4.2.6 Yearly Instructions

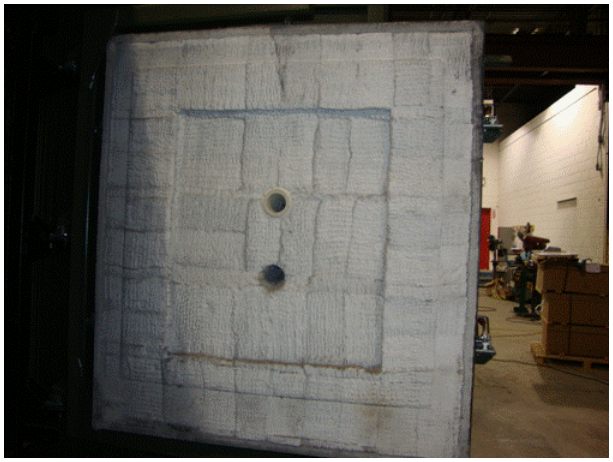
Refractory: (05-001.Y)

When working with the refractory make sure you use the proper tools; wear goggles, dust mask and gloves

INSTRUCTION 05-001.Y.01:
CHECK DOOR GASKET ALONG PRIMARY & SECONDARY CHAMBER DOORS

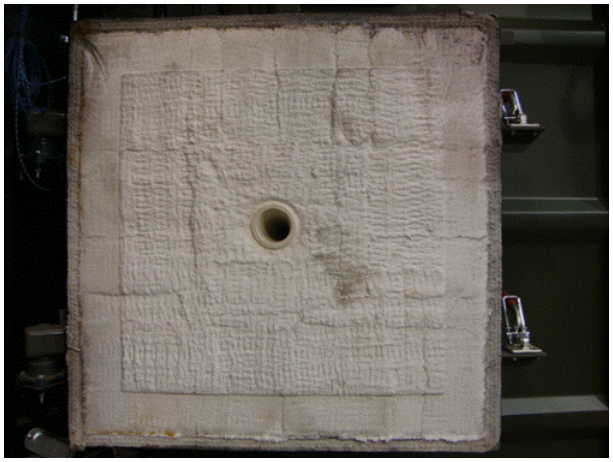
1. If required replace the door gasket. The gasket can last over 2 years but will depend on the careful use by the operator when loading and unloading.

2. Remove the damaged section of door gasket from door and reinstall new gasket



Primary Door (refractory lined)

Primary Door Gasket



Secondary Door (refractory lined)

Secondary Door Gasket

Electrical: (05-004.Y)

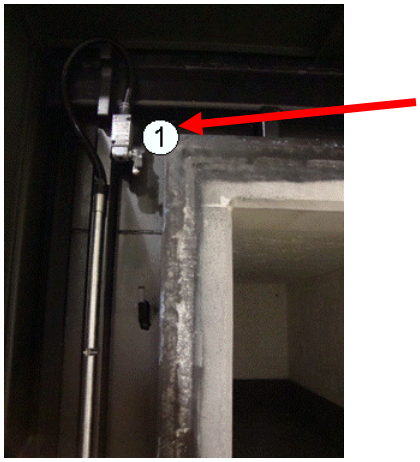
When working with electrical components ensure lock out instructions are being followed

Please follow all instructions outlined in *Section 4.2.2 Zero Mechanical State & Lock Out Instructions.*

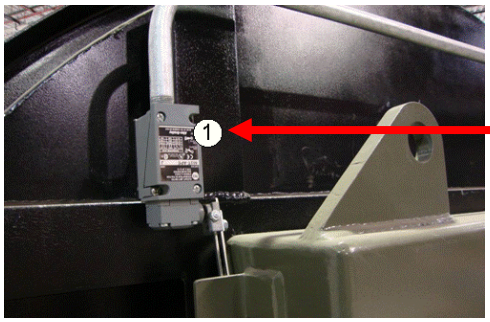
INSTRUCTION 05-004.Y.01: CHECK LIMIT SWITCHES

NOTE **System must not be running or in cool down to perform this inspection**.

1. Open Primary and Secondary Chamber doors and check top view screen on the HMI Panel view to ensure that it indicates door is open.
2. Close Primary and Secondary Chamber doors and check top view screen on the HMI Panel View to ensure that it indicates door is closed.
3. All limit switches located on the unit are checked this way.
4. Replace limit switches if necessary.



Primary Chamber Limit Switch



Secondary Chamber Limit Switch

5. See *Part IV Section 4 CMI 4.4.1/05-005A*.
6. Check all other limit switches in the system.

4.3 CORRECTIVE MAINTENANCE INSTRUCTIONS (CMI)

The following instructions relate to the replacement or correction (fixing) of components of the EWS Mobile Incinerator Package.

These Corrective Instructions are grouped in this section by the following:

4.4.1 General Corrective Maintenance Instructions
4.4.2 Refractory Corrective Maintenance Instructions
4.4.3 Primary & Secondary Burner Corrective Maintenance Instructions
4.4.4 Primary & Secondary Blower Corrective Maintenance Instructions
4.4.5 Main Control Panel Corrective Maintenance Instructions

As per the *Preventive Maintenance Instructions Section 4.2* of this *Manual*, the following table is utilized to identify the components of the system that require corrective maintenance.

System Component		**Identification number**	
Primary Burner		**01-002**	
	Replacing Fuel Filter		4.4.1/01-002A
Secondary Burner		**02-002**	
	Replacing Fuel Filter		4.4.1/02-002A
Thermocouple		**05-002**	
	Replacing Thermocouple		4.4.1/05-002A
Limit Switch		**05-005**	
	Limit Switch Replacement		4.4.1/05-005A
Container Door Gasket		**05-006**	
	Replacement of Container Door Gasket		4.4.1/05-006A
Refractory		**05-001**	
	Wall Refractory: Gaps between the Modules		4.4.2/05-001A
	Wall Refractory: Replacement of the Modules		4.4.2/05-001B
	Door Gasket		4.4.2/05-001C
	Castable Refractory		4.4.2/05-001D
	Temporary Repair of Castable		4.4.2/05-001E
Primary Burner		**01-002**	
	HT Lead & Electrode Replacement		4.4.3/01-002A
	Diffuser Disc Replacement		4.4.3/01-002B
	Nozzle Replacement		4.4.3/01-002C
	End Cone Replacement		4.4.3/01-002D
	Nozzle Assembly Repair or Replacement		4.4.3/01-002E
	Burner Flexible Oil Line Replacement		4.4.3/01-002F
	Low Level Switch Replacement		4.4.3/01-002G
	Inspection Window Replacement		4.4.3/01-002H
	Fuel Pump Replacement		4.4.3/01-002I
	Control Box Replacement		4.4.3/01-002J
	Oil Tube Replacement		4.4.3/01-002K
	Burner PE Cell & UV Detector Replacement		4.4.3/01-002L
	Burner Fan Motor Replacement		4.4.3/01-002M
Secondary Burner		**02-002**	
	HT Lead & Electrode Replacement		4.4.3/02-002A

