission of the operational data. This computer accesses to HZI's FTP server by means of a modem.

A leased transfer line is not required as the data are transmitted daily and as the data volume is small (< 5MB/day). In a predefined time interval all relevant measuring data are automatically exported from the computer.

***Data transmission***

For the transmission of the operational data HZI supplies a central FTP server accessible by internet any time. The data stream flows only from the plant to the FTP server (unidirectional). HZI does not require direct access to the plant. The operator chooses himself when he wants to transmit the data to the FTP server.

A firewall ensures that the FTP server can only send data. Therefore, there aren't any risks of transfer of viruses or access by third parties.

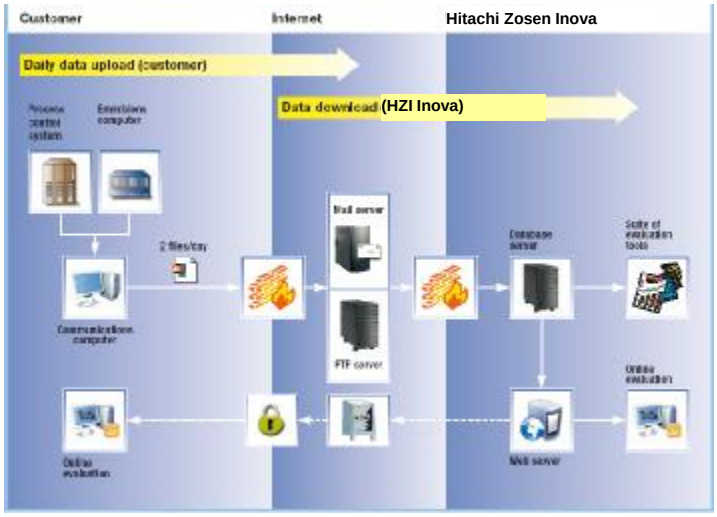



Figure 2: Unidirectional data transmission

## 18BAA1 Electromagnetic Compatibility (EMC)

All components have the "CE" label.

The reliability of the DCS may not be interfered through radio sets and cordless or mobile phones under normal conditions (closed cabinets) according to DIN EN 50081-2 and EN 55011.

## 18BAB1 Safety Devices

The following standards will be used:

- DIN-Standards for safety systems
- TRD-411
- EN 12952
- EN 50156

### *Emergency stop push button (PB)*

Emergency functions are implemented where necessary for safety function and personnel safety.

The emergency PB is fitted in a separate case and is mounted close to the drive assembly or compound machinery.

The amount of closing and opening contacts is depending on the application. Generally a minimum of 2 opening contacts is installed.

In all modes of operation the emergency PB has the highest priority over all functions, regardless of whether the operation relates to single equipment (running machine) or to a function group.

After the reset of the safety system the equipment can only be restarted from the process control room.

The resetting of the emergency PB cannot result in a restart of the equipment or a group of equipment.

### *Primary safety devices (hard-wired safety devices)*

Protective devices that provide protection for the entire plant are primary safety devices.

Protective devices for personnel (e.g. the emergency PB) or for parts of the plant (e.g. low fluid level) are machine specific safety devices.

The electrical protection devices for motors (fuses, thermal protection) are handled directly on the level of the motor control modules.

These safety devices are hardwired according to the failsafe principle and act directly on the motor starter.

### *Safety PLC*

For the safe operation of the plant and for the protection of personnel and the environment different requirements will be fulfilled. Due to that, actuators, sensors and controls are designed according to the relevant standards and norms. Where necessary a 2 out of 3 solution of measurements will be implemented (up to SIL level 3).

The power supply is 230 VAC UPS supply. The power supply will be redundant including the power supply cable. A failure of one supply may not lead to a shutdown of the plant. The supplies will be decoupled from each other.

## 18BAA1 Autonomous systems

Autonomous parts of the plant are defined as process segments unit in terms of process technology, electrical, electronic equipment and electromechanical equipment.

*List of some independent package units e.g.:*

- Waste cranes
- IR Camera for fire detection
- Grate and ram feeder control
- Compressed air stations

Package units are parts of the instrumentation and control system of process segments that can be operated locally, i.e. in a process-oriented manner, and the instrumentation and control equipment for it is generally located in the field and close to the process.

In all applications, common alarms and status signals will be transmitted to the overall DCS. However command signals (release, start and stop) are controlled by the overall DCS.

Autonomous systems and autonomous PLC's are designed as non-redundant (CPU, power supply, signal and/or bus-interface) except where the process requires (e.g. combustion control system, turbine package).

These systems will be connected to the main DCS by bus or hardwired signals (via Remote /IO's).

# Appendix F

## Plant Operation Outline

**During the proposal phase this document doesn't reflect the actual proposed plant configuration.**

| Rev. | Prepared (Name, Date, Initials) | Reviewed (Name, Date, Initials) | Released (Name, Date, Initials) | Short description of the change |
|---|---|---|---|---|
| 05 | | | | |
| 04 | | | | |
| 03 | Pst 22.04.2014 | Rs / Bij 24.04.2014 | Sts 24.04.2014 | see chapter 5 – page 57 |
| 02 | Pst 07.05.2012 | Pst / Bij 07.05.2012 | Pst 07.05.2012 | see chapter 5 – page 54 |
| 01 | Pst / Frd 14.09.2011 | Beg / Har / Bij / Hot 03.10.2011 | Rs / Ct / Sts / Bad 31.10.2011 | Complete overhaul of the document |
| 00 | Pst 14.09.2011 | xx.09.2011 | 31.10.2011 | First Edition |

# Plant Operation Outline

| | | | |
|---|---|---|---|
| **Project-No.:** | **P-9999** | **Project Name:** | |
| **PIRS:** | **14.01** | **Doc.-No. – Rev.:** | **99000270-V03** |

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# Table of Contents

# 1. Introduction

The plant operation outline describes the plant regarding the conceptual setup of the control system, process monitoring and the automation degree.

This outline is held in a general form and is, in this form, valid for all projects and proposals. If necessary, it must be adapted to a specific project during the basic engineering (BE) phase.

It also describes the methods with regard to safety precautions realized within the distributed control system (DCS) and within the safety PLC.

> The final version of the **PLANT OPERATION CONCEPT** consists of the **PLANT OPERATION OUTLINE** (this document) and the different **associated documents** listed in chapter 1.4 of this document.

## *1.1 Purpose*

The primary purpose of this document is to give an overview of the degree of automation of the plant. It explains the different levels of automation, the various operation modes of the plant and its equipment.

Additionally this document should give a general overview of the plant operation. In an abbreviated manner the different operation statuses and transitions between the different statuses of the plant are described. Also included are the various steps to start and stop the entire plant. Emergency operations such as power failure or complete black-out are also addressed in this document.

In a further chapter a general overview on the structure and principles for personnel safety and plant protection is given.

## *1.2 Scope*

This document is valid for all projects of Hitachi Zosen Inova AG, for all employees of Hitachi Zosen Inova AG, for members of a consortium and for suppliers.

## *1.3 Definitions and Abbreviations*

| Abbreviation | Explanation |
|---|---|
| 2oo3 | Two (**2**) **o**ut **o**f Three (**3**) Measurement |
| AIL | **A**sset **I**ntegrity **L**evel (Safety requirement related to assets and environmental aspects) |
| ACC | **A**ir **C**ooled **C**ondenser |
| ALM | Alarm Active |
| ACQ | Alarm Acknowledged |
| BE | **B**asic **E**ngineering |
| BoP | **B**alance **o**f **P**lant (Auxiliaries such as water supply, compressed air supply, fuel oil supply, etc.) |
| CAE | **C**omputer **A**ided **E**ngineering |
| CCR | **C**entral **C**ontrol **R**oom |
| CCS | **C**ombustion **C**ontrol **S**ystem |

| | |
|---|---|
| CCWS | **C**losed **C**ooling **W**ater **S**ystem |
| CEMS | **C**ontinuous **E**mission **M**onitoring **S**ystem |
| CPU | **C**entral **P**rocessing **U**nit |
| DCS | **D**istributed **C**ontrol **S**ystem |
| DE | **D**etail **E**ngineering |
| EBE | **E**xtended **B**asic **E**ngineering |
| EIC | **E**lectrical, **I**nstrumentation, **C**ontrol |
| EDG | **E**mergency **D**iesel **G**enerator |
| EPS | **E**mergency **P**ower **S**ystem |
| ESP | **E**lectro**s**tatic **P**recipitator |
| FDS | **F**unctional **D**esign **S**pecification |
| FG | **F**unction **G**roup |
| FGT | **F**lue **G**as **T**reatment |
| HAZOP | **Haz**ard and **Op**erability Study |
| HMI | **H**uman **M**achine **I**nterface |
| HP | **H**igh **P**ressure (Steam) |
| I/O | **I**nput / **O**utput |
| KKS | Reference and Designation System for Power Plants<br>(**K**raftwerks-**K**ennzeichen-**S**ystem) |
| LOP | **L**ocal **O**perating **P**anel |
| LP | **L**ow **P**ressure (Steam) |
| MCB | **Mo**tor **C**ontrol **B**ox |
| MCC | **M**otor **C**ontrol **C**enter |
| MCR | **M**easure **C**ontrol **R**ecording |
| MFG | **M**ain **F**unction **G**roup |
| MIL | **M**ain **I**nterlock **L**ist |
| MP | **M**edium **P**ressure (Steam) |
| n/a | **n**ot **a**pplicable |
| O&M | **O**peration and **M**aintenance Manual |
| PID | **P**iping and **I**nstrumentation **D**iagram |
| PLC | **P**rogrammable **L**ogic **C**ontroller |
| PRDS | **P**ressure **R**educing **D**e**S**uperheating (valve) |
| PU | **P**ackage **U**nit |
| RTN | **R**eturn **t**o **N**ormal Operation |
| SCC | **S**econdary **C**ombustion **C**hamber |
| SDE | **S**ingle **D**rive **E**quipment |
| SIL | **S**afety **I**ntegrity **L**evel (Safety requirement related to personnel safety) |
| SIS | **S**afety **I**nstrumented **S**ystem |
| SP | **S**et**P**oint |

| | |
|---|---|
| UPS | **U**n-interrupted **P**ower **S**upply |
| VFD | **V**ariable **F**requency **D**rive (of a motor) |
| WSC | **W**ater **S**team **C**ycle |

### *1.4 Associated Documents*

The following documents will be prepared for a specific project in order to finalize the overall **plant operating concept** during the engineering phase.

| Title | Engineering Phase | Filing (HZI internal) | Document Description |
|---|---|---|---|
| **Plant Operation Outline** | **BE** Basic Engineering | **PIRS \14 \01** | This document. |
| **Package Unit List** | **BE** Basic Engineering | **PIRS \14 \03** | List of all package units within the plant containing a PLC or a similar logic controller. |
| **Long Distance Data Transmittal Connection Concept** | **BE** Basic Engineering | **PIRS \15 \04** | Document explaining the concept for external plant communication connections. |
| **EU-, UV-, EM-Typicals** | **BE** Basic Engineering | **PIRS \16 \25** (Comos) | Electrical typicals of all various drives used within the plant. Consists of a series of signals within the DCS. |
| **Main Interlock Matrix EIC** | **BE** Basic Engineering | **PIRS \14 \02** | Overview of the electrical interlocks between switchboards in the form of a table. |
| **Electrical Power System Functional Description** | **BE** Basic Engineering | **PIRS \14 \02** | Description of the operational control philosophy and interlocks for the electrical power network. |
| | | | |
| **Function Group Table** | **EBE** Extended Basic Engineering | **PIRS \14 \03** | Table on which every drive (SDE) is associated with its superior function group. |
| **Main Interlock List** | **EBE** Extended Basic Engineering | **PIRS \13 \08** | Overview of the most important interlocks between different systems in the form of a table. |

| | | | |
|---|---|---|---|
| **EIC Emergency Stop List** | **EBE**<br>Extended Basic Engineering | **PIRS \14 \02** | List of all plant shut-down stops and emergency stops within the plant; the list consists of<br>- Plant Shut-Down-Stops<br>- Area Shut-Down-Stops<br>- single drive E-Stops |
| **Control System Operating Concept** | **EBE**<br>Extended Basic Engineering | **PIRS \14 \02** | Description of the general rules for instrumentation, equipment, process control system, and the user interface, which must be applied in their entirety to the HZI waste processing plant.<br>The process control system forms the central operating, control, and data tracking entity for all the units and ancillary subsystems located in the plant. |
| | | | |
| **Functional Design Specification (FDS) for all Systems** | **DE**<br>Detail Engineering | **PIRS \13 \09**<br>(Comos) | Schematic and verbal description to define the functionality of a system. Contains an explanation of the function and a logic diagram. |
| **FDS Plant Protection** | **DE**<br>Detail Engineering | **PIRS \13 \09**<br>(Comos) | Schematic and verbal description to define the functionality of the safety PLC (refer also to sheet 1 of the main interlock list). |
| **FDS General Interlocks** | **DE**<br>Detail Engineering | **PIRS \13 \09**<br>(Comos) | Schematic and verbal description to define the functionality of interlocks between different systems (refer also to sheet 2 of the main interlock list). |
| **EIC Emergency Power Start-Up and Safe Shut-Down Sequence** | **DE**<br>Detail Engineering | **PIRS \13 \09**<br>(Comos) | Description of the emergency power start-up sequence which is launched at a plant black-out. The sequence defines the starting time after the generator start to equalize the load on the generator. |
| | | | |
| **Start-Up and Shut-Down Table** | **DE**<br>Detail Engineering | **PIRS \14 \04** | Detailed description of the start-up and shut-down procedure. Is part of the operation and maintenance manual (O&M), will be finalized during commissioning. |

## 2. Operation Modes

The system is divided into a hierarchy of different levels to sort components and drives in more or less independent process areas. This allows for a structured design and automation concept.

| **Hierarchical level** | *Examples* |
|---|---|
| Ø **Line** | Line 1 / Line 2 |
| Ø **Line Sections** | Grate Combustion / Flue Gas Treatment |
| Ø **Process Sections** | Bottom Ash Handling / Combustion Air Supply |
| Ø **Process Units** | Primary Air System / Hydraulic Station |
| Ø **Process Equipment** | Motors / Valves / Actuators – Single Drive Equipment |

The plant operation is performed through Main Function Groups (MFG) and Function Groups (FG).

