DWG. NO. H349000-4540-75-031-0001

4144-MO-012 GARBAGE TRUCK

4143-MO-003 MAINTENANCE FUEL/LUBE TRUCK

4540-IN-001 WASTE INCINERATOR

NON-HAZARDOUS WASTE MILNE PORT 2540-75-031-0001

ARTIC DIESEL FUEL TRUCK SERVICE AREA

4143-MO-003

SLUDGE FILTER CAKE SEWAGE TREATMENT PLANT

4144-MO-012

WASTE FROM WORKSHOP/WELDSHOP/WAREHOUSE

4144-MO-012

WASTE FROM ACCOMMODATION

4144-MO-012

WASTE MANAGEMENT BUILDING 4540-BLD-001

INCINERATOR 4540-VP-001

DIESEL FUEL

ROTARY PUMP

USED OIL

ROTARY PUMP

BURNABLE WASTE

4540-IN-001

REFER TO VENDOR P&ID DWG. NO. E349000-TX001-00-031-0001

FIRE

XA

TJ 001

TJ 002

FIRE ALARM

FAULT MONITOR

TO ATMOSPHERE

STACK

NON-HAZARDOUS WASTE

GENERAL TRUCK

LANDFILL

HAZARDOUS WASTE

PALLETIZED DRUM CONTAINMENT AREA

GENERAL TRUCK

HAZARDOUS WASTE TO MILNE PORT 2540-75-031-0001

NOTES:

1. ALL INSTRUMENTS ARE VENDOR SUPPLIED.
2. VENDORS ARE RESPONSIBLE FOR STAMPING OF IFC PACKAGE DOCUMENTS.

DRAWING NO.	DRAWING TITLE
H349000-4540-05-030-0001	MINE SITE, WASTE MANAGEMENT, PFD
H349000-1000-75-041-0007	ALL AREAS, LEGEND SHEET 7 OF 7 – EQUIPMENT, P&ID
H349000-1000-75-041-0006	ALL AREAS, LEGEND SHEET 6 OF 7 – EQUIPMENT, P&ID
H349000-1000-75-041-0005	ALL AREAS, LEGEND SHEET 5 OF 7 – INSTRUMENTATION, P&ID
H349000-1000-75-041-0004	ALL AREAS, LEGEND SHEET 4 OF 7 – INSTRUMENTATION, P&ID
H349000-1000-75-041-0003	ALL AREAS, LEGEND SHEET 3 OF 7 – PIPING, P&ID
H349000-1000-75-041-0002	ALL AREAS, LEGEND SHEET 2 OF 7 – ASSET TAGGING, P&ID
H349000-1000-75-041-0001	ALL AREAS, LEGEND SHEET 1 OF 7 – ASSET TAGGING, P&ID

REFERENCE DRAWINGS

NO.	DESCRIPTION	BY	CHK'D	APP'D	DATE
1	AS-BUILT	JB	SH	JC	2015-01-07

REVISIONS

AS BUILT

NO CHANGES, CONSTRUCTED WITHIN ACCEPTABLE TOLERANCES.

REV.	ISSUE FOR	AUTH. BY	DATE
1	AS-BUILT	SH / JC	2015-01-07
0	APPROVED FOR CONSTRUCTION	O.A.	2013-08-28

ISSUE AUTHORIZATION

HATCH

DESIGNED BY J. FESAR DATE 2013-03-25	DRAWN BY J. FESAR DATE 2013-03-25
CHECKED BY L. GONZALES-SARDI DATE 2013-08-28	DISCIP. ENGR. O. ATTFIELD DATE 2013-08-28
PROJ. DES. COORD. T. THERTELL DATE 2013-08-28	PROJ. ENGR. JAMES CLELAND DATE 2013-08-28
PROJ. MGR. STEVEN PERRY DATE 2013-08-28	

Baffinland

MARY RIVER PROJECT

MINE SITE
WASTE MANAGEMENT
PIPING & INSTRUMENTATION DIAGRAM

SCALE NTS OR AS NOTED | DWG. NO. H349000-4540-75-031-0001 | REV. 1

ORIGINAL SHEET SIZE: ISO A1 (841 x 594)

$USERNAME$ $DATE$ $FILE$ $TIME$

Appendix B

Survey Data

Mine Waste Management Building and Incinerator Foundation Blocks As Built - 7Aug2014.asc

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Appendix C

Facility Description Supporting Documents

A. E349000-TX001-00-118-0001: Equipment Manual – EWS Mobile Incinerator: ECO M2TN ***[148 pages]***

B. E349000-TX001-00-083-0001: Waste Incinerator Control Philosophy ***[17 pages]***

Document been superseeded by
E349000-TX001-00-118-0002

EQUIPMENT MANUAL

Revision B

EWS Mobile Incinerator: ECO M2TN

DECEMBER 2013

HATCH	VENDOR DATA REVIEW		
Doc Number	E349000-TX001-00-118-0001	Sub	03
Date Received			

Review Grade	Next Submittal Status
☐ **C1** – Proceed to next submission & status	☐ Internal Review ☐ Certified Final ☐ Final ☐ As-Built
☐ **C2** – Proceed with exceptions as noted to next submission & status	**Next Submittal Date:**
☐ **C3** – Do not proceed, revise as noted & resubmit	

No further submission required - Complete	☐
☒ **C4 -** No further submission required - Cancelled	☐
No further submission required - Superseded	☒

Package Coordinator: Name, signature and Date:
Ammaar Zia 11/13/2014

REVIEWED ONLY FOR GENERAL CONFORMITY WITH THE SPECIFICATIONS. ACCEPTANCE BY THE ENGINEER DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THIS DRAWING/DOCUMENT IS EITHER ACCURATE OR COMPLETE. THE SOLE RESPONSIBILTY FOR CORRECT DESIGN, DETAILS & DIMENSIONS SHALL REMAIN WITH THE PARTY SUBMITTING THE DRAWING/DOCUMENT.

AMENDMENT LIST

Section	Description of Change (Subject of Amendment)	Rev Status (AL #)	Rev Date (AL Date)	Initials
All	Submittal to Hatch	Rev 0	6-Aug-13	CM
All	Added Retrieval of Data from PLC	Rev A	7-Aug-13	KD
All	Replaced nota with note	Rev B	16-Dec-13	CM
3.3.4	Added procedure for fuel valves	Rev B	16-Dec-13	CM

TABLE OF CONTENTS

1.0 GENERAL INFORMATION

1.1 COMMON ACRONYMS

Acronym	Full Name
AC	Air Conditioning
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
Cd	Cadmium
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSA	Canadian Standards Association
DCH0	Default Channel Zero
DP	Delta Pressure (amount of pressure change)
EPC	Electronic Proportional Control
ESC key	Escape Key
EWS	Eco Waste Solutions
EWS Mobile	EWS Mobile Incinerator
H20	Water
HCl	Hydrochloric Acid
HCL	Hydrogen chloride
Hg	Mercury
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
ISO	International Organization for Standards
KPa	Kilopascals
LCD	Liquid Crystal Display
LED	Light-emitting Diode
MCR	Master Control Relay
ME	Mist Eliminator
MPCB	Motor Protection Circuit Breaker
N.C.	Normally Closed
N.O.	Normally Open
NO_x	Oxides of Nitrogen
O_2	Oxygen
Pb	Lead
PCCD/PCCF	Dioxins & Furans
PDT	Pole Double Throw
PET	Polyethylene Terephthalate
pH meter	pH meter
P&ID	Process & Instrumentation Diagram
PLC	Programmable Logic Controller
PM	Particulate Matter

Acronym	Full Name
PPM	Parts Per Million
SPDT	Single Pole Double Throw
SCFM	Standard Cubic Feet Meter
SO2	Sulphur Dioxide
SOC	Southern Operational Command
SOW	Statement of Work
SO_x	Oxides of Sulphur
SP	Static Pressure
TEFC	Totally Enclosed, Fan-Cooled
THC	Total Hydrocarbon
USB key	Universal Serial Bus
VDC	Volts Direct Current
VFD	Variable Frequency Drive
W.C.	Water Column

1.2 EWS CONTACT INFORMATION

	CONTACT INFORMATION	
Eco Waste Solutions	5195 Harvester Road, Unit 14	
	Burlington, Ontario, Canada	
	L7L 6E9	
Phone	905-634-7022	
Toll Free	1-866-326-2876	
Fax	905-634-0831	
email	info@ecosolutions.com	
Ask for/Address to	Customer Service Manager	

1.3 HEALTH & SAFETY PRECAUTION

1.3.1 Health and Safety Precautions

PLEASE READ THIS SECTION BEFORE READING THE REST OF THE MANUAL

1.3.2 Safety Warnings

 The **EWS Mobile Incinerator** has a number of safety related hazards that need to be recognized by all operators:

- Electricity
- Heavy mechanical parts which may move due to gravity
- High Temperature
- Explosive Gases
- Flammable Liquids

IMPORTANT POINTS TO FOLLOW

THE EWS MOBILE INCINERATOR CAN CAUSE SERIOUS INJURY OR DEATH, please follow these points below:

1.3.2.1 KEEP CLEAR OF ANY MOVING PARTS AT ALL TIMES.

1.3.2.2 BEFORE STARTING THE CYCLE OF THE SYSTEM ENSURE THAT ALL PERSONNEL ARE CLEAR OF THE EWS MOBILE INCINERATOR.

1.3.2.3 DO NOT ATTEMPT TO START OR OPERATE THIS EQUIPMENT UNTIL THIS MANUAL IS READ THOROUGHLY AND IS UNDERSTOOD

1.3.2.4 RESPONSIBILITY FOR THE SAFE OPERATION AND MAINTENANCE OF THE EQUIPMENT SUPPLIED REST SOLELY ON THOSE OPERATION IT.

