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Operational Techniques and Monitoring Plan

Ellough Energy Recovery Facility

V.C.Cooke Limited

CRM 0157 001

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Operational Techniques and Monitoring Plan – CRM 0157 001 PE R 006

Project:	Ellough Energy Recovery Facility
For:	V.C. Cooke Limited
Status:	**FINAL**
Date:	August 2023
Author:	Steph Charnaud, Director of Permitting
Reviewer:	Peter Cumberlidge, Director

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1.0 Introduction

1.1 Overview

1.1.1 V.C. Cooke Limited (hereby referred to as "the Operator") proposes to operate a Small Waste Incineration Plant (SWIP) to be located off Ellough Road next to the Moor Business Park, Beccles, Suffolk, NR34 7TQ.

1.1.2 The proposed plant will receive Refuse Derived Fuel (RDF) from V.C. Cooke's adjacent Permitted waste operation, as well as from other operations. The RDF consists of waste types, which are not able to be recycled and are currently send to landfill.

1.1.3 The RDF will be transferred onto the site from the neighbouring site, as required by covered articulated lorry, and deposited onto the walking floor. The RDF will arrive pre-treated and shredded down to 200mm. Nominally 24,369 tonnes of RDF will be supplied per annum which will feed the plant at a maximum rate of 2.89 tonnes per hour.

1.1.4 The RDF will be combusted in a Hurst steam solid fuel combustor with a heat recovery system. The gas from combustion will be used to drive the high-pressure hybrid boiler. The electricity produced by steam from the boiler will be utilised by neighbouring sites.

1.1.5 This document has been prepared to support a Part A(2) Small Waste Incineration Plant (SWIP) Permit Application comprising of the following listed activities under the Environmental Permitting (England and Wales) Regulations 2016 (as amended):

- Schedule 13A – A waste incineration plant or waste co-incineration plant with a capacity less than or equal to 10 tonnes per day for hazardous waste or 3 tonnes per hour for non-hazardous wastes.

1.1.6 This document has been prepared to fulfil the requirements set out within Section 5, 6 & 7 of the Permit application form; to provide details of the operational techniques that will be used to minimise and control emissions from the proposed facility; and to demonstrate that the technology selection and control measures to be implemented follow appropriate guidance.

1.2 The Applicant

1.2.1 The Facility will be operated by V.C. Cooke Limited.

1.2.2 V.C. Cooke Limited is a private limited company whose registered office address is: VC Cooke, Ellough Road, Beccles, England, NR34 7TQ. The Company Number as registered on Company's House is: 06693252 and was incorporated on 9th September 2008.

1.3 Site Location

1.3.1 The proposed facility's full address is:

V.C. Cooke Ltd
Ellough Road
Beccles
Suffolk
NR34 7TQ

1.3.2 The proposed Facility will occupy approximately 1.15ha of land which is centred at national grid reference TM 44079 88422. The location of the site is illustrated on the map provided in the Drawings Section of this Application referenced CRM 0157 001 PE D 001 Site Location Plan.

1.3.3 The proposed development is located off Ellough Road next to the Moor Business Park. The villages of Worlingham and North Cove are located approximately 1.4km north and 2.2km northeast. beyond this, the centre of the market town of Beccles is located approximately 2.7km northwest.

1.4 Regulated Activities

1.4.1 The facility will consist of a single line incineration plant.

1.4.2 The Operator is applying to East Suffolk Council to operate a Part A (2) SWIP Permit.

1.4.3 The proposed plant will receive no more than 24,369 tonnes of waste per annum. The plant will accept feedstock defined within Article 3.1 of the Waste Framework Directive (non-hazardous RDF) and will be limited to processing no more than 2.89 tonnes per hour of material based upon an operational run time of up to 8432 hour per annum to allow for downtime for planned maintenance.

1.4.4 The Draft Environmental Permitting Technical Guidance Note PG13/1(20), Reference document for the operation of small waste incineration plants (SWIPs) (referred to as 'PG13/1'). PG13/1 states:

"In determining whether a SWIP is an incineration or a co-incineration plant, the regulator will have regard to the main purpose of the plant. Where the main purpose of the plant is the generation of energy or the production of material products, the SWIP shall be considered to be a co-incineration plant."

1.4.5 As the main purpose of the plant is to thermally treat waste to produce energy it is regulated as a co-incineration plant.

1.4.6 The RDF will be sourced from the existing VC Cooke waste management facility, which is located on the adjacent site, and local permitted waste management facilities.

1.4.7 The proposed thermal input of the Boiler is 9.894MWth with and electrical output of 2.5MWe from the resulting steam turbine from a waste input of 2.89 tonnes/hour.

1.4.8 The scope of all regulated activities is summarised on Table 1.4.1 below.

Table 1.4.1: Regulated Activities

IED Activities			
Listed Activity	**Description of Specified Activity**	**Limits of Specified Activity**	**Specified Waste Management Operations**
Schedule 13A Small Waste Incineration Plant	• A waste incineration plant or waste co-incineration plant with a capacity less than or equal to 10 tonnes per day for hazardous waste or 3 tonnes per	The receipt of fuels. The thermal treatment (by combustion) of RDF feedstocks to produce heat, for use in a boiler to produce	• D10: Incineration on Land (Burning Waste in Combustion Unit) • D15: Temporary storage of wastes

	hour for non-hazardous wastes	steam for a turbine to produce electricity. Air-pollution control (APC) of gases.	pending D10 activities • D9: Physico-chemical treatment resulting in final compounds or mixtures which are discarded by any of the operations numbered D1 to D12. • R13 Storage of waste pending any of the operations numbered R1 to R12.
DAAs	• Fuel reception and storage; • Raw material reception and storage; • Fuel feeding system; • Gas conditioning, including cleaning and cooling; • Residue handling; • Controls and monitoring; • Storage and handling of wastes generated by process		

1.5 Planning Status

1.5.1 Planning application was submitted to Suffolk County Council on 18th November 2022 and planning consent was granted on 27th April 2023.

1.6 Relevant Legislation and Guidance

1.6.1 The proposed activities are subject to a number of National, European and International legislation, statutory and non-statutory guidance documents. Operators are required through the Permit application process, to demonstrate how they will comply with the relevant requirements of this legislation and guidance.

1.6.2 This application has been prepared using the Draft Environmental Permitting Technical Guidance Note PG13/1(20), Reference document for the operation of small waste incineration plants (SWIPs).

1.6.3 The following pieces of legislation and guidance are relevant to the proposed operations:

- Environment Permitting Technical Guidance PG13/1(20), Reference document for the operation of small waste incineration plants (SWIPs), Draft.
- The Environmental Permitting (England and Wales) Regulations 2016 (as amended);
- Chapter IV of Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) Text with EEA relevance (IED ChIV).
- Environmental Permitting: General Guidance Manual on Policy and Procedures for A2 and B Installations, Defra: May 2011;
- Environmental Permitting Core Guidance, Defra; March 2013 (as amended);
- Environmental Permitting Guidance: The Waste Framework Directive, Defra 2011;
- Environment Agency Monitoring Guidance Series:

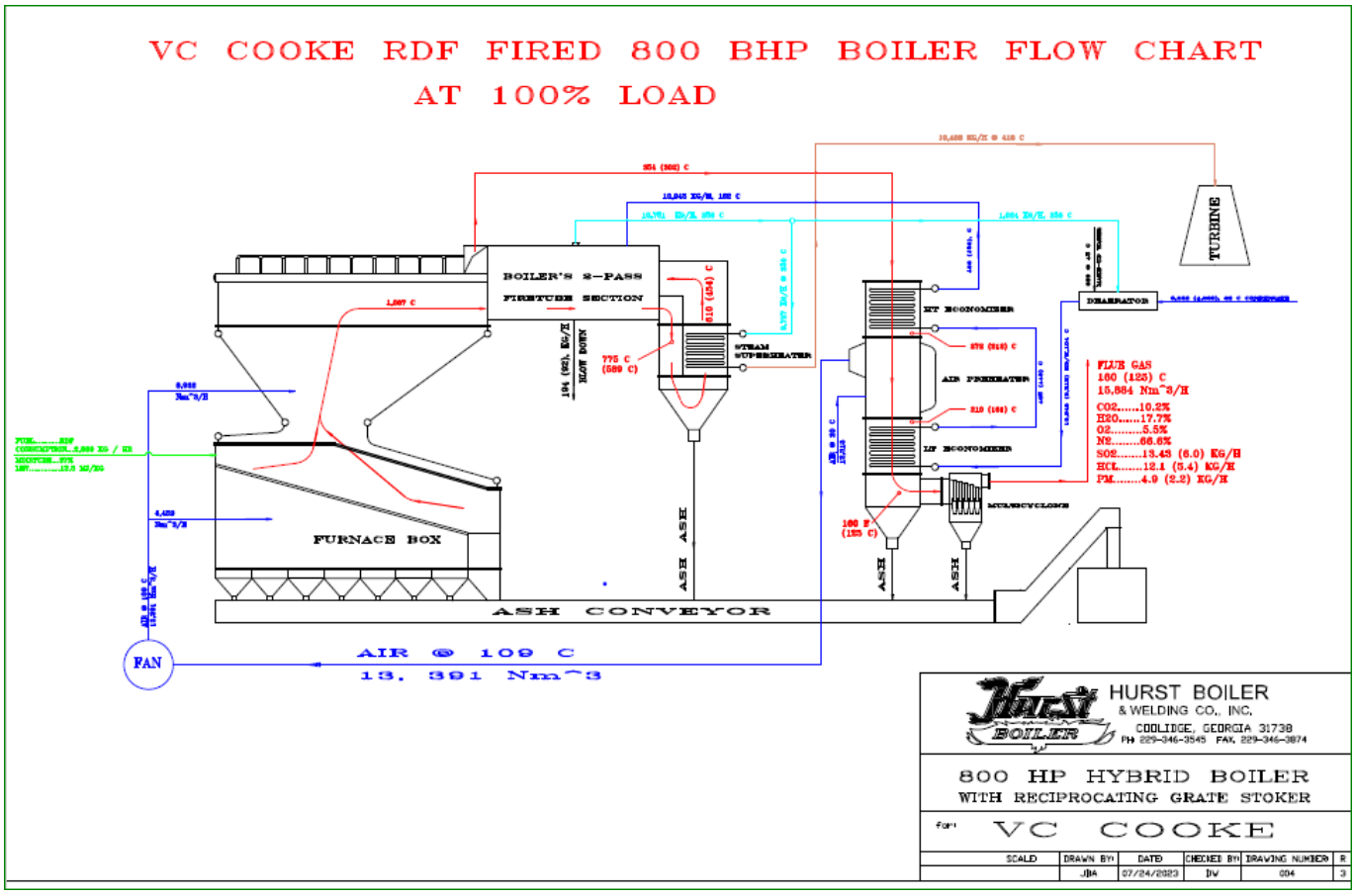
- Sector Guidance Note EPR 5.01: Guidance on the Incineration of Waste, Environment Agency, 2009; and ;
- The Environment Agency's Regulatory Guidance Note series; in particular RGN2 for the purpose of defining the installation as a 'SWIP'.

2.0 Process Description

2.1 Overview

2.1.1 This section of the report describes the purpose and operation of the proposed Facility. Figure 2.1.1 below illustrates the main components to be installed at the site.

Figure 2.1.1: RDF Fired 800 BHP Boiler Flow Chart



2.1.2 A detailed Site Layout Plan is provided in the Drawings section of this application, along with a larger version of the above diagram and a mass balance is provided in Section 3.9 below.

2.1.3 The proposed Facility comprises of the following processes:

- Acceptance, Storage and feeding of RDF
- Combustion of RDF and production of steam through a steam boiler
- Use of steam in a turbine to produce electricity
- Treatment collection and storage of incinerator bottom ash and fly ash
- Storage of other waste materials from the process
- Storage of raw materials for input into the process
- Site drainage

2.2 Storage of Input Waste

2.2.1 The RDF will be stored on the adjacent EA permitted waste site. RDF will be brought into the SWIP facility by a by covered articulated lorry and deposited onto the walking floor. Nominally 24,369 tonnes of RDF will be delivered per load which will feed the plant for 8.3-8.65 hours at a rate of 2.89 tonnes per hour. RDF will be weighed as it's transferred from the EA permitted site to the SWIP and records will be kept.

2.3 Feeding of Input Waste

2.3.1 The RDF will be transported by the walking floor to the metering bin which will feed the RDF into the combustion furnace at a specified rate.

2.3.2 The metering bin uses a pneumatically actuated damper system to evenly distribute the RDF from the conveyor into each of the metering tubes which in turn spread the RDF onto the sloped metal reciprocating furnace grates, ensuring a continuous even spread.

2.4 Combustion

2.4.1 Once the RDF has been transferred from the metering bin into the furnace, it is dispersed upon a series of metal grates and the combustion process begins.

2.4.2 The reciprocating grate technology is sloped to facilitate the movement of the RDF through the combustion zones of the furnace at a rate which ensure the most efficient heat transfer to the water in the boiler.

2.4.3 After initial ignition of the RDF followed by heating and drying, volatile gasses start to be released. The remaining RDF continues to travel along the reciprocating grate and continues to be processed.

2.4.4 The furnace is divided into multiple zones, each zone incorporates an under-fire combustion air supply to ensure complete combustion. Each zone incorporates an under-grate air plenum that will supply a prescribed quantity of air to ensure complete combustion of the RDF. Once the heated fuel reacts with the under-air fire, volatile gasses are released and rise towards the top of the furnace where over fire combustion air is introduced. The over fire air mixes with the volatile gasses causing a complete combustion reaction that releases the maximum amount of heat from the fuel, which in turn ensures a more efficient heat transfer to the boiler.

2.4.5 Generally, in the furnace, 45% excess air is required for full combustion of RDF fuel. In other words, total air required for combustion is 45% more than required for a stoichiometric condition. However, only 25-35% of the air required for full combustion flows through the reciprocating grate into the furnace gasification zone.

2.4.6 Airflow through the furnace is controlled by four (4) air zones at approximately:

- Zone 1 = 10% of flow,
- Zone 2 = 35% of flow,
- Zone 3 = 35% of flow, and
- Zone 4 = 20% of flow.

2.5 Afterburner

2.5.1 The open area of the furnace necks down allowing a lesser volume of combusted fuel into the afterburner zone of the system. This necking down of volume provides a distinct separation of the Combustor zone from the afterburner zone. At the base of this transition (lower portion of the neck area) is refractory material that reflects heat down onto fuel thereby enhancing full separation (dissociation) of the fuel components (volatile matter and char on the reciprocating grate). This process drives the remaining volatiles, air, and carbon into the afterburner zone.

2.6 Afterburner to Boiler for Steam Generation

2.6.1 Air is introduced above the refractory section of the neck area and creates a turbulent vortex of gases that flow into the afterburner zone. The introduction of air at this location provides a second stage of combustion and fully oxidizes the remaining volatiles and carbon monoxide to release all remaining heat available from the fuel into a gaseous state at the base of the water tube boiler. In this way, steam is generated at the desired conditions—temperature and pressure. The steam is then available drive the steam turbine generator.

2.6.2 When all of the volatile gasses have been burnt then ash remains. The ash is pushed off the end of the grate into a waterfilled ash bed then disposed of by the ash conveyor system as described in section 2.8 below.

2.7 Treatment and Storage of Ash

2.7.1 The last level of the reciprocating grates is to push the unburnt ash into a water trough that quenches the remaining embers and saturates the ash so that no dust escapes. The saturated ash sinks to the bottom of the water trough where it is pulled by a chain to outside of the furnace. The design of the ash removal system is such that the combustion of RDF can continue to operate while ash removal is occurring.

2.7.2 Once the ash exits the furnace the chain is to travel up an inclined slope to drain the water, the as is then discharged onto a separate conveyor and deposited within a collection bin. The ash will be transported off site and will be used in the production of aggregate by a local Permitted site, Ley Plant, Sandpit Lane, Ellough Industrial Estate, Beccles, NR34 7TH.