**NOTE**

**The operating personnel starts and stops the equipment of the plant in semi-automatic way, using main function groups and function groups.**

Main function groups and function groups act on process units and process sections. Process units or sections are the physical system in the field whereas MFG and FG reside only in the DCS. START and STOP of complete lines is NOT provided.

| ***PLANT*** | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Line*** | | | | | | | | | | | | | | | | | | | | | | |
| **Line Section A** | | | | | | | | | | | **Line Section B** | | | | | | | | | | | |
| **Process Section A-1** | | | | | | | **Process Section A-2** | | | | | **Process Section B-1** | | | | | | | **Process Section B-2** | | | | |
| Process Unit A-1.1 | | | | Process Unit A-1.2 | | | Process Unit A-2.1 | | Process Unit A-2.2 | | | Process Unit B-1.1 | | | | Process Unit B-1.2 | | | Process Unit B-2.1 | | | | |
| Process Equipment A-1.1.1 | Process Equipment A-1.1.2 | Process Equipment A-1.1.3 | Process Equipment A-1.1.4 | Process Equipment A-1.2.1 | Process Equipment A-1.2.2 | Process Equipment A-2.1.1 | Process Equipment A-2.1.2 | Process Equipment A-2.2.1 | Process Equipment A-2.2.2 | Process Equipment A-2.2.3 | Process Equipment B-1.1.1 | Process Equipment B-1.1.2 | Process Equipment B-1.1.3 | Process Equipment B-1.1.4 | Process Equipment B-1.2.1 | Process Equipment B-1.2.2 | Process Equipment B-1.2.3 | Process Equipment B-2.1.1 | Process Equipment B-2.1.2 | Process Equipment B-2.1.3 | Process Equipment B-2.1.4 | Process Equipment B-2.1.5 |

### *2.1 Definition of Main Function Groups and Function Groups*

**Main Function Groups** can be defined on the hierarchy level of a **Process Section** when multiple **Process Units** are tied together to form a common system.

**Function Groups** are defined on the hierarchy level of a **Process Unit** when at least one **Single Drive Equipment** (SDE) must be addressed.

In most of the cases each main function group (MFG) and each function group (FG) consist of both, a START sequence and a STOP sequence.

The START sequence can be executed if the PERMANENT CONDITIONS and the START RELEASE are fulfilled.

If the PERMANENT CONDITIONS are NOT fulfilled any more the STOP sequence is being executed.

The function group table is a table which shows the different hierarchical levels of the plant as well as defines the various MFG's and FG's. Additional information in the function group table are:

- on which hierarchical level a piece of equipment can be switched to MANUAL mode
- whether the control of the equipment is realized in the DCS or in a package unit
- lists the different locations from where a system can be operated

An example of a function group table can be found on the following pages.

## 2.1.1 Example of a Function Group Table

| | | | | | | | | | | | | | Location of Control | | Location of Operator Interface | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line Section | Process Section | **MFG** | KKS No. … ED | Process Unit | **FG** | KKS No. ... EE | Automatic Operation (AutoOp) | Process Equipment | **SDE** | KKS No. | DCS / PU | | DCS | PU | CCR | PU | LOP | MCB |
| Grate / Combustion | Waste Feed & Transport System | | | Feed Hopper | | 1 HFA00 EE001 | Bridge Breaking Program | Hydraulic Valve Feed hopper Flap(s) | A/M | 1 HHX70 AA310 | DCS | | X | | X | | X | |
| | | | | Ram Feeder | M | 1 HFY00 EE001 | | Control Cabinet Ram Feeder | A/M | 1 HFY10 GH501 | PU | | | X | X | X | | |
| | | | | | | | | Hydraulic Valves Ram Feeder | A/M | 1 HHX81 /82 AA020 | | | | X | | X | | |
| | | | | Grate | M | 1 HHY00 EE001 | | Control Cabinet Grate | A/M | 1 HFY10 GH501 | PU | | | X | X | X | | |
| | | | | | | | | Hydraulic Valves Grate Elements | A | 1 HHX11 /12/13/.. AA030 | | | | X | | X | | |
| | Combustion Air Supply | | | Primary Air System | M | 1 HLA10 EE001 | Flow Control | Fan / Motor | A/M | 1 HLB10 AN001 | DCS | | X | | X | | | |
| | | | | | | | Suction Switchover | Air Source Switch Damper | A/M | 1 HLA10 AA300 | DCS | | X | | X | | | |
| | | | | | | | | Primary Air Dampers Zones 1 to 5 | A/M | 1 HLA10 /20/30.. AA400 | DCS | | X | | X | | | |
| | | | | Primary Air Preheater | M | 1 LBG00 EE001 | Temperature Control | Saturated Steam Control Valve | A/M | 1 LBG20 AA400 | DCS | | X | | X | | | |
| | | | | | | | Condensate Level Control | Condensate Control Valve | A/M | 1 LCN30 AA410 | DCS | | X | | X | | | |

| | | | | | | | | | | | | | Location of Control | | Location of Operator Interface | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line Section | Process Section | **MFG** | KKS No. … ED | Process Unit | **FG** | KKS No. ... EE | Automatic Operation (AutoOp) | Process Equipment | **SDE** | KKS No. | DCS / PU | | DCS | PU | CCR | PU | LOP | MCB |
| | | | | Secondary Air System | M | 1 HLA20 EE001 | Flow Control | Fan / Motor | A/M | 1 HLB20 AN001 | DCS | | X | | X | | | |
| | Combustion Control System (CCS) | | | Combustion Control System | M | 1 HFY10 EE002 | | | A/M | | DCS | | X | | X | | | |
| | Start-up and Auxiliary Burners | M | | Burner 1 | A/M | 1 HLY00 EE001 | | Control Cabinet | A/M | 1 HJY10 GH501 | PU | | X | | X | X | | |
| | | | | | | | | Combustion Air Fan | A | 1 HJL10 AN001 | | | | X | | | | |
| | | | | | | | | Cooling Air Fan | A | 1 HJQ10 AN001 | | | | X | | | | |
| | Bottom Ash Extraction | | | Bottom Ash Extractor | M | 1 HDA00 EE001 | | Extractor Motor | A/M | 1 HDA10 AF001 | DCS | | X | | X | | | X |
| | | | | | | | Auto Refill | Bottom Ash Water Valve | A/M | 1 HDA10 AA300 | DCS | | X | | X | | | |
| | | | | | | | | Bottom Ash Water Pumps | A/M | 1ETN11 /12 AP001 | DCS | | X | | X | | | |

Legend:

| M | A | MFG | FG | SDE | DCS | PU | CCR | LOP | MCB |
|---|---|---|---|---|---|---|---|---|---|
| Manual Start | Auto Start | Main Function Group | Function Group | Single Drive Equipment | Distributed Control System | Package Unit | Central Control Room | Local Operating Panel | Motor Control Box |

### 2.1.2 Main Function Group (MFG)

A process section is defined as a main function group if it has a certain degree of independence in control, maintenance, and operation. A main function group controls automatically its subordinate function groups.

A START command on a main function group level launches a sequence which starts the different function groups included in the main function group.

Examples for main function groups are:

- bottom ash handling
- residue discharge
- etc.

A main function group (MFG) can only be started when the PERMANENT CONDITIONS are satisfied and the START RELEASE is ACTIVE.

Included in the START RELEASE of the main function group is the requirement that ALL subordinated function groups are in AUTO mode.

A main function group can only be stopped when the STOP RELEASE is active.

The main function group is being started via a sequence (START sequence) and is also being stopped via a sequence (STOP sequence).

A soon as the PERMANENT CONDITIONS are not satisfied any more (also during the START sequence) the main function group will be stopped. The STOP sequence will be launched regardless of the STOP RELEASE and the main function group will be set to FAILURE.

If the START sequence winds up in a step (due to an exceedance of the step internal supervision time) the main function group will be set to FAILURE. At the same time the STOP sequence will be launched regardless of the STOP RELEASE.

For every MFG the PERMANENT CONDITIONS and the START (or STOP) RELEASES are displayed in the DCS. This allows a quick analysis of all the requirements involved in a system start.

Each step of the START and the STOP sequence is displayed in the DCS.

### 2.1.3 Function Group (FG)

A process unit is defined as a functional subgroup of a process section. A function group controls automatically its associated process equipment such as motors, drives, etc.

A START command on a function group level launches a sequence which starts the different single drives included in the function group.

Besides the «START» command each function group consists of an «ALL AUTO» command which switches all the single drive equipment contained in the respective function group into AUTO mode simultaneously. This allows to recover quickly when the unit or a part of the system has tripped.

Examples of function groups within the main function group "Residue Discharge" are:

- mechanical discharge semi dry
- pneumatic discharge semi dry
- etc.

A function group (FG) can only be started when the PERMANENT CONDITIONS are satisfied and the START RELEASE is active.

Except of redundant equipment all SDE in AUTO is part of the START RELEASE for the respective FG.

A function group can only be stopped when the STOP RELEASE is active.

*For example there exists a STOP RELEASE for the FG Hydraulic Station: The FG Ram Feeder and the FG Grate must be stopped, before the FG Hydraulic Station can be stopped (this ensures, that the ram feeder and the grate are in their initial and safe position).*

The function is being started via a sequence (START sequence) and is also being stopped via a sequence (STOP sequence).

A soon as the PERMANENT CONDITIONS are not satisfied any more (also during the START sequence) the function group will be stopped. The STOP sequence will be launched regardless of the STOP RELEASE and the function group will be set to FAILURE.

If the START sequence winds up in a step (due to an exceedance of the step internal supervision time) the function group will be set to FAILURE. At the same time the STOP sequence will be launched regardless of the STOP RELEASE.

Depending on the functionality and the tasks of the system the various function groups can react slightly different in the following two ways:

1. If a non-redundant drive is being set to FAILURE the associated function group will be set to FAILURE, but remains in operation. When there is a redundancy of drives, the stand-by drive will automatically be activated and the function group remains in operation.

**OR**

2. If a non-redundant drive is being set to FAILURE the associated function group will be set to FAILURE and the STOP sequence will automatically be launched (the function group will be stopped). When there is a redundancy of drives, the stand-by drive will automatically be activated and the function group remains in operation.

   This is shown in the logic diagram of the respective system.

In case the FG is being started from a superior MFG, the FG must be set to AUTO mode.

In MANUAL mode the FG can be started at the FG itself, in AUTO mode the FG can receive START and STOP commands from the MFG.

For every FG the PERMANENT CONDITIONS and the START (or STOP) RELEASES are displayed in the DCS. This allows a quick analysis of all the requirements involved in a system start.

Each step of the START and the STOP sequence are displayed in the DCS.

### 2.1.4 Automatic Operation (AutoOp)

Automatic operations are considered to be periodic, automatic sequences or logic functions within a function group (e.g. 2-way level controls of a tank using two contacts or two thresholds from a continuous measurement).

Automatic operations are normally being started and stopped within the function group. They cannot be switched to manual mode but remain active as long as the FG is in operation.

### 2.1.5 Single Drive Equipment (SDE)

A process equipment is a physical unit consisting of a drive part and a mechanism.

Examples of process equipment of the function group "Feed Hopper Cooling System» are:

- feed hopper cooling pump
- feed valve in the feed hopper cooling circuit
- etc.

**Every single drive within the plant may be individually switched to from AUTO to MANUAL mode and vice versa at any time.**

A common command («ALL AUTO») on the FG level switches ALL single drive equipment in the respective function group to AUTO mode simultaneously.

The changeover of the operation mode of a single drive from AUTO to MANUAL **DOES NOT** change the operation status of the respective drive (e.g. when the drive is in operation, it remains in operation or when the drive is stopped it remains stopped).

When switching a single drive from MANUAL to AUTO the drive may be started. This depends on the status of the corresponding function group or the actual process requirements (e.g. when switching the cooling air fan of the hydraulic station from MANUAL to AUTO the fan starts immediately when the oil temperature is above the threshold).

Interlocks and start releases defined for the single drives remain active in MANUAL mode.

**NOTE**

In MANUAL mode the operator is responsible for the proper control of the process.

## *2.2 Definition of Operation Modes*

### 2.2.1 Introduction

A distributed control system (DCS) assists the operator to run the entire plant according to the specifications and the design in a safe and secure manner in terms of personnel and equipment.

The DCS monitors and controls the process in real time. The human machine interface (HMI) makes all necessary information on the actual plant status available to the operator at any time.

In addition to the process related information the DCS also generates WARNINGS and ALARMS in case exceptional conditions develop. In the case process thresholds are reached or limits are passed over the DCS reacts and intervenes in order to correct the abnormal situation. As a backup of the DCS a Safety PLC reacts on critical equipment when the DCS is not reacting.

Besides the execution of monitoring and control tasks the DCS also serves as a data storage unit for measured process values (e.g. flow, pressure, temperature, etc.) as well as for all operator inputs (e.g. setpoint changes, start and/or stop of function groups, manual start and/or stop of equipment, etc.).

In normal operation all equipment is operated in AUTO - REMOTE - controlled from the DCS in the control room (see also chapter 2.2.2).

All individual equipment can be switched to MANUAL mode. In this mode the operator can actuate the equipment directly from the DCS in the control room (see also chapter 2.2.3). The switchover from AUTO to MANUAL (and vice versa) must be carried out by the operator in the DCS.

When a single drive (SDE) fails it will automatically be switched to MANUAL mode. This is also the case when a safety stop shuts the drive down. The SDE must be RESET, before it can be switched back to AUTO or before it can be STARTED in MANUAL mode.

Selected systems can be operated in LOCAL mode, either at the local control unit (package unit) or at the local operating panel (LOP).

Depending on the nature of the system, the following two ways to operate equipment locally are being used:

1. The equipment can be switched to LOCAL operation at the local control panel by means of a key switch. Local operation is then indicated in the DCS in the control room. The respective equipment is directly activated at the local control panel. No release from the DCS is necessary (e.g. Ram Feeder / Grate Control Cabinet, ash conveyors, etc.).

   LOCAL operation can be AUTO (on PU's) or MANUAL (on motors) (see also chapters 2.2.4 and 2.2.5).

**OR**

2. Before the equipment can be switched to LOCAL the operator in the control room must release local operation from the DCS. The local operator must request local operation. The control room operator acknowledges the request and thereby releases local operation (e.g. filling of silos or tanks, operation of hydraulically driven equipment, etc.).

   LOCAL operation is AUTO in this case (see also chapter 2.2.4).

REMOTE control from the DCS is disabled while equipment is operated in LOCAL mode. Switchback from LOCAL to AUTO operation is always released from the local control panel or package unit.

### 2.2.2 AUTO - REMOTE Mode

During normal operation, function groups are controlled from remote (from the control room) by the automation logic in the DCS and / or package units.

In normal operation the equipment is in AUTOMATIC mode. No alarms or failures are active. There is a normal signal exchange between the package units and the DCS.

In AUTO - REMOTE mode single drive equipment is actuated (e.g. started or stopped) automatically by a sequence or an automatic operation (AutoOp) without operator intervention.

### 2.2.3 MANUAL - REMOTE Mode

Process equipment is started and stopped manually in the DCS in the control room. All necessary information for changing the status of equipment is shown on the HMI.

Change from MANUAL to AUTO control mode and vice versa is made by the operator using a selector switch which is part of every drive control unit (motors, valves, dampers, heaters, etc.). When switching from AUTO to MANUAL mode and vice versa, the operation status (running, open, closed, etc.) of the equipment is not changed.

All automatic functions are disabled in MANUAL mode.

Safety devices (plant protection, equipment protection devices and mechanical safety guards) remain active.

