

# RENEWABLE ENERGY CONSULTANTS, LLC

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MULTI-FUEL COMBUSTION SYSTEM



## FEATURES



REFRACTORY LINED WALLS FOR IMPROVED COMBUSTION



AUTOMATED-VFD CONTROLLED FUEL-FEED SYSTEM



FULLY MODULATING WITH 5:1 TURN DOWN RATIO



BACK-FIRE PREVENTION



HIGH COMBUSTION EFFICIENCY UP TO 89%



MULTI-FUEL COMBUSTION SYSTEM DESIGN

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August 22, 2013

Dear Customer,

The following is a detailed explanation of SIM Moving Grate Boiler:

The SIM Boiler has the Ash Augers below the Chain Grate, located on the floor of the Boiler. The Ash Augers are basically removing any additional dust and particles that drop off of the top of the Chain Grate as it revolves around, with the face positioned upside down at that point. (Please notice the Augers running the length of the Stoker in the "Stoker & Boiler Isometric" picture)

The plenums, located between the Chain Grate, are fed air from a pressure chamber, through an adjustable damper, which is located in the middle of each plenum. This distributes air equally to the full length of the plenum which gives a much more consistent air flow through the entire plenum, creating a very effective combustion across the width of the Moving Grate. The dampers are tightly sealed when closed and do not allow any air to leak out when closed. This is the only Boiler of this type that has this leak-tight feature.

The Grate moves consistently and is on VFD. The speed of the Moving Grate is determined by the rpm of the VFD Multiple Auger Infeed System, which allows the fuel to be fed on a consistent layer of fuel across the Chain Grate, and not a mound of fuel, such is the case with other types of Boilers, (especially Plate Grate Boilers). The hydraulics are eliminated and all drives are VFD, electric motor driven. The Chain Grate Drive has a built in clutch, preventing any breakage should there be a possible jamming of the Grate, for one reason or another. The Chain Grate has overlapping sections, eliminating any ash dropping through the grate.

The Ash Removal System is very quiet, being electrically activated, and is not noisy when activated. Our experience is that the hydraulics have a constant oil leakage, need filter change periodically, hose replacement and are noisy when operating.

The Stoker has 6 inches of sheet insulation and 7 inches of poured refractory, equaling a total of 13 inches of insulation.

The Multi-Clone has 3 Cyclones within the main Cyclone, and the separated particles are dropped directly into the Ash Auger System, through an airlock, which eliminates an extra motor to move the ash.

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The Control Panel has CSA and ENTECA (Worldwide) Standards.

The Soot Blasters are built into the door and swing away from the tube area when the doors are open. This eliminates having to remove the Soot Blaster, after opening the doors. The doors have special hinges that allow the doors to swing out to the side of the Boiler which allows easy and open access to the tubes.

There are 2 Over Air Blowers. The Over-fire Air Blower at the infeed end flows air over the fire, below the arches. The Over-Arch Blower at the outfeed end, combusts any particles moving above the arches, that are not combusted by the Over-fire Blower while still in the Stoker, (under the arches). This second blower also keeps the top of the arches clean from any ash collection.

The pictures show a 2 – Metering Box Infeed System, which is a special model for mixing dry and wet material in specific applications. We offer the standard Boiler with a Single Metering Box with a Multi-Auger Infeed System.

The Fire Retardant System has 5 or 6 nozzles in the Metering Box. If a fire backs up through the Multi-Screw area to the Metering Box, the sensors activate the water system and it floods the Multi-Auger Infeed System.

The Incline Infeed Auger stops and the Multi-Infeed Augers and Moving Grate increase in speed, moving the burning fuel to the end of the Grate to the Automatic Ash Removal Auger.

**The SIM Boiler can burn Coal, Wood Chips (50% moisture), Pellets, Sawdust, Shavings, Pellets, Corn Stover / Fodder, Wheat Flax, Poultry Litter, Horse Manure, Grasses, (Miscanthus, Switch Grass, Hay, Etc.), Paper, C & D Waste, and many other types of Solid Fuel.**

An Oil or Gas Burner can be supplied with the Boiler for backup, if requested.

I have attached the Boiler pictures for you to review and explained as follows:

Concerning the “**Moveable Grate**” picture, (Top Right of brochure):

- 1 - Show the Ash Removal System from the Cyclone, Under Air Fan and a Double Infeed System, 2 Over Air-Fans, at the top of the Stoker. The 2 Silver Motors, will not be included unless a customer special orders a Dual Infeed Style Boiler. This also shows the Chain Grate Drive Motor, which is yellow colored.