1.3.2.5 OBEY THE FOLLOWING GENERAL SAFETY INSTRUCTIONS AT ALL TIMES.

NOTE
A qualified operator is a person whom the owner of the equipment deems as having the required experience, training and skills to perform the required work and shall be limited to Construction Engineering trades only.

1.3.3 General Safety Instructions

1.3.3.1 Keep the electrical panel doors closed at all times except when performing electrical maintenance or troubleshooting.

1.3.3.2 Allow only qualified operators to perform maintenance and troubleshooting on the machine.

1.3.3.3 Open and lockout the Main Disconnect Switch on the electrical control panel while working on the machine.

1.3.3.4 Do not bypass or tie down any of the door safety limit switches.

1.3.3.5 Do not open any of the doors while the Primary or Secondary Chambers are above 200°F (93 °C).

1.3.3.6 Do not enter the Primary Chamber unless the Emergency Stop Button is pushed

1.3.3.7 When opening or closing the Primary Chamber door keep clear of the door and ensure that the path for the door is clear.

1.3.3.8 Secure the Primary Chamber door when it is open so it cannot move accidentally.

1.3.3.9 Immediately correct any fuel leaks.

1.3.3.10 Do not fill the Primary Chamber above the breech opening. Overfilling can result in poor burning and damage to the **EWS Mobile Incinerator.**

1.3.3.11 Use proper tools; wear impact resistant, CSA certified industrial goggles, full face dust mask (such as Advantage 3000 Respirator) and industrial leather gloves while loading and cleaning the **EWS Mobile Incinerator.**

1.3.3.12 Be aware of component-specific safety hazards listed within each section of this manual.

1.3.4 General Operating and Maintenance Safety Instructions

Proper operating and maintenance procedures must be followed in order for the **EWS Mobile Incinerator** to perform at maximum efficiency. Do not attempt to start or operate this equipment until this manual is read thoroughly and is understood.

The equipment has been designed with many safety features, however, like all thermal processes; this equipment is not free from the inherent hazards of high temperature processes. Safety procedures and precautions must be followed at ALL times during operation.

There are component-specific safety procedures outlined in this manual, however, no amount of written instruction can replace good judgment and safe operating practices.

NOTE

Responsibility for the safe operation and maintenance of the equipment supplied rests solely on those operating it.

There are many engineered features incorporated into the **EWS Mobile Incinerator** to free the operator of repetitive chores. They do not, however, relieve the operator of maintenance responsibilities. In order to maximize the operating life of the equipment, it is strongly recommended that the maintenance schedule be followed diligently (please refer to the Incinerator Maintenance Plan). It is advisable to keep an equipment log) for recording maintenance activities along with unusual operation. In the event that the equipment is not operating in the normal manner contact Eco Waste Solutions immediately (please refer to *Section 1.2 EWS Contact Information*). It is important to report problems as soon as they are noticed to minimize damage that faulty operation could cause.

Proper maintenance of the equipment is essential to ensure long term, reliable operation of the **EWS Mobile Incinerator**. The preventive maintenance procedures outlined in Section 4 of this manual should be adhered to strictly for best service life.

The warranty will become void if proper maintenance is not performed as instructed.

Please note that some of the diagrams and/or photos in this EQUIPMENT MANUAL are conceptual in nature and may not be exact representations of equipment purchased.

2.0 OVERVIEW OF TECHNOLOGY

2.1 INTRODUCTION TO WASTE INCINERATION

2.1.1 Protecting the Environment

2.1.1.1 Why Incinerate?

An advanced technology incinerator like the **EWS Mobile Incinerator** is the basis of a pollution prevention approach to waste management for camp operations. Having an incinerator that can be transported to the point-of-need provides immediate and complete control over the disposal of camp waste.

Incineration is considered to be a sustainable waste management practice because it deals with the waste on-site and as it's generated. Landfills operate on the premise that once it is buried the problem is eliminated. However even landfills with the most advanced engineering can fail. The very fact that a landfill is forever predicts the deterioration and failure of landfill safety systems. The creation of a well-designed landfill has a high upfront capital cost, takes many months to build and requires on-going maintenance in perpetuity making them a poor fit for a mobile camp.

Often camps consider using open air burning to deal with waste. This may involve simply setting fire to the waste pile or the use of a barrel or pit to contain the waste while burning. Open air burning creates air pollution and can lead to damaging health effects for the operator and those living and or working nearby.

By contrast, modern advanced incineration with air pollution control allows for the complete destruction of domestic waste without polluting the air, land or water. The waste material is completely converted to a non-toxic ash that does not attract wildlife.

The primary advantages of incineration are:

- **REDUCTION** of the weight and volume of waste material that must be disposed of using landfills or other means
- **DESTRUCTION** of materials that may be an attractant to wildlife and any pathogenic agents that may be contained within waste materials

2.1.1.2 The Operator – Your Role

As the Operator of the incinerator you have an extremely important role in protecting the environment through the correct operation of this equipment. It is the operator's role and responsibility to protect the environment by:

1. Ensuring that no inappropriate materials are processed and that each batch contains an average mix of waste that resembles the design waste characteristics (particularly volume/weight per batch, average density, and overall heat value). See Waste Table in Section 2.4.2 for details.

2. Understanding the environmental operating permits and commitments made by your employer to regulatory bodies and other stakeholders. This includes the emission targets, monitoring and recording requirements. Understanding the wastes that can and cannot be processed in the equipment as specified by the manufacturer as well as applicable regulatory permits or

other commitments. Undertaking all necessary operational and maintenance practices to ensure compliance with applicable emission limits and operating requirements.

3. Ensuring the burn cycle is long enough to allow for thorough burn-out and the generation of high quality ash residual that is safe for disposal

4. Minimizing particulate matter (dust) emissions during ash removal and handling

5. Disposing of ash properly by sending it to appropriate disposal sites

6. Taking responsibility for regular maintenance inspections and ensuring the appropriate attention is given to any problems immediately.

2.1.1.3 Air Pollutants of Concern

All combustion processes produce an exhaust emission. The **EWS Mobile Incinerator** is technologically advanced and designed to thoroughly combust the waste while producing minimal emissions.

Correct operation and rigorous attention to maintenance will ensure that the **EWS Mobile Incinerator** operates with the least possible impact on the environment.

It is recommended that incinerator operators understand the potential for the creation of pollution from incorrect operation. The following table lists the pollutants that can occur in incinerator exhaust emissions.

POLLUTANT	CONCERN	SOURCE OR CAUSE
CO (Carbon Monoxide)	Combustion Indicator	High levels of CO indicates poor quality combustion
SOx (Oxides of Sulphur)	Contributes to acid rain, respiratory irritant	High sulphur content fuels
NOx (Oxides of Nitrogen)	Contributes to acid rain, respiratory irritant	Incorrect air input, too high operating temperatures
HCl (Hydrochloric Acid)	Contributes to acid rain, corrosive, respiratory irritant	Primarily from the burning of PVC (polyvinyl chloride) plastics
PM (Particulate Matter)	Respiratory effects	Incomplete combustion, rich fuel to air ratio, dust-laden waste stream
PCCD/PCCF (Dioxins & Furans)	Persistent organic compound known to bioaccumulate	Incomplete combustion due to overloading, air ingress, improper waste mix
Heavy Metals including: Pb (Lead), Hg (Mercury), Cd (Cadmium), etc.	Toxic and known to be hazardous to human health and living ecosystems	Presence of heavy metals in the waste stream will lead to appearance in the exhaust gases

2.1.2 Basic Combustion Principles

Combustion is a rapid chemical reaction between oxygen and combustible elements such as carbon or hydrogen. Combustion uses the oxygen in air to react with the combustible materials producing heat which continues the process. Most of the products of combustion are gases. Good combustion produces clean gases that are invisible. Poor combustion will create smoke.

2.1.2.1 Products of Combustion Reaction (Ideal Combustion)

The ideal combustion reaction is often used to explain combustion. In the ideal reaction a completely combustible material - a compound of carbon, hydrogen and oxygen is heated and allowed to react with oxygen. As it is heated water is vaporized and the carbon bonds with the oxygen and heat is released.