The associated function group remains in operation but will show a FAILURE. The FAILURE disappears when the FG is back in normal operation (RESTART of the FG or equipment back in AUTO and running).

MANUAL operation requires an operator intervention.

Examples of interventions in MANUAL control mode:

- instrument tests (start a pump to check pressure downstream of pump)
- forced intervention (speed up filling of a tank by starting the redundant pump in parallel)
- manual control during sensor failure; safety devices remain active
- etc.

Interlocks, permanent conditions and start releases defined for the single drives remain active in manual mode.

**NOTE**

In MANUAL mode the operator is responsible for the proper control of the process.

### 2.2.4 AUTO - LOCAL Mode

Systems which are controlled by a local control cabinet (package units) can be operated locally in automatic mode. The operation from the DCS is then interrupted, e.g. setpoints are not transferred from the DCS to the package unit but the setpoint must be entered at the package unit itself. The automatic control of the process is realized within the package unit.

Process interlocks remain active; the signal exchange between the package unit and the DCS for information purposes remains active.

The associated function group remains in operation.

Examples of package units are:

- waste crane
- ram feeder / grate control cabinet
- start-up and auxiliary burners
- filter cleaning of ash silo
- water treatment plant
- main cooler of the closed cooling water system (CCWS)
- CEMS
- etc.

#### 2.2.5 MANUAL - LOCAL Mode

Selected equipment can be controlled locally from a local operating panel (LOP) (e.g. forward and backward movement to unplug the bottom ash extractor). In this case local control must always be authorized in the DCS.

Local control is NOT normal operation.

**NOTE**

In MANUAL mode the operator is responsible for the proper control of the process.

In MANUAL – LOCAL mode process interlocks (e.g. interlocks between different mechanical transport devices, such as conveyors) are NOT ACTIVE.

Safety functions, such as e.g. pump dry run protections in the DCS (or hardwired to the MCC) remain active.

### *2.3 Local Operating Stations*

#### 2.3.1 Package Units (PU)

Package units are local control cabinets which contain a PLC (CPU). They are connected to the DCS either by BUS or via parallel connections. PU's can be operated locally at their own operator interface. They may receive setpoints and/or commands from the DCS but work completely independent. If the connection to the DCS fails their functionality is not jeopardized.

Examples for Package Units (PU) are:

- waste crane
- ram feeder / grate control cabinet
- start-up and auxiliary burners
- filter cleaning of ash silo
- water treatment plant
- main cooler of the closed cooling water system (CCWS)

- CEMS
- etc.

### 2.3.2 Local Operating Panels (LOP)

Local operating panels are operator interfaces without any intelligence. They consist mainly of switches, buttons and indication lights. These elements are I/O's from and to the DCS. The logic for these elements is programmed in the DCS. If the connection to the DCS fails, the local operator station cannot be operated any more.

Examples for Local Operating Panels (LOP) are:

- silos
- filling stations
- local operation of hydraulically driven equipment
- etc.

### 2.3.3 Motor Control Boxes (MCB)

Motor Control Boxes for selected motors are wired directly to the motor control center (MCC). This means that the respective START and STOP commands act directly on the motor. The signals are NOT routed via the DCS. If the connection to the DCS fails, the selected motors can be operated locally.

Examples for Motor Control Boxes are:

- bottom ash transporting devices
- through chain conveyors
- etc.

**NOTE**

When the respective motors are operated locally (from the MCB) NO interlocks from the DCS are active!

### 2.3.4 Emergency Stop Buttons

Emergency stop buttons are wired directly to the MCC. An additional contact is wired to the DCS to indicate the emergency stopping to the control room operator.

## *2.4 Process Redundancies*

### 2.4.1 Redundant Pumps

For plant availability or operation safety reasons it may be necessary to have redundant pumps installed.

The operation of one single pump is sufficient to meet the process requirements. The second pump installed is on stand-by. It will be started automatically by the DCS whenever an electrical failure of the running pump occurs (motor failure or VFD failure) OR when a process condition (flow / pressure / etc.) is not met any more (broken pump shaft / worn out pump wheel / etc.).

The switch over to the stand-by pump in case of a process condition is performed in such a way that the actually running pump will be stopped first and the stand-by pump will be started immediately thereafter.

For special process conditions it might be necessary to overlap the start of the stand-by pump and the stop of the running pump (during the overlapping time). This will then be specified in the logic diagram.

Periodically the two redundant pumps are switched from stand-by to operation and vice versa. This functionality allows checking the availability of the stand-by equipment in case of a breakdown of the pump in operation. Two different time delays ensure an unequal wear and tear of the pumps. The two time delays can be set in the DCS.

Remark: When starting a pump the process criteria (flow / pressure / etc.) for a switch over and the respective alarm will be by-passed until the process has reached stable conditions.

During the periodical switch over of the pumps the process criteria (flow / pressure / etc.) for a switch over will be by-passed during the switch over time period.

The functionality of the periodical switch over to the stand-by pump can be turned off in the DCS. In this case the starting order of the two pumps must be selected in the DCS (e.g. Pp1 => Pp2 or Pp2 => Pp1).

Remark: In case a switch over of the pumps was initiated AND the process monitoring criteria (flow / pressure / etc.) is not fulfilled after a determined time period BOTH pumps will be stopped. Reason for this is as follows: When the process condition is not re-established within this time period an important leak might be the reason for the pump switch over and in such a case it makes no sense to operate the pump.

Remark: The "*waiting time switchover criteria*" is the time, during which the process criterion must be active before a switch-over takes place. The "*stabilizing time switchover criteria*" is the time, during which the process criterion is by-passed after a switch-over has taken place. The stabilizing time is longer than the waiting time.

In selected cases (hydraulic system) the stand-by pump of a system can be started IN ADDITION to the pump already in operation SIMULTANEOUS or PARALLEL operation of the two pumps).

### 2.4.2 Other Equipment (than Pumps)

When two identical pieces of equipment are installed for the same function (although a single unit is sufficient to meet the process requirements) the stand-by unit must be started manually when the operating unit fails.

### 2.4.3 Pre-Selections

For redundant equipment without automatic periodical switch-over the starting order (e.g. Pp1 => Pp2 or Pp2 => Pp1) must be selected in the DCS.

Other selections in the DCS may be

- Pre-selection of a silo to be emptied or be filled
- Pre-selection of the burner starting order
- other

### 2.4.4 Redundant Measurements (DCS and Safety PLC)

Safety related measurements are carried out as 2 out of 3 measurements (abbreviated as “2oo3” on the PIDs). The treatment of the signals can either be carried out in the Safety PLC or in the DCS. If the signals are treated in the Safety PLC the average value is also transferred to the DCS where it can be further processed (e.g. thresholds or alarms are triggered from this value).

The number of measurements is THREE (3); when all inputs are error free, the output Q is the average value of the measured values (M1, M2, M3).

Faulty Inputs

When one input is faulty (M<4mA or M>20mA), then this value is ignored and the output Q equals the average of the two remaining measurements.

When TWO or MORE inputs are faulty, then the output Q equals the default value => an ALARM is triggered and the safety function is launched.

Deviations

When the deviations of one value (M1) compared to each of the other values (M2, M3) is higher than the «deviation warning» for a time period longer than the monitoring time then an alarm is triggered.

When the deviation is higher than the value «deviation action» for a time period longer than the monitoring time then this value is ignored and the output Q equals the average of the remaining inputs.

When the deviation between the remaining inputs is higher than the value «deviation action» for a time period longer than the monitoring time, then the output Q equals the default value => an ALARM is triggered and the safety function is launched.

Combination of Faults and Deviations

When one input is faulty and the deviation of the remaining inputs is higher than the value «deviation action» then the output Q equals the default value => an alarm is triggered and the safety function is launched.

When one input is ignored because of a deviation and one of the remaining inputs becomes faulty, then the output Q equals the default value => an alarm is triggered and the safety function is launched.

## *2.5 Human Machine Interface (HMI)*

The HMI serves as the link between the distributed control system (DCS) and the operator. The following chapters describe the operability of this interface as well as some operational aspects that are implemented within the DCS.

### 2.5.1 DCS Screen Structure

In order to represent the entire plant on the DCS screens, there are multiple screens to monitor and operate the process.

The different screens are grouped in a hierarchical manner according to the respective plant sections and split (on a lower level) into individual process sections.

An individual screen is not limited to a single PID nor is it limited to a single function group.

The operator will be able to switch from one DCS screen to another in a "logical" way (e.g. in the "direction of flow" of the process). On every screen there is a button, allowing him to jump back to the last active screen. In addition there is a button to jump to the superior DCS screen.

The DCS screens display all the elements, that are necessary to monitor and operate the plant (e.g. valve drives, motors, heaters, controllers, analog process measurements, binary switches, etc.).

The status of each of these elements is displayed directly on the screen (e.g. motor IN OPERATION , STOPPED or TRIPPED, shut-off valve OPEN or CLOSED, controller in MANUAL, AUTO or CASCADE, equipment in AUTO or MANUAL and LOCAL or REMOTE, etc.). The status of the element can be displayed by different colors and/or by changing the elements shape.

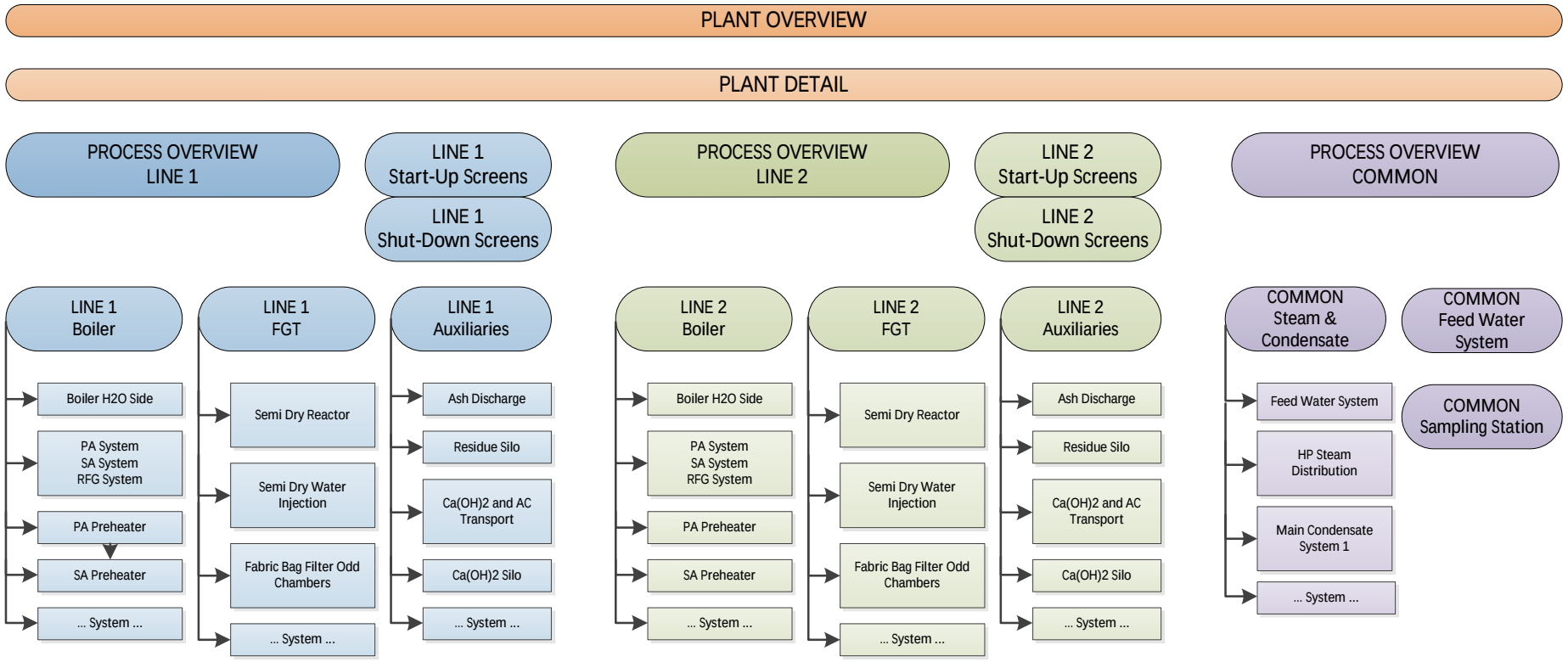
Some (for the process not immediately important) information will be displayed in "Pop-Up Windows".

Examples for such information are:

- controls of motors, valves or heaters
- the 3 individual values of a 2 out of 3 measurement
- controller parameters
- START and STOP buttons for a function group
- display of the START and STOP sequence of a function group
- motor current and/or power, etc.

On every DCS screen there is access to the subordinate displays (ALARM, TREND, EVENT, etc.) by a button in a standard command bar. This command bar is identical in all displays.

### 2.5.2 Example: DCS Screen Structure



### 2.5.3 DCS Access Levels

The DCS is split into different hierarchical levels giving different access to the corresponding level. For each access level except of the visitor / guest level a password is required to log into the system. Every login / logout of every user will be historicized.

**Example of Hierarchy Levels in the DCS:**

| Access Level No. | Title | Description of Activities |
|---|---|---|
| 1 | Visitor / Guest | no right to change anything, right only to watch |
| 2 | Shift Operator | can start and stop equipment, can change setpoints |
| 3 | Shift Supervisor | can change thresholds, can force values |
| 4 | Engineer | can modify all parameters such as timers, config. values, etc. |
| 5 | Administrator | unlimited access to everything |

### 2.5.4 Trends

Trends show time dependent variations of measured process values as curves. Multiple process variables can be combined in a single trend in order to compare their chronological behavior.

A number of standard trends will be pre-defined. Each operator can create his personal trends (user defined trends) using any measured (and stored) values of the plant or DCS internal values such as controller setpoints, etc.

Selected binary signals can also be trended.

### 2.5.5 Alarms and Messages

Different information is displayed in the DCS to inform the operator in real time about the process.

Examples for such information are:

- feedback from the process that a certain condition is being reached (e.g. the combustion control system CCS reports that the secondary air flow controller has reached its minimum output)
- an unexpected stop of a sequence (e.g. start and/or stop of a function group)
- discrepancies between the commanded valve position and actual valve position (e.g. the ammonia flow control valve is jammed)
- incoherence of signals (e.g. valve limit switch OPEN and CLOSED simultaneously)
- measured values outside of limits (exceedance of thresholds) (e.g. pressure LOW)
- DCS errors
- other

Three major types of messages can be distinguished, each type corresponding to one or more necessary measures which must be taken by the operator:

| Level No. | Type | Display Color | Explanation / Example |
|---|---|---|---|
| 1 | ALARM<br>ALM | red | Immediate operator intervention necessary OR automatic safety intervention by the DCS has already been triggered<br>Example:<br>Due to level TOO LOW in the tank, the pump protection (LS3L) has STOPPED the pump and has ,at the same time, triggered an ALARM (LA3L) |
| 2 | WARNING<br>WAR | yellow | Operator intervention essential in a short time period (minutes)<br>Pre-Alarm before an automatic safety intervention (and the associated ALARM) is triggered by the DCS<br>Example:<br>Warning: the water level in the tank has dropped to the LOW threshold (LALL); if the level keeps dropping, the pump will stop |
| 3 | MESSAGE<br>MSG | green | Information for the operator, NO operator intervention necessary<br>Example:<br>OPEN (LSL) and CLOSE (LSH) the water supply valve to control the level in a tank |

Depending on the type of message (MESSAGE / WARNING / ALARM) the event goes along with an audible signal in the control room to catch the operators attention.