	Diffuser Disc Replacement		4.4.3/02-002B
	Nozzle Replacement		4.4.3/02-002C
	End Cone Replacement		4.4.3/02-002D
	Nozzle Assembly Repair or Replacement		4.4.3/02-002E
	Burner Flexible Oil Line Replacement		4.4.3/02-002F
	Low Level Switch Replacement		4.4.3/02-002G
	Inspection Window Replacement		4.4.3/02-002H
	Fuel Pump Replacement		4.4.3/02-002I
	Control Box Replacement		4.4.3/02-002J
	Oil Tube Replacement		4.4.3/02-002K
	Burner PE Cell & UV Detector Replacement		4.4.3/02-002L
	Burner Fan Motor Replacement		4.4.3/02-002M
Primary Blower		**01-001**	
	Air Proving Switch Replacement		4.4.4/01-001A
	Damper Calibration		4.4.4/01-001B
	Modutrol Resistor Replacement		4.4.4/01-001C
	Damper Crank Arm Replacement		4.4.4/01-001D
	Motor Replacement		4.4.4/01-001E
	Modutrol Motor & Transformer Replacement		4.4.4/01-001F
	Replace the Blower Contactor		4.4.4/01-001G
Secondary Blower		**02-001**	
	Air Proving Switch Replacement		4.4.4/02-001A
	Damper Calibration		4.4.4/02-001B
	Modutrol Resistor Replacement		4.4.4/02-001C
	Damper Crank Arm Replacement		4.4.4/02-001D
	Motor Replacement		4.4.4/02-001E
	Modutrol Motor & Transformer Replacement		4.4.4/01-001F
	Replace the Blower Contactor		4.4.4/01-001G
Main Control Panel		**03-010**	
	Main Control Panel		4.4.6/03-010A
	Reboot PLC		4.4.6/03-010B
	PLC Parts Replacement		4.4.6/03-010C

4.3.1 General Corrective Maintenance Instructions

LIMIT SWITCH REPLACEMENT (4.4.1/05-005A)

1. Loosen the 2 screws holding the limit switch in place.
2. Remove limit switch, replace with a new one.
3. Take arm off of old body and mount to new.
4. Tighten the 2 screws holding the limit switch body.

REPLACING THERMOCOUPLE (4.4.1/05-002A)

The thermocouple will require routine replacement. The environment inside the incinerator will erode the protection tube to the point of failure. If the element is exposed to this environment it will be destroyed and will need to be replaced.

1. Unscrew thermocouple lid and remove wires.
2. Remove protection tube. To aid with this a vise and a pipe wrench will be needed.
3. Remove element and replace with new element and protection tube

4. Reinstall on incinerator.

5. After installation turn power back on. Observe the temperature reading of the thermocouple you were just working on. If the wires were installed incorrectly the temperature will read the opposite temperature. (I.e. 20°C would read as -20°C). If this is the case open the thermocouple housing and switch the wires.

REPLACING FUEL FILTER (4.4.1/01-002A AND 02-002A)

The fuel filter will require routine replacement to ensure clean fuel delivery to the Primary and Secondary Chamber burners.

1. Close the Ball Valve on the supply line.

2. Unscrew the used Red filter. Use a bucket to catch the surplus fuel when you unscrew the filter.

3. Before installing the filter lubricate the seal on the new filter.

4. Install the new filter, and open the supply line ball valve.

4.3.2 Refractory Corrective Maintenance Instructions

When working with the refractory make sure you use the proper tools; wear goggles, dust mask and gloves

WALL REFRACTORY: GAPS BETWEEN THE MODULES (4.4.2/05-001A)

The ceramic block refractory will shrink over time exposing the exterior metal shell. These gaps need to be filled in with ceramic refractory blanket.

1. Identify gaps in the chamber that are larger than 1” in width between the modules or if you can see exterior shell.

2. With a Utility knife cut a length of ceramic blanket that will fit in the gap between the modules.

3. Stuff the blanket into the space with a straight edge or ruler.

WALL REFRACTORY: REPLACEMENT OF MODULES (4.4.2/05-001B)

Excessive damage to a section of refractory may necessitate the replacement of modules in the incinerator. Such damage is largely due to mechanical wear. The following diagram walks through the removal and installation of new modules.

A. REMOVAL: Remove existing Module (physically pull away existing refractory from underlying Module Anchor)

B. Remove welded stud from steel casing (cut with hack saw or other device between Module Anchor and Furnace Casing/Shell)

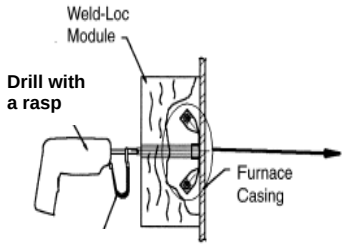


Figure 2: Stud Gun with rasp and Torque Tube (part of module assembly).

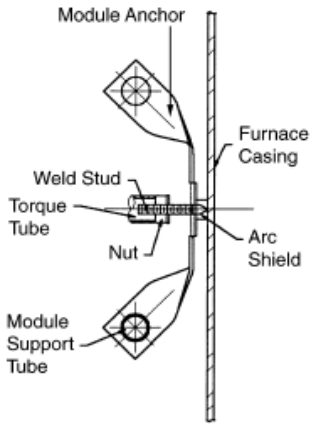


Figure 1: Side view of the Weld Loc Module

C. INSTALLATION: Once the new module is in place take the stud gun (PN: Eco-Stud; EIN: 11-E-S-01-04-016-016) with rasp to the Torque Tube and drill into place.

D. Once it has tightened the Torque Tube should come off with the drill.

DOOR GASKET REFRACTORY (4.4.2/05-001C)

The door gasket will degrade over time and will need to be replaced over time. The bottom of the door will see more degradation due to the waste burning in that vicinity.

1. Identify the damaged section of gasket that will need to be removed
2. With a utility knife cut out the section that needs to be replaced.
3. A new piece of gasket will need to be cut the same length as the removed piece.
4. With contact cement coat the gasket on one side and the door section and install.

CASTABLE REFRACTORY (4.4.2/05-001D)

Operators will notice that the castable refractory will show signs of minor cracking. The minor cracking is normal. Large sections of castable should not separate from the rest of the monolithic cast. Such occurrences are largely due to a sudden impact from machinery or

dropping of the units themselves. Mortar is supplied to help with a temporary repair while a permanent repair is resolved. Such permanent repairs are a third level repair and have to be considered on a case by case basis.

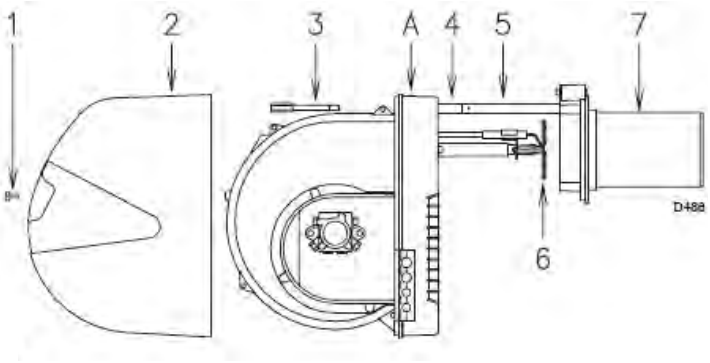
TEMPORARY REPAIR OF CASTABLE (4.4.2/05-001E)

1. Find the pieces of castable refractory that have separated.
2. Clean both the pieces of refractory and the area where the separation occurred.
3. Spread an even amount of high temperature mortar on the pieces and the area of separation.
4. Put the pieces back where they originated and support as necessary for a minimum of an hour while the mortar cures.

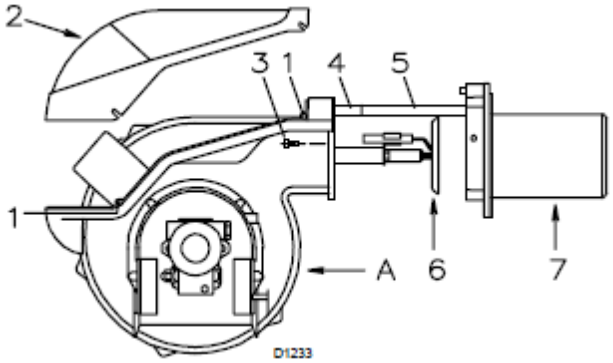
4.3.3 Burner Corrective Maintenance Instructions

Do not store flammable or hazardous materials in the vicinity of fuel burning appliances.