Carbon, Hydrogen, Oxygen + Oxygen + $\longrightarrow$ Heat Carbon Dioxide + Water and Heat

2.1.2.2 Incomplete Combustion

This ideal reaction is theoretical and does not occur in waste combustion systems. Factors that lead to a less than ideal reaction are poor mixing, too little combustion air, and low temperatures. Under those conditions products of incomplete combustion are emitted with the stack gases or system exhaust. The products of incomplete combustion are typically elemental carbon (or soot) and carbon monoxide (CO). Soot particles are very fine and generally result in high opacity (smoke) at the combustion stack. Other products of incomplete combustion that cause concern are hazardous organic compounds such as benzene, dioxins, and furans. Although these compounds are not found in the waste, under incomplete combustion conditions they can be formed as intermediate combustion products.

The waste feed also includes inorganic materials; generally, they are not involved in the combustion reaction. The inorganic materials in the waste feed (ash) are either retained in the ash or are emitted as particulate matter in the combustion gas. Air velocities in the combustion chamber are controlled to reduce the amount of inorganic material entrained (picked up by) the combustion gas and emitted with the combustion gas. If combustion is not complete, organics will remain in the ash.

2.1.2.3 Combustion Indicators

One of the most obvious combustion indicators is the presence of a visible exhaust emission or smoke.

2.1.2.4 Stack Gas Oxygen and Carbon Monoxide

More reliable indicators that can be used to monitor combustion quality are the concentrations of key compounds in the stack gas.

2.1.2.5 Stack Gas: O_2 (Oxygen) concentration

The stack gas O_2 concentration provides a measure of excess air. Waste incinerators typically operate at 140 to 200 percent excess air, which roughly corresponds to 12 to 14 percent O_2 in the stack gas.

- High O_2 means too much excess air (cools gases).
- Low O_2 means insufficient air (incomplete combustion).

2.1.2.6 Stack Gas: Carbon Monoxide (CO) concentration

Each combustion system has a "typical operating range" for CO. If the stack gas, CO concentration goes above this typical range, combustion problems are likely. With a waste incinerator this is typically <100 ppm.

2.1.2.7 Waste Characteristics

Different waste types have different heating values, densities and moisture contents. These primary characteristics of the waste will affect the combustion process.

The **HEATING VALUE** of waste is a measure of the energy released when the waste is burned. It is measured in units of joules per kilogram (j/kg). The heating value is proportional to the energy released when burned. A heating value of about 11.6 MJ/kg or greater is needed to sustain combustion. Wastes with lower heating values can be burned but they will not maintain adequate temperature without the addition of auxiliary fuel.

The **MOISTURE CONTENT** of waste is a measure of the quantity of water contained or saturated in solid dry waste material. It is measured by a ratio or a percentage. The wetter the waste, the higher the moisture content and the longer it will take the waste to burn. As a result, a longer burn time requires more fuel while operating the incinerator. On the contrary, drier waste has lower moisture content. This dry waste requires a shorter burn time which results in less fuel being required.

2.1.2.8 Ash Quality

Visual appearance of the ash can be an indicator of combustion problems. If an incinerator is operating properly, little organic material will remain in the ash. Whitish gray ash indicates better burnout and less carbon than black. The extent of organics combustion can be measured by the quantity of combustible materials remaining in the ash. A noted increase in ash combustibles indicates a combustion problem which may include temperatures that are too low, improper distribution of combustion air in the chamber (plugged air inlets), or burn cycle time is too short.

2.1.2.9 Summary of Key Operation Factors Affecting Combustion

2.1.2.9.1 Combustion Air supply
- i. Sufficient air for complete reaction
- ii. Distributed to promote mixing

2.1.2.9.2 Mixing/Turbulence
- i. Assure contact of oxygen and organics

2.1.2.9.3 Temperature
- i. High enough to sustain combustion
- ii. High enough to complete reaction

2.1.2.9.4 Residence time/Retention time
- i. Sufficient time to allow reaction to complete

2.1.2.9.5 Waste Feed Characteristics

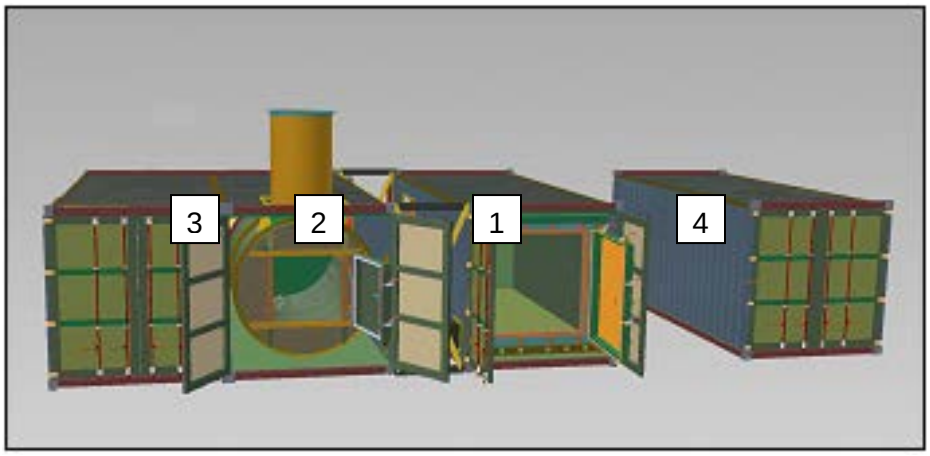
i. Waste feed must be representative of the waste feed assumptions used for the design of the incinerator

All of these key factors are interrelated.

2.1.3 Technology Overview

2.1.3.1 System Description

The **EWS Mobile Incinerator** is a fully containerized transportable waste incinerator system designed to meet the strictest environmental standards. The EWS Mobile Incinerator is comprised of 3 containerized modules and additional shipping container shown below.



View of the EWS Mobile Incinerator Containers

(Left to right: Container 3 - Controls Container, Container 2 - Secondary Chamber Container, Container 1 - Primary Chamber Container, Container 4 – Shipping Container)

2.1.3.2 System Process

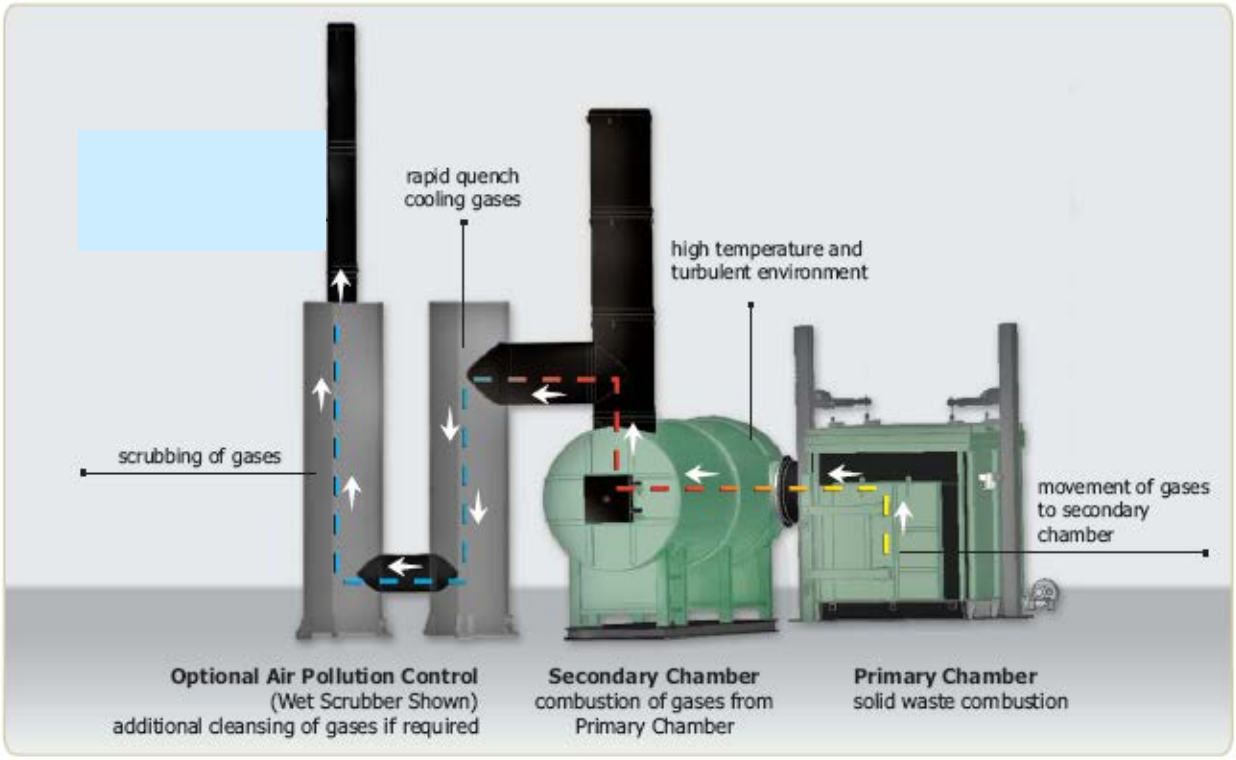
Stage One (Container 1 in diagram)
This container houses the incinerator's **Primary Chamber**. Waste is placed into the chamber until it is full, then the door is sealed shut and the system can be started. The waste will remain in this chamber, for the entire cycle, where it will be burned down to ash.