**Example of an ALARM List:**

| Date | Time | Description | TAG / KKS No. | Type | Status |
|---|---|---|---|---|---|
| 11/04/24 | 19:23:35 | Process Water Valve OPEN - GOH | 1 HDB82 AA300 | MSG | Coming |
| 11/04/24 | 21:08:50 | Fault ID fan - EAL | 1 HNC10 AN001-M01 | ALM | ACQ |

### 2.5.6 Event List / Log List

An event list / log list records **all** operator manipulation made in the DCS.

Examples of recorded actions are:

- changing a setpoint of a controller
- acknowledging an alarm
- starting / stopping a piece of equipment
- starting / stopping a function group
- switching a piece of equipment to MANUAL / AUTO mode
- etc.

**Example of an Event List:**

| Date | Time | Description | TAG / KKS No. | Event | User |
|---|---|---|---|---|---|
| 11/05/28 | 06:22:03 | FG Feed Hopper Cooling System | 1 HFK00 EE001 | START FG | Joe |
| 11/05/28 | 08:21:43 | Main condensate pump 1 | 0 LCA11 AP001-M01 | MANUAL | Bill |
| 11/05/29 | 10:04:15 | Boiler Outlet Temperature Controller | 1 HBK50 DT901 | SP = 189°C | Jack |

### 2.5.7 Start-Up and Shut-Down Screens

In order to assist the operator in starting up or shutting down the plant a series of screens are provided by the DCS. These screens guide the operator through the proposed sequence for starting (and stopping) the different systems (function groups). The screens consist of tables, containing:

- the step number
- the name of the system concerned and a description of the action to be taken
- when applicable, a button to change over to the respective screen on which the action must be executed (e.g. to start the respective function group (FG))
- a feedback signal of the function group concerned (e.g. function group is IN OPERATION) or an acknowledge button to mark that the operator has carried out the respective actions

Each necessary step to start-up or shut-down the plant must be executed manually by the operator.

**NOTE**

There is NO common, automatic sequence to start-up or shut-down a unit or the plant.

The individual steps are NOT interlocked, however the start of individual function groups may be interlocked where process conditions require it.

The table shall serve as a guideline or recommendation; there are different ways to start-up a plant. It is not mandatory to start up the plant using the DCS Start-Up and Shut-Down Screens.

The proposed sequence will be finalized and optimized during the commissioning phase of the plant.

**Example of the Start-Up Screen:**

| Step | Description / Action | KKS No. | Screen | Status |
|---|---|---|---|---|
| 1 | **Building Installation:**<br>Start HVAC, Sanitary Installations, Illumination, Video System | - | - | DONE |
| 2 | **Compressed Air System:**<br>Start Compressed Air FG | 0 QFA30 EE001 | Compressed Air | |
| 3 | **Process Water System:**<br>Start Process Water FG | 0 GHA10 EE001 | Process Water | |
| 4 | **Demineralized Water Plant:**<br>Start Demineralized Water Plant FG | 0 GCL10 EE001 | Demineralized Water Plant | |
| 5 | **etc.** | | | |

## *2.6 General Remarks*

### 2.6.1 Acknowledgment of Alarms

Each operator screen has a common button to acknowledge all alarm associated with the respective function group. The button resets all alarms which are not active any more. Measurements that exceed thresholds or faulty conditions that generate alarms will not be reset; their alarm status will persist.

### 2.6.2 Suppression of Alarms

Process alarms such as «Pressure LOW» (PAL) or «Flow LOW» (FAL) which are associated with the operation status of a process equipment (e.g. pumps or fans) will be suppressed, when the respective drive is not in operation.

The alarm will be suppressed even in the case where the equipment fails => in such a case an alarm of the equipment failure is triggered.

**NOTE**

Despite the suppression of alarms there will be a series of alarms during the start-up and the shut-down phase of the plant (e.g. even with the burners in operation there will be a «Temperature LOW» (TAL) alarm in the secondary combustion chamber during the heat-up phase).

### 2.6.3 Threshold Hysteresis

When not otherwise specified, all thresholds on analog measurements will have a hysteresis of 2% of the measurement range (e.g. a temperature measurement with the range of 0 to 150°C will have a hysteresis on its thresholds of 3°C).

### 2.6.4 Discrepancy Handling

Valves, dampers and control valves are being monitored for their actual position (if they are equipped with the respective position feedbacks) in respect to their DCS output command. A timer allows each device to reach the desired position before an alarm is triggered. Control valves must reach their position with a small tolerance within a defined time, otherwise an alarm is triggered.

The motor control center must feedback a "RUNNING" signal to the DCS after the start command for the motor has been launched in a defined period of time, otherwise an alarm is triggered.

Each step of a sequences is monitored. If the next step is not reached within defined period of time an alarm is triggered.

### 2.6.5 Incoherence Testing

When a motor receives a RUNNING and a STOPPED feedback from the MCC at the same time, an incoherence alarm is triggered without time delay.

When a shut-off valve receives an OPEN and a CLOSED signal from its limit switches at the same time an incoherence alarm is triggered without time delay.

### 2.6.6 Starting and Stopping a Function Group

When starting or stopping a function group the actual status of the sequence as well as the necessary permanent conditions and associated releases are displayed in the DCS to inform the operator about the current situation.

The complete list of all conditions is displayed; green conditions are satisfied, red ones are not satisfied.

Every step of the starting / stopping sequence of a function group will be displayed in detail. When timers between individual steps are included, these count backwards in real time keeping the operator posted on all the details taking place in the respective function group.

This allows the operator to get complete overview of the function group in very short time.

### 2.6.7 Interlock Handling for Single Drive Equipment

In the DCS faceplate of every single drive equipment the interlock conditions are displayed (e.g. dry run protection for a pump or vibrations too high for a fan).

## 3. Plant Operation Status

In order to structure the operation of the plant, the functioning of the plant can be divided into different **Operation Statuses** and into **Transitions**.

Operation statuses describe the conditions of the various systems contained in the entire plant.

Transitions describe the steps necessary to get from one operation status to another.

The graph on the next page shows the structure of the plant operation and the transitions necessary between the different modes.

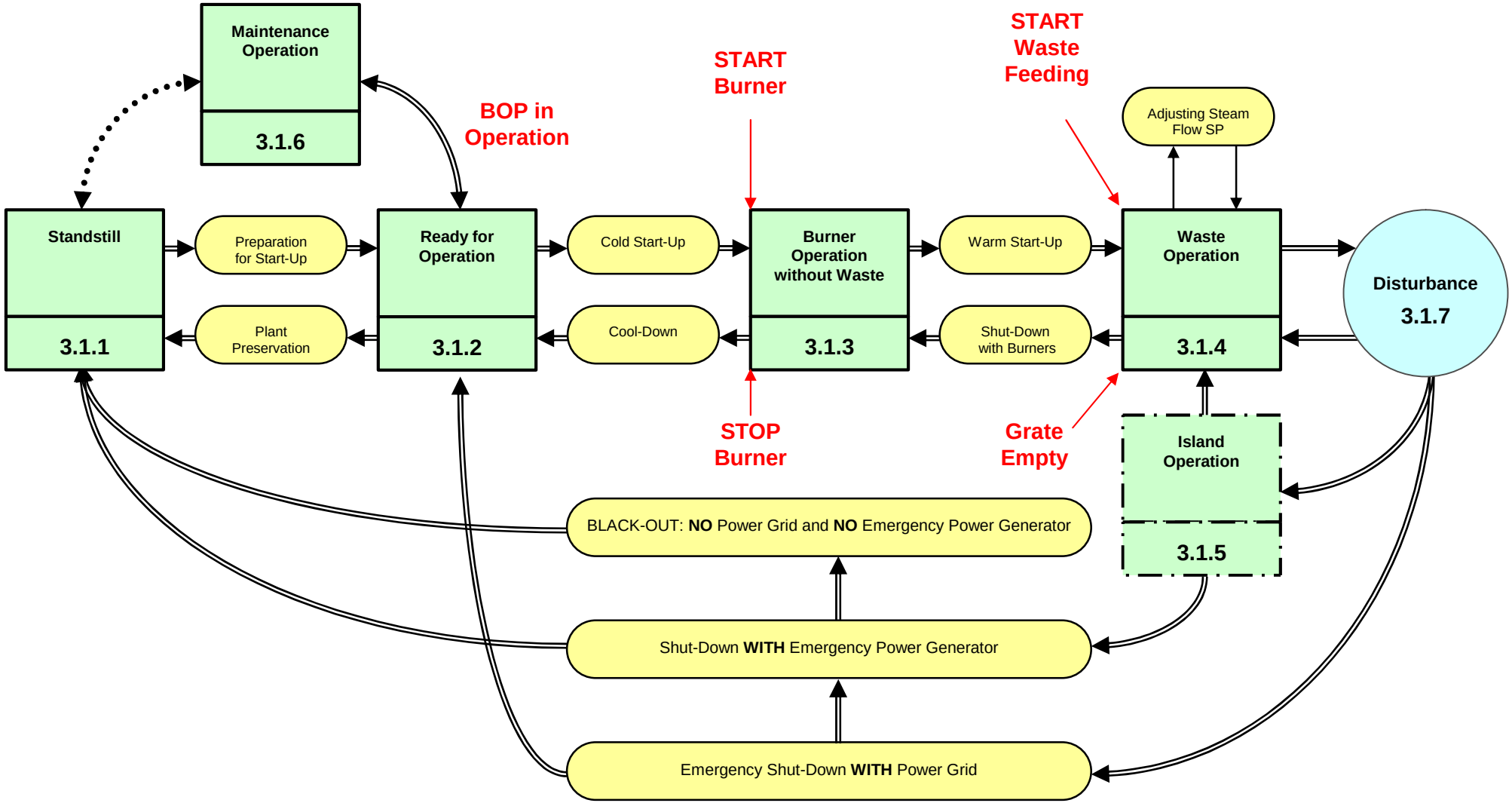
Because the combustion chamber temperature is (among others) one of the most important process variables, there is a clear relation between the combustion chamber temperature and the various operation statuses. This fact is depicted in the second graph.

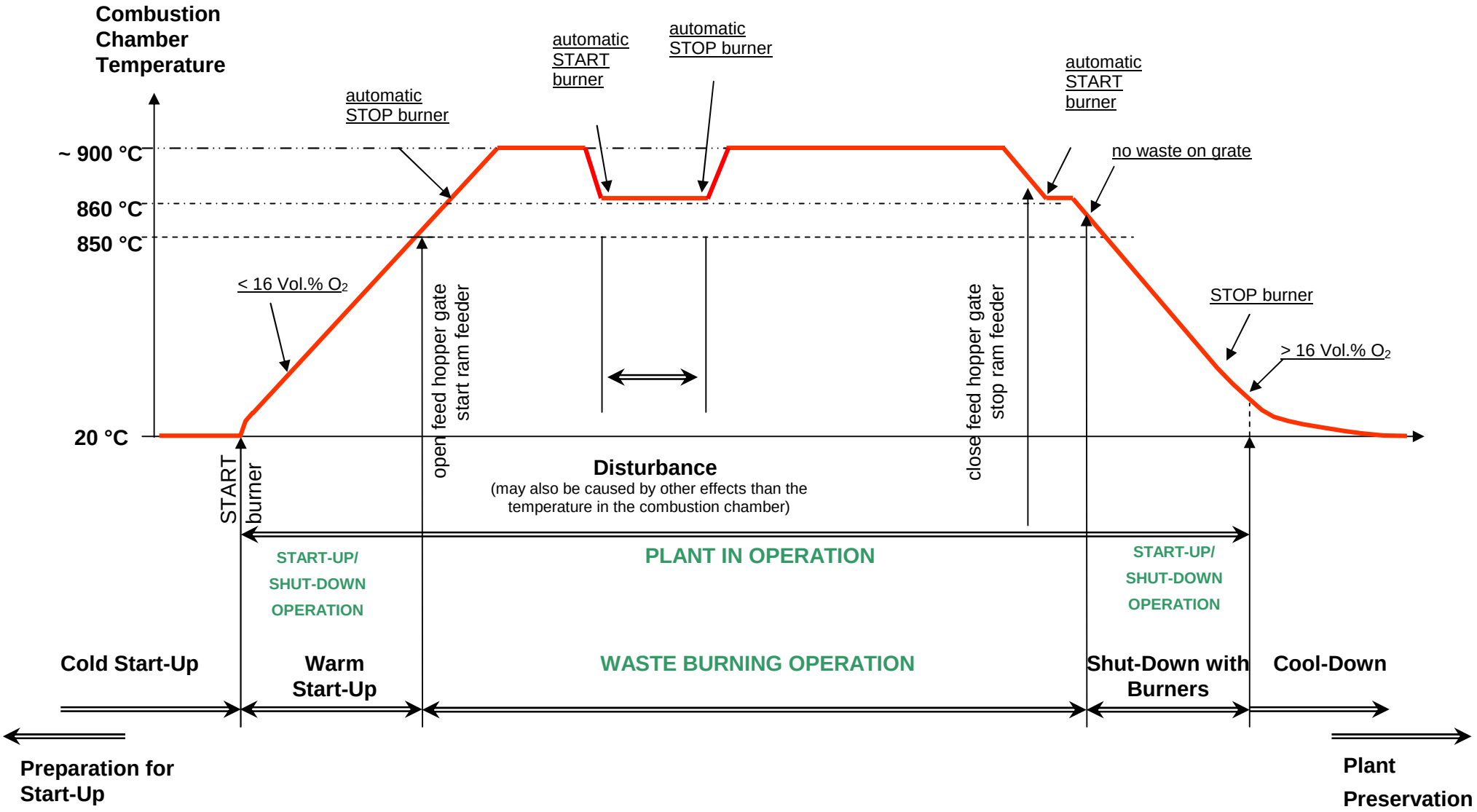
The general structure of the plant operation is developed mainly around burner operation and waste operation. The reason being the legal requirements (for temperature) before waste may be fed to the furnace.

Waste operation (within the boundaries of the load range diagram) is normal operation (the burners are NOT in operation at this point).

Several Transitions, starting with the preparation and start-up of all auxiliaries before a burner start may occur, are necessary to achieve normal operation. Vice versa burner operation is mandatory (as long as there is waste in the furnace) during the shut-down period of the plant.