2.7.3 It is estimated that the Facility shall produce approximately 2,730 tonnes of ash per annum.

2.8 Release of Exhaust Gasses

2.8.1 The flue gasses which exit the stack contain energy in the form of heat that can be further utilised, increasing the overall efficiency of the process. An economiser will be utilised to harness this extra heat, for use in pre-heating the water in the feed water storage device. The economiser, (a convection design heat exchanger), will be mounted directly on top of the exhaust stack of the boiler, to allow the maximum amount of heat transfer.

2.8.2 Before the flue gas is released into the atmosphere it's directed through a multi-cycle to remove particulate matter. This is then collected in a hopper and deposited in a bin before removal off site by an appropriately authorised contractor.

2.8.3 The exhaust stack will include test ports to enable gas sampling with a ladder and platform to ensure safe access. This meets with the requirements of the Environment Agency's MCERTS guidance.

2.8.4 A Selective Non-Catalytic Reduction (SNCR) plant, using urea solution as the reagent, will be utilised to help reduce emissions of nitrogen oxides from the flue gasses. The SNCR technology works by injecting an aqueous solution of urea with specific additives (NOxAMID 40% data sheet in Appendix H) into the flue gas stream. This reaction forms molecular nitrogen and water vapour.

2.9 Storage of Raw Materials

2.9.1 Details of the type, quantity and storage of raw materials utilised at the facility is provided in Appendix A of this report.

2.10 Site Drainage

2.10.1 The Facility does not benefit from a connection to a foul sewer network. Effluent generated within the processing building and from the waste storage and handling areas will be directed to a sealed drainage system. This effluent is then directed, via a silt separator to a 46,000L below ground storage tank. The tank will be emptied on a regular basis by an appropriately authorised contractor for disposal at an appropriately Permitted Facility.

2.10.2 Clean surface water run-off, from the roof and external areas will be collected for reuse on the site neighbouring site for dust suppression and wheel washing. The clean surface water will be stored within an underground proprietary crate attenuation system.

2.10.3 A drainage plan is included within the Drawings Section of this Application.

3.0 Operational Techniques

3.1 Introduction

3.1.1 This section of the report describes the management and operational techniques in place to minimise emissions.

3.2 Waste Acceptance, Storage and Feeding

3.2.1 The proposed Facility will accept no more than 24,369 tonnes of waste per annum. The maximum rate of throughput will be 2.89 tonnes per hour.

3.2.2 The feedstock will consist of RDF, which will have undergone pre-treatment at V.C. Cooke's neighbouring Environment Agency Permitted waste facility. The material will arrive on site loose and delivered directly to the walking floor.

3.2.3 No further treatment will be required prior to feeding the RDF into the furnace.

3.2.4 A full list of waste types to be accepted onto the proposed facility are listed in Table 3.2.1 below.

Table 3.2.1: Proposed Feedstock and EWC Waste Types

Derby Plant - EWC List	
Waste Code	**Description**
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TRAETMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 12	**Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 10	Combustible waste (refuse derived fuel)

3.3 Pre-Acceptance Procedures

3.3.1 All waste deliveries will be pre-arranged and subject to waste supply contracts. The material delivered will be in accordance with an agreed specification. As the waste is to be imported from the neighbouring EA permitted facility also operated by V.C. Cooke Limited, and will be weighed on that weighbridge to ensure records can be maintained.

3.3.2 All waste deliveries to the Facility will be subject to pre-acceptance evaluation prior to arrival on site, which will be linked to the physical and chemical composition of the waste.

3.3.3 The following information will be recorded:

- EWC Code;
- Analysis testing to confirm composition of the material;
- Process generating SIC Code;
- Delivery container type; and
- Written description of the material.

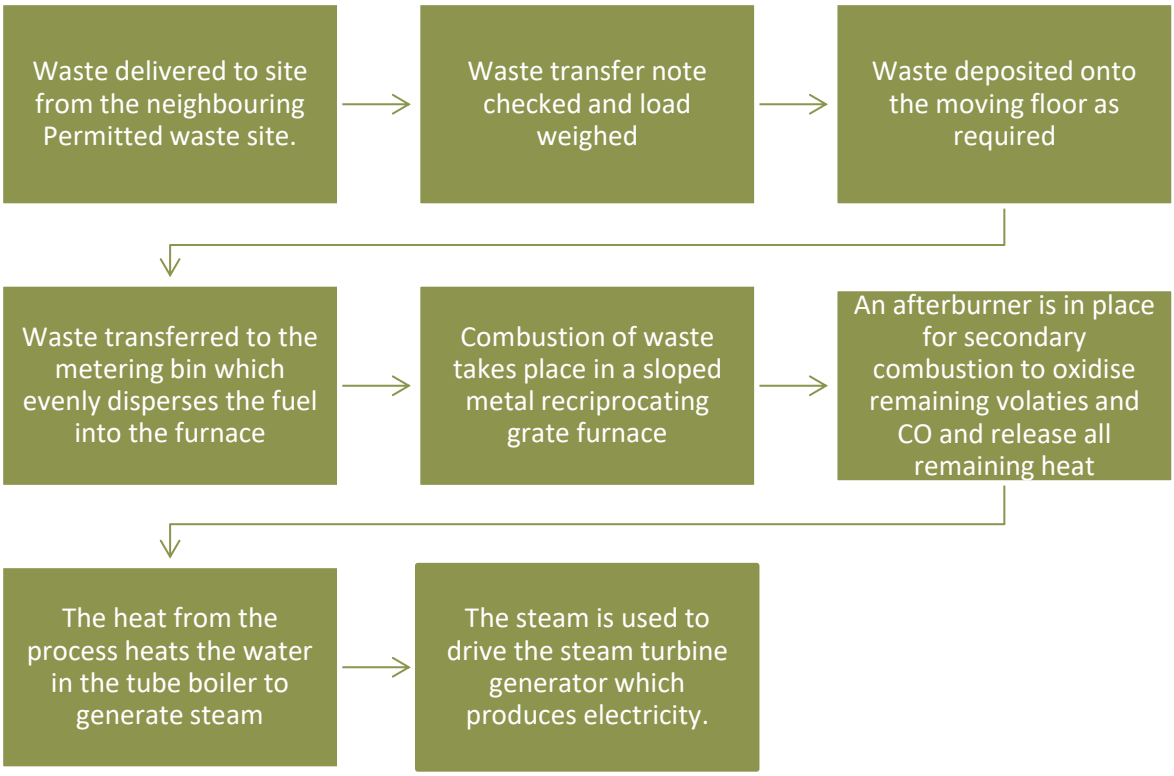
3.3.4 Feedstock will not be accepted until the Operator is confident that the Facility is able to receive the load, and that the nature of material can also be processed without operations impacting on any nearby sensitive receptors or compromising the plant's operational performance and management controls.

3.3.5 Procurement of feedstock contracts will be managed by the Operator who will consult site personnel to confirm that feedstock is suitable to be accepted at the site prior to contracts being agreed. Only following full characterisation of potential new feedstocks and confirmation of their suitability following technical assessment, will a new contract be agreed in order to ensure all Permit conditions can be met.

3.3.6 There will be no ad-hoc feedstock deliveries. If an unscheduled waste delivery arrives on site and it is verified that there has been no prior arrangement made for the delivery, the delivery will be rejected, vehicle turned away, and the incident recorded.

3.3.7 To fulfil Duty of Care requirements, waste is brought to the site must be accompanied with a waste transfer note which includes the source location and description of the waste they are carrying. It is likely that as the waste is proposed to come from a single source Annual Duty of Care notes will be accepted as the producer, description of material, approximate quantity and carrier won't not vary. A copy of these notes will be held at the site office.

Figure 3.3.7: Waste Treatment Process



3.4 On-site Waste Acceptance Reception

3.4.1 The plant will receive loose RDF via covered articulated lorry from the neighbouring permitted waste site. Delivery and collection of waste and recyclable materials will only occur during the following hours:

Monday- Friday 0700 to 1800
Saturday 0800 to 1600
On Sundays and Bank Holidays no deliveries shall take place.

3.4.2 If on arrival to site, the load is not acceptable under the terms of the Permit or agreed specification, entry to the site will be refused and vehicle will be turned away.

3.4.3 Where the site operative is not satisfied with the paperwork provided or description of the incoming material, the vehicle will either be directed to a holding area on site pending further information / inspection or will be rejected and a rejected load form completed, a copy of which will be given to the driver. Should the driver have already unloaded the material, the material will be re-loaded onto the vehicle, the appropriate paperwork completed, and removed from site.

3.4.4 The reception building and outside storage areas of the adjacent facility is be serviced with an impermeable surface.

3.4.5 All storage of feedstock will take place on the adjacent site. Feedstock deliveries in to the SWIP facility will only occur when the walking floor has enough capacity to accept them.

3.5 Start-up and Shut Down Procedures

3.5.1 The Standard Operating Procedure (SOP) for the start-up and shut down of the facility can be found in Appendix B to this document.

3.6 Raw Materials

3.6.1 In line with relevant guidance, all raw materials and site consumables including water must be measured to ensure that they are used efficiently. The Operator will undertake the following as a minimum:

- Maintain records of all consumables and water usage on site;
- Review and record where there are suitable alternative materials identified that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and
- Implement further measures when appropriate.

3.6.2 As detailed above, the plant will accept and process up to 24,369 tonnes of RDF over a period of 12 months. The waste materials will be subject to stringent pre-acceptance criteria at the adjacent site, and be subject to acceptability testing to a pre agreed specification.

3.6.3 All raw materials will be delivered to site via road, during daytime operational hours. Details of the types and amounts of raw materials are provided in the ERA which accompanies this application. The table provided in the ERA also contains information on the potential environmental impact of these raw materials.

3.6.4 All raw chemicals will be handled in accordance with COSHH Regulations as part of quality assurance and safety procedures. Full product data sheets will be available for review by personnel on site.

3.6.5 All liquid chemicals stored on-site will be serviced within suitable secondary containment with a minimum capacity of either 110% of the capacity of the largest vessel or 25% of the total volume (whichever is the greatest). Any spills or leaks will be retained in these areas and treated locally.

3.6.6 The Operator will give due consideration to the environmental impact of all new purchases of raw materials of the site.

3.6.7 Details of all raw materials and chemicals to be used on site, along with the proposed containment and mitigation measures are provided in Section 5 of this application within the Environmental Risk Assessment referenced CRM 0157 001 PE R 005.

3.7 Mass Balance

3.7.1 The typical mass balance of the plant running on commercial and industrial derived RDF is presented in Table 3.7.1 below. The overall mass balance and electricity production for the plant can be found in Table 3.7.2 below.

Table 3.7.1: Typical Mass Balance

Typical Mass Balance from RDF derived from Commercial and Industrial Wastes	
Feed %	100
Ash %	12
Water %	34-40
Gas %	59

Table 3.7.2: Overall Mass Balance

Overall Mass Balance with an average throughput 2891kg/hr	
Throughput (kg/hr)	2891
Ash (kg/hr)	34
Water (kg/hr)	416
Flue Gas (kg/hr)	19925
Flue Gas (Nm^3/hr)	15884
Gross Electrical Output (kWh) -39% eff. Based on 2891kg/hr throughput	2450
Parasitic Load Projected (per kWh)	650
Net Electrical Output (perkWh)	1850

3.8 Energy Recovery

3.8.1 The heat produced by the Facility will be used at the neighbouring permitted waste site with any residual heat being utilised by other local businesses.

3.9 Combustion Temperature and Residence Time

3.9.1 The Industrial Emissions Directive CHIV and PG13/1 require plants to be designed, equipped, built and operated in such a way that the gas resulting from the incineration or co-incineration of waste is raised in a controlled and homogenous way and even under the most unfavourable conditions to a temperature of 850°C for at least two seconds.

3.9.2 The Hurst RDF Fired BHP Hybrid Boiler combustion chamber will reach a temperature of 873°C for at least two seconds as demonstrated by CFD modelling. Temperatures within the combustion chamber will be monitored to ensure this temperature is consistently met.

3.10 Prevention of Accidents

3.10.1 An assessment of the prevention of accidents and measures to reduce the risk of them occurring has been undertaken in line with the Environment Agency's risk assessment overview and supporting risk assessment guidelines. The assessment is included within Appendix A of the 'Environmental Risk Assessment', referenced CRM 0157 001 PE R 004 (ERA) which forms part of this Permit Application.

3.10.2 The site-specific ERA submitted with this application identifies the potential hazards posed by the facility under both normal and abnormal operating conditions. An assessment of each hazard identified has been evaluated and the potential risk and prevention measures described. Possible accidents to be addressed are summarised below:

- Waste storage failure;
- Incoming waste or raw material handling/storage failure;
- Fire;
- Power Failure;
- Vandalism;
- Vehicle Accident; and
- Residues handling/storage failure.

3.10.3 The assessment in the ERA concluded that the risk from accidents to the environment is 'low' taking into account control measures to be put in place.

3.10.4 Operational procedures which identify the actions to be taken to minimise the potential causes of accidents, and the consequences in the event of an accident occurring will be implemented through the EMS. Such actions will include:

- Installation of appropriate abatement measures including a cyclone, filters and comprehensive gas clean up;
- Establishment and maintenance of a list of substances on site that have the potential to cause environmental impact if they escape; and
- Installation of appropriate primary and secondary containment measures.

3.10.5 All personnel will be provided with suitable training to ensure they are familiar with the site's Environmental Management System procedures, which will include training for both normal and abnormal scenarios, and their individual responsibilities in the event of an incident.

3.11 Site Security

3.11.1 Access to the site will be restricted. The main processing areas are located within the main building which is located within a lockable secure compound provided with a metal security

fence, with a sliding gate, which also incorporates the neighbouring permitted waste facility which is also operated by V.C. Cooke Limited.

3.11.2 The facilities' building will be locked when not in use.

3.11.3 The site will benefits from 24/7 security provided by Dardan Security.

3.12 Operator Competency

3.12.1 The process is fully automated and will be controlled by a SCADA (Supervision Control and Data Acquisition System) which will be monitored by technically competent staff members. An application has been submitted to undertake the Certificate of Technical Competence (COTC) Training and a copy of this can be found in Appendix D.

3.12.2 Appropriate training will be provided to all employees by suitably qualified and competent staff, in all aspects of the operation and maintenance of the facility and in accordance with an agreed training plan.

3.12.3 All new staff and visitors will undergo appropriate levels of induction prior to commencing any activities on site. Operational staff will have their duties restricted until they have obtained relevant in-house and/or externally provided training and certification.

3.13 Environment Management System Summary

3.13.1 An Environmental Management System (EMS) will be developed as one of the Operator's management systems and will be applicable to all relevant activities to be undertaken at the facility.

3.13.2 The overall objective of the EMS will be to establish a systematic approach to reduce the impact of the environmental aspects which the Operator can control or influence. The EMS will make reference to ISO14001 standards in that it will be established, documented, implemented, maintained and audited.

3.13.3 Procedures within the EMS will ensure policies are fully implemented and are auditable.

3.14 Decommissioning and Closure

3.14.1 The Operator will prepare a Site Closure Plan which will describe how the site will be decommissioned to return it to a satisfactory state following cessation of operations. Records will be maintained of the location of facilities, infrastructure and storage containing potentially pollution chemicals, as well as the services and surface structures installed during the operating phase of the plant.

3.14.2 De-commissioning will be in compliance with procedures outlined in the Site Closure Plan. During the de-commissioning process, operational records will be reviewed. If areas of deterioration during the operation of the site are identified these areas will be re-examined; remediation undertaken if required; and the site returned to a satisfactory state as defined at the Permit application stage.

3.14.3 Upon Completion of the De-commissioning phase, a Permit Surrender Application will be submitted to the Local Authority to surrender the Permit.

4.0 Emissions and Abatement

4.1 Introduction

4.1.1 This section of the report describes the emissions from the Facility, both point source and fugitive, and the controls in place to prevent or minimise their release.