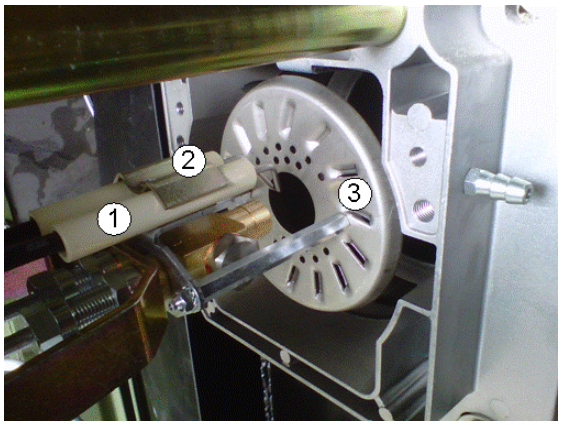
The Burners are pieces of equipment that will require routine corrective and preventive maintenance. Parts within this assembly will need to be repaired or replaced. The most common parts to be repaired or replaced are located at the front end of the burner where the parts are exposed to high temperatures.



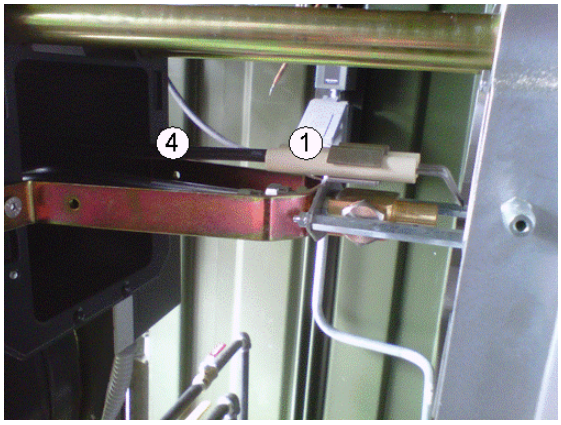
Front End Primary Burner



Front End Secondary Burner



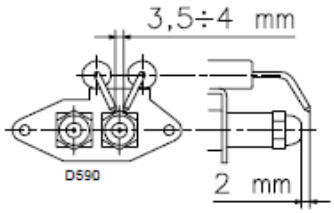
1. Electrode
2. U-bolt
3. Diffuser Disc



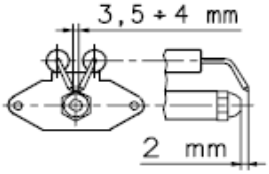
4. HT Leads

HT LEAD & ELECTRODE REPLACEMENT (4.4.3/01-002A & 02-002A)

1. In order to change out the HT leads or Electrode the U-Bolt will have to be removed
2. Remove the electrode by pulling the lead out of the white ceramic tube, replace and re-install.
3. To change the Leads the wire will need to be removed from the burner.
4. Pull the wire out of the burner housing through the rubber grommet.
5. The other end is connected to the back of the control box. Pull the wire straight out and the spring fitting will disengage.
6. Replace the lead with a new one reversing the above directions.
7. When reinstalling the electrodes make sure that they are positioned as shown below:



Primary Burner



Secondary Burner

DIFFUSER DISC REPLACEMENT (4.4.3/01-002B & 02-002B)

1. Locate the diffuser disc in the above pictures.
2. The disc assembly is secured to the nozzle housing by 2 hex nuts.
3. Remove these nuts and remove the assembly from the burner.
4. The disc is attached to the assembly with 2 screws.
5. Remove the screws and replace the disc.
    - Primary Chamber Burner diffuser disc
    - Secondary Chamber Burner diffuser disc
6. Reassemble.

NOZZLE REPLACEMENT (4.4.3/01-002C & 02-002C)

1. Locate the nozzle at the very front end of the burner just behind the diffuser disc.

2. Remove the nozzle with a wrench.

3. Install the new nozzle.
    - Primary Chamber Burner nozzle
    - Secondary Chamber Burner nozzle

END CONE REPLACEMENT (4.4.3/01-002D & 02-002D)

The End Cone is marked Item #7 in the first diagram of Section 4.4.3. The end cone will need replacement when the flame becomes unstable from too much heat damage.

1. Loosen and remove the 4 hex bolts that hold the burner on the flange.

2. Remove the burner completely from the incinerator. This will require more than one operator because the burner is heavy.

3. There are two screws that hold the End Cone on. Remove and save the screws for the new End Cone.

4. Install the new End Cone with the old screws.
    - Primary Chamber burner end cone
    - Secondary Chamber burner end cone

5. Reinstall the burner.

NOZZLE ASSEMBLY REPAIR OR REPLACEMENT (4.4.3/01-002E & 02-002E)

The nozzle assembly is subjected to high heat cycling. The heat cycling will eventually cause the seals and assembly to leak. The assembly will have to be replaced when this occurs. First identify the location of the nozzle assembly.

- Primary Chamber Burner nozzle assembly:
- Secondary Chamber Burner nozzle assembly:

The parts (seals, nozzle assembly) needed for these replacements are all included under one part number.

- Primary Chamber Burner nozzle assembly:
- Secondary Chamber Burner nozzle assembly:

Remove all connections to the nozzle assembly and replace with the above parts.

BURNER FLEXIBLE OIL LINE REPLACEMENT (4.4.3/01-002F & 02-002F)

1. Turn the inline ball valve to the closed position to isolate the fuel supply from the burner. This valve is located down line from the burner.

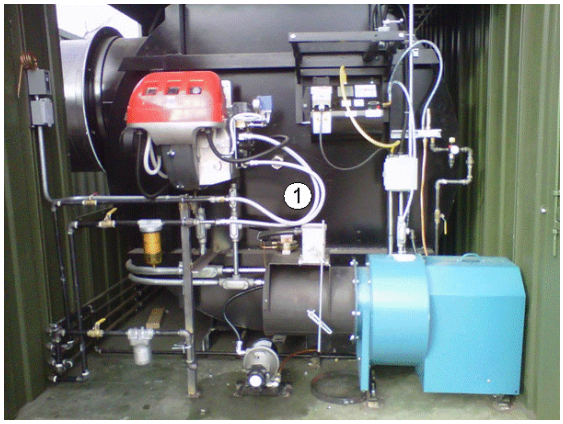
2. Remove flexible lines.

3. Replace with new lines.

    - Primary Chamber Burner flexible oil line:
    - Secondary Chamber Burner flexible oil line

4. Open ball valve.

Primary Chamber Burner Flexible lines
(1 Above)



Secondary Chamber Burner Flexible Lines
(1 Above)

LEVEL SWITCH REPLACEMENT (4.4.3/01-002G & 02-002G)

The level switch is located in the Diesel Tank.

NOTE

Tanks do not have to be emptied to replace.

1. Unplug the level switch from tank.

2. Disconnect the cord and remove the level switch.

3. Replace level switch and reconnect the cord.

4. Plug in the level switch to tank.

INSPECTION WINDOW REPLACEMENT (4.4.3/01-002H & 02-002H)

The inspection window can be identified as Item # 7 on IPD-I03 for the Primary Burner and Item # 32 on IPD-I04 for the Secondary Burner. To replace the window simply remove the old inspection window and replace with a new one:

- Primary Burner inspection window
- Secondary Burner inspection window

FUEL PUMP REPLACEMENT (4.4.3/01-002I & 02-002I)

Identify the pump on the burner you wish to replace the pump on:

- Primary Burner:
- Secondary Burner :

Remove all fuel connections to the pump with the appropriate wrench. Unbolt the pump from the main body of the burner and pull the pump away from the burner to remove.