Concerning the “**Cyclone – Ash System**” pictures:

- 1 - The brochure shows the Multi-Clone and Ash Removal System as well as the Wrap-Around Flange that allows a much better flow of gasses from the Boiler Tubes to the Multi- Clone. This allows a highly efficient separation

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of the particles and gasses, thus producing a very clean emission.  
The Boiler Vessel in the top right hand picture is not a Boilersmith, but a special vessel required by this specific customer.

## **Specifications on Boilers:**

- 1 - 77 BHP to 310 BHP are shown on a chart on page #2.
- 2 – We offer Multi-Fuel, Hot Water or Steam 999999998Boilers from 50 BHP to 600 BHP.

## **Please note that REC also offers the following components:**

- Fuel Storage & Transfer Systems (Walking Floor / Traversing Auger - [Single & Dual Auger] / Silo`s / Grain Bins / Circular Flex Bottom Bins / Combined Self Contained Truck Unloading & Fuel Bin / Elevated Multi-Auger Fuel Storage Bins / Gravity Flow Fuel Bins)
- Eko-Tech 170,000 BTU to 982,000 BTU Pellet Boilers
- Eko-Tech 170,000 BTU to 682,000 BTU Wood Chips Boilers
- Fuzzy Logic 170,000 BTU to 340,000 BTU Multi-Fuel Boilers
- Vertical & Horizontal Low Speed Grinders / Shredders, Horizontal Chippers
- Magnets – [Wedge / Suspended / Overband / Roller / Pneumatic, Etc.]
- Screeners – [Vibratory / Star]
- Material Handling Equipment - [Pneumatic / Belt / Conveyor / Auger / Vibratory, etc.]
- Pelletizing Machines - [50 Lbs. to 2,000 Lbs / Hr.]
- Bagging Systems
- Steam Turbine Generator Systems [5KW to 1.5MW]
- All Components and Installation for these Systems when requested.

If there is anything else I can do for you, please let me know

I look forward to working with you.

Thank you, Bob Rice  
**REC,LLC**



# REC, LLC

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### MULTI-FUEL, MOVING GRATE, BIOMASS BOILER NOMENCLATURE

#### GENERAL INFORMATION:

##### TECHNICAL DATA OF THE PROPOSED FUEL

- Fuel material under consideration:
  - Wood Chips, Coal, Corn Fodder, Poultry Litter, Horse Manure, or other similar fuel
- Moisture content of the fuel – Maximum 50% - Minimum 0%
- Particle size not to exceed 3” for wood chips
- Example:
  - Fuel energy value – based on Laboratory Test results.
  - Example:
    - Green Wood Chips – approx. 5,500 BTU / LB
    - Wax/Cardboard Pellets – approx. 13,000 BTU / LB
    - Plastic Coated Pellets – approx. 11,000 BTU / LB
    - Wood Pellets – approx. 8,100 BTU / LB
  - Density of the fuel supplied:
    - 17 Lbs/Ft<sup>3</sup> – assumed for wood chips

NOTE: Fuel energy value and density of fuel will vary depending on type of fuel supplied

#### EQUIPMENT SPECIFICATIONS:

##### EQUIPMENT LISTING

Under this proposal, our company will provide following equipment:

- ✓ Moving grate stoker system
- ✓ Fuel feed system c/w surge hopper
- ✓ Complete Ash removal system
- ✓ Primary combustion fans, air ducts and damper control
- ✓ Secondary combustion fans and air ducts
- ✓ Multi Cyclone flow true Fly Ash collector and fly ash removal
- ✓ Draft Induced Fan c/w exhaust duct (excluding chimney)
- ✓ Control panel (please see section 2.2 for detailed listing)
- ✓ Touch Screen operator interface
- ✓ Differential pressure transmitter 4-20mA
- ✓ Type «K» thermocouple with convertor 4-20mA
- ✓ 4 Variable Frequency Drives (VFD) for fans
- ✓ Automated soot blasters
- ✓ System start-up, commissioning and Final Acceptance Service

Not included are the following (available per customer request):

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- Unloading of the equipment at the customer's site
- Electrical Main Power input 480/3/60 and electrical connection to stoker control panel
- Electrical materials and labor required to complete the connections
- Mechanical installation of the system
- Domestic water supply to the boiler room
- Compressed air supply
- Connection between supply valve of the boiler and piping network
- Any permits required by local authorities
- Ash storage bin (approx. 60Ft^3 storage capacity)
- Installation, Concrete work, Piping, Excavating, Electrical, Etc.