4.1.2 An Environmental Risk Assessment (ERA) has also been prepared to support the application which describes the impact of emissions to air, water and land.

4.2 Point Source Emission to Air

4.2.1 There will be one point source emission from the proposed plant during normal operations which will arise from the 36m high stack of the CHP.

4.2.2 Details of all emission points are listed in Table 4.1.1 below and are also marked on the Site Layout Plan referenced, CRM 0157 001 PE R 002.

Table 4.1.1: Point Source Emissions to Air

Air Emission Point Reference	Source of Emission	Basis for release	Emissions
A1	Emissions from the boiler	Normal operation	Carbon monoxide, carbon dioxide, particulates, NOx, SOx, TOC, HCL, HF

4.3 Emissions to Surface Waters or Groundwater

4.3.1 There shall be no point source emissions to surface water or groundwater . Clean surface water run-off will be captured for use at the neighbouring EA permitted waste site.

4.4 Emissions to Sewer

4.4.1 There are no direct emission to sewer from the proposed facility as there is no available sewer connection.

4.4.2 Foul drainage from the site will be directed to a 46 000L tank via 2no. 3 stage interceptors which are located on the adjacent site. The collected effluent tank will be tankered off site by a licenced waste carrier for transfer to a suitably permitted treatment facility.

4.5 Emissions to Land

4.5.1 There will be no point source emissions to land from the proposed plant.

4.6 Waste Generation and Minimisation

4.6.1 The plant will give rise to four waste streams generated at various stages of the process, along with waste from the facilities' below ground effluent storage tank

4.6.2 The wastes produced by the plant are as follows:

- Ash
- Particulate matter from the cyclone

- Condensate
- Blowdown

4.6.3 The ash, generated by the incineration of the RDF, travels down the reciprocating grate and is pushed into a 9,069 litre water filled trough that quenches any remaining embers and saturates the ash to prevent dust escaping. The saturated ash sinks to the bottom of the water trough where it is pulled by a chain to outside the furnace. The ash it then discharged onto a conveyor for disposal into an enclosed bin.

4.6.4 When maintenance is required on the water trough the water will be directed to the 46 000l on site storage tank.

4.6.5 Before the exhaust gasses are released to the atmosphere a multi-cyclone collector, will remove particulate matter. This particulate matter will be discharged onto the ash conveyor and be deposited in the enclosed skip along with the ash.

4.6.6 Blowdown and condensate are automatically directed to the onsite storage tank before being taken off site for treatment and disposal.

4.7 Odour

4.7.1 There is potential for exposure to odour to anyone living or working close to the site. Key potential impacts identified are odour from RDF delivery vehicles and odours from the storage and processing of the RDF feedstock material.

4.7.2 The RDF will arrive on site via covered articulated lorry via the neighbouring permitted waste site and be deposited onto the walking floor located within the waste reception building. The building is fitted with fast acting roller shutter doors and operated under negative pressure with three air changes per hour.

4.7.3 The combustion process is a completely enclosed process and has no potential for significant odours, as odorous compounds are destroyed during treatment. The combustion process takes place within the Facilities' processing building, which draws in air from the waste handling area with 3 air changes per hour therefore generating a negative pressure to minimise the escape of odours to the external environment.

4.7.4 The ash which is produced as part of the thermal process is not considered to be inherently odorous. The ash will be stored within an enclosed skip and will be collected by an authorised waste contractor on a regular basis for recycling.

4.8 Noise

4.8.1 Waste reception and processing at the Facility will occur within the existing steel frame building.

4.8.2 Externally, the most significant sources of noise will be from the 36m high flue stack and vehicle movements.

4.8.3 The building houses equipment which has the potential to generate noise including, fans, conveyors, combustion furnace, boiler and the filtration system.

4.8.4 A noise impact assessment has been prepared by Enzygo Limited, a copy of which can be found in the environmental risk assessment, which has been submitted as part of this Permit

application. The assessment demonstrates that the impacts from the noise generated from the proposed operations are not significant.

4.9 Fugitive Emissions to Air

4.9.1 The primary potential sources of fugitive emissions to air will be dust and odours which may escape from the building when the roller shutter doors are opened. Dust may also be generated from vehicle movements across the outside yard areas.

4.9.2 All reception and processing of feedstock material shall be undertaken within the building. No processing of the RDF will be undertaken at the Facility. All processing will occur at the neighbouring EA permitted waste facility. The site building which operates under negative pressure with 3 air changes per hour to minimise the escape of emissions to the external environment.

4.9.3 RDF is accepted onto the site from the neighbouring permitted waste facility. RDF will be accepted loose under strict waste acceptance procedures described in sections 3.2 above. These procedures will ensure only suitable and permitted waste types are excepted onto the site.

4.9.4 Routine housekeeping checks, inspections and regular maintenance shall be undertaken to minimise the risk of fugitive emissions to air. The approach taken on site will be to implement measures following preventative rather than cure approach.

4.10 Fugitive Emissions to Surface Waters, Ground and Groundwater

4.10.1 The facility will use existing infrastructure which has been engineered to provide sealed impermeable surfacing to ensure that there will be no fugitive emissions released to surface water, ground or groundwater.

4.10.2 All above ground tanks will have:

- Impermeable bunds with a capacity of 110% of the largest volume;
- Fill points provided with secondary containment;
- Be subject to regular visual inspection; and
- Spill kits – materials suitable for absorbing and containing minor spillages will be readily available on site.

4.10.3 Details of all raw materials and chemicals to be used on site, along with the proposed containment and mitigation measures are provided in Section 5 of this application within the Environmental Risk Assessment referenced CRM 0157 001 PE R 005.

4.10.4 Routine housekeeping checks and inspections of secondary containment measures will be undertaken to minimise the risk of any spillages. The approach taken on site will be to implement measures following preventative rather than cure approach.

5.0 Site Monitoring Plan

5.1 Overview

5.1.1 Combustion gasses produced by the process will be continuously monitored in line with the requirements of the Environmental Permitting Technical Guidance PG13 Small Waste Incineration Plants (Draft) (PG13) and the Industrial Emissions Directive. The plant's emissions will be monitored by a Continuous Emissions Monitoring System (CEMS), supplied by Gasmet, see Appendix E for details.

5.1.2 Monitoring equipment, techniques, personnel and organisations employed to assist with the monitoring program will have either MCERTS certification or MCERTS accreditation (as appropriate).

5.1.3 Procedures will be prepared for the monitoring of all emissions prior to the site being commissioned.

5.1.4 The Environmental Permit will confirm the required monitoring schedule for the Facility, however the proposed monitoring arrangements are as follows.

5.2 Emissions to Air

5.2.1 There is one main point source emission to air arising from the 36m high stack of the CHP unit. Table 5.2.1 and 5.2.2 below present the proposed emission limit values, in accordance with regulatory standards.

Table 5.2.1: Emissions Monitoring Continuous Monitoring Requirements – Small Waste Co-Incineration Plant (ref 6vol-% O_2)

Substance/ Parameter	Emission Limit Value (mg/Nm^3) [4]				Backstop ELV [3] (mg/Nm^3) Half-hour average
	Daily average	Half-hourly average [1]		10-Minute average [3]	
		100%	97%	95%	
Carbon Monoxide [2]	75	150	N/A	225	150
Total Dust	15	45	15	N/A	225
Oxides of Nitrogen	300	600	300	N/A	N/A
Sulphur dioxide	75	300	75	N/A	N/A
TOC	15	30	15	N/A	30
HCl	15	90	15	N/A	N/A
HF	1.5	6	3	N/A	N/A

1. The regulator may choose which limit to apply, either 100% compliance with the higher value or 97% compliance with the lower value.
2. In the case of CO emissions, 95% compliance with the 10-minute average of 225 mg/Nm^3 is an alternative to 100% compliance with the half hour limit of 150 mg/Nm^3. In which case, this will also be the backstop ELV.
3. The backstop ELV applies during periods when the half-hourly ELV is exceeded.

Substance/ Parameter	Emission Limit Value (mg/Nm³) [4]				Backstop ELV [3] (mg/Nm³) Half-hour average
	Daily average	Half-hourly average [1]		10-Minute average [3]	
		100%	97%	95%	
4. Reference conditions: All emission limit values shall be calculated at a temperature of 273.15 K, a pressure of 101.3 kPa, 6% oxygen and after correcting for the water vapour content of the waste gases.					

Table 5.2.2: Periodic Monitoring Requirements for Small Waste Co-incineration Plants (ref 6% vol-% O_2)

Substance/ Parameter	Emission Limit Value [4]	Averaging / Sampling period
Sulphur dioxide	75 mg/Nm³	Average over the sampling period
HCl	15 mg/Nm³	
HF	3 mg/Nm³	
Cd and Tl	Total: 0.05 mg/Nm³	Average emission limit values [1] over a sampling period of a minimum of 30 minutes and a maximum of 8 hours A minimum sampling period of one hour is recommended.
Hg	0.05 mg/Nm³	
Sb, As, Pb, Cr, Co, Cu, Mn, Ni and V	Total: 0.5 mg/Nm³	
Dioxins and furans [2]	0.1 ITEQ ng/Nm³	Average emission limit value over a sampling period of a minimum of 6 hours and a maximum of 8 hours.
Dioxin-like polychlorinated biphenyls	No limit specified	
Polycyclic aromatic hydrocarbons (PAHs) [3]	No limit specified	Average over the sampling period – a minimum sampling period of 1.5 hours is recommended.
1. These average values cover also the gaseous and the vapour forms of the relevant heavy metal emissions as well as their compounds. 2. The emission limit value refers to the total concentration of dioxins and furans calculated in accordance with the toxic equivalence factors shown in table 5.4 of PG13. 3. The term PAHs refers to the sum of the following PAH compounds: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno (1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene. 4. Reference conditions: All emission limit values shall be calculated at a temperature of 273.15 K, a pressure of 101.3 kPa, 6% oxygen and after correcting for the water vapour content of the waste gases.		

5.3 Derogation to Monitoring Requests

5.3.1 The air quality assessment which accompanies this application shows that emission limits for PCB's and PAH's are modelled as being insignificant. In line with section 5.1.3 of the draft *Environmental Permitting Technical Guidance PG13 Small Waste Incineration Plants*, the Operator would request that this means periodic measurement is not required.

5.3.2 The air quality assessment which accompanies this application also showed that the predicted long and short term impacts on human and ecological sensitive receptors of SO_2, HCL, HF were insignificant and within the prescribed emissions limits. Therefore the applicant would suggest that periodic monitoring of these emission would be adequate.

5.4 Process Monitoring Requirements

5.4.1 The plant will have a computer-based system in place to monitor emissions quality and flow. This supervisory control and data acquisition (SCADA) software will operate continuously gathering and analysing real time data.

5.4.2 In accordance with IED requirements, the following process/operational parameters will be monitored:

- Operational run-time hours;
- Steam flow;
- Steam temperature;
- Combustion chamber temperature;
- Exit gas temperature;
- Differential pressure over multi-cyclone;
- Mass of daily and weekly throughputs;
- Abnormal/emergency operations;
- Raw material usage;
- Energy consumption of the plant.

Waste Streams Generated

- Mass quantities of all wastes removed from site; and
- Fate of waste streams i.e. sent for recovery or disposal.

6.0 Records and Reporting

6.1 General Overview

6.1.1 The operator will ensure that the following information is recorded:

- As built design for newly constructed/developed areas and any changes throughout the operation;
- Site inspections by the operator or regulating body and any subsequent issues and corrective actions taken;
- Emergencies;
- Complaints and actions taken;
- Plant/equipment failure;
- A record of any rejection of feedstock / raw materials;
- Records relating to pre-acceptance for cross-reference and verification at the RDF acceptance stage;
- Any Incidents/accidents on site and actions taken;
- Security failures;
- Severe weather conditions;
- RDF accepted and residue dispatched from the site;
- Monitoring records as required by the Permit;
- Local Authority Inspection Reports; and
- Details of emissions / reportable incidents in accordance with the Permit.

6.1.2 All records will be made available on request. All records, which are required under the condition of the Permit, will be maintained and kept secure from loss, damage or deterioration. Any records held electronically will be backed up on a regular basis.

6.2 Reporting

6.2.1 A summary of the RDF quantities received and residues removed from the site will be made at the frequencies and in a format to be agreed with the Local Authority.

6.2.2 The operator shall inform East Suffolk Council immediately of the following events:

- Any incident or accident significantly affecting the environment;
- A breach of Permit conditions
- For continuous monitoring;
    - If any daily average emission limit value for emissions to air is exceeded;

- If any half-hour average emission limit value for emissions to air is exceeded for more than 4 hours uninterrupted or for more than 60 hours in total;

- For periodic emissions monitoring;
  - If any emission limit value for emissions to air is exceeded.

6.2.3 Reports will be submitted to East Suffolk Council using the appropriate reporting forms as required

Waste Specification

Property	Desired Range or Values
Particle Size (mm)	~ 200mm
Loose Density (kg/m³)	175KG/m³ - 250kg/m³
RDF Moisture Content (wt%)	34-40%
Ash Content (wt%)	10-20%
Compositional Specification of RDF	
Plastic Film	6-10%
Hard Plastics	15-22%
Wood/Plant Tissue	55-60%
Textiles	5-12%
Paper/Card	2-4%
Glass	<1%
Metal	<1%
Fines	<1%
Stones	<1%

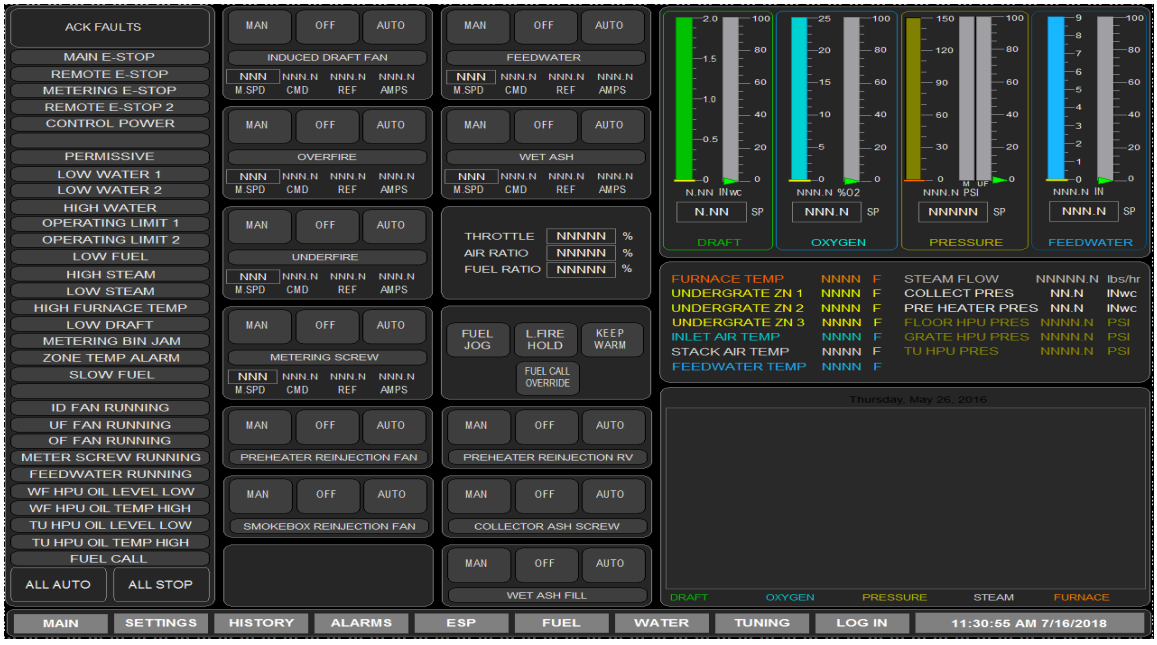
Appendix B – Operational Manual

OPERATOR MANUAL

Start-up & Shut Down

WTE BOILER CONTROL SYSTEM

VC Cooke Limited



100 Boiler Maker Lane
Coolidge, GA 31738-053

Pre-Startup

CSS & HURST assumes that everyone involved with the start-up or operation of this boiler has some training or experience with similar equipment. Those personnel without experience should not be directly involved with the operation or maintenance of the unit. Training is available and should be pursued.