***Plant Operation Statuses and Transitions***




Combustion Chamber Temperature
automatic STOP burner
automatic START burner
automatic STOP burner
automatic START burner
no waste on grate
~ 900 °C
860 °C
850 °C
< 16 Vol.% O2
open feed hopper gate start ram feeder
close feed hopper gate stop ram feeder
STOP burner
> 16 Vol.% O2
20 °C
START burner
Disturbance
(may also be caused by other effects than the temperature in the combustion chamber)
START-UP/ SHUT-DOWN OPERATION
PLANT IN OPERATION
START-UP/ SHUT-DOWN OPERATION
Cold Start-Up
Warm Start-Up
WASTE BURNING OPERATION
Shut-Down with Burners
Cool-Down
Preparation for Start-Up
Plant Preservation

## *3.1 Plant Operation Statuses*

### 3.1.1 Standstill

The entire plant is shut-down and in a cold condition. Depending on the duration of the standstill, some systems may still be in operation (e.g. low voltage power supply, DCS, etc.).

In order to start-up the plant the various procedures to start each individual system (described in the O&M) must be followed.

- A thorough check of the entire plant is absolutely essential. On a final round every piece of equipment to be started must be checked and brought into the condition as described in the O&M.
- All doors, manholes and other access openings must be closed.
- All fluid and solids levels must be checked and adjusted according to the O&M.
- All manual valves must be set to the correct position according to the O&M.

### 3.1.2 Ready for Operation

All necessary common auxiliaries such as electrical power supply, water and fuel supplies, compressed air generation, adsorbent supplies, etc. are in operation or are ready to be started.

All common consumables such as water, fuel, different adsorbents for the flue gas treatment, etc. are available.

All necessary silos and tanks are filled.

Collecting and receiving vessels are drained to a point where they provide enough storage capacity for normal and emergency operation.

### 3.1.3 Burner Operation without Waste

The start-up and auxiliary burners are in operation, the furnace and the rest of the unit are slowly being warmed up respecting the appropriate heat-up curve.

At this point auxiliary systems not yet being used so far can be started up or can be prepared so their start is possible at any time when needed.

### 3.1.4 Waste Operation

The unit is operating with waste according to design and within the load range diagram.

The burners are in auxiliary mode (they are NOT RUNNING); ready to be started whenever the process conditions require it (e.g. when the flue gas temperature in the secondary chamber drops below 860°C).

### 3.1.5 Island Operation

The connection to the external power grid has failed and power cannot be fed to the public grid. The electrical power produced by the turbine/generator set is only as much as the plant is using as actual internal consumption.

Surplus HP steam which cannot be used in the turbine must be routed through the turbine bypass and will be condensed in the ACC.

The turbine/generator control system will immediately switch from power control to frequency control (50 Hz) and the turbine inlet control valve will close until the generated power equals the internal consumption. Simultaneously the pressure reducing desuperheating (PRDS) valve will be driven to a preset open position depending on the current steam flow, before modulating to maintain the operating pressure at the boiler.

Under certain conditions the unit load (live steam flow) must be reduced to partial load in order to avoid a turbine trip.

Depending on the construction of the turbine (e.g. due to insufficient cooling of the low pressure stage) Island Operation of the plant is possible only for a limited period of time.

When the public grid is revived the operator issues a synchronization command to the turbine/generator control system. The turbine/generator set will synchronize the frequency with the public grid and switches from frequency and voltage control back to pressure and power control.

### 3.1.6 Maintenance Operation

In maintenance operation the unit is shut-down. Individual equipment or entire systems may be in operation for **testing purposes** or for other reasons.

When the operation concerns a single drive equipment (SDE) the operation mode is MANUAL - REMOTE or MANUAL - LOCAL.

(see also chapters 2.2.3 and 2.2.5)

When the operation concerns an entire system (MFG or FG) the operation mode is AUTO - REMOTE or AUTO - LOCAL.

(see also chapters 2.2.2 and 2.2.4)

Maintenance operation is only of short duration and NOT considered to be normal operation.

### 3.1.7 Disturbance

A disturbance can be caused by a wide variety of causes. Depending on the nature and the severity of the disturbance different measures must be taken.

Examples:

- The disturbance is minor, repair or exchange of the damaged equipment is possible without interruption of normal waste operation.
  e.g. change of one transmitter within a "2 out of 3" measuring arrangement
- The disturbance requires to reduce the load (steam flow) of the unit, after the repair / exchange of the damaged equipment full load can be resumed.
  e.g. one of the fabric bag filter chambers must be shut-down because of high dust emissions resulting from a damaged filter bag.

- The disturbance requires to stop the waste feed to the system. The burners will start automatically when the combustion chamber temperature has dropped below the threshold. If the damaged equipment can be repaired in reasonable length of time burner operation can be continued. After repair normal waste operation can be resumed.
- The disturbance requires a shut-down of the respective unit, the time path is not critical, thus the unit can be stopped via the normal shut-down procedure.
  e.g. the boiler cleaning equipment is damaged, as a consequence the boiler outlet flue gas temperature is slowly rising
- The disturbance requires a sudden shut-down of the unit, an emergency shut-down must be initiated.(see also chapter 3.2.8)
  e.g. the ID-fan must be shut-down because of a motor failure or a damaged bearing
- A power failure requires a plant shut-down.
  (see also chapters 3.2.10 and 3.2.11)

See also chapter 4.3.

## *3.2 Transitions*

The transition from one operation status to another takes place in several steps (see also chapter 3.1.) The execution of these steps takes place **manually** (with the exception of the transition to island mode, to

During the transition of operation statuses all necessary interlocks are still active for personnel safety and for the protection of the plant.

The following descriptions provide a **general overview** of actions and conditions needed for a change of the operation status (transition). The necessary steps to be taken described in this chapter are exemplary and are not necessarily complete. Depending on the configuration of the plant (single unit or multiple units) the order and number of steps may vary.

A detailed description of the start-up and shut-down procedures will be part of the operation and maintenance manual (O&M).

### 3.2.1 Preparation for Start-Up (exemplary listing)

The following steps need to be executed in order to prepare the plant before a / the unit can be started:

- make round trough plant, make sure all system are in the condition to be started
- start power supply from public grid
- check and make emergency power generator set available (if applicable)
- start high voltage power supply
- start medium voltage power supply
- start low voltage power supply
- start UPS supply
- start DCS
- start building supplies (illumination, HVAC, tap water supply, vacuum cleaning system (if applicable), eye wash stations and emergency showers, etc.)
- start compressed air generation and supply – open valves
- start plant water supplies – open valves

- start firefighting system
- start demineralized water plant
- fill all necessary water tanks – check levels
  (e.g. demineralized water tank / feedwater tank / etc.)
- fill all necessary consumable tanks and silos – check levels
  (e.g. fuel oil tank / $NH_4OH$ supply / activated carbon silo / $Ca(OH)_2$ silo, etc.)
- fill all necessary operating supplements – check levels
  (e.g. hydraulic oil tank / etc.)
- empty residue silo / drain waste water tank – check levels
- start closed cooling water system
- start fuel oil and ignition gas supply

### 3.2.2 Cold Start-Up (exemplary listing)

The list below describes the necessary preparation steps that need to be made before the burners of the unit can be started.

- make round through unit - close all access doors, manholes, ports, nozzles, etc.
- set all manual valves to their correct position
- fill all unit systems with water where applicable – check levels
  (e.g. feed hopper cooling system, grate cooling system, bottom ash extractor, etc.)
- start heaters and heat tracing where applicable – respect preheating time
  (e.g. ESP, grate riddling removal system,
- start CEMS and raw gas measurements including $O_2$-monitor at boiler outlet
- close all boiler drain valves and open all boiler vent valves – leave superheater drain valves OPEN
- open boiler start-up valve
- start feedwater tank level control system
- start feedwater pumps
- start auxiliary condensate system
- fill boiler drum with water – close feedwater control valve
- drain HP, MP and LP steam system – close drain valves
- start condensate system
- open main steam shut-off valve
- start ACC
- start HP steam bypass station
- start hydraulic system
- start ram feeder and grate
- start bottom ash extractor
- start grate riddling removal system
- start HP/LP reducing station
- start boiler ash discharge and boiler ash transport system
- start residue discharge
- start fabric bag filter
- start ID fan – pressure control in AUTO

- start primary and secondary air system – air flows are set to minimum
- start flue gas recirculation system
- start furnace purging program
- stop secondary air system
- stop flue gas recirculation system

### 3.2.3 Warm Start-Up (exemplary listing)

Before waste may be fed to the unit the post combustion chamber temperature must be above the threshold of 850°C in order to comply with the legal requirements (**DIRECTIVE 2000/76/EC)**. Thus the start-up and auxiliary burners must be started to heat the furnace. Once the temperature is above 850°C the start release to open the feed hopper flap(s) is activated.

- start start-up and auxiliary burners
- ramp up secondary combustion chamber temperature following the refractory heat-up curve
- adjust boiler drum level – using feedwater control and drum emergency blow down valves
- close superheater drain valves when steam exits
- close all boiler vent valves when drum pressure is 3 bar(g)
- increase boiler pressure using boiler start-up valve – leave open at least 30% to cool superheaters
- start primary air preheating system
- start $NH_4OH$ supply
- start SNCR system
- start boiler rapping system
- start boiler sampling station
- start $Ca(OH)_2$ transport system
- start activated carbon transport system
- start HZI Semi Dry reactor
- start secondary air system
- start flue gas recirculation system
- burners switch automatically to auxiliary mode when target temperature 850°C is reached
- burners control 863°C secondary combustion chamber temperature
- when secondary combustion chamber temperature has reached 850°C
    - prepare waste to be fed to the feed hopper
    - open feed hopper flap(s)
- manually cover grate with waste
    - adjust ram feeder speed
    - adjust grate stroke frequency
    - adjust primary air flow to individual zones
- start high pressure water injection system to HZI Semi Dry reactor
- start fabric bag filter cleaning
- adjust boiler outlet $O_2$ content by adjusting secondary air flow

- increase thermal load of boiler to 60% of the nominal value
- start boiler attemperators / desuperheaters
- burners will stop automatically when thermal power of waste is sufficient
- start combustion control system
- start chemical dosing station of boiler
- start boiler blow down
- start flash tank level control
- adjust steam flow setpoint in the CCS

### 3.2.4 Adjusting the Steam Flow Setpoint

The targeted steam flow (thermal load) of the unit is set manually in the DCS. The combustion control system (CCS) adjusts the different mass flows (waste flow, air flows, ram feeder and grate movements, etc.) needed to achieve the respective load automatically.

The combustion control system (and the furnace, the flue gas treatment system, etc.) are designed to operate the unit within the limits of the load range diagram.

Outside these limits the plant is either not permitted to run (high end – excessive thermal load) or must be operated manually (low end – unstable combustion).

### 3.2.5 Shut-Down with Burners (exemplary listing)

As long as there is waste on the grate the secondary combustion chamber temperature must remain above 850 °C for regulatory reasons (**DIRECTIVE 2000/76/EC)**. While the heat input from the waste is diminishing during shut-down the start-up and auxiliary burners must compensate for the missing load. The following steps are necessary to shut-down the plant (exemplary list):

- stop feeding waste
- close feed hopper flap(s)
- lower steam flow setpoint to 60% of the nominal value
- burners will start automatically when secondary combustion chamber temperature drops below 860°C – the burners will maintain 863°C
- stop the combustion control system when the steam flow reaches 60% of the nominal value
- shut-down turbine
- launch ram feeder clearing stroke
- adjust grate speed , primary air flow, secondary air flow and flue gas recirculation flow according to the fading combustion intensity
- once the grate is emptied, ramp down the secondary combustion chamber temperature following the refractory cool-down curve
- stop high pressure water injection system to HZI Semi Dry reactor
- stop HZI Semi Dry reactor
- start fabric bag filter intensive cleaning cycle
- stop primary air preheating system
- stop SNCR DyNOR system
- stop activated carbon transport system
- stop boiler attemperators / desuperheaters

- start continuous boiler rapping cycle during cool-down
- stop HP steam bypass station
- stop burners when they have reached minimum load
- stop ACC

### 3.2.6 Cool-Down (exemplary listing)

During the cool-down phase the unit is brought to a condition from where transitions either to maintenance operation or to complete standstill are possible. After shutting down the burners the remaining heat in the unit must be dissipated and the units system still in operation must be stopped. The plants auxiliary systems such as water supply, compressed air supply, power supply, etc. remain in operation.

- stop flue gas recirculation system
- stop $Ca(OH)_2$ transport system
- increase primary air flow to cool furnace
- stop boiler rapping system
- close boiler blow down valve
- adjust boiler drum level manually
- open superheater drain valves
- open boiler vent valves
- drain all boiler drain valves – re-close
- fill boiler drum to level HIGH mark
- close feedwater control valve
- close main steam shut-off valve
- stop NH4OH supply
- stop primary air system
- stop ram feeder
- stop grate
- stop boiler ash transport system
- stop bottom ash extractor
- stop hydraulic station
- stop feed hopper cooling system
- stop boiler ash discharge
- stop grate riddling removal system
- stop residue transport system
- stop ID fan

### 3.2.7 Plant Preservation (exemplary listing)

Depending on the duration of the shut-down and the planned work further systems may be taken out of operation:

- stop CEMS

- stop fuel oil and ignition gas supply
- stop closed cooling water system
- stop demineralized water plant
- stop plant water supply / supplies
- stop compressed air generation and supply
- stop building supplies (illumination, HVAC, tap water supply, vacuum cleaning system, eye wash stations and emergency showers, etc.)
- stop DCS
- stop UPS supply
- stop low voltage power supply
- stop medium voltage power supply
- stop high voltage power supply
- stop power supply from public grid

**NOTE**

For an extended shut-down period every piece of equipment must be conserved according to the suppliers / manufacturer's instructions.

### 3.2.8 Shut-Down Scenarios

There are different scenarios to shut down the plant:

- Normal shut-down of one unit followed by the shut-down of the plant: (see chapters 3.2.5 and 3.2.6)
- Emergency shut-down of a unit (the plant) with the public power grid in operation: (see chapter 3.2.9)
- Shut-down of the plant when it is isolated from the public power grid and island operation mode (the turbine generator is producing just as much electrical power as the plant is consuming; (surplus HP steam not being used in the turbine be routed through the turbine bypass and will be condensed in the ACC; see chapter 3.2.9).

  In such a case, power generated by the emergency diesel generator must be used to shut down the plant in a controlled manner: (see chapters 3.2.5 and 3.2.10)
- If, in an event as described above, the emergency diesel generator cannot be started due to any circumstances the plant must be shut down without any electrical power at all: (see chapter 3.2.11)

### 3.2.9 Emergency Shut-Down WITH Power Grid or Island Mode

Certain situations require an emergency shut-down of a unit or the plant. Such a situation could be:

- a serious failure of the ID fan (with NO possibility to start the auxiliary ID fan motor)
- a major boiler leak leading to an important water loss without the possibility to hold the level in the boiler drum
- failure of the compressed air supply system

- other serious events which require an immediate stop of the unit or the plant
- etc.