Reinstall the new pump, and reattach all fuel connections.

- Primary Burner:
- Secondary Burner :

CONTROL BOX REPLACEMENT (4.4.3/01-002J & 02-002J)

Identify the control box on the burner you wish to replace the control box on:

- Primary Burner:
- Secondary Burner :

Ensure the power is off, unscrew the old control box, and install the new one.

- Primary Burner:
- Secondary Burner :

OIL TUBE REPLACEMENT (4.4.3/01-002K & 02-002K)

Oil tubes leak due to heat cycling which causes the fittings to fail or a loose fitting.

1. Identify the oil tubes on the Primary Burner and Secondary burner

2. First try tightening the fittings to see if the leak stops. If the leak does not stop:

3. Remove the old oil tubes with a wrench and install the new ones:

    - Primary Burner Tubes:
    - Secondary Burner Tubes

BURNER PE CELL & UV DETECTOR REPLACEMENT (4.4.3/01-002L & 02-002L)

Primary Burner: If the PE cell has been damaged, then it will need to be replaced. The PE cell while removed needs to be unplugged from the control box. This is accomplished by pulling the connection towards you. With the new PE cell install the control box end first by pushing the connection hard. Reinstall the PE cell in the burner.

Secondary Burner: If the UV Detector has been damaged, then it will need to be replaced. The UV Detector while removed needs to be unplugged from the control box. This is accomplished by pulling the connection towards you. With the new UV Detector install the control box end first by pushing the connection hard. Reinstall the UV Detector in the burner.

BURNER FAN MOTOR REPLACEMET (4.4.3/01-002M & 02-002M)

Identify the malfunctioning motor in the affected burner:

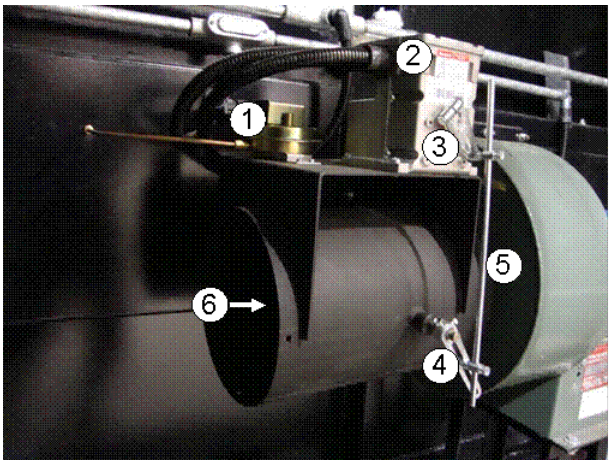
- Primary Burner –
- Secondary Burner -

Unbolt and remove the malfunctioning motor from the housing the burner. Disconnect all electrical connections. Reinstall the new motor exactly how the old motor was installed.

4.3.4 Primary & Secondary Blower Corrective Maintenance Instructions

Do not attempt any maintenance on a fan unless the electrical supply has been completely disconnected and locked. In many cases, a fan can windmill despite removal of all electrical power. The rotating assembly should be blocked securely before attempting maintenance of any kind.

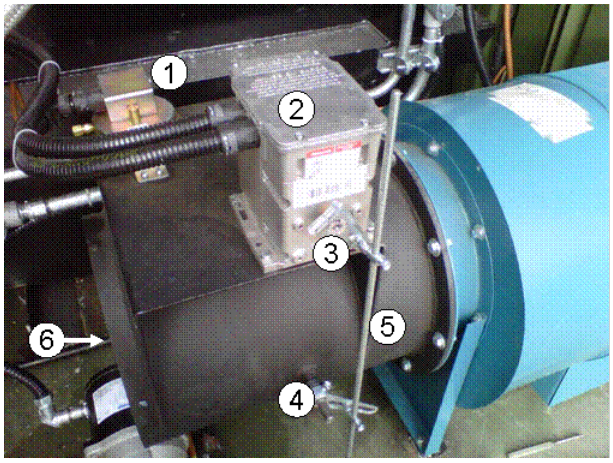
Primary Blower Assemblies are not a commonly repaired part on the incinerator. Parts within this assembly will need to be repaired or replaced. They are outlined below.



Primary Blower

1. Air Proving Switch
2. Modutrol Motor
3. Motor Crank Arm
4. Damper Crank Arm
5. Rod
6. Damper

Secondary Blower Assemblies are not a commonly repaired part on the incinerator. Parts within this assembly will need to be repaired or replaced. They are outlined below.



Secondary Blower

1. Air Proving Switch
2. Modutrol Motor
3. Motor Crank Arm
4. Damper Crank Arm
5. Rod
6. Damper

AIR PROVING SWITCH REPLACEMENT (4.4.4/01-001A & 02-001A)

1. Ensure all power is locked out.
2. Remove wiring from switch.
3. Remove tubing from switch.
4. Unscrew screws at the two locations and remove switch.
5. Reinstall new switch complete with tubing and wiring and then retighten.
6. Turn power back on.

DAMPER CALIBRATION (4.4.4/01-001B & 02-001B)

Sometimes the damper linkage will slip when the connections become loose (Items 3,4,5 in the Secondary Blower photo) In order to ensure that the linkage is correctly calibrated the operator will need to look at the display screen on the control panel while the unit is in operation

1. Read the %Open value on the control panel operator interface (PanelView) for the Primary Blower.
2. During operation the damper is factory preset to be 0% open, or fully closed.
3. Look inside the damper (Item 6) and ensure that the linkage is completely closed.
4. If it is then this maintenance is complete.
5. Should the damper be open even a small percentage the linkages are to be loosened and the damper adjusted to be completely closed, and then retighten.

MODUTROL RESISTOR REPLACEMENT (4.4.4/01-001C & 02-001C)

The Modutrol resistors are located inside the top lid of the Modutrol motor. Remove the lid to the Modutrol motor by unscrewing the top four (4) screws. The connection between the control panel and the Modutrol is made with a small white connector with 3 terminals. Jumpered between these terminals is the resistors.

Remove and replace the resistors one at a time to ensure the correct resistors are replaced. You identify the correct resistor by examining the color band on the center node of the resistor. Replace like resistors.

DAMPER CRANK ARM REPLACEMENT (4.4.4/01-001D & 02-001D)

The crank arm will only need to be replaced if the arm is damaged due to misuse. Identify the damper crank arm (Item #4 in the picture on the previous page).

Identify the location of the linkage on the rod and the damper arm with a marker, so the new crank arm will be in the same spot when reinstalled. Remove the connections to the crank arm and replace with the new one and ensure it is in the same spot as the old one.

MOTOR REPLACEMENT (4.4.4/01-001E & 02-001E)

Replacing the motor requires a second level maintenance. This information can be found in the OEM manual New York Blower, Installation, Maintenance and Operating, IM-160 Junior Fans.

MODUTROL MOTOR & TRANSFORMER REPLACEMENT (4.4.4/01-001F & 02-001F)

To replace a Modutrol motor requires all power to be off to the system as you will need to expose electrical connections. Firstly get the new motor and orientate the motor in the same direction as the old motor. Identify where the conduit is connected on the old motor and punch the connector holes for the new motor.