Satisfactory operation of your WTE combustion system depends on attention to details. The following steps should be attended to at initial startup and after any period of shutdown.

Steam Boilers: Pre-Start

1. Check the feed water tank (deaerator) to verify that water level is correct and that feed water valve that supplies water to the tank is open.

2. Pump suction valves are open.

3. Power is available to the pump(s).

4. Main steam supply valve(s) is open.

5. Safety valve(s) is correct for this boiler design for pressure and capacity

6. Boiler water is at correct level.

7. Verify LOW WATER 2 relay **WLR261** and probe operation by opening water column **BLOWDOWN VALVE** until alarm sounds and feed pump(s) starts.

8. Verify that LOW WATER 1 relay **WLR251** is operational. (You may close FEED WATER VALVE and open bottom blowdown for this check. Be sure to re-open FEED WATER VALVE after closing the blowdown valve.) Pump should start and bring water level in the boiler back to normal operating level.

9. **Verify water treatment system(s) is operational and valves are open.**

10. All control cabinets should be clean –inside and out – with completely functional doors that are closed.

11. Equipment guards should be in place.

12. Set camera system to ‘’MONITOR’’

13. Set fire suppression to ‘’AUTOMATIC’’

Cold Startup – WTE Combustion Systems

*Be sure to read preceding Section **PRE START-UP** prior to starting the boiler. Refer to attached boiler check list before any operation of the systems. When all points in the **PRE START-UP** have been completed, you may proceed to start the unit.*

Sequence

1. Ensure fuel is loaded onto the push floor system and that all necessary pneumatic controls are set to **RUN.**
2. Initiate fuel supply conveyor system, screen magnets and oil pump circuits.
3. Feed fuel conveyors to pre-load fuel inlet conveyor systems until return signal from metering system is activated.
4. Initiate screw metering systems are pre-primed and that water quench circuits are charged.
5. Activate Oilon burner control module and prime burner module, set parameters to match slow ramp-up mode.
6. Charge burner feed loop to operating pressure and verify prior to primary ignition is activated.
7. Activate both air fan circuits and cross check pressure circuits are balanced prior to fuel loading commences.
8. Activate grate motors to **set point 1**
9. Activate air fan VFD – set to **''Cold Start 1''** position to ensure mode is aligned with BMS controls.
10. Enter full **AUTOMATIC** startup when all **MODE** conditions are now in **GREEN**

2. Fuel Feed

To ensure correct ramp up of boiler temperatures refer to cold start-up feed manual for the specific fuel parameters as per the boiler design manual.

1. Activate full fuel feed systems and allow fuel to meter onto grate.
2. Begin primary firing with Oilon burner controls set to ''primary fire''.
3. Set FGT system to fully AUTOMATIC BY-PASS to repass the initial start-up gases are recirculated until system reaches full firing rate.
4. Fuel feed rates to be kept at **1,000kg/hr** until combustion reaches **50%** load output rates
5. Fuel feed rates to match boiler ramp-up rate tables loaded into BMS - **950^{0}C**
6. **ONLY** activate increased fuel feed rates when FGT by-pass is **disabled**.
7. Activate R&R Beth panel – SET TO **''ACTIVE''**

3. CEMS & Pollution Control

On the R&R Beth module:

1. Activate pneumatic systems to **''AUTO''**.
2. BOGE to **''RUN''**
3. Prime APCR tanks
4. Set UREA dosing to .55 on input screen **VSR5**
5. GASMET system to **''PRIME – POSITION 1''**
6. ID fans to fully AUTOMATIC
7. Activate vacuum pumps on all dosing lines
8. Water feed pumps to ''RUN''

4. General Condition – Status

1. Operators to monitor BMS system on TRANSICOMM main screen.
2. Activate DA pumps to ‘’AUTO’’
3. Set water treatment plant to ON
4. Open all water feed valves.
5. Additional checks to be made visually on all fuel feed points to ensure steady state conditions.
6. Once all preliminary run checks are completed begin incremental fuel loading can be set to ‘’AUTO-RAMP’’
7. Periodic review of combustion zones every 10 minutes via observation ports.
8. Boiler set point to be confirmed
9. Set Oilon panel to **BURNER RETRACT-AUTO**

5. M&S TECNIK

1. Initiate M&S module on BMS to full **AUTO – 1**
2. Prime UREA pumps
3. Switch IR mode selection to **AUTO**
4. Activate vacuum pump for **MINSORB**
5. MINSORB dosing to **AUTO**
6. Set pressure to 6barg – **NORMAL**

6. Operational – Ready to Generator Start

1. Begin to increase fuel feed to maintain pressure set POINT 1
2. Maintain fuel feed rates to meet steam demand cycle – set POINT 1
3. Steam pressure should have reached TURBINE start point – 32barg.
4. Activate SIEMANS run status panel.
5. Set generator to FULL AUTO
6. Open steam valves to Super Heater
7. Set ECONOMISER control gates to OPEN

The system should now be able to be brought up to full operational outputs with all systems set to AUTOMATIC on BMS. Ensure that all fuel feed systems are running normally to meet combustion requirements.

Open the vent on top of the boiler to allow trapped air to escape as pressure is building in the boiler. This may be accomplished by opening the vent valve.

Start the **ID FAN VFD14** and then slowly bring the operating pressure up. This will allow the furnace to begin heating the water at a rate that will minimize stresses to the metal parts. It will also allow the lower, colder, zones to warm at a rate more consistent with that of the higher, hotter, zone.

The operating pressure setpoint should not be increased until after steam pressure is evident on the steam pressure gauge.

When steam is detected at the vent valve, close the air vent. Maintain this low fire rate as steam pressure begins to build after which the operating pressure can be increased, and fuel/air ratios can be adjusted for optimum combustion at various rates.

Subsequent firing, from cold, may require a cursory re-reading of the manufacturer's instructions.

1.1 Boiler Main Screen

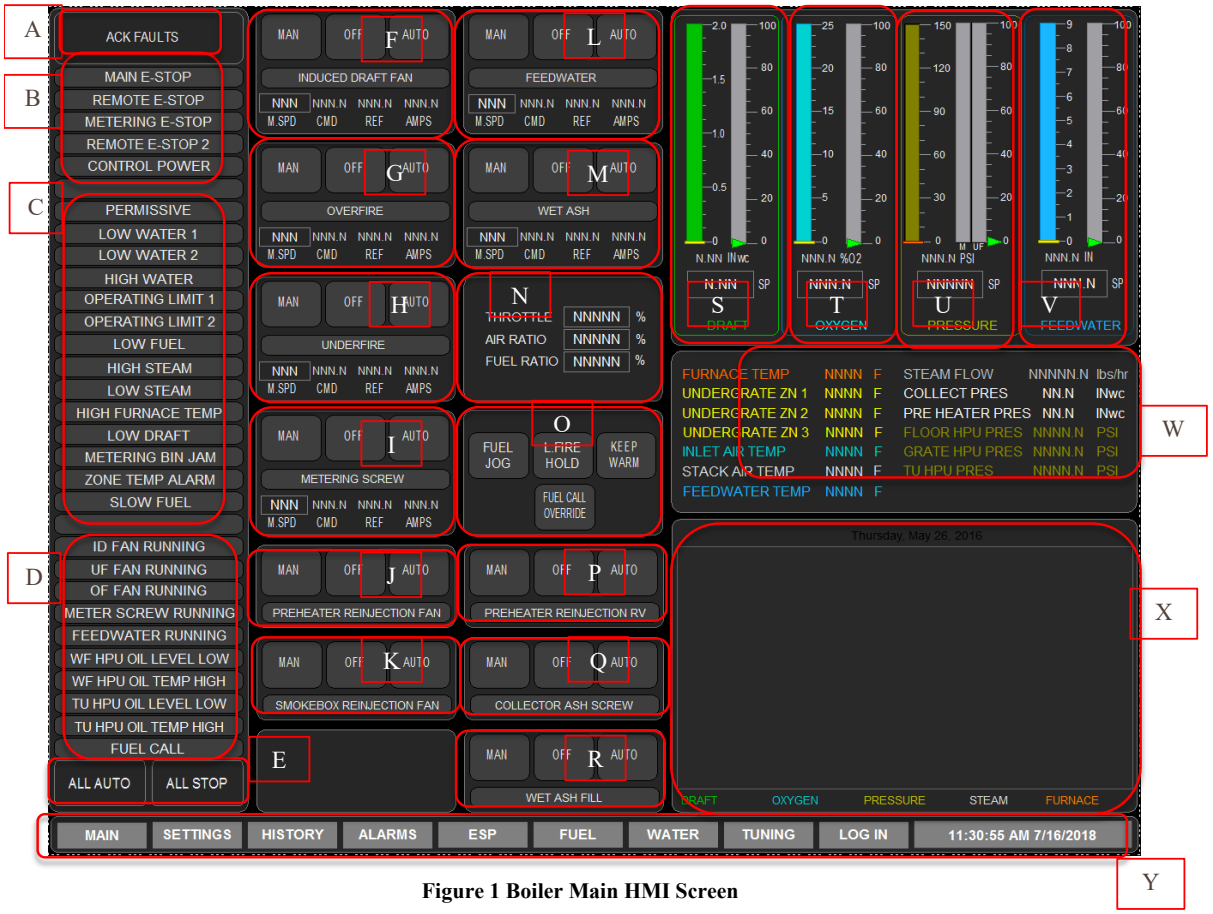


Figure 1 Boiler Main HMI Screen

Status Indication Chart
=OK Condition
=Interlock/Standby Condition
=Alert Condition
=Fault/Alarm Condition (flashing)

General Operating Notes

HURST boilers are designed such that in general operation, the starting, ramping up, slowing, and stopping are all controlled automatically.

Some of the devices you may find on your unit are the Induced Draft FAN (ID FAN VFD14), Over Fire Fan (VFD21), Under Fire Fan (UF FAN VFD28), Metering Bin Screw (METERING BIN VFD35) Ratio Controls & Firing Rate (Boiler Pressure Controller), Feed Water Controls (Feed Water Level

Controller), Low Water Cutoff (LOW WATER 2 relay WLR162), Auxiliary Low Water Cutoff (LOW WATER 1 relay WLR251), and High Pressure Alarm (OPERATING LIMIT switch S349).

LOW WATER 2 relay WLR261 – Low Water Cutoff (LWCO):

This device will protect the boiler from firing when the water level is too low, but there are several things that can go awry and cause this device to fail. The first, is allowing the interconnecting piping from the boiler to the device to become plugged with sludge. "Sludge" is an all-encompassing term for material that has settled out of the water and has blocked normally open paths where water or steam should pass. This sludge may also enter the float chamber of the device and block the device from properly responding to changing water levels in the boiler.

DAILY attention to controlling this sludge buildup by blowing down and physical inspection is a must.

Modifying the electrical or mechanical characteristics of the LOW WATER 2 relay WLR261 in any way may cause it to incorrectly sense boiler water level. If there is any question as to the proper operation of the of this device, you should shut the boiler down and correct the malfunction.

LOW WATER 1 relay S251 – Auxiliary Low Water Cutoff (ALWCO)

LOW WATER 1 relay S251 is a back-up device in the event of failure of LOW WATER 2 relay WLR262 and probe. However, it is never a good idea to simply begin to rely on the ALWCO if you know something is wrong with the LWCO. A failure of the ALWCO could also occur leaving you with no safety device to shut the burner off in the event of low water. The ALWCO may be a float type device or it may be a probe-type control.

HIGH WATER relay WLR241:

HIGH WATER level will protect the boiler from overfilling. When HIGH WATER probe comes in contact with water HIGH WATER relay WLR241 will energize the contacts of the relay. This device can also be used to shutdown feedwater pumps in the event there is no re-circulation line to avoid dead heading of the pumps.

FIRING RATE CONTROLLER:

The firing rate is controlled by pressure (temperature) sensitive devices that have limits within which they cause the burner to respond. The limits of this control must always be within the range of the safety valve(s) setting.

Example: 690 psi designed boiler, 690 psi safety valve setting, and Boiler Pressure Controller set point range not higher than 621 psi (about 90% of safety valve setting with VIRTUAL LIMIT SETPOINT control set at 621-625 psi). The **OPERATING LIMIT** switch S349 is another backup device that only functions if the Boiler Pressure Controller fails.

The Boiler Pressure Controller starts and stops the FSG in response to pressure in the vessel as read by BOILER PRESSURE XMTR517. The Boiler Pressure Controller PID loop modulates the devices associated with the firing rate between the HIGH FIRE and LOW FIRE rates.

The **VIRTUAL LIMIT SETPOINT** is a backup to the Boiler Pressure Controller, such that in the event pressure in the boiler continues to go higher than the Boiler Pressure Controller set point, the VIRTUAL LIMIT SETPOINT will shut down the boiler. This control generally requires operator involvement for manual re-set before the unit will recycle.

FUEL FEED SYSTEM:

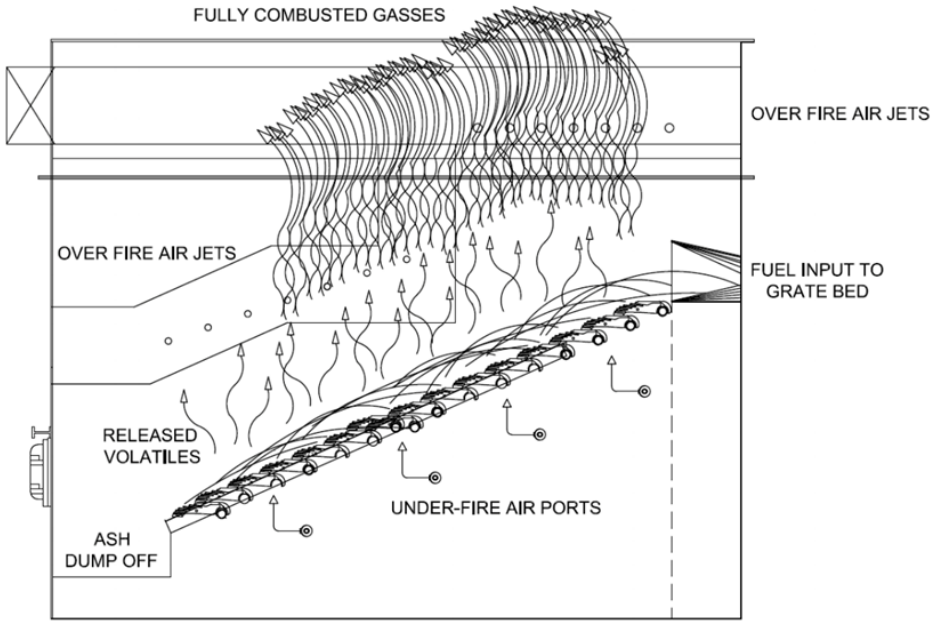
The MSW / RDF boiler cannot function without a steady supply of fuel. In order to redeem the savings of using a MSW / RDF boiler the fuel feed must remain consistent in uniformity and must stay continuous. Without these guidelines in place the boiler operations will be hard to maintain. The fuel along with the under-fire and over-fire air is what produces the energy.

With MSW / RDF fuels, there is almost always an array of particle sizes. Because of this disparity of fuel size, the metering of the fuel must keep the flow in constant turbulence so that the different sizes will not separate themselves. If a trend of separation occurs, the furnace bed will not be uniform, and the burning will be biased toward certain areas. A uniform consistency of fuel will make for a larger surface area of burning and prevent hot spots and dead air zones within the furnace.