**WARNING**

**Avoid overheating of the boiler tubes !**

1st PRIORITY: Maintain the water level in the boiler drum within normal operating limits in order to ensure cooling of the water walls and the evaporator bundles.

2nd PRIORITY: Maintain steam flow in the superheaters for cooling.

When there is a risk of a TOO LOW water level in the boiler drum (water level drops down to a level reaching the water walls)

THEN

Lower the flue gas temperature in the combustion chamber quickly as possible to a target value below 400°C in order to respect the allowable maximum material temperature of the possibly uncooled boiler tubes.

The fuel supply to the unit must be stopped immediately. Depending on the nature of the failure this is done either automatically by an interlock or must be done MANUALLY.

**WARNING**

The boiler drum level must be monitored carefully. If necessary, the feed water control valve must be operated MANUALLY.

**WARNING**

Due to a possible water loss in the water steam cycle:

**Monitor the feedwater tank level carefully**.

Make sure there is enough water in the system.

**NOTE**

Depending on the nature of the failure the number of necessary steps to be carried out and the duration of the emergency shut-down may vary.

The following table is only a rough guideline for an emergency shut-down.

The following steps must be performed in order to achieve this:

- if the nature of the failure allows NOT to discharge the steam via the turbine by-pass station (in MANUAL operation)

THEN

1. open boiler start-up valve approximately 10% (live steam pressure should be lower than the opening pressure of the live steam safety valve – make sure there is always steam flow to cool the superheater bundles)
2. close live steam main shut-off valve (isolate the unit from the steam system)
3. During the subsequent steps:
   - check the life steam flow in order to cool the superheaters
   - if the steam flow is too low for safe cooling of the superheaters then increase the opening position of the start-up valve provided, that the water level in the boiler drum is maintained within its safe limits
   - decrease the opening position of the start-up valve if the water level in the boiler drum is below the safe limit and the flue gas temperature in the secondary combustion chamber is above 400°C

- stop waste feed to the feed hopper
- stop ram feeder and grate
- stop burners (if in operation)
- stop primary air fan
- make sure all primary air zone dampers are closed
- stop combustion control system
- stop secondary air fan
- start grate in MANUAL – adjust grate speed allowing the bottom ash extractor to discharge the bottom ash / waste – make sure the bottom ash extractor system doesn't plug
- start the ram feeder in MANUAL at 5 to maximum 10% speed in order to slowly empty the feed hopper
- close the feed hopper flap(s) as soon as the waste level in the feed chute allows for it
- when the secondary combustion chamber temperature is below 400°C the procedures for normal shut-down may be followed and the start-up valve may be closed
- stop the flue gas treatment system

### 3.2.10 Shut-Down WITH Emergency Power Generator

In case the power supply from the public grid fails, the turbine/generator set will normally be switched to island operating mode (see also chapter 3.1.5).

In this mode the turbine/generator set is producing only the electrical power which is being consumed by the plant itself. Surplus HP steam not being used in the turbine must bypass the turbine and will be condensed in the ACC.

If the turbine/generator set trips or Island Operation mode cannot be established due to other reasons, the emergency power generator will supply certain systems of the plant so it can be shut down in a controlled and safe way.

**NOTE**

The plant can NOT be operated with the emergency power supply in service. The sole purpose of the emergency power supply is to shut the plant down in a controlled and safe way.

The emergency power generator starts and generates power within 30 seconds after a public grid failure when island operation cannot be established.

The systems supplied by emergency power are being connected automatically to the emergency power net in a predefined sequence so the emergency power generator is not being overloaded and risks to trip.

**NOTE**

Only equipment which has been in operation prior to the trip (and which is enabled to be supplied with emergency power) will be re-started during the emergency power launch sequence.

The following systems (exemplary listing) will be supplied automatically with emergency power so the plant can be shut down in a controlled manner:

Immediately after start-up of the emergency power generator

- emergency lighting
- one out of several feedwater pumps
- feedwater control valve
- one out of several condensate pumps
- ID fan auxiliary motor (the main motor is NOT supplied with emergency power)
- one out of several compressors
- the power supply of the UPS system
- turbine control cabinet

Within 60 seconds after start-up of the emergency power generator

- one out of several demineralized water pumps
- one out of several closed cooling water system pumps
- all closed cooling water system fans
- grate cooling system pumps
- the burner cooling air fans

Within 120 seconds after start-up of the emergency power generator

- the waste crane personnel rescue device (the crane grab will NOT be supplied with emergency power)
- process water pump

See also chapter 4.4.1.

All other consumers are NOT energized, unless they are connected to the UPS system (such as: all control cabinets, all instruments and all important shut-off and control valves).

The load sequence of the emergency power generator will be terminated in 3 to 4 minutes after the start of the emergency diesel.

With the above mentioned consumers supplied, the unit (plant) can be shut down in a controlled and safe way:

- when the FG ID Fan is in operation – the ID fan auxiliary motor will be started automatically when the ID fan speed has reached 500 to 450 rpm while winding down from its previous speed
- when the FG ID Fan is NOT in operation – the ID fan is winding down from its last speed towards standstill; when the ID fan speed reaches 500 to 450 rpm, the auxiliary motor must be started MANUALLY)
- one feedwater pump will start in order to supply the boiler with water
- steam is condensed in the ACC
- one condensate pump will start in order to supply condensate to the feedwater tank

**WARNING**

The boiler drum level must be monitored carefully. If necessary, the feed water control valve must be operated MANUALLY.

- the waste remains on the grate
- close the feed hopper flap(s) using the hydraulic pressure reservoir; if this is not possible, carefully monitor the feed hopper using the TV camera; if smoke exits the feed hopper consider using the sprinkler or the fire extinguishing system
- when the secondary combustion chamber temperature is below 400°C the procedures for normal shut-down may be followed as allowed by the limited supply of power

**NOTE**

When the power supply is re-established make a control round in the plant before re-starting any piece of equipment.

- check all hoppers and conveyors; empty if necessary
- re-fill all emergency water vessels if empty
- re-fill all other water vessels if empty

**NOTE**

Before re-starting the plant after an emergency shut-down (according to the steps described in chapters 3.2.2 (Cold Start-Up) and 3.2.3 (Warm Start-Up)) make sure the plant is ready and prepared according to the steps described in chapter 3.2.1 (Preparation for Start-Up).

### 3.2.11 BLACK-OUT: NO Power Grid and NO Emergency Power Generator

In case the power supply from the public grid fails AND Island Operation mode of the turbine/generator set cannot be established AND the diesel engine of the emergency power generator doesn't start the entire plant is not supplied with electrical power (with the exception of the UPS supplied systems).

Such a scenario is considered to be a BLACK-OUT scenario.

**The turbine bypass station (PRDS valve) will CLOSE and steam will be discharged either through the boilers startup valve or its safety valve.**

**NOTE**

The waste must remain on the grate until the hydraulic system can be re-started. When power is available again the waste must be discharged into the bottom ash extractor.

**WARNING**

Be careful not to block the bottom ash extractor with waste; operate the grate manually and frequently check the bottom ash extractor.

**NOTE**

Close the feed hopper flap(s) using the hydraulic pressure reservoir; if this is not possible, carefully monitor the feed hopper using the TV camera; if smoke exits the feed hopper consider using the sprinkler or the fire extinguishing system

**WARNING**

In case the boiler drum level has dropped below the visible and measurable range, make sure that no feedwater will be fed to the boiler until the furnace temperature has dropped below 300°C.

Fill the boiler carefully with a reduced feedwater flow (max. opening of the feedwater control valve $\leq$ 5%).

**NOTE**

When the power supply is re-established make a control round in the plant before re-starting any piece of equipment.

- check all hoppers and conveyors; empty if necessary
- re-fill all emergency water vessels if empty
- re-fill all other water vessels if empty

**NOTE**

Before re-starting the plant after an black out (according to the steps described in chapters 3.2.2 (Cold Start-Up) and 3.2.3 (Warm Start-Up)) make sure the plant is ready and prepared according to the steps described in chapter 3.2.1 (Preparation for Start-Up).

# 4. Personnel Safety and Plant Protection

It is important to eliminate all possible hazardous situations at the design stage of a plant as far as is possible. If it is not possible to eliminate a hazardous situation then additional protective measures are required. These measures include warning signs, control interlocks, direct mechanical guards, complex control system; and emergency stops.

A HAZOP study is conducted to evaluate the risks within a plant and determine where additional measures are required.

Emergency stops are used as the last and final measure to avoid injury to an operator or damage to equipment.

A safe design of the systems along with mechanical and electrical measures assure the safety of the operating personnel and protect critical parts of the plant.

The safety level for critical equipment will be evaluated in a HAZOP and the respective risk analysis.

The **first level** and most proven safety measures are mechanical protections such as safety valves, guards, rails, stops, etc.; e.g. all pressurized or potentially pressurized systems are equipped with mechanical safety valves allowing dangerous pressure build-ups to be vented to a safe place.

The **second level** of safety measures react on a process deviation which could lead to a potential dangerous situation. This level is implemented in a designated Safety-PLC (safety instrumented systems (SIS)). All critical measurements from which thresholds are derived are connected directly to the Safety-PLC. The logic used in the Safety-PLC is being programmed according to the Safety-PLC manufacturers specifications and cannot be accessed without permission.

Because of its limited access manipulation of parameters in the Safety-PLC is only possible with a special access code. Any change to the logic is being automatically recorded.

The Safety-PLC communicates with the DCS via a safe BUS connection. All information treated in the Safety-PLC will be transferred by this BUS and is available in the DCS.

The **third level** of safety measures is the normal way of reaction. Measuring instruments evaluate process parameters and react on thresholds. As a consequence systems are either SHUT-DOWN (e.g. burners), are CLOSED (e.g. ammonia water main shut-off valve(s)) or, in particular cases, are OPENED (e.g. quench emergency water valve) or are STARTED (e.g. cooling system pumps).

The evaluation of the process parameters and the command for action are executed in the DCS. Before any actions are executed WARNINGS and ALARMS are being triggered in the DCS to direct the operators attention to the changing process situation.

The **fourth level** of safety measures is the emergency power supply to selected consumers so the plant can be shut down in a controlled and safe way in case of a public grid failure.

## *4.1 Structure of the Safety Measures*

The safety measures can be divided into four different levels of reaction when a fault or a malfunction emerges.

There are four different stages of reaction in case of a malfunction:

| No. | Type of reaction | Description | MCR-Function (Example) |
|---|---|---|---|
| 1 | Mechanical safety of plant | Installation of redundancies where needed. Logic in the DCS will select the working equipment automatically (switch to the redundant pump, select the two corresponding measurements …), the operation of the plant is not affected. The operating staff must replace the damaged element as fast as possible. | n/a |
| 2 | WARNING and manual operator intervention | Interventions according to the operation and maintenance manual, if the failure can't be repaired within the required time. (e.g. partial load operation, use of staple capacity, shut-down, etc.). | LAH |
| 3 | ALARM and automatic DCS intervention | Disturbance and failure of critical systems are protected by main interlocks in the control and monitoring system (DCS). These main interlocks prevent critical situations and switch the system automatically to a safe operation (e. g. limited operation, if still possible). | LSHH<br>LAHH |
| 4 | ALARM and automatic Safety PLC intervention | Critical situations regarding plant and personnel security are detected using special instruments interlocked in a hard-wired safety chain system, which initiates a safe STOP of the respective equipment (and as a consequence the associated equipment). | LZ3H<br>LA3H |
| Alternative | | | |
| 4 | ALARM and hardwired connection to the MCC | Plant safety in regard to big (expensive) equipment using type-tested contacts wired directly to the MCC (e.g. level LOW in the feedwater tank to protect the feedwater pumps from running dry) | LZL<br>LAL |

### *4.2 Main Interlock List*

The main interlock list gives a common understanding for personnel safety and plant safety issues related shut-downs or stops. It serves to document the interlocks between different systems and shows how the various systems respond to a failure of another system or when thresholds of critical process parameters are reached.

The main interlock list consists of two separate pages. The first page shows the interlocks that are processed in the Safety PLC, the second page serves to document the interlocks between different systems which are handled in the DCS.

Interlocks within single systems such as pump protections or the shut-down of sequenced mechanical transporting devices are NOT part of the main interlock list.

With the exception of a common unit emergency stop button or a plant shut-down emergency stop button in the control room, all other emergency stop buttons are NOT documented in the main interlock list.

The measurements of critical process parameters which must have a safe shut-down of process equipment (in the Safety PLC) as a consequence are either:

- 2 out of 3 measurements (2oo3) processed in the Safety PLC (see also chapter 2.3)

OR alternative

- type tested (German: baumustergeprüfte) binary contacts processed in the Safety PLC

## 4.2.1 Example: Safety Main Interlock List (Thermal Treatment)

**Hitachi Zosen Inova AG**

**This document is NOT a guideline for the programming. For details regarding the programming refer to the logic diagrams and the function descriptions**

**Sheet No. 1**
**Safety Main Interlock List**

Project: NYC Status: 01.03.2011
Project No.: P - 9999 Revision No.: 04
Doc. No.: xxxxxxxx
Drawn : Checked : Approved :