Removal

1. Remove and electrical terminations and remove the transformer.
2. Install the transformer in the new Modutrol motor.
3. Remove all conduit connections on the motor.
4. Remove the damper arm and linkage from the motor.
5. Unbolt the motor from the damper, and ensure all nuts and bolts are kept for the new motor install

Install

1. Bolt the new motor in the same orientation as the old motor.
2. Install the damper arm and linkage to the motor
3. Install all conduit connections

Terminate all electrical connections the same as the old motor.

REPLACE THE BLOWER CONTACTOR 4.4.4/01-001G

1. Turn off Main Disconnect.
2. Open Panel.
3. Remove the wires from blower contactor.
4. Pull the retaining clip up.
5. Tilt contactor forward and remove.
6. To reinstall tilt new contactor until it clicks back in.
7. Pull the retaining clip back down to lock.
8. Reinstall wires to contactor.
9. Close panel.
10. Turn power back on.

4.3.5 Main Control Panel Corrective Maintenance Instructions

MAIN CONTROL PANEL (4.4.6/03-010A)

All control panel diagnostics are to be completed by certified or trained technicians. Electrical drawings / diagrams are provided to aid electricians with any diagnostics. For reference the parts diagrams for the main control panels are drawings

REBOOT PLC (4.4.6/03-010B)

Turn Main Disconnect to the off position on the front of the Control Panel. Turn the main disconnect back on.

PLC PARTS REPLACEMENT (4.4.6/03-010C)

For detailed repair procedures, refer to the OEM Manual, Part IV Control Panel, PLC.

Read all warnings for procedures in each OEM Manual as they contain critical safety information. Disconnect the power from each component before starting each corrective maintenance procedure.

Component	Procedure	OEM Manual	Page No.
Panelview 1000-Series	Replacing the Battery	Panelview (2711P-T10C4A8)	130
Panelview 1000-Series	Replacing the Backlight	Panelview (2711P-T10C4A8)	126

Panelview 1000-Series	Load and SD card	Panelview (2711P-T10C4A8)	135
Panelview 1000-Series	Removing the Product ID Label	Panelview (2711P-T10C4A8)	134
Panelview 1000-Series	Replacing the Bezel	Panelview (2711P-T10C4A8)	124
Panelview 1000-Series	Cleaning the Display Window	Panelview (2711P-T10C4A8)	136
16 Point Relay Output Module	Replacing a Single Module	I/O Modules Compact 16-PointRelay Output Module (1756-OA16)	156
8 Channel Analog Output Module	Replacing a Single Module	Analog I/O modules Compact 1756-OF4 Analog Output Module	187
8 Channel Analog Input Card	Replacing a Single Module	Analog I/O Modules Compact 1756-IF8 Input Card	187
6 Channel Thermocouple Input Module	Replacing a Single Module	Analog I/O Compact 1756-IT6I Thermocouple Input Module	187

4.3.6 Additional Maintenance Instructions

For more detailed and additional maintenance instructions please refer to the OEM manuals for the Incinerator components.

ECO WASTE SOLUTIONS

Project Name: Mary River H34900
EWS Project: 13-2MS

Waste Incinerator Control Philosophy Rev.B

HATCH VENDOR DATA REVIEW

Doc Number	E349000-TX001-00-083-0001	Sub	03
Date Received	20 JUNE 13		

Review Grade

- ☐ C1 – Proceed to next submission & status
- ☐ C2 – Proceed with exceptions as noted to next submission & status
- ☐ C3 – Do not proceed, revise as noted & resubmit
- ☑ C4 – No further submission required - Complete
- ☐ No further submission required - Cancelled
- ☐ No further submission required - Superseded

Next Submittal Status: ☐ Internal Review ☐ Comment Final ☐ Final ☐ As-Built ☑

Next Submittal Date:

Package Coordinator: Name, Signature and Date: M Bellier 26/6/13

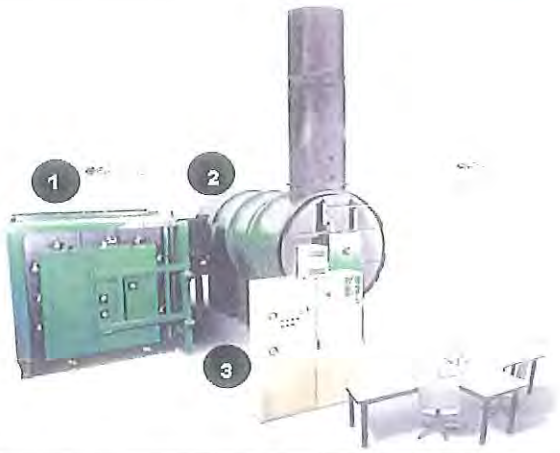
REVIEWED ONLY FOR GENERAL CONFORMANCE WITH THE SPECIFICATIONS. CHECKING BY THE ENGINEER DOES NOT WARRANT OR REPRESENT THAT THE INFORMATION CONTAINED ON THIS DRAWING/DOCUMENT IS EITHER ACCURATE OR COMPLETE. THE SOLE RESPONSIBILITY FOR CORRECT DESIGN, DETAILS & DIMENSIONS SHALL REMAIN WITH THE PARTY SUBMITTING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

Process Description

ECO WASTE SOLUTIONS INCINERATION TECHNOL

System components:

1. Primary Chamber
2. Secondary Chamber
3. Main Control Panel



COMPONENT	FUNCTIONAL OVERVIEW
Primary Chamber	In the first stage, a diesel fired burner is used to elevate the temperature of the **Primary Chamber** to ignite the waste. Once the Primary 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. At these operating temperatures, waste is allowed to fully combust and is rendered sterile. Waste is reduced in volume by over 90%. Independent tests have shown that the residual ash is non-hazardous, non-leaching and essentially inert. After enduring the combustion process, metals and glass remain intact. Preservation of metals and glass not only protects the refractory lining from damage caused by melted and fused metals and glass, but also allows for post-combustion recycling where possible.
Secondary Chamber	As waste burns in the Primary Chamber, gases containing the products of combustion enter the high temperature zone of the **Secondary Chamber** for cleansing. The Secondary Chamber is sized to retain the incoming gases for a minimum of 2 seconds at 1000°C. This chamber utilizes a packaged, high output, fully modulating diesel burner to maintain the required temperature (even in the absence of energy input from the first stage which is important when processing wet or low energy waste such as food). This stage employs a large blower, tightly controlled by the control system using a variable frequency drive on the motor. The blower 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.

Main Control Panel	There is one **Main Control Panel** for the incinerator package 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 system utilizes a PLC (programmable logic controller) to automate its functions. Incinerator critical process parameters such as temperature, combustion airflow, burner output are operated using EWS' patented system control program to maintain optimal combustion.

ECO WASTE SOLUTIONS BATCH SYSTEM OPERATING PHILOSOPHY

As per the specification, the incinerator will be located inside modified containers to be placed outdoors; the **Main Control Panel** will be placed in a small heated and insulated control room in a dedicated container.

There is no need for pre-sorting of the waste if source separation is practiced to keep inappropriate materials out of the waste feed.

The system operates in a batch style. It will be loaded using the front door of the **Primary Chamber**, it is expected that each day the **Primary Chamber** will be loaded to design capacity or at a minimum, to half capacity. If waste quantities are not sufficient to operate the machine daily, it can be used to store the waste until requirement is met.

Once loading is complete, the door is sealed shut and the **Secondary Chamber** is fired. The system is interlocked so that **Primary Chamber** waste is not allowed to combust until the **Secondary Chamber** is at operating temperature. Once this occurs, usually within the first 30 minutes of the cycle, the **Primary Chamber** cycle is initiated. During this phase, gaseous products of combustion produced from the solid waste burning in the **Primary Chamber** are burned off in the highly oxygenated, turbulent environment of the **Secondary Chamber** for a minimum of 2 seconds at a temperature of 1000°C to complete the combustion reaction.