Stage Two (Container 2 in diagram)
This container houses the Incinerator's **Secondary Chamber** which burns the off-gases coming from the Primary Chamber that are continually formed as the waste is burned.

2.1.3.3 Process Overview

The following illustration depicts the process flow described previously and provides a schematic representation of the creation of gases and their flow through the system.

The system shown below is a graphic representation of the process and does not show the modules housed in ISO containers.



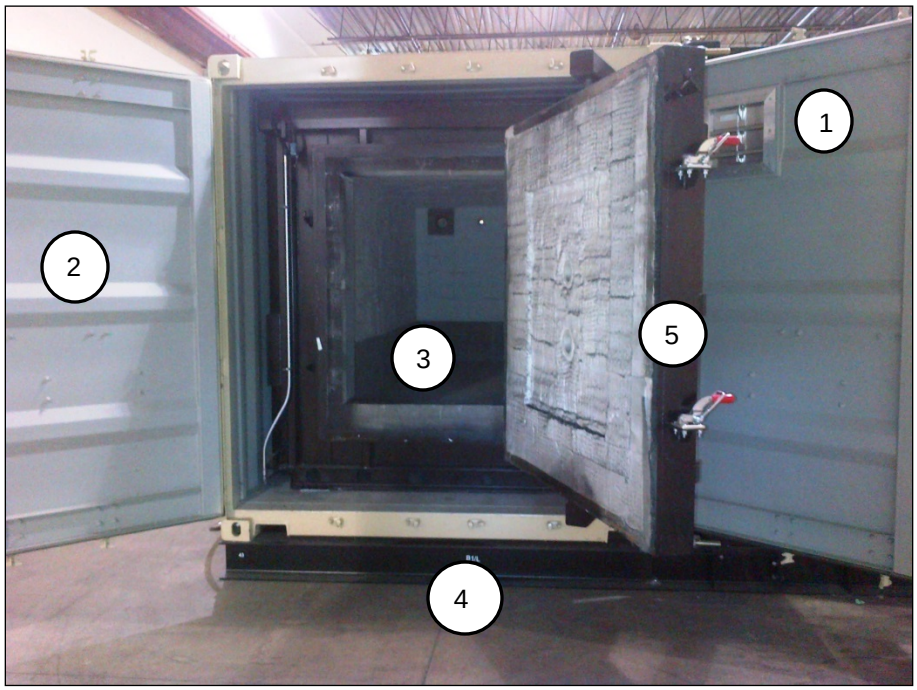
2.1.3.4 Functional Description of Major Components

The components within the Mobile Incinerator package that involve combustion are referred to as the incinerator. The main modules of the incinerator are the Primary Chamber and the Secondary Chamber. Both Chambers are large vessels constructed of steel with a special insulating liner known as refractory. The Primary and Secondary Chambers are described in detail below.

2.1.3.4.1 Primary Chamber

The **Primary Chamber** has a large front-opening door for loading of solid waste and removal of the ash residuals. Waste is loaded using a small skid-steer loader. The waste is dumped into the front of the chamber then pushed towards the back until full. Once the chamber is full, the door is closed and sealed shut using the toggle clamps. The operator will then use the control panel located in the Control Container to start the system. The Secondary Chamber must be at operating temperature before the Primary Chamber can activate.

To begin the process of burning the solid waste the **Primary Chamber Burner** is used to elevate the temperature of the Primary Chamber to ignite the waste. The burner package has a single motor that operates both the diesel fuel pump and combustion air supply fan of the burner. The burner ignites the fuel and supplies combustion air to create heat.



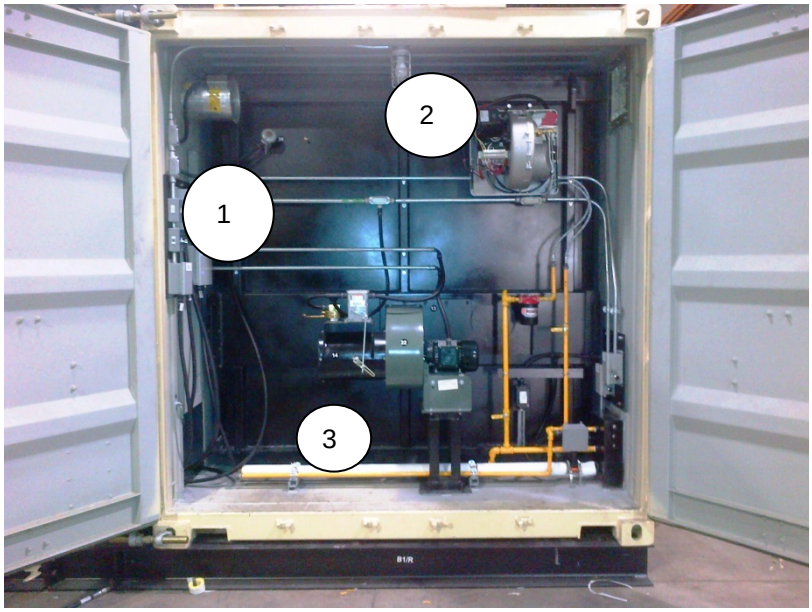
1. Louver
2. Container door
3. Opening for loading
4. Base frame
5. Toggle clamps

Front View: Primary Chamber Container (Chamber open)

A **Thermocouple** is used to measure the temperature of the Chamber. Once the Chamber reaches a temperature of approximately 650-850°C, the burn process becomes self-fuelling and the burner will shut off. To save fuel and control temperatures, only when the energy contained within the waste is depleted will the burner periodically turn on.

The amount of heat released from the oxidation of the waste, is controlled by limiting the air into the Primary Chamber to less than what is required for complete combustion. This is described as *starved air* conditions. With controlled air and temperature the waste is dried, heated and oxidized thereby releasing moisture and volatile components. The non-volatile, combustible portion of the waste is burned to provide heat while the non-combustible portion accumulates as residual. These conditions ensure that the waste is allowed to fully combust and is rendered sterile. Waste volume is reduced by over 90%. After enduring the combustion process, metals and glass remain intact. Preservation of metals and glass protects the refractory lining from damage caused by melted and fused metals and glass, but also allows for post-combustion recycling where possible.

This chamber also has a small **cooling fan**, typically referred to as the **Primary Chamber Blower**. The blower does not operate during the burn cycle but will activate automatically once the burn is complete and the system goes into cool down phase. The blower then cools the chamber for a period of 12 hours so that the chamber will be sufficiently cool for the Operator to safely remove the ash and begin to load a new batch of waste.



1. Thermocouple
2. Burner (Diesel-fired)
3. Primary Chamber Blower/Cooling Fan

Rear View: Primary Chamber Container

2.1.3.4.2 Secondary Chamber

As waste burns in the Primary Chamber, gases containing the products of combustion are pulled continuously into the high temperature zone of the **Secondary Chamber** where the oxidation reaction of the combustible products is completed.

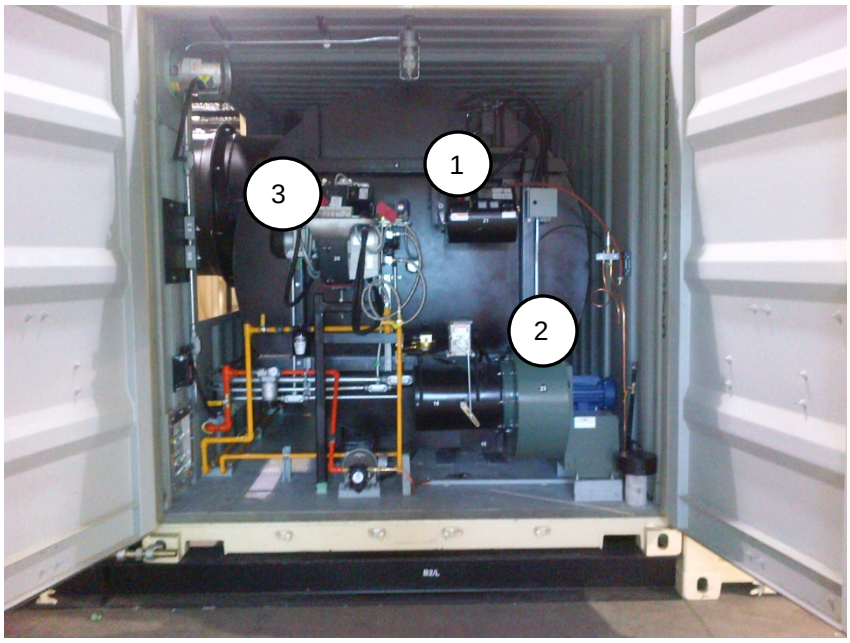
To accomplish this, the Secondary Chamber controls the temperature at 1000°C using a thermocouple to constantly measure the temperature inside the chamber. The temperature readings are monitored by the system's PLC and the PLC will initiate operational changes such as increasing or decreasing the speed of the **Secondary Chamber Blower** and the output of the **Secondary Chamber Burner (Diesel-fired).**

The **Secondary Chamber Blower** air is introduced into the chamber by an air ring manifold that surrounds the Secondary Chamber. The manifold has small air jets called tweers that open into the chamber at the side walls and create a powerful vortex of excess air to mix the incoming gases and ensure complete combustion. The flow of air is tightly managed by the control system using a Variable Frequency Drive (VFD) to control the speed of the fan and modulating motors on the blower inlet dampers.