FURNACE:

The Furnace is made up of several parts which include the Induced Draft Fan, the Fuel Grates, and the Over Fire and Under Fire Fans. All these devices work together to achieve stoichiometric combustion. Stoichiometric combustion happens when every available fuel molecule released is matched by an oxygen molecule from the over-fire fan resulting in a flue gas analysis which reveals no carbon monoxide and no oxygen. While this level of combustion is only achievable in laboratory settings. Certain steps discussed below can aid in efficient combustion within the boiler environment.

Often, MSW / RDF fuel systems use too much under-fire air and, co-consequently, do not have an adequate fuel pile in the furnace. When this air/fuel ratio is imbalanced, combustion occurs prematurely which not only reduces efficiency potential, but can also induce damage to the furnace. As the fuel burns, it goes through a progression. First, any moisture within the fuel evaporates. Once dry, the fuel will start to release volatile gasses. As more air is introduced, the gasses ignite and release energy. This process will continue until just the carbon is left to burn out. Finally, the ashes are released and remain to be disposed of. Below in Figure 75 is sectional view of the furnace as the fuel goes through different stages of combustion.



Furnace Section

When looking at the fuel pile within the furnace, there should be no grates visible. It should not even seem like the pile is burning. When adequate amounts of air are used, the fuel pile will appear to be “smoking”, but what is happening is the heat and air are reacting with the fuel and releasing the fuel’s volatile gasses. If too much under-fire air is used, the volatile gasses will release and combust at the same time, releasing heat on the furnace floor instead of in the upper section of the furnace where heat transfer will begin to occur. This premature combustion can rapidly reduce the life of the grates as well as impair heat transfer and even entrain ash/dust particles within the flue gasses.

Operators must use care not to reduce the under-fire air so low that the boiler loses combustion. This can be dangerous as a system may react by ramping the fan rates which will cause more of the fuel to become volatile and fill the furnace. If these gases were suddenly sparked, there could be dangerous blow back and cause damage to the boiler equipment and anyone within close proximity. The best way to ensure an appropriate amount of air is to have a control system that throttles the air input along with the fuel input. For certain kind of fuels, different ratios will need to be used. Keep records of which scenarios keep the best fuel pile on the grates and enough air to volatilize the fuel at a rate to keep up with production.

Once the heated fuel reacts with the under-fire air and volatile gasses are released, over-fire air is used to violently mix with the gasses and cause them to combust, releasing heat to be transferred through the boiler heating surfaces and into the water within the vessel. If there is a lack of over-fire air, large quantities of carbon monoxide and other combustibles will travel through the system and out of the stack. This waste of fuel results in heat loss and decreases efficiency. An over-abundance of combustion air results in heat loss absorbed by the excess air, also decreasing efficiency. The goal here is to find a “sweet spot” for the over-fire air. In the same way that the under-fire air should modulate with the fuel feed rate, the amount of over-fire air should be solely dependent upon the amount of oxygen in the stack. Lower amounts of oxygen indicate more efficient combustion. Take stack readings to see the correlation between the carbon monoxide and oxygen levels to determine the best oxygen setting for a respective boiler system.

The Fuel Grates move the fuel down the fuel floor in a uniform pattern to aid in combustion and ultimately to dump the ash into the ash collection system. The grates are moved in sequence using timers to actuate the grates. These timers must be dialed in during start-up in order to prevent an inconsistent uniformity of the fuel.

In order to keep the flue gases from increasing inside and creating an unsafe environment inside the furnace an Induced Draft Fan is utilized. The Induced Draft Fan produces a pressure lower than the atmospheric pressure in the system or in other terms produces a negative pressure. This negative pressure will remove the flue gases which will then be transported to a dust collection system and then out to the flue or chimney. The Induced draft fan is operated via the control system in order to

keep a constant draft and maintain a safe environment. The boiler control system cannot and will not function without the Induced Draft Fan.

FEEDWATER CONTROL:

As steam is allowed to escape the boiler, water must be forced into the unit to maintain the Normal Operating Water Level. This make-up water is normally supplied from a pump or pumps that are dedicated to this one unit. The starting and stopping of the feedwater pump (on smaller units) is typically controlled by the same device that acts as the LWCO. When the water level rises to a point just above the

LWCO point, it starts the pump and allows it to pump water through the feedwater line until the upper-level limit is satisfied. Then, the pump is allowed to stop until the next cycle is required.

On larger units, the water is normally fed continuously to the boiler through a modulating feedwater valve allowing only the amount of water to pass as is necessary to maintain the Normal Operating Water Level in the boiler. This means that the feedwater pump runs continuously. The modulating feedwater valve may be pneumatic or electric and it responds to the water level in the boiler to control the rate of water allowed into the unit through the Feed Water Level Controller.

Shut Down – General

The combustion system will need to be shutdown to carry out essential maintenance along with any compliance requirements. You should follow all local requirements to meet your statutory or country mandated protocols.

Short term:

If you intend to shut your boiler down for a period not to exceed 3 days, (72 hours), you may simply turn off the power, close the valves and leave the water at the normal operating level without further preparation.

Long term:

If you intend to shut down the boiler for a period exceeding 3 days – up to 14 days, turn off the power, fill the boiler completely with water, close all the valves, and take no further steps of preparation.

However, in both cases cited above, if there are other boilers connected in the system with this unit, precautions must be taken to ascertain that no bleed-over is taking place that would pressurize the idled boiler either through the introduction of feedwater or steam.

Shutdown – Operational

Fuel Feed System

1. Start the shutdown procedures in the BMS by selecting **''CONTROL STOP''**
2. Reduce fuel feed rate at 400kg/hour
3. Monitor pressure levels on BMS – low water alarms to be **GREEN.**
4. Move all pressure monitors to **''CS1=AUTO''**
5. Monitor combustion on the grate to ensure controlled burn out.
6. Activate Oilon burner module to position ''AUTO STOP''
7. Ensure burner fuel lines are primed to ''ACTIVE''.
8. Reduce water trough speeds to match fuel outrun.

It is essential to ensure FGT compliance that shut down temperatures are maintained – consult **TRANSICOMM** to ensure temperatures are being maintained.

1. Set FGT to **''AUTO BYPASS''**
2. Set APCR to **''SHUTDOWN''**
3. Reduce boiler feedwater pumps to **''STANDBY''.**
4. LWCO controls to **''MANUAL''**
5. Continue to limit fuel cutoff until boiler reaches 50% turndown threshold.
6. Enable FGT trace heating to **''AUTO'' Essential to minimise moisture fouling system**

Turbine & Generator

Select shutdown menu from SIEMENS control screen and activate timed shutdown when steam pressure falls below 29barg. TRANSICOMM alerts to be managed to ensure the SIEMENS interface remains activated and **DOES NOT enter FAULT mode**.

Divert steam load on shutdown phase to either (Operational Decision):

1. ACC loop
2. DA Loop
3. Steam to boiler Superheater

Final Stage – Shutdown

1. Terminate fuel feed from walking floor.
2. Shutdown pneumatic control at the BOGE screen
3. Stop fuel infeed conveyors with 50% load on conveyors – **DO NOT EMPTY CONVEYOR**
4. Isolate screw metering motors – set to ''STANDBY''.
5. Shutdown all combustion air fans – ''STANDBY''
6. Set steam vent valve motors to ''AUTO Blow Off'' set pressures 10barg.
7. Set Automatic Blowdown to ''MANUAL''
8. Stop bottom ash conveyor systems.
9. Carry out visual inspection through combustion ports to confirm combustion terminated

Once the operators have confirmed visual checks open **BOILER WATERTUBE** end plate covers to vent heat.

Extended period:

For periods of shutdown beyond 14 days, you must consider either a “wet layup” or a “dry layup”.

For wet layup fill the boiler completely with treated water, close all valves on the boiler, and carefully monitor the quality of the water at least weekly during the layup period. Also verify weekly that leakage or other influences have not lowered the water level in the boiler. If it is not full, add water to maintain a condition of full.

The success of this storage method depends largely upon eliminating any air coming in contact with any of the waterside of the unit while maintaining good boiler-quality water inside.

For dry layup drain all the water from the boiler, wash and flush as necessary to remove all sludge from the waterside, and use whatever method is available to COMPLETELY dry the waterside of the unit.

Then, when the unit is completely dry inside, place moisture absorbing material inside on pans, if possible, and seal the water side as tightly as possible from the outside environment. The absorbing materials must be checked weekly and replaced when they become damp.

The success of this storage method depends largely upon eliminating any moist air from coming in contact with any metal surface inside the boiler for the entire period of lay up. If you are in an area subject to freezing temperatures, be sure to disconnect and drain all connecting lines.

For this extended period of shutdown, it is recommended that all gas-side surfaces be brushed to remove all soot or other foreign deposits, which could lead to corrosion of the metal parts during the time of shutdown.

Table of Alarms

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
ESTOP/ MAIN ENCLOSURE ESTOP S222		S222 is in the extended position; S222 N.C. contact is energized and N.O. contact is de-energized; S222 RD LED light is energized; PLC 24Vdc digital input I:0.0 is de-energized; See DWG #'s 10 & 13.	CONTROL POWER RELAY B238 will be energized. PLC digital input I:0.3 will be energized.	Will allow all VFD's, motors, and control valves MOA's to transition to AUTO or MAN modes.
		N/A	N/A	N/A
		N/A	N/A	N/A
		S222 is de-pressed; S222 N.C. contact is de-energized and N.O. contact is energized; S222 RD LED light is de-energized; PLC 24Vdc digital input I:0.0 is energized; See DWG #'s 10 & 13.	CONTROL POWER RELAY B238 will be de-energized. PLC digital input I:0.3 will be de-energized.	Will cause all VFD's, motors, and control valves MOA's to transition to the OFF mode.
ESTOP/ METERING BIN S229		S229 is in the extended position; S227 N.C. contact is energized and N.O. contact is de-energized; S227 RD LED light is energized; PLC 24Vdc digital input I:0.1 is de-energized; See DWG #'s 10 & 13.	CONTROL POWER RELAY B238 will be energized. PLC digital input I:0.3 will be energized.	Will allow all VFD's, motors, and control valves MOA's to transition to AUTO or MAN modes.
		N/A	N/A	N/A
		N/A	N/A	N/A
		S229 is de-pressed; S227 N.C. contact is de-energized and N.O. contact is energized; S227 RD LED light is de-energized; PLC 24Vdc digital input I:0.1 is energized; See DWG #'s 10 & 13.	CONTROL POWER RELAY B238 will be de-energized. PLC digital input I:0.3 will be de-energized.	Will cause all VFD's, motors, and control valves MOA's to transition to the OFF mode.
ESTOP/ REMOTE DOOR S234		S234 is in the extended position; S234 N.C. contact is energized and N.O. contact is de-energized; S232 RD LED light is energized; PLC 24Vdc digital input I:0.2 is de-energized;	CONTROL POWER RELAY B238 will be energized. PLC digital input I:0.3 will be energized.	Will allow all VFD's, motors, and control valves MOA's to transition to AUTO or MAN modes.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		See DWG #'s 10 & 13.		
		N/A	N/A	N/A
		N/A	N/A	N/A
		S234 is de-pressed; S232 N.C. contact is de-energized and N.O. contact is energized; S234 RD LED light is de-energized; PLC 24Vdc digital input I:0.2 is energized; See DWG #'s 10 & 13.	CONTROL POWER RELAY B238 will be de-energized. PLC digital input I:0.3 will be de-energized.	Will cause all VFD's, motors, and control valves MOA's to transition to the OFF mode.
CONTROL POWER/ CONTROL POWER RELAY B238		B238 relay is energized; B238 N.O. contacts are energized; S236 GREEN LED is energized; PLC 24Vdc digital input I:0.3 is energized; See DWG #'s 10 & 13.	Output 24Vdc power to Digital Output cards from CB218 is energized; 24Vdc connection to LOW WATER 2 relay K271 N.O. contact is energized; See DWG #'s 9, 10, 12 & 13.	The UF FAN VFD28 and METERING BIN VFD35 will be allowed to operate normally.
		N/A	N/A	N/A
		N/A	N/A	N/A
		B238 relay is de-energized; B238 N.O. contacts are de-energized; S236 GREEN LED is de-energized; PLC 24Vdc digital input I:0.3 is de-energized; See DWG #'s 10 & 13.	Output 24Vdc power to Digital Output cards from CB218 is de-energized; 24Vdc connection to LOW WATER 2 relay K271 N.O. contact is de-energized then LW2 SAFE DISABLE relay K274 is energized; S236 switch must be de-pressed in order to re-energize CONTROL POWER relay B238 provided that the ESTOP condition(s) has been cleared and all ESTOP are in the OK condition; See DWG #'s 9, 10, 12 & 13.	The UF FAN VFD28 and METERING BIN VFD35 will be interlocked and will not be allowed to run.
HIGH WATER/ HIGH WATER WLR241		HIGH WATER probe is NOT immersed in water for a time less than the ON delay timer setting; WLR246 N.C. contact terminal #7 is energized; PLC 24Vdc input I:0.4 is energized; Timer setpoints are set on Boiler Settings HMI page;	-	FEEDWATER PUMPS VFD136 will be allowed to operate.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		See Figure 27 in Section 4.2.F and DWG #'s 11 & 13.		
		N/A	N/A	N/A
		N/A	N/A	N/A
		HIGH WATER probe is immersed in water for a time greater than the ON delay and less than the OFF delay timer settings; WLR241 N.C. contact terminal #7 is de-energized; PLC 24Vdc input I:0.4 is de-energized; Timer setpoints are set on Boiler Settings HMI page; See Figure 27 in Section 4.2.F and DWG #'s 11 & 13.	-	FEEDWATER PUMPS VFD136 will be interlocked and NOT allowed to run when NOT in BYPASS MODE; HIGH WATER Alarm condition will become active; Alarm will be displayed on HMI.
HIGH WATER RESET/ HIGH WATER WLR246		HIGH WATER RESET probe is NOT immersed in water for a time less than the ON delay timer setting; WLR246 N.C. contact terminal #7 is energized; PLC 24Vdc input I:0.5 is energized; Timer setpoints are set on Boiler Settings HMI page; See Figure 27 in Section 4.2.F above and DWG #'s 11 & 13.	-	FEEDWATER PUMPS VFD136 will be allowed to run when in BYPASS MODE.
		N/A	N/A	N/A
		N/A	N/A	N/A
		HIGH WATER probe is immersed in water for a time greater than the ON delay and less than the OFF delay timer settings; WLR246 N.C. contact terminal #7 is de-energized; PLC 24Vdc input I:0.5 is de-energized; Timer setpoints are set on Boiler Settings HMI page; See Figure 27 in Section 4.2.F above and DWG #'s 11 & 13.	-	FEEDWATER PUMPS VFD136 will be interlocked and NOT allowed to run when in BYPASS MODE; HIGH WATER RESET Alarm condition will become active; Alarm will be displayed on HMI.
LOW WATER 1/ LOW WATER 1 WLR251		LOW WATER 1 probe is immersed in water; WLR251 N.O. contact terminal #10 is energized; PLC 24Vdc input I:0.6 is energized; See DWG #'s 11 & 13.	-	The OF FAN VFD21 will be allowed to operate.
		N/A	N/A	N/A
		N/A	N/A	N/A
		LOW WATER 1 probe is NOT immersed in water; WLR251 N.O. contact terminal #10 is de-energized; PLC 24Vdc input I:0.6 is de-energized; See DWG #'s 11 & 13.	-	The OF FAN VFD21 will be interlocked and not allowed to operate; LOW WATER 1 Alarm condition will become active. Alarm will be displayed on HMI.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
LOW WATER 2/ LOW WATER 2 WLR261		LOW WATER 2 probe is immersed in water; WLR161 N.O. contact terminal #10 is energized; LOW WATER 2 R1 K270 & LOW WATER 2 R2 K272 relays are energized; PLC 24Vdc input I:0.7 is energized; See DWG #'s 12 & 13.	K270 relay N.O. contact is in energized state after probe is immersed in water and LOW WATER 2 RESET switch S268 has been de-pressed; K271 relay N.O. contact is in energized state after probe is immersed in water and CONTROL POWER relay 238 is energized then LW2 SAFE DISABLE is energized; LW2 SAFE DISABLE relay K274 is energized; LW2 SAFE DISABLE K274 N.O. contact is energized and allows 24VDC power to UNDER FIRE SAFETY relay B276 and METERING BIN SAFETY relay B278 are energized which allow UNDER FIRE FAN and METERING BIN VFD's to operate; See DWG # 12.	The OF FAN VFD21 will be allowed to operate.
		N/A	N/A	N/A
		N/A	N/A	N/A
		LOW WATER 2 probe is NOT immersed in water; WLR161 N.O. contact terminal #10 is de-energized; LOW WATER 2 R1 K172, LOW WATER 2 R2 K173, LOW WATER 2 R3 K174, & LOW WATER 2 R4 K175 relays are de-energized; PLC 24Vdc input I:0.4 is de-energized; See DWG #'s 7 & 13.	K270 relay N.O. contact is in de-energized state after probe is NOT immersed in water; K271 relay N.O. contact is in de-energized state after probe is NOT immersed in water and LW2 SAFE DISABLE is de-energized; LW2 SAFE DISABLE relay K274 is de-energized; LW2 SAFE DIISABLE K274 N.O. contact is de-energized and does not allow 24VDC power to UNDER FIRE SAFETY relay B276 and METERING BIN SAFETY relay B278; The UNDER FIRE FAN and METERING BIN VFD's are interlocked and not allowed to operate; See DWG # 12.	The OF FAN VFD21 will be interlocked and not allowed to operate. LOW WATER 2 Alarm condition will become active. Alarm will be displayed on HMI.
PERMISSIVE 1/ VIRTUAL LIMIT		CONTROL POWER digital input I:0.3 is energized; ID Fan running feedback is active; LOW DRAFT digital input I:3.0 is energized;	See CONTROL POWER interlock for physical devices effected.	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated; See OPERATING LIMIT 1 & 2 interlocks for effected PLC Logic.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		LOW WATER 1 digital input I:1.6 is energized; LOW WATER 2 digital input I:1.7 is energized; HIGH FURNACE TEMP Alarm is NOT active; ZONE TEMP Alarm is NOT active; HIGH STEAM digital input I:3.1 is energized; HIGH ZONE TEMP Alarm is NOT active; OPERATING LIMIT digital input I:3.2 is energized; OPERATING LIMIT 2 Alarm is NOT active; LOW FUEL Alarm is NOT active		
		N/A	N/A	N/A
		N/A	N/A	N/A
		CONTROL POWER digital input I:0.3 is de-energized -OR- ID Fan running feedback is NOT active -OR- LOW DRAFT digital input I:3.0 is de-energized -OR- LOW WATER 1 digital input I:1.6 is de-energized -OR- LOW WATER 2 digital input I:1.7 is de-energized -OR- HIGH FURNACE TEMP Alarm is active -OR- ZONE TEMP Alarm is active -OR- HIGH STEAM digital input I:3.1 is de-energized -OR- HIGH ZONE TEMP Alarm is active -OR- OPERATING LIMIT 2 digital input I:3.2 is de-energized -OR- OPERATING LIMIT 1 Alarm is active -OR- OW FUEL Alarm is active	See CONTROL POWER interlock for physical devices effected.	The UF FAN VFD28 and METERING BIN VFD35 are interlocked and are NOT allowed to operate; See OPERATING LIMIT 1 & 2 interlocks for effected PLC Logic.
OPERATING LIMIT 2/ OPERATING LIMIT S349		OPERATING LIMIT switch S349 is held closed by boiler pressure being below physical device set point; PLC 24Vdc digital input I:3.2 is energized; See DWG # 15.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated.
		N/A	N/A	N/A
		N/A	N/A	N/A
		OPERATING LIMIT switch S349 is held open by boiler pressure	N/A	The UF FAN VFD28 and METERING BIN VFD35 are interlocked and are NOT