In the **Secondary Combustion Chamber** the combustion gases are exposed a highly-oxygenated and extremely turbulent environment for a minimum of 2 seconds at a temperature of 1000°C to complete the combustion reaction.

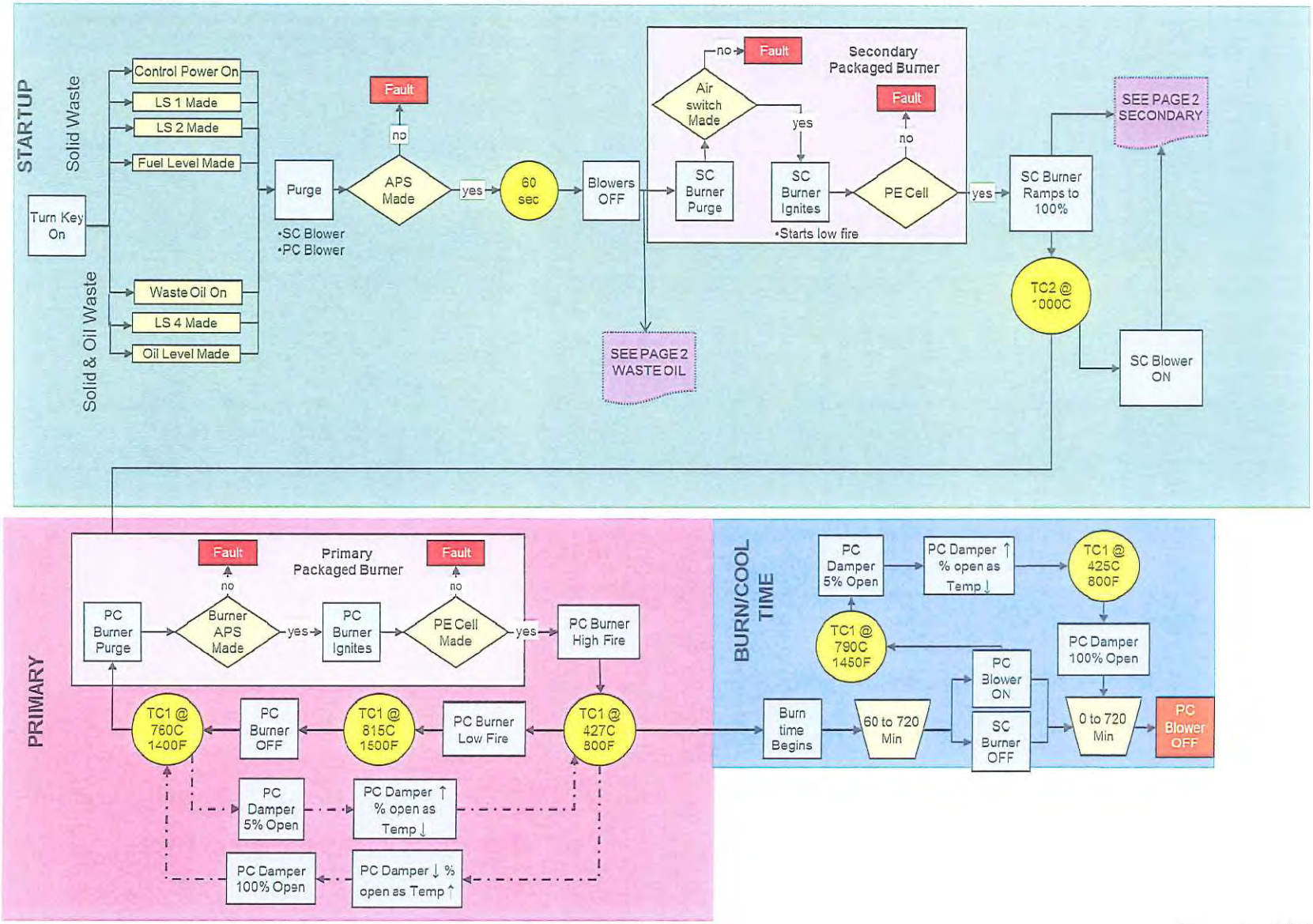
The system Primary Chamber full size front door allows for easy access to remove the ash daily.

The entire process will be controlled by the PLC in the **Main Control Panel**. All key operating parameters will be controlled to factory pre-set conditions programmed into the PLC. For simplicity of operation, the Main Control Panel has a touch-screen user interface with a full colour graphic display. The Operator can see the status of all of critical components and visual alarms for any malfunctions. The software also allows for logging and recording of system data, including historical trends. It is not necessary to constantly monitor the process. Various communication protocols are available to allow the incinerator PLC to communicate with the PCS or other remote computer.

ECO WASTE SOLUTIONS

Project Name: Mary River H34900
EWS project: 13-2MS

Waste Incinerator Control Block Diagram



- - - - ▸ Dashed lines: ongoing damper adjustments
..... ▸ Dotted lines: ongoing VFD adjustments

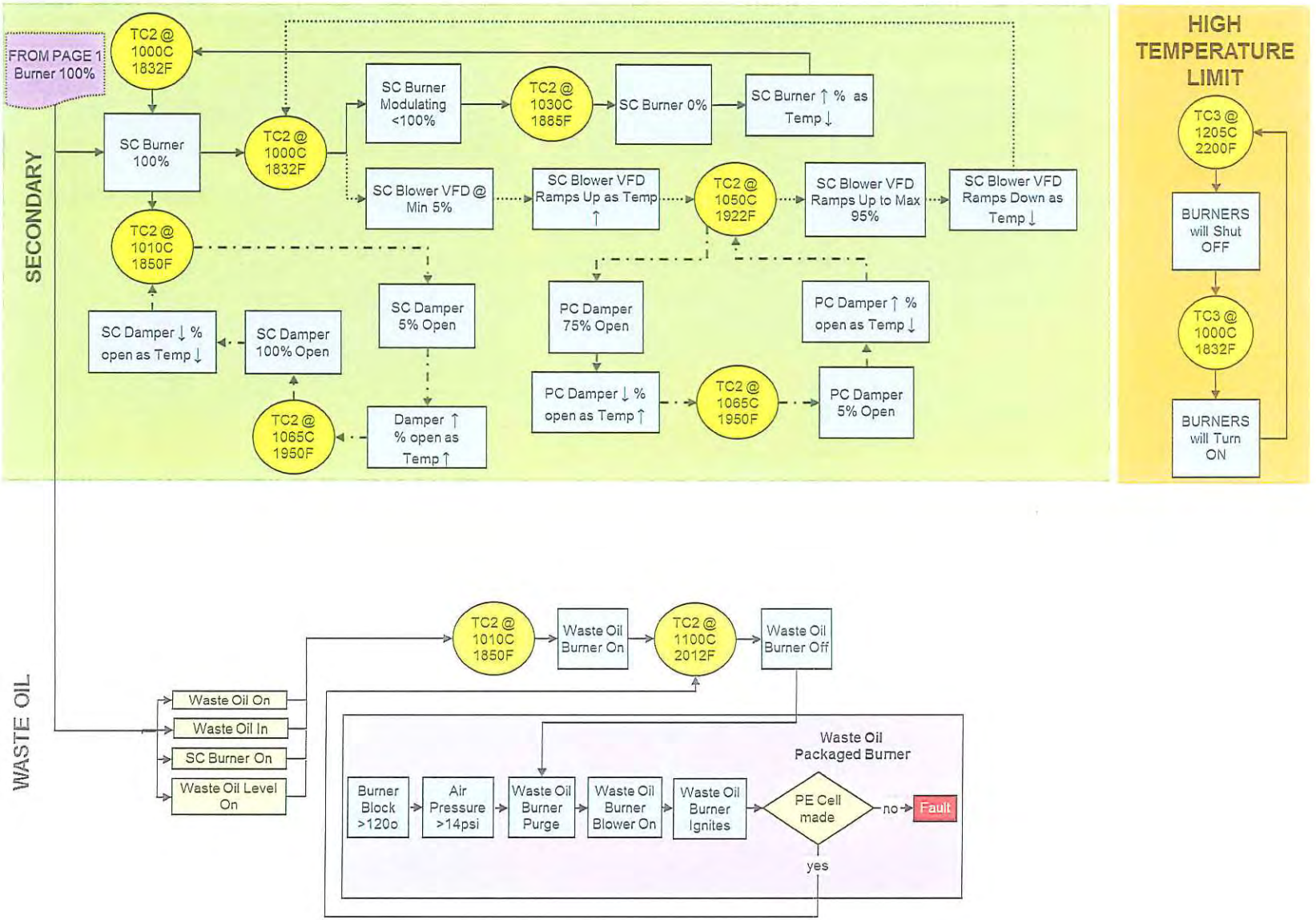
•TC1 = Primary Chamber Controlling Thermocouple
•TC2 = Secondary Chamber Controlling Thermocouple
•TC3 = Stack Thermocouple