The blower is extremely important as it creates the turbulence required to mix the gases and oxygenate them. This fosters the high efficiency combustion required to break hydrocarbon chains into carbon dioxide and water vapour. It also acts to cool the chamber and prevent temperature overruns.

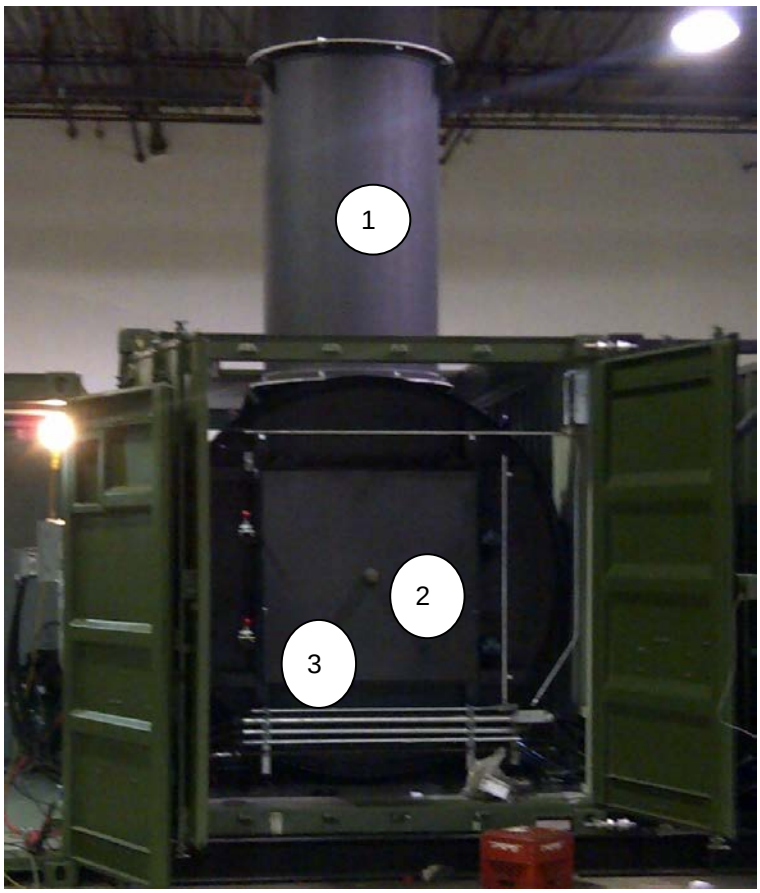
Secondary Chamber Burner (Diesel-fired) is similar to the burner used in the Primary Chamber except that it is a much higher output burner and its output is self-modulated over a broad range for very precise temperature control.

The Secondary Chamber is sized to allow two seconds of retention time. This is the time that the gases from the Primary Chamber are retained in the Secondary Chamber before they exit to the next stage. Two seconds of retention is considered to be ideal to destroy any harmful organic hydrocarbons produced from the Primary Chamber.



1. Waste Oil Burner
2. Secondary Chamber Blower/Fan
3. Secondary Chamber Burner (Diesel-fired)

Front View: Secondary Chamber Container



1. Stack
2. Secondary Chamber View Port
3. Secondary Chamber Access Door

Sample Rear View: Secondary Chamber Container

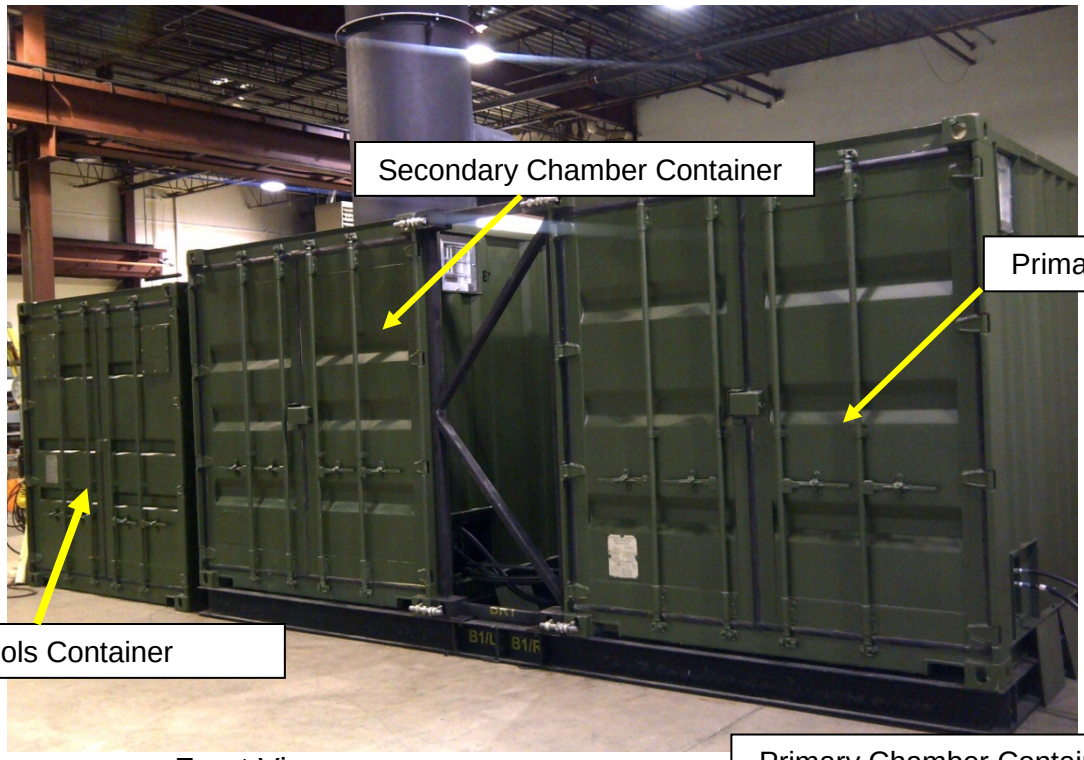
2.1.3.4.3 Main Control Panel

There is one Main Control Panel that controls all of the interconnecting modules. The Operator has one simple interface to start the equipment, view system status and change control settings if required. The entire process is managed using a **PLC** (programmable logic controller) to automate the operation. The critical process parameters such as temperature, combustion airflow and burner output are operated using EWS' patented system control program to maintain optimal combustion.

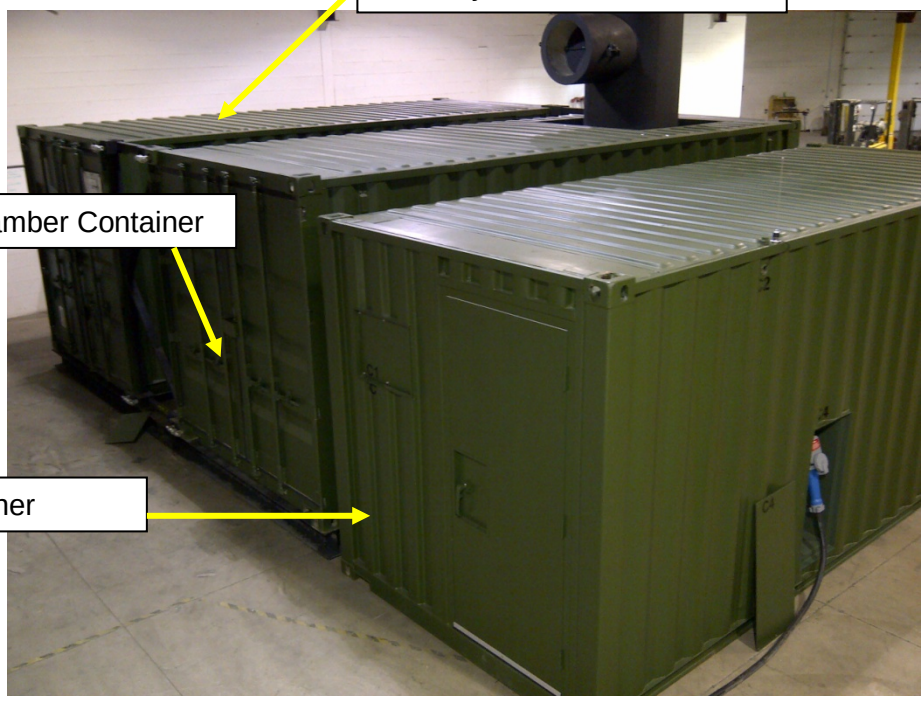
Front View: Main Control Panel

2.2 DESCRIPTION OF EWS MOBILE INCINERATOR

2.2.1 EWS Mobile Incinerator Containers



Front View



Rear View

The **EWS Mobile Incinerator** consists of the following containers as depicted in the drawing.