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		being above the physical device set point; PLC 24Vdc digital input I:3.2 is de-energized; See DWG # 15.		allowed to operate normally: If the LOW FIRE ENGAGE HMI PB is pressed the UF Fan will operate at 10Hz, and the METERING BIN will operate at 10Hz as well.
OPERATING LIMIT 1/ VIRTUAL LIMT		OPERATING LIMIT setpoint percentage is greater than BOILER PRESSURE transmitter XMTR517 analog input I:8.Ch3Data reading; Setpoint is set on Boiler Settings HMI page; See Figure 28 in Section 4.2.G above and DWG # 20.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated.
		N/A	N/A	N/A
		N/A	N/A	N/A
		OPERATING LIMIT setpoint percentage is less than BOILER PRESSURE transmitter XMTR517 analog input I:8.Ch3Data reading; Setpoint is set on Boiler Settings HMI page; See Figure 28 in Section 4.2.G above and DWG # 20.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are interlocked and are NOT allowed to operate normally; If the LOW FIRE ENGAGE HMI PB is pressed the UF Fan will operate at 10Hz, and the METERING BIN will operate at 10Hz as well.
LOW FUEL/ REV COUNT PROX S352		During a FUEL CALL condition the REVOLUTION COUNTER stays below the LOW FUEL Setpoint that is set on the Boiler Settings HMI page; PLC 24Vdc digital input I:3.5 is energized at each revolution and counts up on the REVOLUTION COUNTER; See Figure 23 in Section 4.2.B above and DWG # 15.	S209 N.C. switch is in the closed position, which energizes LIMITS circuit. See DWG # 8.	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated.
		N/A	N/A	N/A
		N/A	N/A	N/A
		During a FUEL CALL condition the REVOLUTION COUNTER EXCEEDS the LOW FUEL Setpoint that is set on the Boiler Settings HMI page; PLC 24Vdc digital input I:3.5 is energized at each revolution and counts up on the REVOLUTION COUNTER; See Figure 23 in Section 4.2.B above and DWG # 15.	S209 N.C. switch is in the closed position, which de-energizes LIMITS circuit. See DWG # 8.	The UF FAN VFD28 and METERING BIN VFD35 are interlocked and are NOT allowed to operate.
HIGH STEAM/ HIGH LIMIT S348		HIGH STEAM switch S348 is held closed by boiler temperature being below physical device set point; PLC 24Vdc digital input I:3.1 is energized; See DWG # 15.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated.
		N/A	N/A	N/A
		N/A	N/A	N/A
		HIGH STEAM switch S348 is held open by boiler temperature	N/A	The UF FAN VFD28 and METERING BIN VFD35 are

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		being above physical device set point; PLC 24Vdc digital input I:3.1 is de-energized; See DWG # 15.		interlocked and are NOT allowed to operate.
HIGH FURNACE TEMP/ VIRTUAL LIMIT		FURNACE TEMPERATURE XMTR513 scaled analog value is less than hard coded PLC value; Hard coded value is determined prior to start-up.	N/A	The OF FAN VFD21 will be allowed to operate.
		N/A	N/A	N/A
		N/A	N/A	N/A
		FURNACE TEMPERATURE XMTR513 scaled analog value is greater than hard coded PLC value; Hard coded value is determined prior to start-up.	N/A	The OF FAN VFD21 will be interlocked and not allowed to operate. HIGH FURNACE TEMPERATURE Alarm condition will become active; Alarm will be displayed on HMI.
LOW DRAFT/ LOW DRAFT S645		LOW DRAFT SWITCH is held closed by boiler draft being above physical device setpoint; PLC 24Vdc digital input I:3.0 is energized; See DWG #15	N/A	The OF FAN VFD28 will be allowed to operate.
		N/A	N/A	N/A
		N/A	N/A	N/A
		LOW DRAFT SWITCH is held open by boiler draft being below physical device setpoint; PLC 24Vdc digital input I:3.0 is de-energized; See DWG #15	N/A	The OF FAN VFD28 will be interlocked and not allowed to operate; LOW DRAFT Alarm condition will become active; Alarm will be displayed on HMI.
METERING BIN JAM/ METERING JAM S353A		The METERING BIN JAM PHOTO EYE S353A is unblocked or blocked for a time less than the ON delay timer settings shown on the Boiler Settings HMI page; See section 4.2.C above and DWG #15.	N/A	The INCLINE DRAG CHAIN B159 and VIBRATING CONVEYOR B128 will be allowed to operate.
		N/A	N/A	N/A
		N/A	N/A	N/A
		The METERING BIN JAM PHOTO EYE S353A is blocked for a time greater than the ON delay timer and unblocked less than the OFF delay timer settings shown on the Boiler Settings HMI page; See section 4.2.C above and DWG #15.	-	The INCLINE DRAG CHAIN B159 and VIBRATING CONVEYOR B128 will be interlocked and not be allowed to operate; METERING BIN JAM Alarm will be displayed on the HMI.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
ZONE TEMP/ UNDERGRATE TEMP XMTR542, UNDERGRATE TEMP XMTR546, & UNDERGRATE TEMP XMTR550		All of the ZONE TEMPERATURE transmitters scaled analog value is less than the temperature setpoint; All transmitters must be below the single setpoint; Temperature setpoints are set on Boiler Settings HMI page; See Figure 25 in Section 4.2.D above and DWG # 22.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are allowed to be operated.
		N/A	N/A	N/A
		N/A	N/A	N/A
		Any of the ZONE TEMPERATURE transmitters scaled analog value is above the temperature setpoint; Temperature setpoints are set on Boiler Settings HMI page; See Figure 25 in Section 4.2.D above and DWG # 22.	N/A	The UF FAN VFD28 and METERING BIN VFD35 are interlocked and are NOT allowed to operate.
ID FAN RUNNING/ ID FAN VFD14		ID FAN VFD14 is not faulted and is sending a running feedback to the PLC via EtherNet.	N/A	Equipment allowed to operate in AUTO or MANUAL mode : - PRE-HEATER B462 -- - COLLECTOR VIBRATOR B463 - OF FAN VFD21 -UF FAN VFD28 - METERING BIN VFD35 - COLLECTOR ASH SCREW B73 - PREHEATER REINJECTION FAN B49 - PREHEATER REINJECTION RV B82 - REAR SMOKEBOX REINJECTION FAN B65
		-	-	-
		N/A	N/A	N/A
		ID FAN VFD14 is faulted and/or is not sending a running feedback to the PLC via EtherNet.	N/A	Equipment interlocked and NOT allowed to operate in AUTO or MANUAL mode : - PRE-HEATER B462 -- - COLLECTOR VIBRATOR B463 - OF FAN VFD21 -UF FAN VFD28 - METERING BIN VFD35 - COLLECTOR ASH SCREW B73 - PREHEATER REINJECTION FAN B49 - PREHEATER REINJECTION RV B82 - REAR SMOKEBOX REINJECTION FAN

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
				B65 All other equipment
UF FAN RUNNING/ UF FAN VFD28		UF FAN VFD28 is not faulted and is sending a running feedback to the PLC via EtherNet.	N/A	FUEL JOG mode is allowed to operate; The METERING BIN VFD35 is allowed to be operated.
		UF FAN VFD28 is not faulted and is commanded to run in AUTO or MANUAL mode, but not running due to Permissive to run not satisfied; See below for permissives : ID FAN VFD14 is not running -OR- PERMISSIVE 1 is not in OK condition -OR- OF FAN VFD21 is not running and/or is faulted	N/A	FUEL JOG mode is NOT allowed to operate unless OF FAN VFD21 is running; The METERING BIN VFD35 is allowed to be operated.
		N/A	N/A	N/A
		UF FAN VFD28 is faulted	-	FUEL JOG mode is NOT allowed to operate unless OF FAN VFD21 is running; The METERING BIN VFD35 is interlocked and not allowed to be operated.
OF FAN RUNNING/ OF FAN VFD21		OF FAN VFD21 is not faulted and is sending a running feedback to the PLC via EtherNet.	N/A	FUEL JOG mode is allowed to operate; The METERING BIN VFD35 is allowed to be operated.
		OF FAN VFD21 is not faulted and is commanded to run in AUTO or MANUAL mode, but not running due to Permissive to run not satisfied; See below for permissives : ID FAN VFD14 is faulted and/or not running -OR- LOW WATER 1 or 2 alarm condition is active -OR- FURNACE HIGH TEMPERATURE alarm is active -OR- LOW DRAFT alarm is active	N/A	FUEL JOG mode is NOT allowed to operate unless OF FAN VFD21 is running; The METERING BIN VFD35 is allowed to be operated.
		N/A	N/A	N/A
		OF FAN VFD21 is faulted	N/A	FUEL JOG mode is NOT allowed to operate unless OF FAN VFD21 is running; The METERING BIN VFD35 is interlocked and not allowed to be operated.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
METERING SCREW(S) RUNNING/ METERING BIN VFD35		METERING BIN VFD35 is not faulted and is sending a running feedback to the PLC via EtherNet.	N/A	N/A
		METERING BIN VFD35 is not faulted and is commanded to run in AUTO or MANUAL mode, but not running due to Permissive to run not satisfied; See below for permissives : PERMISSIVE 1 is in Alarm condition -OR- OF FAN VFD21 is not running -OR UF FAN VFD21 permissive to run is not satisfied -OR- UF FAN VFD28 is not running -OR OF FAN VFD28 permissive to run is not satisfied	N/A	N/A
		N/A	N/A	N/A
		METERING BIN VFD35 is faulted.	N/A	N/A
FEEDWATER RUNNING/ FEEDWATER PUMPS VFD136		FEEDWATER PUMP VFD136 is not faulted and is sending a running feedback to the PLC via EtherNet.	N/A	N/A
		FEEDWATER PUMP VFD136 is not faulted and is commanded to run in AUTO or MANUAL mode, but not running due to Permissive to run not satisfied; See below for permissives : Dearator Low Water signal sent via EtherNet is energized; -OR- FEEDWATER BYPASS mode is active -OR HIGH WATER ALARM is active -OR- UF FAN VFD28 is not running	N/A	N/A
		N/A	N/A	N/A
		FEEDWATER PUMP VFD136 is faulted.	N/A	N/A
WF HPU OIL LEVEL LOW/ FUEL FLOOR OIL LEVEL SWITCH S373		FUEL FLOOR OIL LEVEL SWITCH S373 is immersed in liquid and in the N.C. state; PLC 24Vdc digital input I:4.5 is energized. See DWG #16.	N/A	HYD POWER UNIT WALKING FLOOR B701 is allowed to operate
		N/A	N/A	N/A
		N/A	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		FUEL FLOOR OIL LEVEL SWITCH S373 is NOT immersed in liquid and in the N.O. state; PLC 24Vdc digital input I:4.5 is de-energized. See DWG #16.	-	HYD POWER UNIT WALKING FLOOR B701 is interlocked and NOT allowed to operate.
WF HPU OIL TEMP HIGH/ FUEL FLOOR OIL TEMP HIGH SWITCH S372		FUEL FLOOR OIL TEMP SWITCH S373 is held closed by oil temperature not being above physical device setpoint in the N.C. state; PLC 24Vdc digital input I:4.4 is energized; See DWG #16.	-	HYD POWER UNIT WALKING FLOOR B701 is allowed to operate
		N/A	N/A	N/A
		N/A	N/A	N/A
		FUEL FLOOR OIL TEMP SWITCH S373 is held open by oil temperature being above physical device setpoint in the N.O. state; PLC 24Vdc digital input I:4.4 is de-energized; See DWG #16.	-	HYD POWER UNIT WALKING FLOOR B701 is interlocked and NOT allowed to operate.
TU HPU OIL LEVEL LOW/ TRUCK UNLOADER OIL TEMP HIGH SWITCH S375		TRUCK UNLOADER OIL LEVEL SWITCH S375 is immersed in liquid and in the N.C. state; PLC 24Vdc digital input I:4.7 is energized; See DWG #16.	-	HYD POWER UNIT TRUCK UNLOADER B708 is allowed to operate
		N/A	N/A	N/A
		N/A	N/A	N/A
		TRUCK UNLOADER OIL LEVEL SWITCH S375 is NOT immersed in liquid and in the N.O. state; PLC 24Vdc digital input I:4.7 is de-energized; See DWG #16.	-	HYD POWER UNIT TRUCK UNLOADER B708 is interlocked and NOT allowed to operate.
TU HPU OIL TEMP HIGH/ TRUCK UNLOADER OIL TEMP HIGH SWITCH S374		TRUCK UNLOADER OIL TEMP SWITCH S374 is held closed by oil temperature not being above physical device setpoint in the N.C. state; PLC 24Vdc digital input I:4.5 is energized. See DWG #16.	-	HYD POWER UNIT TRUCK UNLOADER B708 is allowed to operate
		N/A	N/A	N/A
		N/A	N/A	N/A
		TRUCK UNLOADER OIL TEMP SWITCH S374 is held open by oil temperature being above physical device setpoint in the N.O. state; PLC 24Vdc digital input I:4.6 is de-energized; See DWG #16.	-	HYD POWER UNIT TRUCK UNLOADER B708 is interlocked and NOT allowed to operate.