Adjustable Customer settings
Adjustable EWS only settings

ECO WASTE SOLUTIONS

Project Name: Mary River H34900
EWS project: 13-2MS

Waste Incinerator Control Block Diagram



Functional description document for burner management system can be located within the Riello / Clean Burn supplied User Manuals:

- **Primary Chamber Burners E349000-TX001-00-118-0001**
  Light oil burners Riello (RL 28/2)
  Low – High Operation
  Installation, use and maintenance instructions

- **Secondary Chamber Burners E349000-TX001-00-118-0002**
  Light oil burners Riello (RL 100/M)
  Low – High or Modulating Operation
  Installation, use and maintenance instructions

- **Waste Oil Burner E349000-TX001-00-118-0003**
  Multi Oil Burner Clean Burn CB550-S2
  Low – High Operation
  Installation, use and maintenance instructions

Control Loops

Loop Name	Secondary Chamber Burner Temperature Control
Control Algorithm	PID
Action	Reverse
Modes	Automatic
Process Variable	Secondary Chamber Thermocouple; PLC Tag: Secondary_Chamber_Temperature; Instrument / Equipment Tag: TE 1236
Set Point	1000° C
Controlled Variable	Secondary Burner; PLC Tag:Secondary_Burner_Percent_Fire; Instrument / Equipment Tag: BR 1210
Rate of Change Limit	None
Control Description	Regulates Output Of Secondary Burner to Maintain Constant Secondary Temperature

Loop Name	Waste Oil Temperature Control
Control Algorithm	On-Off
Modes	Automatic
Process Variable	Secondary Chamber Thermocouple; PLC Tag: Secondary_Chamber_Temperature; Instrument / Equipment Tag: TE 1236
Set Point	1010° C Switched On 1100° C Switched Off
Controlled Variable	Waste Oil Burner; PLC Tag: Start_Waste Oil Burner; Instrument / Equipment Tag: BR1206
Rate of Change Limit	None
Control Description	Regulates Output of Waste Oil Burner to Prevent Secondary Over Temperature

Loop Name	Primary Chamber Temperature Control
Control Algorithm	On-Off
Modes	Automatic
Process Variable	Primary Chamber Top Thermocouple; PLC Tag: Primary_Chamber_Top_Temperature; Instrument / Equipment Tag: TE 1231
Set Points	674°C switches from Low Fire To High Fire 704°C Switches from High Fire To Low Fire 760°C Switches from Off To Low Fire 815° C Switches from Low Fire To Off
Controlled Variable	Primary Burner; PLC Tag: Primary_Burner_Low_Fire; PLC Tag: Primary_Burner_High_Fire; Instrument / Equipment Tag: BR 1209
Rate of Change Limit	None
Control Description	Raises Primary Temperature to point where waste ignites.

Loop Name	Primary Chamber Damper Control
Control Algorithm	Inverse Ramp Calculation
$$CV = 100 - \frac{Pri_{1_{Damper_{MaxPosition_{Point}}}} - Pri_{1_{Damper_{MinPosition_{Point}}}}}{Pri_{1_{Damper_{HiTemp_{Point}}}} - Pri_{1_{Damper_{LoTemp_{Point\alpha}}}}} * \left(Primary_{1_{Chamber_{Top_{Temperature}}}} - Pri_{1_{Damper_{LoTemp_{Point}}}}\right)$$	
Modes	Automatic
Process Variable	Primary Chamber Top Thermocouple; PLC Tag: Primary_Chamber_Top_Temperature; Instrument / Equipment Tag: TE 1231
Set Points	**During Burn** Maximum Damper Position = 100%; High Temperature Point = 760; Minimum Damper Position = 5%; Low temperature Point = 427 **Cool Down** Maximum Damper Position = 100%; High Temperature Point = 760; Minimum Damper Position = 5%; Low temperature Point = 427
Controlled Variable	Primary Damper; PLC Tag:Primary_1_Damper_Position; Instrument / Equipment Tag: FV 1201
Rate of Change Limit	None
Control Description	**Purge** During the purge cycle the damper is set to 100% open and when the purge is complete the damper is set to 0%. **Cycle On** Controls air flow into primary, based on temperature to regulate combustion of waste and emission of smoke. The final primary damper position is the lower value of " **Primary Chamber Damper Control**" and "**Primary Chambers Damper Control For Secondary Cooling**".

Loop Name	Primary Chambers Damper Control For Secondary Cooling
Control Algorithm	Inverse Ramp Calculation
$$CV = 75 - \frac{Pri_{Damp_{Sec_{Cool_{Max_{Pos_{Pt_{From_{HMI}}}}}}}} - Pri_{Dam_{Sec_{Cool_{Min_{Pos_{Pt_{From_{HMI}}}}}}}}}{Pri_{Damp_{Sec_{Cool_{Hi_{Temp_{Pt_{From_{HMI}}}}}}}} - Pri_{Damp_{Sec_{Cool_{Lo_{Temp_{Pt_{From_{HMI}}}}}}}}} * \left(Secondary_{Chamber_{Temperature}} - Pri_{Damp_{Sec_{Cool_{Lo_{Temp_{Pt_{From_{HMI}}}}}}}}}\right)$$	
Modes	Automatic
Process Variable	Secondary Chamber Thermocouple; PLC Tag: Secondary_Chamber_Temperature; Instrument / Equipment Tag: TE 1236
Set Points	Maximum Damper Position = 75%; High Temperature Point = 1065; Minimum Damper Position = 27%; Low temperature Point = 1037
Controlled Variable	Primary Damper; PLC Tag: Primary_Damper_Position, Instrument / Equipment Tag: FV 1201
Rate of Change Limit	None
Control Description	**Purge** During the purge cycle the damper is set to 100% open and when the purge is complete the damper is set to 0%. **Cycle On** Controls air flow into primary to assist in cooling of secondary chamber. This is a separate control loop. The final primary damper position is the lower value of " **Primary Chamber Damper Control**".