2.2.1.1 **Primary Chamber Container:** containing the Primary Chamber and diesel oil connectors

2.2.1.2 **Secondary Chamber Container:** containing the Secondary Chamber

2.2.1.3 **Controls Container:** containing the Main Control Panel (Monitoring and Control Centre) as well as the electrical hook-ups and Air Compressor

2.2.1.4 **Shipping Container:** Container to hold components during transportation (Not Shown)

EWS Mobile Incinerator: Description of each Container

2.2.1.1 #1 Primary Chamber Container

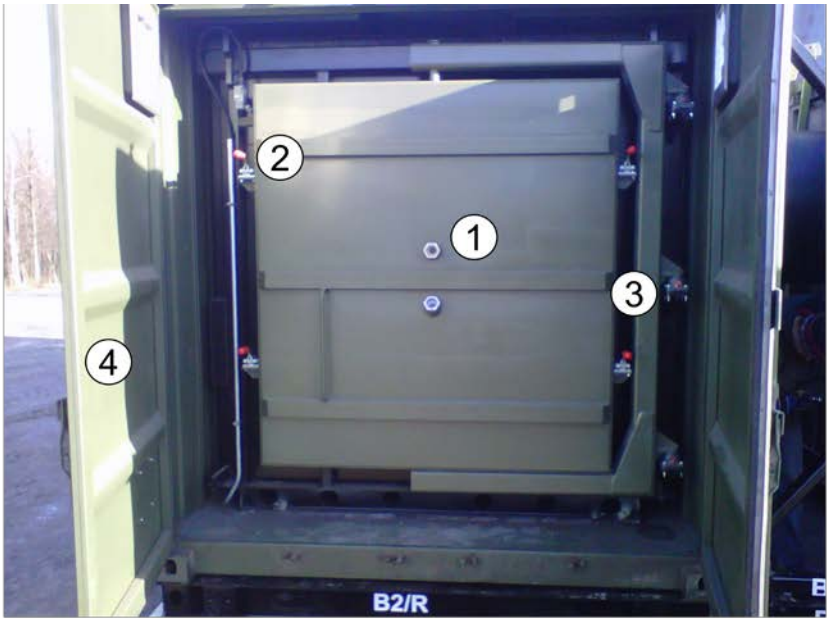
a. This standard 20' ISO shipping container permanently encloses the **Primary Chamber.**

b. At one end of the container the operator can open the container and gain access to the large front-loading primary chamber door. The Primary Chamber door will pivot on its hinge to allow for an opening of 90°.

c. At the other end of the container the doors will allow for unencumbered access to the auxiliary fuel (diesel) burner. Also located at this end is the Primary Chamber cooling fan. Other than during periodic maintenance and installation and disassembly, there is no need to regularly access these components and therefore these doors will be kept closed.
   i. The Primary Chamber including all of its major components and plumbing will be shipped fully assembled within the container, with minimal assembly of interconnections required in the field.

d. This container includes its own air handling system.

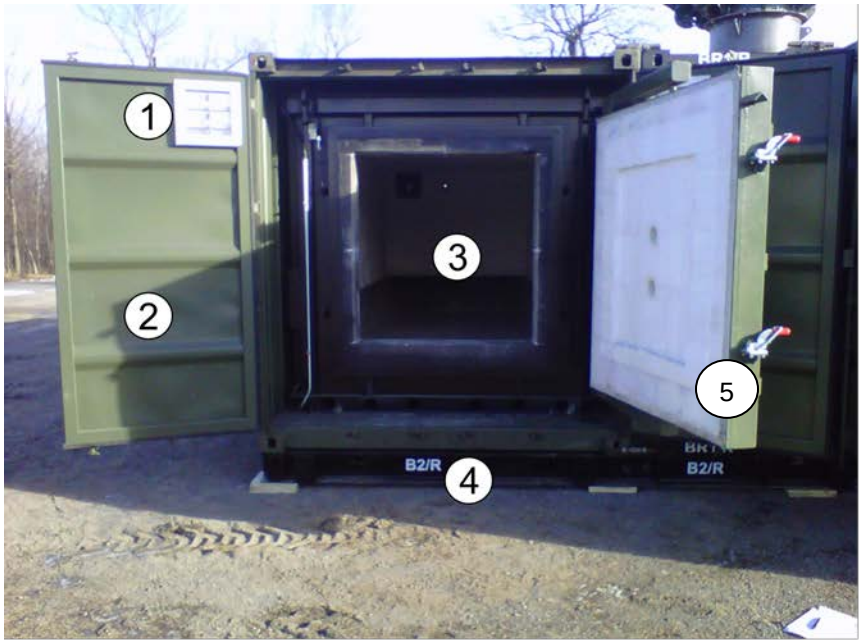
e. This container is modified to allow interconnections to the other containers:
   i. Hatch opening for interconnecting duct Breech between Primary and Secondary Chamber Containers
   ii. Utility Bridge for fuel in, fuel return line out, electrical power in and instrument cables out



1. Primary Chamber View ports (2)
2. Toggle Clamps (4)
3. Door Bearings (3)
4. Primary Chamber Container Door

Front View: Primary Chamber Container

(with Primary Chamber Door Closed)



1. Container Louver
2. Primary Chamber Container Door
3. Opening into Primary Chamber (loading area)
4. Base frame
5. Toggle Clamps

Front View: Primary Chamber Container

(with Primary Chamber Door Open)

1. Thermocouple
2. Burner (Diesel-fired)
3. Primary Chamber Blower/Cooling Fan

Rear View: Primary Chamber Container

2.2.1.2 #2 Secondary Chamber Container

a. This standard 20' ISO shipping container permanently encloses the **Secondary Chamber.**

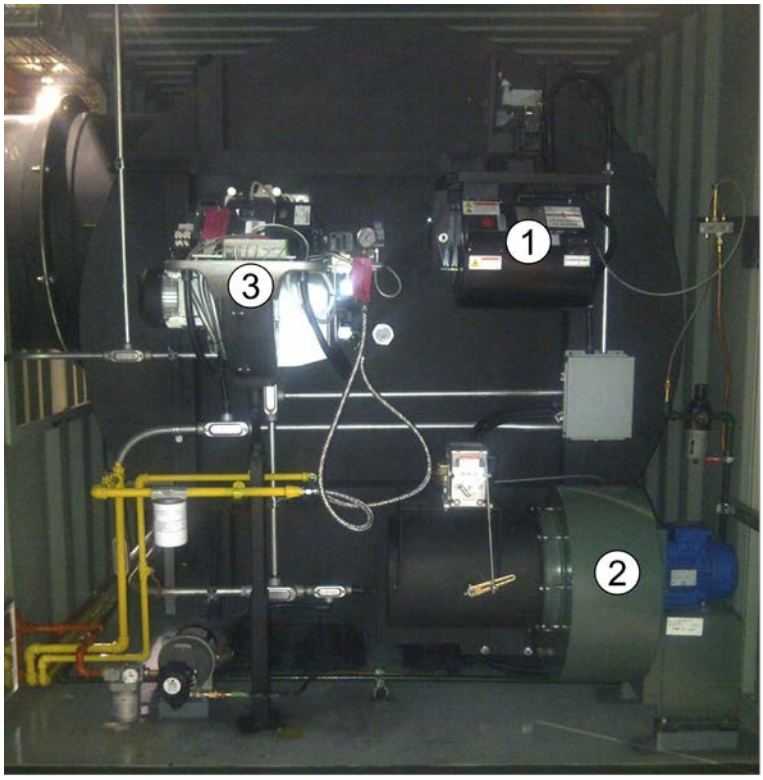
b. This container will be accessed by the Operator on a daily basis. The doors provide access for periodic maintenance and for access during installation and disassembly.

c. The Secondary Chamber including all of its major components and plumbing will be shipped fully assembled within the container, with minimal assembly of interconnections required in the field.

d. The Secondary Chamber includes an access door for inspection and maintenance access for the Secondary Burner