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
FUEL CALL/ METERING BIN PHOTO EYE S350A METERING BIN PHOTO EYE S351A		Either : METERING BIN PHOTO EYE S350A -OR- METERING BIN PHOTOEY S351A is unblocked or blocked for a time less than the ON delay timer settings shown on the Boiler Settings HMI page; See section 4.2.C above and DWG #15.	N/A	INCLINE DRAG CHAIN B129 is allowed to operate; VIBRATING CONVEYOR B158 is allowed to operate; DIVERTER SOLENOID 1B & 1A area allowed to operate;
		N/A	N/A	N/A
		N/A	N/A	N/A
		N/A	N/A	N/A
HPU TRUCK UNLOADER/ HYD POWER UNIT TRUCK UNLOADER B708		PLC digital output O:6.2 is energized; -AND-HYD POWER UNIT TRUCK UNLOADER Relay B444 N.O. Aux contact is energized; -AND- HYD POWER UNIT TRUCK UNLOADER CB707 auxiliary N.O. contact is energized; See DWG. #'S 15 & 18.	-	TRUCK UNLOADER SOLENOID 1A, 2A, & 3A are allowed to operate.
		HPU TRUCK UNLOADER is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : TRUCK UNLOAD FUEL CALL (See Figure 48 in Section 4.3.Q)) ; -OR- TRUCK UNLOADER OIL LEVEL SWITCH S375 is NOT immersed in liquid and in the N.O. state; -OR-TRUCK UNLOADER OIL TEMP SWITCH S374 is held open in the N.O. state by oil temperature being above physical device setpoint; See DWG. #'S 15, 16, & 18.	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.2 is de-energized; -OR-HYD POWER UNIT TRUCK UNLOADER Relay B444 N.O. Aux contact is de-energized; -OR- HYD POWER UNIT TRUCK UNLOADER CB707 auxiliary N.O. contact is de-energized; See DWG. #'S 15 & 18.	-	TRUCK UNLOADER SOLENOID 1A, 2A, & 3A are interlocked and NOT allowed to operate.
		PLC digital output O:6.1 is energized;	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
HPU WALKING FLOOR / HYD POWER UNIT WALKING FLOOR B701		-AND-HYD POWER UNIT WALKING FLOOR Relay B443 N.O. Aux contact is energized; -AND- HYD POWER UNIT WALKING FLOOR CB700 i auxiliary N.O. contact is energized; See DWG. #'S 15 & 18.		
		HPU WALKING FLOOR is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : TRUCK UNLOADER FUEL CALL EYE is NOT active (See Figure 48 in Section 4.3.Q) ; -OR- WALKING FLOOR OIL LEVEL SWITCH S373 is NOT immersed in liquid and in the N.O. state; -OR-WALKING FLOOR OIL TEMP SWITCH S372 is held open in the N.O. state by oil temperature being above physical device setpoint; See DWG. #'S 15, 16, & 18.	N/A	N/A
		N/A	N/A	N/A
		Permissives to run are satisfied -AND- PLC digital output O:6.1 is de-energized; -OR-HYD POWER UNIT WALKING FLOOR Relay B443 N.O. Aux contact is de-energized; -OR- HYD POWER UNIT WALKING FLOOR CB700 auxiliary N.O. contact is de-energized; See DWG. #'S 15 & 18.	N/A	N/A
VIBRATING CONVEYOR/ VIBRATING CONVEYOR B158		PLC digital output O:6.0 is energized; -AND-VIBRATING CONVEYOR Relay B442 N.O. Aux contact is energized; -AND- VIBRATING CONVEYOR CB157 auxiliary N.O. contact is energized; See DWG. #'S 14 & 18.	N/A	N/A
		VIBRATING CONVEYOR is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : VIBRATING CONVEYOR FILL EYE is active (See Figure 48 in Section 4.3.Q) ; -OR- METERING BIN JAM alarm is active; -OR-GRATE HYD UNIT B89 is NOT running; -OR-INCLINE DRAG CHAIN B129 is NOT running; See DWG. #'S 15, 16, & 18.	N/A	N/A
		N/A	N/A	N/A
		Permissives to run are satisfied -AND- PLC digital output O:6.0 is de-energized;	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		-OR-VIBRATING CONVEYOR Relay B442 N.O. Aux contact is de-energized; -OR- VIBRATING CONVEYOR CB157 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 18.		
INCLINE DRAG CHAIN/ INCLINE DRAG CHAIN VFD128		INCLINE DRAG CHAIN VFD128 is NOT faulted and is sending a running feedback to the PLC via EtherNet.	-	VIBRATING CONVEYOR B158 is allowed to operate.
		INCLINE DRAG CHAIN is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : FUEL CALL is NOT active (See Figure 43 in Section 4.3.L) ; -OR- METERING BIN JAM alarm is active; -OR-GRATE HYD UNIT B89 is NOT running; See DWG. #'S 6 & 14.	N/A	N/A
		N/A	N/A	N/A
		INCLINE DRAG CHAIN VFD128 is faulted.	-	VIBRATING CONVEYOR B158 is interlocked and not allowed to operate.
HPU GRATE/DIVERTER / GRATE HYDRAULIC UNIT B89		PLC digital output O:6.5 is energized; -AND-GRATE HYDRAULIC UNIT Relay B420 N.O. Aux contact is energized; -AND- GRATE HYDRAULIC UNIT CB88 auxiliary N.O. contact is energized; See DWG. #'S 14 & 17.	-	-
		N/A	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.5 is de-energized; -OR-GRATE HYDRAULIC UNIT Relay B420 N.O. Aux contact is de-energized; -OR- GRATE HYDAULIC UNIT CB88 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 17.	-	-
PREHEATER REINJECTION FAN / PRE HEATER REINJECTION FAN B49		PLC digital output O:6.0 is energized; -AND-PRE HEATER REIJECTION FAN Relay B415 N.O. Aux contact is energized; -AND- PRE HEATER REINJECTION FAN CB48 auxiliary N.O. contact is energized; See DWG. #'S 14 & 17.	N/A	N/A
		PREHEATER REINJECTION FAN is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : ID FAN VFD14 is NOT running;	N/A	N/A
		N/A	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		PLC digital output O:6.0 is de-energized; -OR-PRE HEATER REINJECTION FAN Relay B415 N.O. Aux contact is de-energized; -OR- PRE HEATER REINJECTION FAN CB48 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 17.	N/A	N/A
SMOKE BOX REINJECTION FAN / REAR SMOKEBOX REINJECTION FAN B65		PLC digital output O:6.2 is energized; -AND-REAR SMOKE BOX REINJECTION FAN Relay B417 N.O. Aux contact is energized; -AND- REAR SMOKE BOX REINJECTION FAN CB64 auxiliary N.O. contact is energized; See DWG. #'S 14 & 17.	N/A	N/A
		SMOKEBOX REINJECTION FAN is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : ID FAN VFD14 is NOT running;	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.2 is de-energized; -OR-REAR SMOKEBOX REINJECTION FAN Relay B417 N.O. Aux contact is de-energized; -OR- REAR SMOKEBOX REINJECTION FAN CB48 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 17.	N/A	N/A
PREHEATER REINJECTION RV/ PRE HEATER REINJECTION ROTARY VALVE B82		PLC digital output O:6.4 is energized; -AND-PRE HEATER REINJECTION RV Relay B419 N.O. Aux contact is energized; -AND- PRE HEATER REINJECTION RV CB81 auxiliary N.O. contact is energized; See DWG. #'S 14 & 17.	-	-
		PREHEATER REINJECTION RV is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : ID FAN VFD14 is NOT running;	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.4 is de-energized; -OR-PRE HEATER REINJECTION RV Relay B419 N.O. Aux contact is de-energized;	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
		-OR- PRE HEATER REINJECTION RV CB81 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 17.		
COLLECTOR ASH SCREW/ COLLECTOR ASH SCREW B73		PLC digital output O:6.3 is energized; -AND-COLLECTOR ASH SCREW Relay B418 N.O. Aux contact is energized; -AND- COLLECTOR ASH SCREW CB72 auxiliary N.O. contact is energized; See DWG. #'S 14 & 17.	N/A	N/A
		COLLECTOR ASH SCREW is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : ID FAN VFD14 is NOT running; -OR-COLLECTOR ASH CONVEYOR Interval Timer has not exceeded setpoint; Interval timer setpoint is found in Boiler Settings HMI page; See Figure 29 in Section 4.2.H.	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.3 is de-energized; -OR-COLLECTOR ASH SCREW Relay B418 N.O. Aux contact is de-energized; -OR- COLLECTOR ASH SCREW CB72 auxiliary N.O. contact is de-energized; See DWG. #'S 14 & 17.	N/A	N/A
WET ASH FILL/ WET ASH FILL L465		PLC digital output O:7.5 is energized; -AND- WET ASH LEVEL switch S359 is immersed in water for greater than 10 seconds See DWG. # 17.	N/A	N/A
		WET ASH FILL is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissive : WET ASH LEVEL switch S359 is NOT immersed in water for greater than 10 seconds; Interval timer setpoint is found in Boiler Settings HMI page; See Figure 29 in Section 4.2.H.	N/A	N/A
		N/A	N/A	N/A
		N/A	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
FEEDWATER PUMP 1 / FEEDWATER PUMP 1 B137		PLC digital output O:6.13 is energized; -AND-FEEDWATER PUMP 1 Relay B428 N.O. Aux contact is energized; See DWG. # 19.	N/A	N/A
		FEEDWATER PUMP 1 is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : PUMP 1 is NOT selected from Boiler Feed Water HMI screen; See Figure 53 in Section 4.4.F; -OR- BYPASS mode is NOT active -AND-HIGH WATER is active -AND HIGH WATER RESET is active	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.13 is de-energized; -AND-FEEDWATER PUMP 1 Relay B428 N.O. Aux contact is de-energized; See DWG. # 19.	N/A	N/A
FEEDWATER PUMP 2 / FEEDWATER PUMP 2 B144		PLC digital output O:6.14 is energized; -AND-FEEDWATER PUMP 2 Relay B429 N.O. Aux contact is energized; See DWG. # 19.	-	-
		FEEDWATER PUMP 2 is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : PUMP 2 is NOT selected from Boiler Feed Water HMI screen; See Figure 53 in Section 4.4.F; -OR- BYPASS mode is NOT active -AND-HIGH WATER is active -AND HIGH WATER RESET is active	N/A	N/A
		N/A	N/A	N/A
		PLC digital output O:6.14 is de-energized; -AND-FEEDWATER PUMP 2 Relay B429 N.O. Aux contact is de-energized; See DWG. # 19.	N/A	N/A

Indicator/Device	State	Interlocking Device State	Electrically Interlocked Device State	PLC Logic Interlock
WET ASH CONVEYOR / WET ASH CHAIN VFD41		WET ASH CONVEYOR VFD41 is NOT faulted and is sending a running feedback to the PLC via EtherNet.	N/A	N/A
		WET ASH CONVEYOR is in AUTO or MANUAL mode and permissive to run is not satisfied; See below for permissives : The WET ASH RUN TIMER has not been exceeded; This timer is set on the Boiler Settings HMI screen; See Figure 32 in Section 4.2.K;	N/A	N/A
		N/A	N/A	N/A
		WET ASH CONVEYOR VFD41 is faulted.	N/A	N/A

Appendix C - Contents Page of EMS / Management System Structure

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Appendix D – WAMITAB Certificate

wamitab

Certificate No. OCC8691

Operator Competence Certificate

Title:

Waste and Resource Management - Physical Treatment - 4WRMa

This Certificate is awarded to

Ileana Radu

Awarded: 04/06/2018

Authorised

WAMITAB Chief Executive Officer

CIWM Chief Executive Officer

The Chartered Institution of Wastes Management

This certificate is jointly awarded by WAMITAB and the Chartered Institution of Wastes Management (CIWM) and provides evidence to meet the Operator Competence requirements of the Environmental Permitting (EP) Regulations, which came into force on 6 April 2008.

00116337

Credit certificate
This certificate determines credit awarded to:

Ileana Radu

Units gained:

		Credit Value	Credit Level
M5059077	Environmental Protection in Waste and Resource Management	3	4
T5059078	Communication, interaction and influence of stakeholders and other non-legislative factors within Waste and Resources management	3	4
A5059079	Legislation to support the operation of a Waste and Resources Management Facility	4	4
M5059080	Health and safety principles and practices in the Waste and Resource Management Sector	3	4
T5059081	Principles of Sustainable Waste and Resource Management	3	4
Y5059087	Principles and Practices of Managing a Physical Treatment Processing Facility for Waste and Resources	3	4

Awarded: 04/06/2018
Authorised

Serial No.: 29562/WRM1/1

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

Corff dyfarnu cydnabyddedig
Cymwysterau Cymru Qualifications Wales
Recognised awarding body

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland. Qualifications Wales regulates this qualification where it is awarded to learners assessed wholly or mainly in Wales.

00116381

wamitab

Qualification Title:

WAMITAB Level 4 Certificate in Waste and Resource Management - 4WRMa

Qualification Accreditation Number:

601/2388/6

This Certificate is awarded to

Ileana Radu

Awarded: 04/06/2018

Serial No:29562/4WRMa/1

Authorised

Chris James
Chief Executive Officer, WAMITAB

Regulated by Ofqual

Corff dyfarnu cydnabyddedig
Cymwysterau Cymru Qualifications Wales
Recognised awarding body

CCEA Regulation

The qualifications regulators logos on this certificate indicate that the qualification is accredited only for England, Wales and Northern Ireland. Qualifications Wales regulates this qualification where it is awarded to learners assessed wholly or mainly in Wales.