**Implementation in the Safety - PLC**

Hitachi Zosen INOVA

| Part of plant | | | | | | | | | | | Part of plant | Waste Storage | Thermal Treatment | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | System | | Feed Hopper | Ram Feeder & Grate Control | | Primary Air | | Secondary Air | Flue Gas Recirculation | | Wall Air | Burners | Pneum. Ash Removal | Boiler Cleaning |
| | | | | | | | | | | | Actuator | Crane | Damper | Ram Feeder | Grate | Fan (FC or motor) | Zone Dampers | Fan (FC or motor) | Fan (FC or motor) | Fresh Air Damper | Flue Gas Damper | Fan (FC or motor) | Burners 1 & 2 | Pneum. Ash Removal | Boiler Cleaning |
| | | | | | | | | | | | KKS Actuator | 0 EAF10 GH501 | 1 HHX70 AA310 | 1 HFY10 EA301 | 1 HHY10 EA301 | 1 HLB10 AN001 | 1 HHL10...50 AA400 | 1 HLB20 AN001 | 1 HNF10 AN001 | 1 HNG10 AA300 | 1 HNF10 AA300 | 1 HLB30 AN001 | 1 HJY10...20 EA001 | 1 ... | 1 ... |
| | | | | | | | | | | | PID No. | | 00044928 | 00050688 | 00050688 | 00044937 | 00044937 | 00044938 | 00044941 | 00044941 | 00044941 | 00044939 | 00044942 00044943 00044944 00044945 | 00044942 00044943 00044944 00044945 | |
| | No. | PID No. | System | Deviation | Ref. | Function MCR | KKS Sensor | KKS Signal | Threshold Value | Timer | | | | | | | | | | | | | | | | |
| Gen. | 1 | | Unit EMERGENCY STOP | EMERGENCY STOP OPERATED | | HZ | | 1 HHY10 CH001 | – | – | | *STOP 1)* | | *STOP* | *STOP* | *STOP* | [CLOSE] | *STOP* | *STOP* | *CLOSE* | *CLOSE* | *STOP* | *STOP* | *STOP* | *STOP* |
| Thermal Treatment | 2 | 00044937 | Primary Air Purging | Flow TOO LOW | | FSL | 1 HLA10 CP001 1 HLA10 CT001 | 1 HLA10 CF901 | < ??'000 m³/h LN START-UP | – | | | | | | | | | | | | | | *START LOCKED 2)* | | |
| | 3 | 00044938 | Secondary Air Purging | Flow TOO LOW | | FSL | 1 HLA22 CP001 1 HLA22 CT001 | 1 HLA22 CF901 | < ??'000 m³/h LN START-UP | – | | | | | | | | | | | | | | *START LOCKED 2)* | | |
| | 4 | 00044941 | Flue Gas Recirculation Purging | Flow TOO LOW | | FSL | 1 HNF10 CP001 1 HNF10 CT001 | 1 HNF10 CF901 | < ??'000 m³/h LN START-UP | – | | | | | | | | | | | | | | *START LOCKED 2)* | | |
| | 5 | 00044927 | Secondary Combustion Chamber | Temparature MUCH TOO LOW | | TZLLL | 1 HBK10 CT011-013 | 1 HBK10 CT901 | < 650 °C | – | | | | | | | | | | | | | | *START LOCKED 2)* | | |
| | 6 | 00044927 | Secondary Combustion Chamber | Pressure MUCH TOO HIGH | | PZHHH | | 1 HBK10 CP301 | > + 12.0 mbar | – | | [STOP] 1) | | [STOP] | [STOP] | *STOP* | [CLOSE] | *STOP* | | | | *STOP* | *STOP* | | |
| | 7 | 00044927 | Secondary Combustion Chamber | Pressure TOO LOW | | PZLL | | 1 HBK10 CP302 | < – 12.0 mbar | – | | [STOP] 1) | | [STOP] | [STOP] | *STOP* | [CLOSE] | *STOP* | *STOP* | *CLOSE* | *CLOSE* | *STOP* | *STOP* | | |
| | 8 | 00044966 | Boiler Drum | Level TOO LOW | | LZLL | | 1 HAD10 CL301 | < – 180 mm | – | | [STOP] 1) | | [STOP] | [STOP] | *STOP* | [CLOSE] | *STOP* | *STOP* | | | *STOP* | *STOP* | | |
| | 9 | 00044966 | Boiler Drum | Level TOO HIGH | | LZHH | | 1 HAD10 CL302 | > + 180 mm | – | | [STOP] 1) | | | | | | | | | | | | | |

## *4.3 Emergency Stop Concept*

### 4.3.1 General

The requirements related to emergency stop devices and systems in EN ISO 13850 and EN 60947-5-5 are complied with.

Activating an emergency stop doesn't lead to a worse situation for neither personal nor material.

**Categories**

The classification defined in EN 60204 as stated below are as follows:

*Emergency Stop Category 0*

Uncontrolled emergency stop – power is immediately removed from the device or from a group of devices. The loss of power initiates all brakes and failsafe mechanical stopping devices as well as all operational and safety interlocks.

*Emergency Stop Category 1*

Controlled emergency stop - the power supply is only removed once the devices have stopped according to the defined emergency shutdown sequence.

**Actions**

Direct/immediate emergency stops are required when moving parts can collide with personal or plant structures (e.g. cranes and conveyors) or when personnel could be caught in moving parts. In this case the emergency stop pushbuttons are hardwired directly to the switchgear supplying power to the actuator.

Emergency stops can be either directly hardwired to the local control panel, to the local actuator, to the circuit breaker in the motor control center (MCC) or, in exceptional circumstances, to the failsafe programmable logic controller (Failsafe-PLC).

To achieve a controlled stop, a safety system is required to perform the safe, sequential, shutdown of the plant or the faulty part of equipment, using hardwired control interfaces. Electronic cards, programmable logic controllers (PLC) or computer systems are not considered to be safety systems unless they comply with the requirements for a failsafe PLC as defined in EN 61508.

Refer to the document "TII 16.25 EU- UV- EM- Typicals" for the interfaces to the switchgear and the different drives.

**Alarm messages**

Every activation of any emergency stop device or button initiates an alarm in the DCS.

The emergency stop buttons have one dedicated contact for alarm purposes.

### 4.3.2 Local Emergency Stops

Local emergency stops are enclosed in separate casings and mounted in the vicinity of the device to be shut down immediately in case of an emergency.

The position of these emergency stops will be determined during detail engineering and in collaboration with the customers operating personal and/or the consultant.

### 4.3.3 Group Emergency Stops

Group emergency stops are located on local package unit (PU) field control cabinets or in the control room (e.g. line emergency stop).

These signals are connected to the fail-safe PLC and initiate the emergency shutdown of the power supply to all devices in the group or of the entire incineration line.

The “Main Interlocking Matrix E&C” (see also chapter 1.4), which will be generated during the extended basic engineering phase of the project shows the dependencies of the group emergency stops and the allocated drives.

#### 4.3.4 Emergency Stop List

All process emergency stop devices and buttons are listed in the document “Emergency Stop List”. The list will be generated during the extended basic engineering phase of the project (see also chapter 1.4).

On the PIDs these emergency stop devices are labeled with the KKS designation «HZ». They are different to the normal stop devices labeled with the KKS designation «HS».

### *4.4 Failures and Disturbances*

The following chapters describe a selection of the most important disturbances and/or failures.

It is NOT a complete list of all failures and disturbances which can occur.

#### 4.4.1 Electrical Power Supply Failure

In case of failure of the internal electrical power supply from the turbine generator as well as the external electrical power supply from the grid (failure of a transformer or BLACK-OUT), the emergency power generator starts automatically. The DCS starts the emergency operation sequence which allows to supply electrical energy to important plant equipment for a safe shut-down of the plant.

Until the emergency power generator is started the DCS is supplied from batteries via the uninterruptible power supply (UPS). The battery packs are designed for a power outage of approximately 60 min but are re-charged automatically after availability of the emergency power generator.

The emergency operation sequence is described in detail in chapter 3.2.10.

#### 4.4.2 Water Supply Failure

If the plants water supply fails, several systems are affected and the plant must be shut down when reliable supply cannot be established. The main affected systems are

- the demineralized water plant
- the sampling station
- the bottom ash extractor
- the grate riddling removal system
- etc.

Storage capacities, tanks and vessels are sized in a way that a short disturbance in the system does not influence normal plant operation. However if the problem cannot be solved within a reasonable time period the affected plant section or in the worst case the entire plant must be shut down.

### 4.4.3 Compressed Air Supply Failure

The plant is supplied with compressed air via two legs, instrument air and process air. There is no difference in the air quality, the system pressure and the air dew point are identical. The two legs each consist of a pressure reservoir each with enough storage capacity to shut the plant down in a safe manner. Actuators and instruments are being supplied with instrument air whereas viewports and atomizing nozzles are supplied with process air.

In case the pressure in the instrument air leg drops, the process air leg is automatically isolated from the instrument air leg and the remaining capacity of the process air reservoir can be used in the instrument air leg in order to shut the plant down.

### 4.4.4 LP Steam Supply Failure

During normal operation low pressure steam is extracted from the turbine. When the turbine is not in operation LP steam is produced in the HP/LP reducing station. This means that there is a virtual redundancy for this system.

Low pressure steam is supplied to various systems such as

- feedwater tank (pre-heating and removal of non-condensable gases)
- primary air pre-heater
- turbine gland steam system
- etc.

If low pressure steam cannot be supplied to the connected systems within a short period of time, the plant or the affected part of the plant must be shut down.

### 4.4.5 DCS Failure

The control system (DCS) is redundant (CPU's, servers and BUS). Not only the server but also the entire communication and data exchange system consists of a completely independent back-up unit. The DCS is powered via a redundant uninterruptible power supply (UPS) and ensures operability even in the case of a power failure. The two systems operate in parallel. One system is in operation and works a the master system, the redundant system serves as a slave system, ready to take over all the tasks in case of a system crash of the master system.

### 4.4.6 ID Fan Failure

In case of an ID fan failure the unit must be shut down. The ID fan is equipped with an auxiliary motor which will start in case the main motor of the fan or the frequency converter are defective or during a BLACK-OUT scenario. Since the auxiliary motor is not designed to start the fan, it can only be started while the fan rotor is turning in a range of 450 to 500 rpm. The task of the auxiliary motor is to ensure a minimum draft through the furnace and the flue gas cleaning system to avoid that flue gas can exit into the boiler hall.

The unit may NOT be operated with the auxiliary motor of the ID fan – it must be shut down. With a trip of the ID fan main motor the combustion air fans will also trip and thus the combustion intensity will be reduced drastically. This leads to an emergency shut-down.

### 4.4.7 General Equipment Failure

Failures of individual equipment or entire process units (systems) are indicated in the DCS in such a way that they are comprehensible for the operating personnel. The information is displayed in the DCS in different forms:

- list of alarms
- indication of the disturbance at the equipment
- indication of alarm values or thresholds (pressure, temperature, flow, quality etc.)
- collective alarms of function groups
- indication of missing start conditions or permanent conditions for an action to follow

The following table shows the effects of various system / unit failures on the plant / unit operation and actions to be initiated.

‘Normal shut-down’ means basically the shut-down procedure according to the shut-down procedure of the unit under consideration of the limitations from the process disturbance.

Depending on the configuration of the plant (single unit or multiple units) the effects of process disturbances and failures may vary.

### 4.4.8 Exemplary Table of Process Disturbances and Failures

| **Process Disturbance or Failure** | **Redundancy** | **Delay Time (*)** [min] | **Necessary Interventions**<br>(*) if no redundancy OR redundancy is not working | **Emergency Shut-Down necessary ?** |
|---|---|---|---|---|
| **Thermal Treatment** | | | | |
| Failure of one waste crane | Yes | Depends on waste level in feed hopper | normal operation possible, when the damaged crane can be pushed into the service bay | No |
| Failure of feed hopper cooling system | No | 0<br>120 | emergency cooling with town/process water,<br>then normal shut-down (depends on the level in the process water tank) | No |
| Failure of primary air system | No | 0<br><br>60 | stop of grate incineration, operation at reduced thermal load (steam flow) with start-up and auxiliary burners<br>normal shut-down (discharge of remaining waste on the grate) | No |
| Failure of primary air pre-heater | No | | operation at reduced thermal load (depending on the heat value of waste) | No |
| Failure of secondary air system | No | 0<br>120 | reduce thermal load (70%)<br>at 70 %, then normal shut-down | No |
| Failure of flue gas recirculation system | No | 0 | reduce thermal load (70%); operation with secondary air only (manual operation) | No |
| Failure of first hydraulic station pump | Yes | 60 | reduce thermal load | No |

| Process Disturbance or Failure | Redundancy | Delay Time (*) [min] | Necessary Interventions (*) if no redundancy OR redundancy is not working | Emergency Shut-Down necessary ? |
|---|---|---|---|---|
| Failure of second hydraulic station pump | Yes | 15 | Normal shut-down | No |
| Failure of ram feeder | No | 0<br>60 | reduce thermal load<br>then normal shut-down | No |
| Failure of grate | No | 0<br>60 | reduce thermal load<br>then normal shut-down | No |
| Failure of start-up and auxiliary burner | No | -<br>0 | continuous operation until furnace temperature < 850°C<br>when temperature < 850°C, then normal shut-down | No |
| Creeping water loss in the boiler | n/a | | normal shut-down | No |
| Cracked tube in the boiler | n/a | 0 | - | Yes |
| Failure of bottom ash extractor | No | 0<br>120 | stop of last grate zone<br>normal shut-down | No |
| Failure of bottom ash water supply | Yes, using process water | 0 | continuous operation with process water possible | No |
| Failure of bottom ash water supply with<br>Level < LSL | No | 0<br>30 | stop of bottom ash extractor and stop of last grate zone<br>normal shut-down | No |

| Process Disturbance or Failure | Redundancy | Delay Time (*) [min] | Necessary Interventions (*) if no redundancy OR redundancy is not working | Emergency Shut-Down necessary ? |
|---|---|---|---|---|
| Failure of bottom ash handling | No | 0<br>120 | stop of last grate zone<br>normal shut-down | No |
| Failure boiler cleaning devices | No | several hours<br><br>0 | reduction of thermal load depending on the boiler outlet temperature of the flue gas, then normal shut-down<br>outlet temperature too high, then normal shut-down | No |
| Failure ash / bottom ash handling system | No | several hours<br>0 | continuous reduction of thermal load depending on the outlet temperature of flue gas<br>outlet temperature too high, then normal shut-down | No |
| **Flue Gas Treatment** | | | | |
| Failure of $NH_4OH$ injection unit | No | 0 | depending on national regulation for $NO_X$ emission, then stop of feeding waste | No |
| Failure of water injection HZI Semi Dry (water injection pumps) | Yes | 0<br>0 | continuous operation<br>normal shut-down if temperature at top of reactor is too high | No |
| Failure of activated carbon and $Ca(OH)_2$ system | No | 0<br>10 | continuous operation with reduced load | No |
| Failure of flue gas reheating system for the fabric bag filter | No | - | only used during cold start-up of the unit | No |
| Loss of fabric bag filter (1 chamber) | Yes | 0 | continuous operation with possibly reduced thermal load (steam flow) | No |

| Process Disturbance or Failure | Redundancy | Delay Time (*) [min] | Necessary Interventions (*) if no redundancy OR redundancy is not working | Emergency Shut-Down necessary ? |
|---|---|---|---|---|
| Loss of fabric bag filter (all chambers) | No | 0<br>0 | stop the activated carbon and $Ca(OH)_2$ supply<br>then normal shut-down | No |
| Failure of residue transport below fabric bag filter | No | - | continuous operation possible until max. level LSH in fabric bag filter bunker is reached | No |
| Failure of ID fan frequency converter or main motor | No | 0 | auxiliary motor of ID fan starts at 500 to 450 rpm | Yes |
| Failure in the flue gas ducts | No | 0 | when the pressure is too low on the suction side of the ID fan | Yes |
| **Heat Recovery** | | | | |
| Failure of de-mineralized water plant | No | Hours or days<br>0 | depends on size of the storage tank and possibility of supply from an external source<br>normal shut-down when level of tank gets too low | No |
| Failure of first feedwater pump | Yes | 0 | automatic switch-over to redundant pump | No |
| Failure of second feedwater pump | No | 0 | emergency shut-down | Yes |
| Failure of first condensate pump | Yes | 0 | automatic switch-over to redundant pump | No |

| Process Disturbance or Failure | Redundancy | Delay Time (*) [min] | Necessary Interventions (*) if no redundancy OR redundancy is not working | Emergency Shut-Down necessary ? |
|---|---|---|---|---|
| Failure of second condensate pump | No | 2 | emergency shut-down | Yes |
| Failure of air cooled condenser (ACC) | No | 0 | | Yes |
| Failure of steam turbine | No | 0 | possible reduction of thermal load with external power supply and steam condensation via turbine bypass operation (ACC) | No |
| Failure of the closed cooling water system (CCWS) pump | Yes | 0 | normal shut-down | No |

## 5. Revisions

| Rev. | Date / Initial | Objects, Chapter | Modification |
|---|---|---|---|
| 01 | Halloween 2011<br>/ Pst | all | Complete overhaul of the document |
| 02 | 07.05.12<br>/ Pst | 1.4<br>2.1.3<br><br><br>3.2.9 | Corrected and extended the list of associated documents<br>added the description of the "ALL AUTO" command for MFG's and FG's<br>Harmonized description of 2oo3 block with the respective description in Comos<br>Corrected the description of the emergency shut-down scenario |
| 03 | 22.04.14<br>/ Pst | 1.4<br><br>2.5.2<br>3.1.5<br>4.3 | Corrections of the number and names of the associated documents in conjunction with GP 425<br>Added example of the DCS screen structure<br>More precise description of the island mode<br>New chapter: Emergency Stop Concept (incorporated the formerly associated document in the POO) |
| 04 | | | |
| | | | |

# Appendix G

## NSW EPA/TNG Meeting Minutes

**Meeting Minutes. TNG & EPA Energy from Waste 12 February 2015**

Present:

Steve Beaman EPA
Sarah Crossie EPA
Marc Stammbach HZI
Ian Malouf TNG

**Chlorine concentrations**

In the EU regulation the following is stated in the WID (Waste Incineration Directive): If hazardous waste with a content of more than 1% of halogenated organic substances, expressed as chlorine, is incinerated, the temperature has to be raised to 1100°C for at least two seconds.