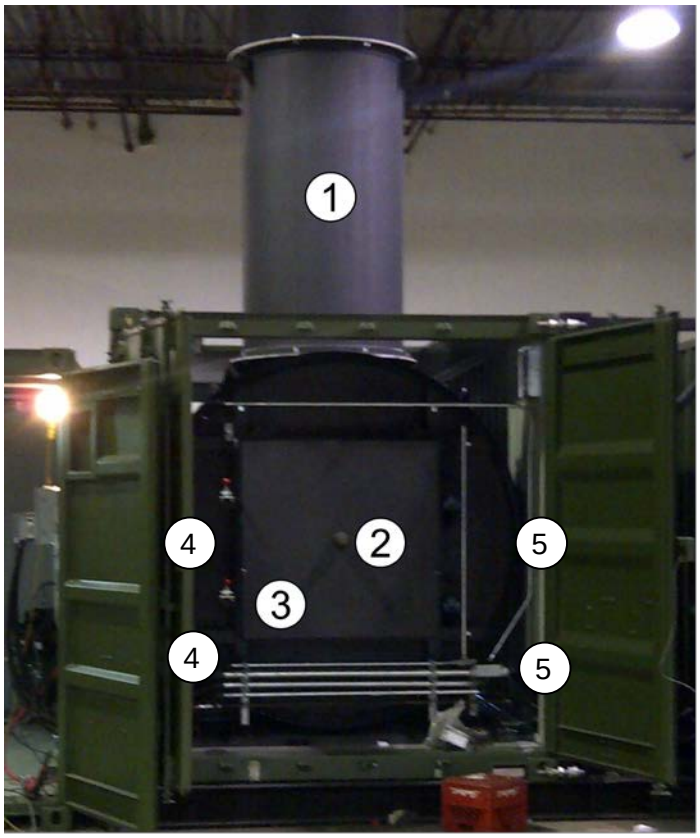
e. This container includes its own air handling system.

f. This container is modified to allow inter connections to the other containers.
   i. Hatch opening for interconnecting duct, Breech between Primary and Secondary Chamber Containers
   ii. Utility Bridge (Secondary Chamber to Primary Chamber) Interface for fuel in, fuel return line out, electrical power in and instrument cables out.
   iii. Utility Bridge (Secondary Chamber to Controls Container) fuel, electrical, instrument and air.



1. Waste Oil Burner
2. Secondary Chamber Blower/Fan
3. Secondary Chamber Burner (Diesel-fired)

Front View: Secondary Chamber Container



1. Stack
2. Secondary Chamber View Port
3. Secondary Chamber Access Door
4. Toggle Clamps (2)
5. Door Bearings

Rear View: Secondary Chamber Container

2.2.1.3 #3 Controls Container

a. This standard 20' ISO shipping container houses the Main Control Panel for the entire **EWS Mobile Incinerator** package.

b. This container will be the main point of operations and control for the entire **EWS Mobile Incinerator** package.

c. This container is modified to allow inter connections to the other containers.
   i. Utility Bridge Interface with Secondary Chamber, fuel, electrical, instrument and air.
   ii. Main power supply connection

1. Main Power Supply Connection 2" (power supply cable and coupling to be supplied by customer)

2. Control Room Door

2.3 SPECIFICATIONS & MATERIALS OF CONSTRUCTION

2.3.1 EWS Mobile Incinerator: Operating Parameters

Operational Parameter	Rating
Incinerator Type	Controlled-air, two-stage
Fuel Type	Main: Diesel; Auxiliary: Waste Oil
Waste load capacity	2000 kg
Batch cycle time	8-10 hours estimate
Factory Pre-set minimum burn time	480 minutes
Cool down cycle	10-12 hours
Pre-set automated cool down cycle operation time	720 minutes

2.3.2 EWS Mobile Incinerator: Technical Specifications

2.3.2.1 Incinerator: Materials of Construction

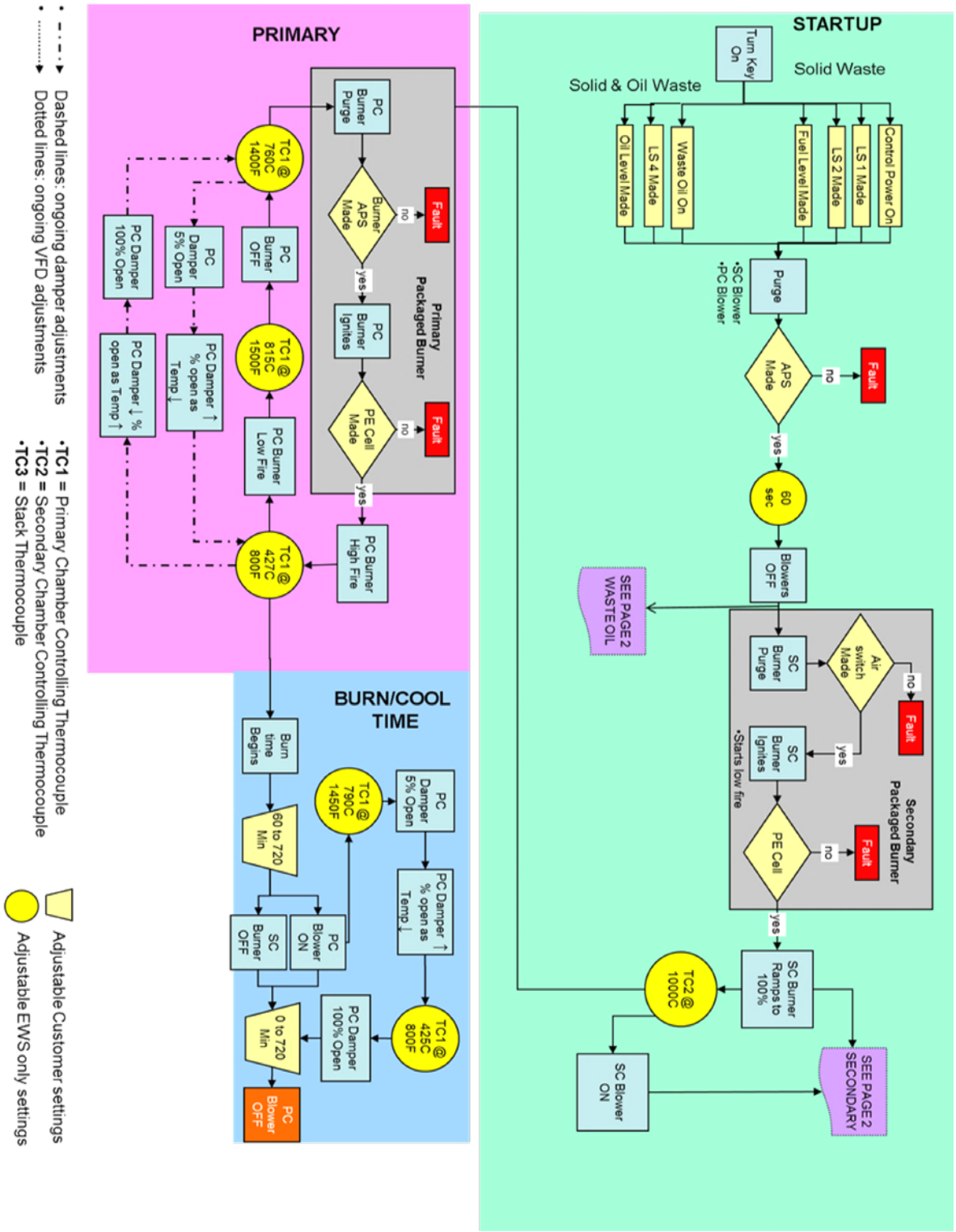
Component	Material of Construction
Incinerator Shell	¼" thick mild steel, welded with continuous bead welds Sand-blasted and painted with rust-inhibiting, high temperature paint
Incinerator Lining – Primary Chamber Floor	Factory cured, reinforced castable monolithic refractory, 6" thick Rated to 1760°C
Incinerator Lining – Primary Chamber walls and roof, Secondary Chamber interior	Ceramic fibre modules, 6" thick Rated to 1200°C Modules are lightweight and are individually anchored to the shell (Heavy, high-strength material not required or desirable in these areas) Highly reflective, does not retain heat against shell Immune to thermal shock from temperature cycling inherent in batch operation
Incinerator Lining – Door jambs, lintels, breech openings, and other penetrations	Factory cured, formed, reinforced castable refractory, 6" thick Rated to 1200°C High-strength, erosion and abrasion resistant material required in the susceptible areas
Fuel Oil Tanks (Diesel & Waste Oil)	Mild steel tank, sand-blasted and coated with corrosion resistant paint. Double-wall construction.