Loop Name	Secondary Chamber Damper Control
Control Algorithm	Ramp calculation
$$CV = \text{Secondary}_{\text{Damper}_{\text{MinPosFrom}_{\text{HMI}}}} + \frac{\text{Secondary}_{\text{Damper}_{\text{MaxPosFrom}_{\text{HMI}}}} - \text{Secondary}_{\text{Damper}_{\text{MinPosFrom}_{\text{HMI}}}}}{\text{Secondary}_{\text{Damper}_{\text{HiTempFrom}_{\text{HMI}}}} - \text{Secondary}_{\text{Damper}_{\text{LoTempFrom}_{\text{HMI}}}}} * \left(\text{Secondary}_{\text{Chamber}_{\text{Temperature}}} - \text{Secondary}_{\text{Damper}_{\text{LoTempFrom}_{\text{HMI}}}}\right)$$	
Modes	Automatic
Process Variable	Secondary Chamber Thermocouple; PLC Tag: Secondary_Chamber_Temperature; Instrument / Equipment Tag: TE 1236
Set Points	Maximum Damper Position = 100%; High Temperature Point = 1065; Minimum Damper Position = 39%; Low temperature Point = 1010
Controlled Variable	Secondary Damper; PLC Tag: Secondary_Damper_Position; Instrument / Equipment Tag: FV 1202
Rate of Change Limit	None
Control Description	**Purge** During the purge cycle the damper is set to 100% open and when the purge is complete the damper is set to 0%. **Cycle On** Increases Airflow into Secondary Chamber as Secondary Chamber Temperature Increases to assist in Secondary Chamber cooling

Loop Name	Secondary Chamber Blower Control
Control Algorithm	Ramp calculation
$CV = \text{Secondary}_{\text{Blower}_{\text{Min}_{\text{Speed}_{\text{From}_{\text{HMI}}}}}} + \frac{\text{Secondary}_{\text{Blower}_{\text{Max}_{\text{Speed}_{\text{From}_{\text{HMI}}}}}} - \text{Secondary}_{\text{Blower}_{\text{Min}_{\text{Speed}_{\text{From}_{\text{HMI}}}}}}}{\text{Secondary}_{\text{Blower}_{\text{Hi}_{\text{Temp}_{\text{From}_{\text{HMI}}}}}} - \text{Secondary}_{\text{Blower}_{\text{Lo}_{\text{Temp}_{\text{From}_{\text{HMI}}}}}}} * \left(\text{Secondary}_{\text{Chamber}_{\text{Temperature}}} - \text{Secondary}_{\text{Blower}_{\text{Lo}_{\text{Temp}_{\text{From}_{\text{HMI}}}}}}\right)$	
Modes	Automatic
Process Variable	Secondary Chamber Thermocouple; PLC Tag: Secondary_Chamber_Temperature; Instrument / Equipment Tag: TE 1236
Set Points	Max Blower Speed = 95%(1350 RPM); High Temperature Point = 1095; Min Blower Speed = 10% (142 RPM); Low temperature Point = 1037
Controlled Variable	Secondary Blower; PLC Tag: Secondary_Blower_Speed; Instrument / Equipment Tag: SB 1202
Rate of Change Limit	None
Control Description	Increases Airflow into Secondary Chamber as Secondary Chamber Temperature Increases to assist in Secondary Chamber cooling

Interlocks

Device / Sequence:

- Burn Sequence and/or
- Manual Burner Startup interlocks.

Action:

- System does not start.
- If running, system will shut down all blowers, burners and close dampers.

Interlock Type	Location	Interlock	Description
Safety	Incinerator		E-Stop Button
Process	Primary Chamber	ZSC 1231	Primary Chamber Door Switch
Process	Secondary Chamber	ZSC 1232	Secondary Chamber Door Switch
Process	Primary Chamber Blower	PSH 1201	Primary Chamber Air Proving Switch
Process	Secondary Chamber Blower	PSH 1202	Secondary Chamber Air Proving Switch
Process	Primary Chamber	TE 1231	Primary Chamber Controlling Thermocouple defective TE-1231 = 1371°C
Process	Secondary Chamber	TE 1236	Secondary Chamber Controlling Thermocouple defective TE 1236 = 1371°C
Process	Primary Chamber Blower	MT 1201	Primary Chamber Blower Motor Overload
Process	Secondary Chamber Blower	MT 1202	Secondary Chamber Blower Variable Frequency Drive
Process	Fuel Storage Tank	LSL 1211	Low Level Switch
Process	Waste Oil Storage Tank	LSL 1206	Low Level Switch

Device / Sequence:

- Chamber temperature high limit

Action:

- All burners will shut down
- System will remain on – secondary blower and damper positions
- All burners will restart when lower temperature is reached (1010°C)

Interlock Type	Location	Interlock	Description
Process	~~Chamber~~ Secondary Chamber	TE 1236	High Temperature Limit Interlock Tripped when TE 1236 > 1200°C Reset when TE 1236 < 1010°C

Alarms

Instrument Equipment Tag:	Alarm Tag	Description	Initial Set Point	Time Delay	Conditioning	Priority
TE 1231 ✓	Primary_TC_Fault	The Primary Chamber Thermocouple is faulted.	None Thermocouples are monitored by the thermocouple input module which will set a fault bit for a defective thermocouple	Built into the Thermocouple module	None	Alarm and system shutdown Critical
TE 1236 ✓	Secondary_Chamber_TC_Fault	The Secondary Chamber Thermocouple is faulted.	None Thermocouples are monitored by the thermocouple input module which will set a fault bit for a defective thermocouple	Built into the Thermocouple module	None	Alarm and system shutdown Critical
BR 1209 ✓	Primary_Burner_Fault	The Primary Chamber Burner is faulted.	None The PLC monitors a fault signal from the burner	Built into the burner control box	None	Alarm only, no system shutdown Warning
BR 1210 ✓	Secondary_Burner_Fault	The Secondary Burner is faulted.	None The PLC monitors a fault signal from the burner	Built into the burner control box	None	Alarm only, no system shutdown Warning

Instrument Equipment Tag:	Alarm Tag	Description	Initial Set Point	Time Delay	Conditioning	Priority
BR 1205	Waste Oil_Burner_Fault	The Waste Oil Burner is faulted.	None The PLC monitors a fault signal from the burner	Built into the burner control box	None	Alarm only, no system shutdown Warning
PSH 1201	Pri_Blower_Delay_Air_Flow_Fault.DN	The system has shut down due to Primary Chamber Blower low air flow.	Factory Calibrated	10 seconds	None	Alarm and system shutdown Critical
PB 1201	Pri_Blower_Delay_OL_Fault.DN	The Primary Chamber Blower motor overload is tripped.	2.0 Amps	1 second	None	Alarm and system shutdown Critical
PSH 1202	Sec_Blower_Delay_Air_Flow_Fault.DN	The system has shut down due to Secondary Chamber Blower low air flow.	Factory Calibrated	20 seconds	None	Alarm and system shutdown Critical
SB 1202	Secondary_Blower_VFD_Fault	The Secondary Chamber Blower Variable Frequency Drive is faulted.	Factory Calibrated	Built into the VFD	None	Alarm and system shutdown Critical
ZSI 1205	Waste_Oil_Burner_Not_In_Fault	System shutdown due to Waste Oil Burner not all the way in when burning waste oil	None	None	None	Alarm and system shutdown Critical

Instrument Equipment Tag:	Alarm Tag	Description	Initial Set Point	Time Delay	Conditioning	Priority
ZSO 1205 ✓	Waste_Oil_Burner_Not_In_Fault	System shutdown due to Waste Oil Burner not all the way out when burning solid waste only	None	None	None	Alarm and system shutdown Critical
LSL 1211 ✓	Delay_Low_Fuel_Level.DN	The Burner fuel level is low.	10 " from bottom of tank	10 seconds	None	Alarm and system shutdown Critical