In the NSW EfW policy the following is stated: If a waste has a content of more than 1% of halogenated organic substances, expressed as chlorine, the temperature should be raised to 1100°C for at least 2 seconds after the last injection of air.

There is a small, but significant difference between these two texts, with considerable implications for EfW in Australia ("hazardous waste" versus "waste").

PVC is not classified as a hazardous waste in both jurisdictions. Moreover, the WID regulation is not concerned about "chlorine", but about "hazardous waste with halogenated organic substances".

In the European EfW experience it has been found that EfW typically has to cope with concentrations of PVC of around 1% (MSW) with around 0.4% as back ground chlorine (not PVC related). Residual fractions from recycling, C&D and C&I can reach up to nearly 10% in the European experience.

If TNG would find similar chlorine level of around 1% in MSW as per European experience, the current NSW EfW policy would require burning at 1,100°C/2 instead of 850°C/2s. Current technology (from all EfW providers) doesn't allow efficient energy recovery at the higher temperature. In consequence, the energy efficiency requirement of R1>0.65 cannot be achieved. Hence, the NSW EfW Policy will contradict itself unless the wording is changed (back to the European WID).

TNG believes that the text of the NSW EfW Policy needs to be amended to reflect the EU regulation and the European experience of safe EfW at chlorine concentrations of typically around 1% with some waste fractions up to 8%. The issue is of chlorine is purely technical, e.g. the capability of the flue gas treatment to cope with short-term chlorine peaks as well as long-term chlorine concentrations – whatever level they are.

EPA will consider this proposal of a change to the NSW EfW Policy.

**Contaminants in Waste Streams**

Note 2 of NSW EfW Policy (page 9): "Waste streams proposed for energy recovery should not contain contaminants such as batteries, light bulbs or other electrical or hazardous wastes."

Above is technically impossible to assure. In addition, it is known that even in countries (example Switzerland) with household battery, car battery, fluorescent lamp, electrical and electronics collection schemes a significant proportion (low percentage to plus 30%) are estimated to go to EfW plants, e.g. the only alternative in the absence of landfills (as prohibited).

TNG proposed to either delete this Note 2 or to amend with: "as economically and technically justifiable".

EPA will consider this proposal of a change to the NSW EfW Policy.

**Sourcing eligible waste**

TNG has quantified the potential amount of eligible waste from "authorised facilities" in the market for EfW. This exercise used publically available documents and the EfW Policy's resource recovery criteria to quantify the scale of each mixed and separated waste stream in the market. The exercise demonstrated that there was enough C&D and C&I material (TNG's target streams) to fuel the facility today.

The tonnes received today by DADI exceed the tonnes required for Lines 1 & 2 (582,000tpa), thus proving that TNG already has access to enough eligible tonnes for the first stage of operation. This data will be provided:

- To EPA with client details (as commercial in confidence and not for publication),
- To DA document without client details (for publication).

TNG proposes to continue the DA process for four lines, but to delay the construction of lines 3 & 4 until the eligible sources of waste required for four lines can be confirmed to the satisfaction of the Department.

TNG will double the capacity of its existing C&D MRF at the Genesis site with a focus on C&I as part of the TNG project.

EPA noted and welcomed these comments.

In TNG's experience up to 90% of C&D waste is already sorted at the construction sites during the demolition stage. TNG has already independent auditing under the GreenStar reporting guidelines in place and will continue to do so and will expand this method to its suppliers.

EPA will consider this proposal.

**ASR (Automobile Shredder Residue) – "Flock"**

"Flock" waste is not identified as an independent waste stream in the NSW EfW Policy, but classified as commercial waste.

EPA indicated that flock is not excluded from EfW and will likely be included in an amended version of the NSW EfW policy and that the resource recovery threshold would be 25%, in accordance with current metal recycling operations.

**Ash composition**

The ash composition will be estimated from overseas EfW installations burning similar wastes as TNG.

TNG has engaged Rambol (EfW consultancy) to conduct sensitivity testing utilising the specific waste characterisation identified previously for each target waste source. The results will reflect the actual characterisation and input waste streams into the facility. MRA will review this sensitivity testing against the licenses of appropriate landfills.

EPA welcomed this approach.

# Appendix H

## Estimation of ash and residue Composition

# MEMO

| | |
|---|---|
| Job | **The Next Generation Project**<br>**Estimation of ash and residue composition** |
| Client | **Ian Malouf, Dial-a-Dump Industries** |
| Memo no. | **TNGWTE-141-001, ver. 3** |
| Date | **18 March 2015** |
| To | **Ian Malouf** |
| From | **Tore Hulgaard** |
| Copy to | **Martin Brunner; Ramboll**<br>**Ute Fleck, HZI**<br>**Claudia Einsporn, HZI** |

Date 18 March 2015

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## 1. Introduction

Ramboll and HZI have been asked to do an assessment of the ash fractions from the plant, based on the expected waste composition.

The assessment has been based on the expected waste composition received from DADI, version *Composition Summary Final 090215b.*

The assessment of the ash fraction has been divided 3 fractions:

- Bottom ash
- Boiler ash
- Fly ash/APC residue

The assessment has been made by Ramboll and HZI in collaboration. Furthermore Ramboll have made a few minor comments/considerations to the assessment.

## 2. Ash and residue composition

We have performed an estimation of the ash and residue amounts and composition based on the expected waste composition.

The estimate has been performed in close collaboration with HZI, and is based on the experience from Ramboll and HZI, including available literature data.

The mass balance is followed for each element from waste to the amounts and composition of the respective outputs, i.e. bottom ash, boiler ash, and APC residue (APC=air pollution control).

The anticipated amount of added lime and activated carbon (PAC= pulverized activated carbon) are considered, including the effect on

the resulting amount of the APC-residue.

The input mass flow of waste is chosen at the nominal load point of 34.5 tonnes/h. Each output is characterised by its mass flow for one EfW line at 34.5 tonnes/h and the specific contaminant concentration and leachable concentration.

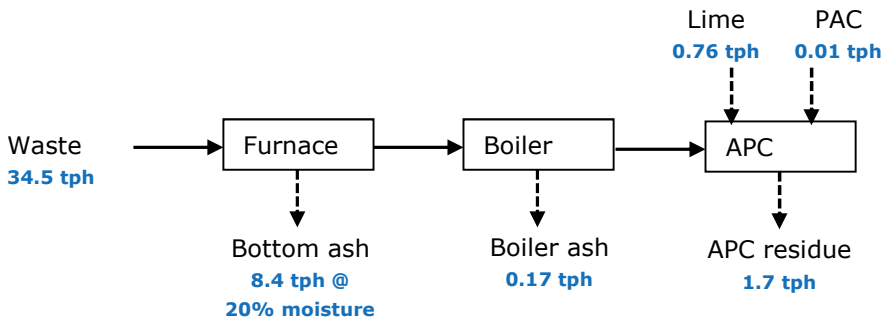


**Figure 1 Mass flows, estimated nominal**

We note that the residual composition of waste is a consequence of the composition and mass flow of each material fraction. Moreover that material fractions are not precisely defined when it comes to elemental composition. Also the mass flows of each material fraction may vary. For these reasons quite large variations should be foreseen. However a WtE facility is designed to cope exactly with such variations.

The residues may be handled as separate products or they may be mixed and handled as one residue. I Europe the bottom ash is often used for road construction, otherwise the boiler ash could be mixed into the bottom ash. The APC residue is usually kept and disposed as a separate fraction. The resulting residues and their composition are compared with limit values in Appendix 1.

In USA it is common to mix the residues and treat them as one, as illustrated with resulting concentrations in Appendix 2. In this case the output mass is the sum of residues mass flows in Figure 1, i.e. estimated as 10.3 tph.

## 2.1 Accumulated ash quantities

At nominal load the plant will be processing 1,105,000 tonnes/year of waste.

Based on the estimated waste composition, the total amount of ash and residue will be (rounded amounts):

| | | |
|---|---|---|
| Bottom Ash: | 270.000 | tonnes/year @ 20% moisture content |
| Boiler Ash: | 5.000 | tonnes/year |
| APC Residue: | 55.000 | tonnes/year |
| Sum | 330,000 | tonnes/year |

**Appendix 1**

## Composition and leaching properties of individual residues

**Energy from Waste Facility, Eastern Creek**

**TCLP and SCC values for classifying waste by chemical assessment**

| | Bottom ash | | Boiler ash | | APC residue | | Waste Classification Guideline Table 2 | |
|---|---|---|---|---|---|---|---|---|
| | Leachable concentration | Specific contaminant concentration | Leachable concentration | Specific contaminant concentration | Leachable concentration | Specific contaminant concentration | Leachable concentration | Specific contaminant concentration |
| **Contaminant** | TCLP1 mg/l | SCC1 mg/kg DM | TCLP1 mg/l | SCC1 mg/kg | TCLP1 mg/l | SCC1 mg/kg | TCLP1 mg/l | SCC1 mg/kg |
| Antimony | | 46 | | 600 | | 360 | | |
| **Arsenic** | 0.1 | 10 | 0.3 | 30 | 0.2 | 18 | 5 | 500 |
| **Benzo(a)pyrene** | < 0.001 | < 0.1 | < 0.01 | < 1 | < 0.01 | < 1 | 0.04 | 10 |
| **Cadmium** | 0.3 | 18 | 2.4 | 120 | 3.1 | 156 | 1 | 100 |
| Chlorine | | 2,769 | | 36,000 | | 164,360 | | |
| Chromium | | 1,205 | | 750 | | 225 | | |
| **Chromium (VI)** | < 0.1 | < 10 | < 0.1 | < 10 | < 0.01 | < 1 | 5 | 1,900 |
| Copper | | 4,821 | | 3,000 | | 900 | | |
| Fluorine | | 154 | | 1,200 | | 3,265 | | |
| **Lead** | 2.5 | 1,000 | 7.5 | 3,000 | 4.5 | 1,800 | 5 | 1,500 |
| Manganese | | 2,892 | | 1,800 | | 540 | | |
| **Mercury** | < 0.01 | 0.3 | < 0.01 | 2 | < 0.01 | 19 | 0.2 | 50 |
| **Nickel** | 0.1 | 241 | 0.1 | 150 | < 0.1 | 45 | 2 | 1,050 |
| Sulfur | | 5,128 | | 40,000 | | 55,203 | | |
| Thalium | | 0 | | 3 | | 4 | | |
| Tin | | 333 | | 1 | | 600 | | |
| Vanadium | | 100 | | 0.30 | | 180 | | |
| Zinc | | 7,051 | | 25 | | 20,000 | | |
| | | | | | | | | |
| C org | | 8,051 | | 6280 | | 8,740 | | |
| $SiO_2$ | | 438,462 | | 270,000 | | 63,000 | | |
| CaO | | 110,769 | | 144,000 | | 349,765 | | |
| $Al_2O_3$ | | 101,538 | | 110,000 | | 33,000 | | |
| $Fe_2O_3$ | | 78,769 | | 38,400 | | 8,960 | | |
| $Na_2O$ | | 9,231 | | 8,000 | | 3,200 | | |
| MgO | | 23,077 | | 30,000 | | 7,000 | | |
| $K_2O$ | | 5,769 | | 15,000 | | 6,000 | | |
| Other matrix elements | | 2,410 | | 1,500 | | 450 | | |

**Appendix 2**

**Composition and leaching properties of residues when mixed**

## Energy from Waste Facility, Eastern Creek

**TCLP and SCC values for classifying waste by chemical assessment**

| | mix Bottom ash, Boiler ash, APC residue | | Waste Classification Guideline Table 2 | |
|---|---|---|---|---|
| | Leachable concentration | Specific contaminant concentration | Leachable concentration | Specific contaminant concentration |
| **Contaminant** | TCLP1 mg/l | SCC1 mg/kg DM | TCLP1 mg/l | SCC1 mg/kg |
| Antimony | | 120 | | |
| **Arsenic** | 0.1 | 12 | 5 | 500 |
| **Benzo(a)pyrene** | < 0.001 | < 0.1 | 0.04 | 10 |
| **Cadmium** | 0.8 | 48 | 1 | 100 |
| Chlorine | | 35,752 | | |
| Chromium | | 1,000 | | |
| **Chromium (VI)** | < 0.1 | < 10 | 5 | 1,900 |
| Copper | | 4,000 | | |
| Fluorine | | 797 | | |
| **Lead** | 3 | 1,200 | 5 | 1,500 |
| Manganese | | 2,400 | | |
| **Mercury** | < 0.01 | 4 | 0.2 | 50 |
| **Nickel** | 0.1 | 200 | 2 | 1,050 |
| Sulfur | | 15,841 | | |
| Thalium | | 1 | | |
| Tin | | 400 | | |
| Vanadium | | 120 | | |
| Zinc | | 10,000 | | |
| | | | | |
| C org | | 8,154 | | |
| $SiO_2$ | | 360,000 | | |
| CaO | | 159,233 | | |
| $Al_2O_3$ | | 88,000 | | |
| $Fe_2O_3$ | | 64,000 | | |
| $Na_2O$ | | 8,000 | | |
| MgO | | 20,000 | | |
| $K_2O$ | | 6,000 | | |
| Other matrix elements | | 2,000 | | |