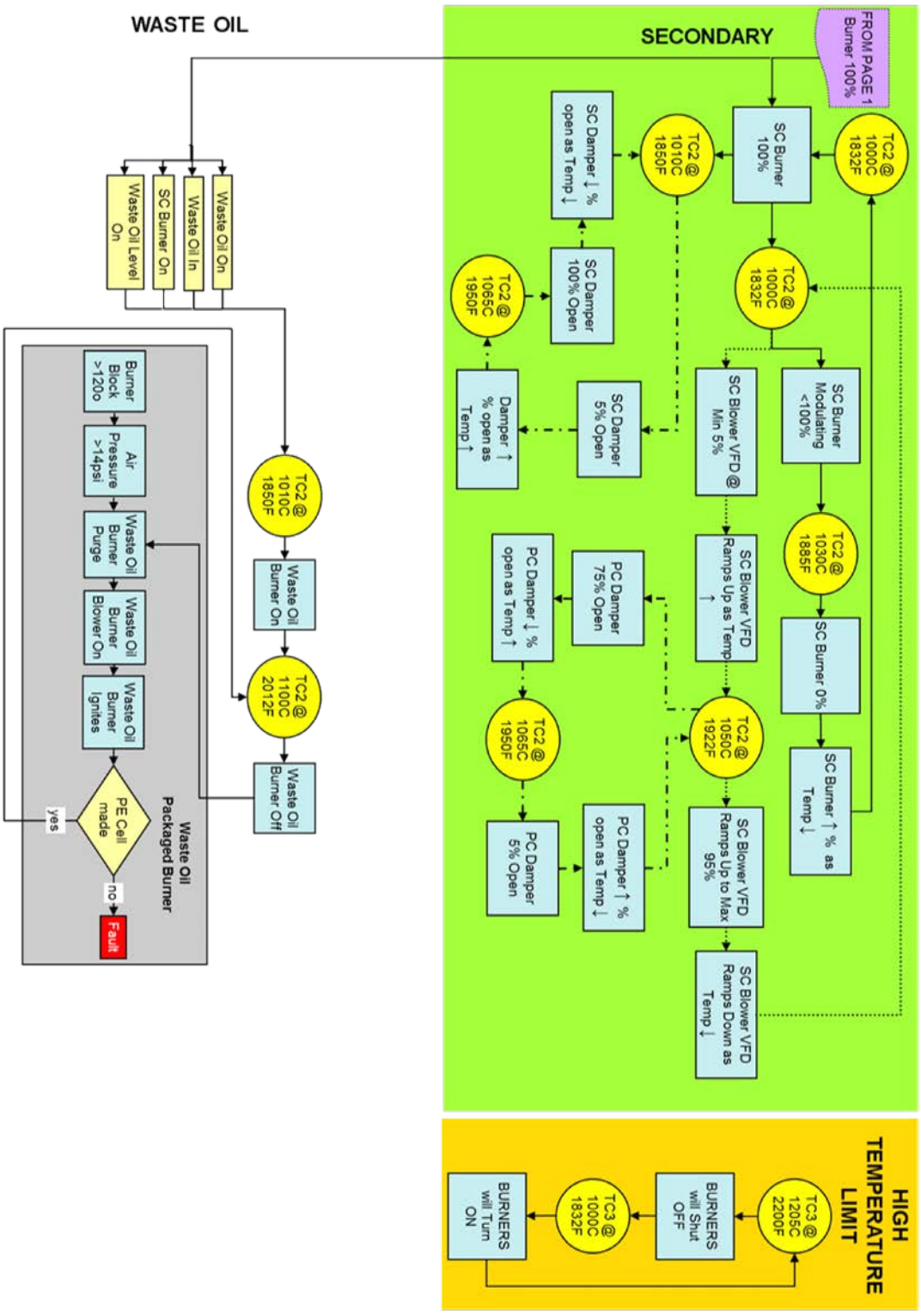
2.3.2.2 Incinerator: Major Components Specifications

Component	Description	Size/Rating
Control System	Single main control cabinet houses all motor starters, breakers and overloads. PLC process controller, Variable Frequency Drive (VFDs) to control Secondary Blower. LCD Operator Interface.	Electrical Power Design Input: 600V, 60 A
Packaged Diesel Fired Burners	Industrial burners each with built-in blower to supply combustion air, oil pump driven by same motor. Burner complete with integral relief valve and filter, fuel pressure gauge, air proving switch and igniters.	Primary Burner Rating: 97/154-395 kW **Motor: 0.7 kW** Secondary Burner Rating: 332/711-1482 kW **Motor: 2.1 kW**
Blowers	Factory run tested packaged design. Fan construction able to withstand high heat environment.	<u>Primary Blower:</u> Flow rate:1700 m^3/h Standard Static Pressure (SP): 31.5 mmH_2O **Motor: 1.12 kW (1.5 HP)** <u>Secondary Blower:</u> Flow Rate:4247 m^3/h Standard SP: 61 mmH_2O **Motor: 1.5 kW (2 HP)** Note: Standard Air, 70°F, 0.075IB/CF (21°C, 1.20 kg/m^3)
Diesel Fuel Tank	Includes all required accessories: vent, drain, level sensor and lifting lugs.	Volume: 2200 litres
Waste Oil Tank	Includes all required accessories: vent, drain, level sensors, heater and lifting lugs.	Volume: 500 litres

2.3.3 EWS Mobile Incinerator: Controls Philosophy

2.3.3.1 EWS Mobile Incinerator Package Central Control System




WASTE OIL
SECONDARY
FROM PAGE 1 Burner 100%
TC2 @ 1000C 1832F
SC Burner 100%
TC2 @ 1010C 1850F
SC Damper ↓ % open as Temp ↓
TC2 @ 1065C 1950F
SC Damper 100% Open
TC2 @ 1000C 1832F
SC Blower VFD @ Min 5%
SC Burner Modulating <100%
Damper ↑ % open as Temp ↑
SC Damper 5% Open
TC2 @ 1030C 1885F
SC Blower VFD Ramps Up as Temp ↑
PC Damper ↓ % open as Temp ↑
PC Damper 75% Open
SC Burner 0%
TC2 @ 1065C 1950F
TC2 @ 1050C 1922F
SC Burner ↑ % as Temp ↓
PC Damper 5% Open
PC Damper ↑ % open as Temp ↓
SC Blower VFD Ramps Up to Max 95%
SC Blower VFD Ramps Down as Temp ↓
HIGH TEMPERATURE LIMIT
TC3 @ 1205C 2200F
BURNERS will Shut OFF
TC3 @ 1000C 1832F
BURNERS will Turn ON
Waste Oil Level On
SC Burner On
Waste Oil In
Waste Oil On
TC2 @ 1010C 1850F
Waste Oil Burner On
TC2 @ 1100C 2012F
Waste Oil Burner Off
Waste Oil Packaged Burner
Burner Block >120o
Air Pressure >14psi
Waste Oil Burner Purge
Waste Oil Burner Blower On
Waste Oil Burner Ignites
PE Cell made
yes
no
Fault

2.4 WASTE PROCESSING CAPABILITIES

2.4.1 EWS Mobile Incinerator Waste Description

The waste types to be processed include: personal domestic waste, kitchen waste, dewatered sewage sludge, paper, packaging, lumber and textiles, documents, occasional tires and clinical medical waste (only gauze and needles). Furthermore, the specification indicates that hazardous materials including batteries will be eliminated from the incinerator waste stream.

2.4.2 Design Waste Assumptions

Quantity	**2000 kg/day**
Density	**160-240 kg/m^3**
Higher Heat Value	**15,150 KJ/kg**
Moisture Content	**Up to 40%**

System capacity of 2000 kg per day is based on the above waste mix assumptions. Waste will be loose, as received and not compacted prior to loading. If high volumes of PET (clear plastic) water bottles are received some compaction is recommended to ensure that the waste mix characteristics are representative of materials presented in the quote AMR-ECO M 2TN.

NOTE

2.4.2.1 Higher heat value materials should be mixed with lower heat value materials to ensure that the average heat value of the batch load is approximately that listed above. Overloading the system with high heat value materials can cause uncontrolled combustion leading to pollution and/or damage to the incinerator system.

2.4.2.2 A batch system capacity is closely related to the waste density. If a large amount of very low density, low weight materials are loaded into the system at one time the volume of the Primary Chamber may limit the capacity to much less than it is rated for. Care should be taken to mix waste materials to ensure the correct density range. Also, materials containing large air spaces such as empty plastic bottles, and cardboard boxes should be flattened before loading.

2.4.2.3 When processing batches of very wet materials the burn cycle time should be increased to accommodate the additional time required to dry the waste before it can combust.

2.4.2.4 Do not load the system with more than 25% by volume of extremely wet materials such as grey water or wet garbage.

2.4.2.5 When possible layer the materials so that the load is a mix of wet and dry, and/or high and low heat value materials.

2.4.2.6 Never load more than approximately 20 litres of high heat value waste such as kitchen grease or used cooking oil as this can lead to an uncontrolled burn.

2.4.2.7 See the list in Section 2.4.4 "Unacceptable Waste Materials" for items that should not be processed in the **EWS Mobile Incinerator**.