Item #	Description X – included / O – optional / NA – Not Available		Price
1	Type "C" 3-Pass Boiler with rated net output capacity of BHP desired	x	
2	Moving Grate (Chain Grate) stoker system	x	
3	Multi-screw Fuel Feed System c/w surge hopper	x	
4	Complete Automated Ash Removal System	x	
5	Ash Storage Bin (60 Ft^3 capacity – approx. 2,000Lbs) (Quoted separately)	o	
6	Multi-cyclone fly ash collection system (less than 150mg/m^3)	x	
7	Flue Gas ducting – between boiler and multi-cyclone flow true	x	
8	20' of SS Chimney mounted at the discharge of the exhaust chimney fan	x	
10	PLC – System control panel (480V, 3PH, 60Hz)	x	
11	Touch Screen User Interface Panel	x	
12	Compressor (7.5HP) with 200USG storage tank (Quoted separately)	o	
<b>13</b>	<b>Fuel Storage Options: (Quoted separately)</b>	o	
<b>13-A</b>	Woodchips Hydraulic Grate storage system (supply only)	o	
<b>13-B</b>	Woodchips fuel transfer system (horizontal and incline augers)	o	
14	System start-up, commissioning and Final Acceptance Service	x	

## BOILER

Type "C.0" Style, low pressure boiler rated for 30 Psig maximum hot water pressure (20 Psig typical operating. pressure) or Low Pressure 15PSI Steam, or High Pressure 150PSI to 300PSI Steam. Supplied boiler is firebox, three-pass style boiler. Three-pass boilers are designed and constructed to the **ASME boiler code**. Type "C" 3-Pass boilers provide large combustion volume and are designed for maximum heat recovery and efficiency. Supplied boiler horsepower will be rated for **W/A - BHP (W/A - BTU/Hr)** net output capacity.

## STOKER

The stoker consists of steel base with factory installed chain grate. Stoker chain links are cast from a special high heat resistant alloy cast iron. The moving stoker grate design has a significant advantage over other systems. The system provides a large area of the chain grate that is conservatively designed to assure complete solid fuel combustion. It has been designed to handle hard to burn fuels (agricultural residue) and high moisture fuels (with moisture content up to 50% wet basis). The chain grate design reduces ash fusion problems and clinker formation.

The base of the stoker is constructed of 0.250" (or thicker) steel and it is lined with a high temperature insulation and refractory. The refractory lining of the combustion chamber uses high grade, high alumina refractory that combined with high density insulation, significantly reduces heat losses from

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the combustion chamber.

The combustion chamber has been designed to provide required amount of air and turbulence to provide complete combustion of the fuel and same reducing the emissions. The primary combustion air consists of multi-zoned under-fire air plenums. Each plenum has an external damper that allows for precise combustion air control. It allows for directing more combustion air where combustion takes place and less air further away from the fire zone.

The total volume of under-fire air (primary combustion air) is precisely metered by a Combustion Air Fan powered by a Variable Speed Drive. The amount of combustion air is a function of the power demanded by the boiler control system. Included, as part of the stoker, is modulating-feed rate control system (fuel handling).

Maximum feed rate , for the proposed stoker, is **W/A - BTU/HR Input** (based on 75Lbs of wood (or other fuel) per FT<sup>2</sup> of stoker grate and burning wood with the caloric value of 5,500 Btu/Lb.

## FUEL HANDLING

We will provide VFD driven fuel (option one) -metering system –consists of two metering drums that meter product onto the chain grate and further into the combustion area.(option two) -multi screw for loose biomass or densified biomass. The loose biomass feed system consists of the multi screw feeder and surge hopper. The multi-screw feed system is mounted directly onto the stoker with a surge hopper mounted onto the multi-screw feed system. Unless otherwise arranged, the customer is responsible for the fuel delivery to the surge hopper.

The metering system has a built in (anti burn-back system) which prevents any of the multi fuels from burning back underneath the metering drums. The anti-burn-back system in heat activated.

The multi-screw feed system feeds biomass fuel onto the chain grate. The fuel feed rate is driven by variable speed controller. The chain grate is variable speed to enable complete fuel combustion. Ash is collected (in the hopper) at the end of the chain, where it is removed automatically.