00116384

Continuing Competence Certificate

This certificate confirms that

Ileana Radu

Has met the relevant requirements of the Continuing Competence scheme for the following award(s) which will remain current for two years from 15/06/2020

TMNH Treatment - Non Hazardous Waste

Expiry Date: 15/06/2022

Verification date: 09/06/2020

Authorised:

Learner ID: 29562

Certificate No.: 5166008

Date of Issue: 15/06/2020

WAMITAB Chief Executive Officer

CIWM Chief Executive Officer

The Chartered Institution of Wastes Management

00149008

Continuing Competence Certificate

This certificate confirms that

Ileana Radu

Has met the relevant requirements of the Continuing Competence scheme for the following award(s) which will remain current for two years from 08/07/2020

TSNH Transfer - Non Hazardous Waste

Expiry Date: 08/07/2022

Verification date: 23/06/2020

Authorised:

Learner ID: 29562

Certificate No.: 5166748

Date of Issue: 08/07/2020

WAMITAB Chief Executive Officer

CIWM Chief Executive Officer

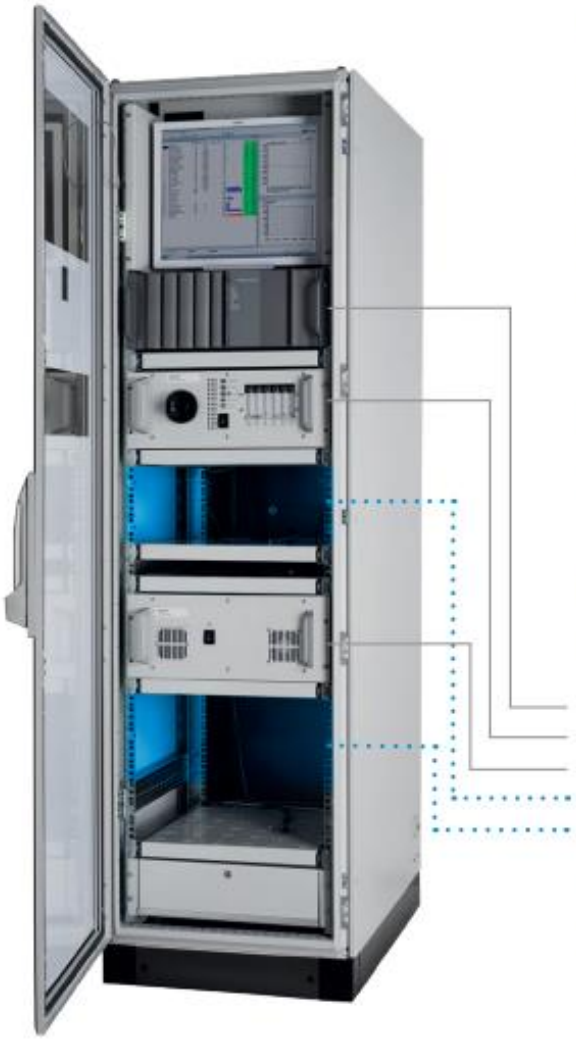
The Chartered Institution of Wastes Management

00149682


gasmet
> Know what's in the air.
gasmet
CEMS II e

Continuous Emissions Monitoring System CEMS II *e*

Future of emissions monitoring is all about continuous monitoring of multiple gases according to the declining emission limits and ability to measure new pollutants. Gasmet's futureproof, fully automatic solution and world-class support from our experts offers peace-of-mind throughout the lifetime of the investment.



What is the CEMS II *e*?

Gasmet provides a complete CEMS II *e* solution package for continuous emission monitoring. It consists of system, lifetime service and support, all necessary documentation and training, and of course our expertise. The CEMS II *e* is a fully automatic and TÜV and MCERTS certified (QAL1) system based on FTIR (Fourier-transform infrared spectroscopy) technique.

The CEMS II *e* has a flexible design with versatile integration options. Both measuring and alarm information can be transferred to automation and reporting systems. The system is also equipped with automatic quality assurance features to assure seamless operation.

CEMS II *e* consists of the following modules:

> CEMS II cabinet
> Heated probe and sample line
> Industrial computer
> Sampling system
> FTIR Analyzer
> Oxygen analyzer *(Optional)*
> Flame Ionization Detector, GFID *(Optional)*

Modular designs provide flexibility throughout the lifetime of the system: operation, maintenance and service.

What is it used for?

The CEMS II *e* is used in a wide range of industrial processes and is designed for continuous measurements of pollutants from hot, wet and corrosive gas streams. The system is typically used in:

/ Waste Incineration Plants / Cement Plants
/ Power Plants / Aluminum Production
/ Fertilizer & Nitric Acid Production
/ Carbon Capture & Storage

Which gases can be measured?

CEMS II *e* can simultaneously measure the following 16 gases as standard: H_2O, CO_2, CO, N_2O, NO, NO_2, SO_2, HCl, HF, NH_3, CH_4, C_2H_6, C_3H_8, C_2H_4, C_6H_{14} and CH_2O as well as combination of components such as NOx and TOC. There is also an option for certified oxygen measurement.

For more available compounds or more information, please contact your local Gasmet representative.

CEMS II *ef*

CEMS II *ef* is available for certified TOC measurement with GFID. The certified measuring ranges are from 0–15 to 0–500 mg/m^3.

How does it work?

The system utilizes FTIR spectroscopy, which is a powerful technology for the simultaneous measurement of multiple gases. It's the industry's standard in many emissions monitoring applications. The measurement ranges can be changed easily and quickly (either extend or reduce) thanks to the Calcmet software and FTIR technology.

Why choose the Gasmet CEMS II *e*?

> Certified and fully automatic system with annual availability of 98.4%
> Flexible in order to meet customer-specific requirements
> Easy to operate & low-cost of ownership
> Robust design for challenging conditions
> The lowest uncertainties in the market (lower than required)
> 6-month maintenance interval for all certified compounds
> Worldwide technical service and support

Any questions? Ask more from our CEM experts:
contact@gasmet.fi

With us, you buy with confidence.

Our products represent **the pinnacle** of what can be achieved in the measurement of gaseous emissions using automated measuring systems. **We excel** in manufacturing reliable, sensitive, and cost-effective continuous emission monitoring solutions that represent the future of gas analysis. **We have a world leading reputation**, and we take pride in making sure all our current devices and future solutions are fully certified to the latest standards.

Ready to take the next step with us?

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Gasmet Technologies Oy
Mestarintie 6
01730 Vantaa, Finland

Tel. +358 9 7590 0400
contact@gasmet.fi
www.gasmet.com

CERTIFICATE OF INCORPORATION OF A PRIVATE LIMITED COMPANY

Company No. 06693252

The Registrar of Companies for England and Wales hereby certifies that
V.C COOKE LIMITED

is this day incorporated under the Companies Act 1985 as a private company and that the company is limited.

Given at Companies House on 9th September 2008

N06693252K

THE OFFICIAL SEAL OF THE REGISTRAR OF COMPANIES

Companies House
for the record

The above information was communicated in non-legible form and authenticated by the Registrar of Companies under section 710A of the Companies Act 1985

BETH® flue gas cleaning

In today's energy generation processes, substitute fuels are increasingly converted into electricity. During the combustion of substitute fuels, substances are mostly produced which cannot be removed with classical cleaning methods.
They can mainly be divided into 2 categories:

1st category:
Harmful acid gases (such as HCl, HF, SO_x, among others)

In the area of harmful acid gases, we thus offer advanced solutions with calcium compounds or sodium hydrogen carbonate (also known as sodium bicarbonate). These compounds can bind harmful acid gases chemically and thus render them harmless for the environment, humans and the plant. In doing so, in each case we decide which sorbent and necessary accessory is better suited for the process to reach the required limits and minimize the operating costs. The bound harmful gases are released in form of solid salts together with the regular dust/ash on our BETHPULS-baghouses and discharged after the cleaning process. An elaborate separation of the salts and the arising dust is not necessary in most cases.

2nd category:
(such as cadmium, mercury, lead, among others)

Furthermore, pollution loads arise in form of metals (cadmium, arsenic, mercury) or hydrocarbons (dioxins, PCDD), which need to be significantly reduced due to increasingly stricter bills. Activated carbon is added for these applications. In addition, activated carbon is also regenerative. In doing so, the environmental burden can be further reduced through loaded activated carbon. The choice of activated carbon will be naturally adjusted to your process.

Of course it is possible to simultaneously remove both metals, hydrocarbons and harmful acid gases from the process. Activated carbon and lime hydrates/sodium bicarbonate do not impede each other in their function.

Lime hydrate in pure form

Sodium bicarbonate powder

Activated carbon

BETH® Filter GmbH
Lübeck • GERMANY
Phone: +49 451 5 30 75 00 • Fax: +49 451 5 30 76 00
E-Mail: info@beth-filter.de • www.beth-filter.de

Appendix H – NOx AMID 40 Product Data Sheet & Safety Data Sheet

Safety Data Sheet
Additive – NOxAMID® K

according to (EG) Nr. 1907/2006 (REACH) / changed by regulation (EU) Nr. 453/2010)

1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY

1.1 Product identifiers

Product name: **NOxAMID® K**
Substance name: **Additive**

1.2 Use of substance / mixture

additive, industrial use, water treatment chemical, conditioning agent

1.3 Details of the supplier of the safety data sheet

Mehldau & Steinfath Umwelttechnik GmbH
Alfredstraße 279
D-45133 Essen

1.4 Contact Person: **Zentrale**

Phone: +49 (0)201 43 783 -0
Fax: +49 (0)201 43 783 -33
E-Mail: zentrale@ms-umwelt.de
Homepage: www.ms-umwelt.de

1.5 Emergency telephone number:

Emergency CONTACT (24-Hour-Number):
Europe: GBK GmbH +49 (0)6132-84463
International: GBK/Infotrac ID 108808: (001) 352 323 3500

2. HAZARDS IDENTIFICATION

2.2 Classification of the substance or mixture

Product definition:
Mixture

Classification according to regulation (EG) Nr. 1272/2008 (substances):
Not classified
The product is not classified as hazardous according to Regulation (EC) 1272/2008 as amended.

Classification according to regulation EU-guidelines 67/548/EWG or 1999/45/EG:
Not classified

2.3 Label elements

Labelling according to regulation (EG) Nr. 1272/2008 (substances)
Unnecessary

Labelling (67/548/EWG or 1999/45/EG):
Unnecessary

2.3 Other hazards

The substance does not meet the criteria for PBT or vPvB according to the regulation (EC) Nr. 1907/2006, appendix XIII.

3. COMPOSITION / INFORMATION ON INGREDIENTS

3.1 Substances

Not specified, s. mixture

3.2 Mixture
This mixture does not contain substances which must be named after the REACH-restrictive.

4. FIRST AID MEASURES

4.1 Description of first aid measures

General Information: If symptoms persist, call a doctor. Show the doctor this Savety Data Sheet.

After inhalation: Provide fresh air.

After skin contact: Wash thoroughly with copious water.

After eye contact: After contact with eyes, rinse immediately with copious water. Consult a doctor in case of complaints.

After swallow: Flush mouth, drink copious water. Medical advice.

4.2 Most important symptoms and effects, both acute and delayed
No further relevant information available.

4.3 Indication of any immediate medical attention or special treatment needed
No further relevant information available.

5. FIRE-FIGHTING MEASURES

5.1 Extinguishing media
The product is not flammable. Use fire extinguishing methods suitable to surrounding conditions.

5.2 Special hazards arising from the substance or mixture
No further relevant information available.

5.3 Advice for firefighters
Ambient air independent breathing apparatus (EN 133)

Additional information:
The product is not flammable. Use fire extinguishing methods suitable to surrounding conditions. In case of fire the following can be released: NH_3, CO

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures
Particular danger of slipping on leaked product.

6.2 Environment precautions
Not into the drains / surface water / should not release into groundwater.

6.3 Methods and materials for containment and cleaning up
Soak up with absorbent material (for example sand, diatomaceous earth, universal binder). Send in suitable containers for recovery or disposal. Flush away residues with water.

6.4 Reference to other sections
No

7. HANDLING AND STORAGE

7.1 Precautions for safe handling

Fire precautions: This product is not flammable. No special measures required.
Explosion protection: No special measures required.

Wash hands after contact

7.2 Conditions for safe storage, including any incompatibilities

Information on storage conditions: Avoid seepage into the ground.

Needs container: Suitable materials for containers: Polyethylen of high density (HDPE), Polyethylen of low density (LDPE), high-grade steel 1.4301 (V2), high-grade steel 1.4401 (V4), glass.

Unsuitable materials for containers: Paper, iron, tin (tinplate).

Storage class according to VCI: 13 – non-combustible materials.

7.3 Specific end applications

No.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 Control Parameters

Occupational exposure limit: no

Organic occupational exposure limit: no

8.2 Exposure controls and personal protective equipment

Personal protective equipment:

Eye protection:

Tightly sealed safety glasses according to EN 166

Breathing protection:

Breathing protection by inadequate ventilation.
Gas filter for non-organic gas/fumes (EN 14387 type B).

Hand protection:

Chemical resistant protective gloves (EN 374)
Natural rubber / natural latex (NR) – 0.5 mm coating thickness
Chloroprene rubber (CR) – 0.5 mm coating thickness
Nitrile rubber (NBR) – 0.4 mm coating thickness
Butyle rubber (Butyl) – 0.7 mm coating thickness
Fluorrelastomer (FKM) – 0.7 mm coating thickness
Polyvinyl chloride (PVC) – 0.7 mm coating thickness

General protective and hygienic measures:

No special protective equipment required. Avoid contact with the eyes and skin.
Please follow the usual instructions when handling with chemicals.
Wash hands before breaks and at the end of work.

9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Aggregate state:	liquid
Colour:	yellow/brown
pH-value (20 °C):	ca. 8 (20 °C)
Solidification temperature:	not specified
Flashpoint:	not specified
Flammability:	not relevant (liquid)
Ignition temperature:	not specified
Thickness (20°C)	ca. 1,3 g/cm³
Solubility in water:	100%
Dynamic viscosity (20°C):	< 100 mPa s

10. STABILITY AND REACTIVITY

10.1 Reactivity
Not reactive under normal conditions.

10.2 Chemical stability
Does not decompose at intended usage.

10.3 Possibility of hazardous reaction
No hazardous reactions known.

10.4 Conditions to avoid
No conditions to avoid known.

10.5 Incompatible materials
Oxidizing substances

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Irritant effect on the skin
No irritant effect on skin.

Irritant effect on the eye
No major damages to eyes. Moderate irritating.

12. ECOLOGICAL INFORMATION

12.1 Toxicity
1272/2008/EG: Not water hazardous.

12.2 Persistence and degradability
Anorganic salts are not biologically degradebale.

12.3 Other adverse effects
Do not discharge into drains or watercourses.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Must be supplied to a proper disposal, in compliance with the regulations for waste recycling and -disposal.

Classification of waste has to take place, ancestry oriented, to the regulation of the European Waste Catalogue (AVV).

Uncleaned packaging:
Disposal must be made according to official regulations; contaminated packages have to be treated like substance. Packaging has to be emptied. Then they can be supplied after being thoroughly cleaned for reuse.

14. TRANSPORT INFORMATION

Not a hazardous material according to transport regulations. (ADR RID ADNR IMDG/GGVSEE ICAO/IATA)

15: REGULATORY INFORMATION

15.1 Safety, health and environmental regulation / legislation specific for the substance or mixture

National Regulation (Germany):

Statutory order on hazardous incidents:	not regulated
Water hazard class:	WGK 1, slightly hazardous to water according to VwVwS attached 2.
Technical instructions on air quality (TA Luft):	TA-Luft Nr. 5.2.1 total dust incl. fine dust

Other regulations: no employment restriction

16. OTHER INFORMATION

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific features and shall not establish a legally valid contractual relationship.

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NOxAMID® 40

Urea Solution for NOx-Removal
According to the SNCR-Method

PRODUCT CHARACTERISTICS

This product is a solution of technical urea in demineralized water.

Active ingredients (percentage urea by mass):	40% by weight
Chemical formula of urea:	$(NH_2)_2$ CO
Other usual designations:	Harnstoff, Urea, Carbamid
CAS-No:	[57-13-6]
EG-No (EINECS-No):	200-315-5
Molecular weight:	60,10 g
Equivalent molecular weight:	30,05 g
Density at 20 °C:	1,112 g/ml
pH-value (depending on storage time):	8 to 10
Crystallisation point:	0 °C
Appearance at 20 °C:	Clear, colorless solution
Odour:	Slightly like ammonia
Specification urea content:	Not less than 39% by weight
Other additives:	Special additives for avoiding hardness precipitations when diluting with industrial water (max. hardness 20 °d corresponds to approx. 360 ppm as $CaCO_3$).

Transport and Storage

This product is delivered in cubic tank containers (IBC) up to 1,500 l and in road tanks up to approx. 22,000 l.

Recommended materials with which the product comes into contact:
High-grade steel, resistant to chemical protective layers and plastics. Nonferrous heavy metal are not suitable, in particular copper, just as unalloyed steel or galvanized steel. The material aluminium should be avoided if possible, since aluminum is usually not resistant to alkali (aluminate formation).

Ordinance on hazardous substances:	No dangerous material according to the GGVSE, ADR etc.
Water hazard class:	WGK 1 (low hazardous to water)

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