## ASH HANDLING

The system shall incorporate automated ash removal as follows. Each of the combustion air plenums is equipped with ash removal gates that drops off the ashes onto the transfer-augers and further onto the cross auger (main ash removal). The transfer and cross auger shall be factory installed into the stoker base. Ash will drop off the end of the moving chain grate onto the cross auger. The cross auger will then transport ash out of the base automatically.

**(Depending on the system layout and additional ash transfer auger may be required).**

## SOOT BLASTERS

The soot blower system is factory installed into the door of the boiler. The function of the soot blower is to eliminate any soot build-up within the boiler tubes, thus increasing its heat recovery efficiency. Included is an automatic soot blower control. PLC controlled soot blower is programmed to blow the tubes at predetermined intervals, guaranteeing a maximum tube heat recovery 24 hrs a day. The timed cycle (user selectable) allows each tube to be cleaned at least once in 24 Hrs period. Compressed air (min. 40SCFM at 100PSIG) is required for proper operation of the soot blower system.

## FLY ASH COLLECTION

Dust collection system. The dust collection system is a mechanical dust collector (**multi-cyclone flow true**) system that is designed to remove up to 90% of the fly ash from the exhaust air stream. The supplied dust collector is equipped with an air lock and elbow connection between the dust collector and chimney.

## INDUCED DRAFT FAN

Included is an Induced Draft Fan (ID Fan). A radial blade design, rated for high temperature operation, c/w TEFC, high efficiency motor and heat sling. The function of the ID Fan is to create a negative pressure inside the combustion chamber. The fan is coupled with the Fly Ash Collector. The ID Fan pulls the exhaust air from the combustion chamber through the boiler and multi-cyclone fly true ash collector and exhausts it through the Stainless Steel Chimney that extends approx. 30ft above the floor level.

## CHIMNEY - Optional

Supplied chimney is pressure rated, Stainless Steel inside and outside. The chimney is lined with 2” thick high temperature insulation and comes with roof flashing and “No Loss” chimney exit section. The “No Loss” chimney section is designed to eliminate any exit losses and at the same time prevent any rain or snow from entering the chimney. The chimney is sized based on the maximum firing rate of the system and to maintain a minimum flue gas exit velocities required.

## PNEUMATICS

The equipment requires compressed air approx. 40 SCFM at 100 Psig for the proper operation of the soot blowing system.

7.5 HP compressors with minimum 240 USG storage tank – is required for proper system operation.

## ELECTRICAL:

### .1 ELECTRICAL SPECIFICATION

The electrical control equipment is enclosed in a wall-mounted cabinet. Air-cooling fan is fitted into the electrical control cabinet to prevent the cabinet from overheating. The equipment is supplied with a **3Phase 480V or 208V** electrical control panel designed to operate the stoker, fuel feed auger(s), ash removal auger, and combustion air, over-fire air and draft-inducing (exhaust) fan. Electrical panel is PLC controlled, completed with 10” visual user interface for visual function display. The PLC control system will be Allan Bradley, designed to deliver many years of trouble free operation. The PLC is designed to monitor the boiler, stoker, and fuel feed and safety conditions of all integrated components. All fans and fuel metering system are VFD driven. Using VFDs allows the operator to adjust and control the system to obtain the best efficiencies and lowest emissions possible.

All wires including earth connections will be separately identified with the same numbers as are shown on the electrical schematic diagrams.

The equipment electricians will be to CSA standards. Local approval of the equipment may be required when the equipment is installed at customer location.

### .2 ELECTRICAL COMPONENTS

The PLC control will be enclosed in the electrical panel. This will be used to provide control of the main system and other components.

A 8” color touch screen mounted on the electrical enclosure will display all necessary component selections, equipment set-up and program status information. All the system control software is allowing the operator to open and close selected windows as necessary.

#### Components:

Touch Screen Control (8” Color) -----	Qty 1
PLC -----	Qty 1
Panel Enclosure (36”Wx48”Lx12”D) -----	Qty 1
20 HP VFD (chimney fan air blower) -----	Qty 1
3 HP VFD (combustion air blower) -----	Qty 1
3 HP VFD (over-fire air blower) -----	Qty 2
1.5 HP VFD (fuel feed auger)-----	Qty 1
1 HP VFD (metering drum)-----	Qty 2
1 HP ash removal -----	Qty 2
Line Side Reactors -----	Qty 3
100 AMP Disconnect -----	Qty 1
Differential Pressure Sensor -----	Qty 1
Alarm Buzzer -----	Qty 1
Contactors	
Relays	
Overloads	



Hand / Off / Auto Switches

### **.3 SYSTEM CONTROL**

A main switch button will be mounted on the control panel. On the start-up the system will automatically fire at a user pre-set speed. On/Off time and cycle times will be pre-set by the user and stored in the PLC.

All motors will have Hand/Off/Auto selectable switches. During a normal system operation all the switches will be in the Auto position. The "Hand" (manual) mode will operate all motors at the pre-set speed. The "Hand" option will also be used during equipment testing and troubleshooting.

The set-up will be performed via touch screen controller directly connected to the PLC. The touch screen will display all the functions of the system (including alarm status). The set-up screen will be password protected (for authorized personnel only).

### **.4 CONTROL FEATURES**

Type K thermocouple will be used in combination with the temperature controller. Temperature controller will have a PID function with 4-20Ma output to control the fuel feed rate, combustion and over-fire air volume (in order to maintain a proper fuel combustion).

Photohelic switch will be used to maintain a negative pressure inside the combustion chamber cavity. The switch has a 4-20Ma output that controls Exhaust Air blower speed.

#### **Hold Fire:**

Used only during the periods of low heat demand. When the system reaches the set point temperature the system will shut down. If the temperature remains at the set point for a long period of time the system will start up at a pre-set "time intervals" and feed the fuel in order to maintain fire. The "time intervals" are selectable by the user.

#### **Alarms:**

High Priority Alarms (will sound the alarm and shut down the system and will require a manual reset):

High Temperature condition

Low Temperature condition

Low Priority Alarms (will sound an alarm only):

Fuel Feed system Jam

Motion Detection on the Chain Grate

## **4 SITE CONDITIONS AND MAINS SERVICE SUPPLY:**

Unless otherwise shown, our standard equipment is designed to operate within the following standards and conditions.

### **4.1 SUPPLY VOLTAGE**

**480V or 208V 3 Phase** 60Hz + Earth or as requested and confirmed in the purchase order.

### **4.2 FOUNDATIONS**

The equipment must be installed on a stable foundation, depending upon the nature of the sub soil, a site having at least a 8" depth of concrete 30 Mpa or better c/w 15M rebar spaced 12" on center would normally be adequate.

We **strongly recommend** that you have the site surveyed by a qualified engineer and follow their advice in respect of the construction of the "below floor level" foundation while observing the "floor surface" requirement prescribed by the Floor Plan provided.

The equipment is mounted directly onto the floor preferably on housekeeping pad.

## **5 INSTALLATION AND COMMISSIONING:**

### **5.1 SYSTEM ACCEPTANCE**

Prior to dispatch of the equipment from our shop the equipment will be fully inspected and will undergo a few days of testing.

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The proposed tests include:

- Correct functioning of the equipment
- Safety Review

## **5.2 INSTALLATION**

The customer would be responsible for unloading the equipment, moving to the site, placing on to foundation (housekeeping pad if one is made) installation of the dust collecting system, fuel delivery system and ash removal.

The customer would be responsible for making connection of the incoming electrical supply to the main control panel and between the control panel and junction box(s) located on the stoker base.

The customer will be responsible for making all the piping network connections to the boiler supply outlet.

Our technician will complete the verification of all the mechanical, electrical and electronic checks.

## **5.3 COMMISSIONING AND FINAL ACCEPTANCE TESTS**

Our Service Technician will commission the equipment during this time. It is the customer's responsibility to provide a supply all the necessary components, services of the customer's Inspection Department and necessary equipment to ensure that the capability of the equipment can be proven without delay to provide an Acceptance Certificate (if required).

Our Service Technician will start up the system and verify all the functions of the system during this time. Maximum 3 days on-site visit is allocated for this task.

## 6: Delivery

The scheduled delivery of the above stated equipment would take place no later than Twelve (12) weeks from the date of the down payment. (Boiler shipment will be delayed 2 weeks if Fuel Storage is shipped with Boiler. Rebar & complete drawings & instructions are issued)

## 7: Warranties

Supplied product will carry the warranty as specified by the manufacturer. Our company will not be responsible for any expense incurred through faulty merchandise, during installation, removal from service such as labor, transportation, or interest costs, due to defective material supplied by the manufacturer. We will however, approach the manufacturer involved for compensation as it applies to their warranty.

All building modifications, including: concrete work, structural, mechanical and electrical is the responsibility of the customer.

Bob Rice  
REC, LLC









